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Abstract—Meteoritical Bulletin 104 contains 2279 meteorites including 12 falls (Annama, Cartersville, Creston, Diepenveen, Famenin, Izarzar, Nkayi, Porangaba, San Juan de Ocotán, Trâpeäng Rônoäs, Xinglongquan, Žd'ár nad Sázavou), with 1847 ordinary chondrites, 138 carbonaceous chondrites, 128 HED achondrites, 38 lunar meteorites, 24 ureilites, 22 Martian meteorites, 19 iron meteorites, 17 primitive achondrites, 14 enstatite chondrites, 10 mesosiderites, 9 Rumuruti chondrites, 5 pallasites, 4 ungrouped achondrites, 2 enstatite achondrites, 1 ungrouped chondrite, and 1 Kakangari chondrite, and with 996 from Antarctica, 790 from Africa, 337 from Asia, 111 from South America, 30 from North America, 11 from Oceania, and 4 from Europe. Note: 1 meteorite from Russia was counted as European.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Data S1. A complete copy of entire Meteoritical Society Bulletin can be found in the supplementary

information of this article as well as on the Meteoritical Bulletin Archive page at http://meteoriticalsociety.org/?page_id=57. Information about the approved meteorites can be obtained from the Meteoritical Bulletin Database (MBD) available online at <https://www.lpi.usra.edu/meteor/>.

1. Alphabetical text entries for non-Antarctic meteorites

Aguada de Varas 001 (AdV 001) 24°52'S, 69°16'W

Antofagasta, Chile

Find: 2007 May 13

Classification: Ordinary chondrite (L5)

History: The meteorite was recovered by Michael Warner while looking for fossils and meteorites in the Atacama Desert. A second trip to this location did not uncover additional meteorites.

Physical characteristics: Physical Characteristics: One complete 630 g stone measuring approx. $5 \times 8 \times 5$ cm with broken surfaces. The exterior is brownish in color with patchy, weathered brown fusion crust. Cut interior is black with a few chondrules outlined with opaques. It exhibits a sheen from numerous iron oxide veins.

Petrography: (D. Hill, *UAz*) The meteorite is extremely weathered and is cross cut with numerous parallel iron oxide veins. The stone has a density of 3.4 g/cm^3 (M. Warner). Chondrules up to 2 mm in diameter are set in a recrystallized groundmass. Most chondrules are porphyritic, especially the largest ones. Smaller barred olivine, radiating pyroxene and granulitic chondrules with diameters from 0.5-1 mm are present. Regions between these chondrules exhibit intergrown boundaries while still preserving the relict textures of the fragments. Sulfides occur as discontinuous irregular rims up to 100 μm wide on chondrules, individual 100- μm wide irregular grains, and as lacy inclusions up to 1 cm long.

Geochemistry: Mineral Compositions and geochemistry: Olivine, $\text{Fa}_{23.8 \pm 0.5}$ (N=82); low-Ca pyroxene, $\text{Fs}_{20.1 \pm 0.7}\text{Wo}_{1.40 \pm 1.14}$ (N=36); Plagioclase $\text{Or}_{1.3}\text{Ab}_{55.1}\text{An}_{43.6}$ (N=6). Although physical appearance suggests type 6, well-defined chondrule boundaries seen in microprobe BSE and olivine and low-Ca pyroxene histograms indicate type 5.

Classification: D. Hill, *UAz*; M. Warner. Ordinary chondrite (L5, W3)

Specimens: 594 g, M. Warner; 35.6 g type specimen, *UAz*.

Al Haggounia 003 27.299°N, 12.141°W

Western Sahara

Find: 2013 May

Classification: HED achondrite (Eucrite, unbrecciated)

History: Found on May 15, 2013, by Mr. M. Smara in the Chwichiya region and subsequently purchased by John Higgins.

Physical characteristics: All of the stones have pitted irregular surfaces and are light gray to dark gray to pale brown in overall color. Several stones have remnants of dark fusion crust. Most of the stones have partial coatings of greenish to whitish lichens.

Petrography: (A. Irving, *UWS*) Unbrecciated with subophitic texture and some cross-cutting microfault zones. Minerals are exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite, troilite and minor stained metal.

Geochemistry: (P. Carpenter, *WUSL*) Orthopyroxene host ($\text{Fs}_{60.4-60.7}\text{Wo}_{3.2-2.6}$, $\text{FeO/MnO} = 31-32$, N = 2), clinopyroxene exsolution lamellae ($\text{Fs}_{25.9-26.0}\text{Wo}_{44.3-44.4}$, $\text{FeO/MnO} = 30-32$, N = 2), plagioclase ($\text{An}_{88.6-89.0}\text{Or}_{0.5-0.4}$, N = 2).

Classification: Eucrite (unbrecciated).

Specimens: 24 g including one polished thin section at *UWB*; remaining material with Mr. J. Higgins.

Annama 68.77491°N, 30.78726°E

Murmanskaya oblast', Russia

Confirmed fall: 2014 Apr 19

Classification: Ordinary chondrite (H5)

History: A bright fireball appeared in the night sky over the Kola Peninsula, close to the Finnish border, on April 19, 2014. It was instrumentally recorded in Finland from the Kuusamo, Mikkeli and Muhos observing sites belonging to the Finnish Fireball Working Group. Additionally, a publicly available [video](#) made by Alexandr Nesterov in Snezhnogorsk, Russia, from the opposite side of the fireball track, was carefully calibrated and taken into account in trajectory reconstruction. The fireball was very bright and was witnessed by many eye-witnesses in Russia, Finland, and Norway. The trajectory reconstruction, dark flight simulations and pre-impact orbit determination were done by Esko Lyytinen, Jarmo Moilanen, Steinar Midtskogen, Maria Gritsevich, Valery Lupovka, and Vasily Dmitriev. The initial mass of meteoroid was estimated to be about 500 kg. Based on the analysis of fireball observations it was predicted that part of the meteoroid survived atmospheric entry and reached the ground. Therefore, a meteorite recovery expedition was organized to search the calculated landing area. The international expedition participants were Alexei Ischenko, Tomas Kohout, Nikolai Kruglikov, and Grigory Yakovlev, logistically supported by Maria Gritsevich and Viktor Grokhovsky. The 5-day expedition took place at the end of May following snow melt and preceding vegetation growth. On May 29, 2014, a first 120.4 g meteorite fragment was found by Nikolai Kruglikov on a local forest road within the predicted impact area. A second 47.5 g meteorite fragment was found by Alexei Ischenko nearby on the following day. The name Annama is after a nearby river which is the closest landmark to the find location. Two subsequent expeditions did not lead to recovery of more meteorites.

Physical characteristics: The 120.4 g meteorite is ~70% covered with black fusion crust, with apparent stream lines on one side. The fresh surface is bright with abundant thin dark impact melt veins. The 47.5 g meteorite is fully covered with dark fusion crust. Bulk density of both meteorites (measured with modified Archimedeian method using glass beads) is 3.5 g/cm³, grain density of both meteorites (measured with gas pycnometry) is 3.8 g/cm³. Resulting porosity is 5-8% (values measured by T. Kohout and M. Gritsevich, *UHelsinki*). Bulk density of the second meteorite (measured with Archimedeian method using ethanol) is 3.6 g/cm³ (values measured by G. Yakovlev at *UrFU*). Magnetic susceptibility of both meteorites is $\log \chi = 5.4$ (χ in 10⁻⁹ m³/kg, measured by T. Kohout and G. Yakovlev).

Petrography: Classification (J. Haloda, P. Halodova, *CzGS*) Thin sections show a recrystallized fine-grained granular texture. Chondrule shapes are readily delineated. Irregular fractures in olivine and undulatory extinction of olivine and plagioclase indicate a shock stage of S2. Thin veins of impact melt are also present.

Geochemistry: EPMA results (J. Haloda, P. Halodova, *CzGS*), Olivine $\text{Fa}_{18.6 \pm 0.3}$ (N=60) and low-Ca pyroxene $\text{Fs}_{16.6 \pm 0.2}$ and $\text{Wo}_{1.26 \pm 0.26}$ (N=65). Also present are diopside ($\text{Fs}_6\text{Wo}_{46}$), plagioclase ($\text{Ab}_{80}\text{An}_{14}\text{Or}_6$), chromite, chlorapatite, merrillite, troilite, kamacite, taenite and tetrataenite.

Classification (J. Haloda, P. Halodova, *CzGS*), Ordinary chondrite, H5, S2, W0.

Specimens: 120.4 g main meteorite was divided into a 98.4 g type specimen (*UrFU*), 6.2 g cut-off (*Vernad*), 2 thin sections (*Vernad* and *LTKM*) and several smaller (below 1 g) fragments

(*UHelsinki*). Second 47.5 g meteorite was divided into 40.0 g and 6.6 g fragments, both located in *UHelsinki*.

Apizaco 19.42°N, 98.13°W

Tlaxcala, Mexico

Find: 1961

Classification: Iron meteorite (IIIAB)

History: The meteorite was found by Louis Giraud in about 1961 at the edge of a maize field in the Tlaxcala province of Mexico. Louis and his father Marcel were quail hunting. The exact location is no longer known; they frequently drove from Mexico City to this field and woods region to hunt quail, but the location varied from trip to trip. Apizaco is a small city within about 10 km of the discovery location. The meteorite has been in the possession of Marcel and Louis Giraud since it was found.

Petrography: The meteorite is a medium octahedrite with a bandwidth of ~1.05 mm. It has no heat altered zone and fresh surfaces rust relatively quickly. It has a 0.2 mm oxide filled crack that crosses 80% of the cut face. A low-resolution microscopic study shows a well-preserved structure with no evidence of cosmic reheating. There are numerous small (typically 0.7-1.5 mm) dark plessite fields. No FeS was observed. Schreibersite is rare, but in one region several elongated grains (the largest 0.6-3 mm) are quasi parallel suggesting that this was a region with some trapped melt. Fine (~0.02 mm) schreibersite lamellae are found in rare kamacite intersections.

Geochemistry: Composition: Co, 5.25 mg/g; Ni, 85.5 mg/g; Ga, 21.4 µg/g; Ge, <60 µg/g; As, 9.35 µg/g; Ir, 0.322 µg/g; and Au, 1.174 µg/g.

Classification: The meteorite is a normal member of group IIIAB.

Specimens: The nearest compositional relatives are [Seneca Falls](#) (New York) and [Sierra Sandon](#) (Chile) which are obviously not part of the same fall event. The Mexican meteorite [Asarco Mexicana](#), for which geographic coordinates are not known, has 15% lower As and Ir contents and 10% lower Au content and is very unlikely to be part of the same fall.

Aridal 010 25°46.6'N, 14°06.84'W

Western Sahara

Find: 2013 Apr 24

Classification: Primitive achondrite (Brachinite)

History: Found by Svend Buhl and Tomas Fuellengraben on April 24, 2013

Physical characteristics: A single brownish, oxidized stone.

Petrography: Optical microscope examination of a polished section reveals an equilibrated texture with triple junctions. Main mineral is olivine (grain size 400 µm). Accessory plagioclase (grain size 500 µm) and pyroxene (grain size 150-400 µm). Presence of Ca-phosphate and chromite.

Geochemistry: Olivine Fa=28.6±0.7 (n=14), FeO/MnO=50.0±1.8; Augite Fs=10.6±0.2 (n=3) Wo=43.7±0.2 (n=3), FeO/MnO=28.0±2.1, Al₂O₃=0.6 wt%; Plagioclase Ab_{82.2} O1.4 An_{16.34}. Oxygen isotopic composition (J. Gattacceca, C. Sonzogni, *CEREGE*) δ¹⁷O=3.10 per mil, δ¹⁸O=6.17 per mil, Δ¹⁷O=-0.11 per mil (analysis of 1.5 mg of hand-picked olivine grains after acid washing of a 200 mg powdered sample, TFL slope=0.52).

Classification: Based on petrography, geochemistry and oxygen isotopic composition this is a primitive achondrite (brachinite).

Specimens: 26 g at *FSAC*, 14 g at *CEREGE*. Main mass with Svend Buhl.

Aridal 011 25°38.965'N, 13°50.790'W

Rio de Oro, Western Sahara

Find: 2012 Feb 16

Classification: Ordinary chondrite (LL5)

History: Discovered by S. Buhl and A. Kopelt during natural history expedition close to the astronomical point of Ammat el Quebch in the Boujdour area on 2012 Feb 21.

Physical characteristics: One stone of 285 g, nearly complete, covered with gray-black crust; saw-cut shows chondrules and various clasts set in fine-grained gray groundmass. Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.65$. One stone of 103 g, dominantly covered with gray-black crust; saw-cut shows chondrules and various clasts set in fine-grained gray groundmass. Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.60$. One stone of 180 g, nearly covered with gray-black crust. Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.29$.

Petrography: Microprobe examination of a polished thin section shows moderately developed chondrules (porphyritic, granular, barred) up to 2 mm (av. 0.9 mm), chondrule and mineral fragments in recrystallized matrix with few metal grains.

Geochemistry: (R. Bartoschewitz, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{27.4-28.8}$; av. $\text{Fa}_{28.4 \pm 0.38}$ (n=13); pyroxene $\text{Fs}_{22.8-29.1}\text{Wo}_{1.2-1.9}$; av. $\text{Fs}_{23.9 \pm 1.8}\text{Wo}_{1.6 \pm 0.17}$ (n=10); feldspar $\text{An}_{10-17}\text{Or}_{6-18}$; kamacite Ni = 4.5-4.7, Co = 1.3 wt.-%; chromite CRAL = 86.2; FFM = 91.8; Fe/Mg=10,95.

Classification: Ordinary Chondrite (LL5) of shock stage S3 and weathering grade W1.

Specimens: 21.6 g on deposit at *FSAC*

Aridal 012 25°38.332'N, 13°49.553'W

Rio de Oro, Western Sahara

Find: 2012 Feb 16

Classification: Ordinary chondrite (H4)

History: Discovered by T. Füllengraben and R. Bartoschewitz during natural history expedition close to the astronomical point of Ammat el Quebch in the Boujdour area on 2012 Feb 16.

Physical characteristics: One brown stone and many small fragments totaling 1953 g; saw-cut shows chondrules set in fine-grained brown groundmass. Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.89$.

Petrography: Microprobe examination of a polished thin section shows well developed chondrules (porphyritic, radial) up to 1.2 mm (av. 0.7 mm), chondrule and mineral fragments in recrystallized, brecciated groundmass with highly oxidized metal.

Geochemistry: (R. Bartoschewitz, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{18.8-20.1}$; av. $\text{Fa}_{19.3 \pm 0.31}$ (n=21); pyroxene $\text{Fs}_{16.5-17.2}\text{Wo}_{1.2-1.5}$; av. $\text{Fs}_{16.8 \pm 0.28}\text{Wo}_{1.4 \pm 0.11}$ (n=7); kamacite Ni = 6.8-7.0, Co = 0.6 wt.-%.

Classification: Ordinary Chondrite (H4) of shock stage S3 and weathering grade W3.

Specimens: 26.9 g on deposit at *FSAC*

Aridal 013 25°38.445'N, 13°49.585'W

Rio de Oro, Western Sahara

Find: 2012 Feb 16

Classification: Ordinary chondrite (H5)

History: Discovered by R. Bartoschewitz and T. Füllengraben during a natural history expedition close to the astronomical point of Ammat el Quebch in the Boujdour area on 2012 Feb 16.

Physical characteristics: One brown stone and seven smaller fragments totaling 1029 g; saw-cut shows chondrules set in fine-grained brown groundmass. Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.92$.

Petrography: Microprobe examination of a polished thin section shows qwl-defined chondrules (porphyritic, barred, radial, granular) up to 1.5 mm (av. 0.5 mm), chondrule and mineral fragments in recrystallized, brecciated groundmass with highly oxidized metal.

Geochemistry: (R. Bartoschewitz, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{18.8-19.5}$; av. $\text{Fa}_{19.0 \pm 0.18}$ (n=17); pyroxene $\text{Fs}_{16.9-17.4}\text{Wo}_{1.3-1.5}$; av. $\text{Fs}_{16.8 \pm 0.22}\text{Wo}_{1.4 \pm 0.07}$ (n=6); kamacite Ni = 6.9-7.0, Co = 0.6 wt.%.

Classification: Ordinary Chondrite (H5) of shock stage S3 and weathering grade W3.

Specimens: 22.9 g on deposit at FSAC

Aridal 014 25°38.026'N, 13°49.936'W

Rio de Oro, Western Sahara

Find: 2012 Feb 16-21

Classification: Ordinary chondrite (H4)

History: Discovered by S. Vassiliev and M. Jost, T. Füllengraben and R. Bartoschewitz during a natural history expedition close to the astronomical point of Ammat el Quebch in the Boujdour area on 2012 Feb 16 and 21.

Physical characteristics: 38 brown stones totaling 2939.7 g; saw-cut shows chondrules set in fine-grained brown groundmass. Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.72$.

Petrography: Recrystallized matrix with various types of chondrules up to 1.5 mm (average ~0.5 mm).

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{18.7-19.4}$; av. $\text{Fa}_{19.0 \pm 1.28}$ (n=14); pyroxene $\text{Fs}_{16.2-17.5}\text{Wo}_{1.2-1.5}$; av. $\text{Fs}_{16.7 \pm 0.38}\text{Wo}_{1.4 \pm 0.07}$ (n=10); kamacite Ni=7.0, Co=0.6 (all in wt.%).

Classification: Ordinary Chondrite (H4) of shock stage S3 and weathering grade W4.

Specimens: 45.7 g on deposit at FSAC

Aridal 015 25°38.718'N, 13°49.67'W

Rio de Oro, Western Sahara

Find: 2012 Feb 21

Classification: Ordinary chondrite (H4)

History: Discovered by A. Koppelt, R. Bartoschewitz, T. Füllengraben and S. Buhl during a natural history expedition close to the astronomical point of Ammat el Quebch in the Boujdour area on 2012 Feb 21.

Physical characteristics: 12 brown stones totaling 1025 g; saw-cut shows chondrules set in fine-grained brown groundmass. Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.60$.

Petrography: Microprobe examination of a polished thin section shows well-developed chondrules (porphyritic, barred, radial, granular) up to 1.0 mm (av. 0.5 mm), chondrule and mineral fragments in recrystallized, brecciated groundmass with highly oxidized metal.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $Fa_{18.9-22.2}$; av. $Fa_{19.4\pm0.80}$ (n=16); pyroxene $Fs_{16.4-17.5}Wo_{1.3-1.5}$; av. $Fs_{16.9\pm0.37}Wo_{1.5\pm0.08}$ (n=6); kamacite Ni=6.9-7.0, Co=0.6 (all in wt.%).

Classification: Ordinary Chondrite (H4) of shock stage S3 and weathering grade W4.

Specimens: 36.8 g on deposit at FSAC

Aridal 016 25°38.783'N, 13°49.962'W

Rio de Oro, Western Sahara

Find: 2012 Feb 21

Classification: Ordinary chondrite (H4)

History: Discovered by R. Bartoschewitz, T. Füllengraben, S. Vassiliev and M. Jost during a natural history expedition close to the astronomical point of Ammat el Quebch in the Boujdour area on 2012 Feb 21.

Physical characteristics: 28 brown stones totaling about 2.21 kg. Some stones show brown fusion crust. Saw-cut shows chondrules set in fine-grained brown groundmass. Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.35-4.63$.

Petrography: Microprobe examination of a polished thin section shows well-developed chondrules (porphyritic, radial, barred) up to 1 mm (av. 0.5 mm), chondrule and mineral fragments in recrystallized, brecciated groundmass with highly oxidized metal.

Geochemistry: (R. Bartoschewitz, P. Appel and B. Mader, *Kiel*) Olivine: $Fa_{18.4-19.4}$; av. $Fa_{19.0\pm0.24}$ (n=17); pyroxene $Fs_{16.2-17.0}Wo_{1.2-1.5}$; av. $Fs_{16.7\pm0.27}Wo_{1.3\pm0.12}$ (n=6); chromite: CRAL=84.2, FFM=85.8.

Classification: Ordinary Chondrite (H4) of shock stage S3 and weathering grade W3.

Specimens: 26.5 g on deposit at FSAC

Bazine Creek 38°37'14.02"N, 99°48'29.34"W

Kansas, United States

Find: 2014 Apr 15

Classification: Ordinary chondrite (L4)

History: A single mass was found by M. Rooney while he was hunting arrowheads.

Physical characteristics: Well-preserved secondary (classic oatmeal texture) fusion crust over 100% of the stone. No primary fusion crust visible.

Petrography: The plagioclase grains are small, typically <5-10 μm . Chondrules are well defined, consistent with a type 4 designation. A few of the low-Ca pyroxene grains exhibit polysynthetic twinning. This is characteristic of all type-3 and many type-4 ordinary chondrites, but is absent from type 5 OC. Thus, the sample is L4 and not L5.

Specimens: Allen Shaw holds 372.65 g

Bou Kra 006 26°51'50.2''N, 12° 36'14.5''W

Saguia el Hamra, Western Sahara

Found: 2014 Nov 12

Classification: Ordinary chondrite (L6)

History: Lead by the local guide Mohamed Zeroual, meteorite collectors Joachim Lemm, Rob Lenssen, Gert Jan Netjes, Hanno Strufe and Kally Wombacher conducted a systematic search for meteorites in Western Sahara. On November 12, 2014, Hanno Strufe found the meteorite on a

small plateau adjacent to the Wadi Qued Saquia. It was found on a fine-grained limestone and chert desert pavement.

Physical characteristics: The angular, flight marked individual has a trapezoidal base and is partly covered by fusion crust.

Bou Kra 007 26°46.487'N, 12°44.055'W

Saguia el Hamra, Western Sahara

Find: 2012 Feb 24

Classification: Ordinary chondrite (H5)

History: Discovered by S. Buhl and A. Koppelt during a natural history expedition at Grart Nwimissiat, Saquia al Hamra on 2012 Feb 24.

Physical characteristics: One brown stone of 105.2 g; saw-cut shows chondrules set in fine-grained brown groundmass. Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.64$.

Petrography: Microprobe examination of a polished thin section shows well-defined chondrules (porphyritic, barred, radial, complex) up to 2 mm (av. 0.7 mm), chondrule and mineral fragments in recrystallized, brecciated groundmass with highly oxidized metal.

Geochemistry: (R. Bartoschewitz, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{18.3-19.5}$; av. $\text{Fa}_{19.0 \pm 0.32}$ (n=16); pyroxene $\text{Fs}_{16.8-16.9}\text{Wo}_{1.1-1.2}$; av. $\text{Fs}_{16.8 \pm 0.03}\text{Wo}_{1.1 \pm 0.03}$ (n=3).

Classification: Ordinary Chondrite (H5) of shock stage S3 and weathering grade W4.

Specimens: 20.6 g on deposit at FSAC

Bou Kra 008 26°55.950'N, 12°56.440'W

Saguia el Hamra, Western Sahara

Find: 2012 Feb 25, 26

Classification: Ordinary chondrite (H4)

History: Discovered by S. Buhl and A. Koppelt during a natural history expedition at Grart Nwimissiat, Saquia al Hamra on 2012 Feb 25.

Physical characteristics: One brown stone of 304.5 g plus a chunk of 1.7 g; saw-cut shows chondrules set in fine-grained brown groundmass. Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.17$.

Petrography: Microprobe examination of a polished thin section shows well-defined chondrules (porphyritic, barred, radial) up to 1 mm (av. 0.6 mm), chondrule and mineral fragments in recrystallized, brecciated groundmass.

Geochemistry: (R. Bartoschewitz, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{18.2-19.9}$; av. $\text{Fa}_{18.6 \pm 0.37}$ (n=18); pyroxene $\text{Fs}_{16.0-16.6}\text{Wo}_{0.4-1.5}$; av. $\text{Fs}_{16.3 \pm 0.23}\text{Wo}_{1.2 \pm 0.41}$ (n=6); kamacite Ni = 3.0-7.1, Co=0.5-0.7 wt.%.

Classification: Ordinary Chondrite (H4) of shock stage S3 and weathering grade W1/2.

Specimens: 23.3 g on deposit at FSAC

Bullhead City 35°11.16'N, 114°27.18'W

Arizona, United States

Find: 23 Jan 2012

Classification: Ordinary chondrite (L6)

History: A 3.3 g fusion crusted meteorite was found on Jan 23, 2012, by Todd Parker while he was hunting meteorites on light-colored limestone in the Mohave Desert. Two days later, Larry Atkins found a 119 g crusted individual more than 3 miles away. Since then, 17 stones weighing

a total of 4.97 kg have been recovered, the largest weighing 1225 g, indicating a possible strewn field. Samples from 3 different stones were characterized by Alan Rubin, *UCLA*.

Petrography: The rock contains thin veins of metal-sulfide, 50- μm -size plagioclase grains and fine-grained metal-sulfide intergrowths.

Geochemistry: The 3 stones have the following descriptions and compositions: L6, W2, S4, olivine $\text{Fa}_{24.5\pm0.4}$ ($n=12$); low-Ca pyroxene: $\text{Fs}_{21.5}\text{Wo}_{1.7}$ ($n=3$); L6, W1, S4, olivine $\text{Fa}_{24.3\pm0.4}$ ($n=9$); low-Ca pyroxene: $\text{Fs}_{20.8}\text{Wo}_{1.5}$ ($n=8$); and L6, W2, S4, olivine $\text{Fa}_{24.2\pm0.2}$ ($n=11$); low-Ca pyroxene: $\text{Fs}_{20.8}\text{Wo}_{1.5}$ ($n=7$). When averaged: L6 W2 S4, $\text{Fa}_{24.3\pm0.4}$ ($n=32$, $\text{Fs}_{20.9\pm0.3}\text{Wo}_{1.5\pm0.1}$ ($n=18$).

Bumble Bee 34° 12' 00"N, 112° 09' 45"W

Arizona, USA

Find: 2004

Classification: Ordinary chondrite (H6)

History: Around the spring of 2004, Mr. Ed Bishop found an unusual rounded brown stone while he was metal detecting for gold, ~1/2 mile west of the ghost town of Bumble Bee, Arizona. He brought the stone to Carleton Moore at *ASU*, who subsequently purchased it.

Physical characteristics: Well-rounded stone covered in patches of remnant fusion crust. The stone has a shape of a squat teardrop and lacks regmaglypts. Interior is a dark gray-green with a uniform distribution of small metal and troilite grains. Chondrules not visible.

Petrography: (L. Garvie, *ASU*) Thin section shows largely recrystallized texture with only two recognizable chondrules (both BO, 400 and 450 μm diameter). Olivine grains show straight extinction characteristic of S1. Plagioclase abundant and coarse grained, to 200 μm . Troilite (<200 μm) is single crystal and lacks shock lamellae. Metal dominated by kamacite (<250 μm) and zoned grains with tetrataenite rims and kamacite cores (<150 μm). Only one Cu grain (40 μm) found between troilite-metal grains. Chromite to 200 μm shows rounded outlines and lacks cracks. Scattered phosphates (Ca-Cl and Ca-Mg-Na) to 200 μm .

Geochemistry: (L. Garvie, *ASU*) Olivine, $\text{Fa}_{19.5\pm0.2}$, $\text{Fe/Mn}=38.9\pm2.1$, $n=11$. Low Ca pyroxene $\text{Fs}_{17.4\pm0.2}\text{Wo}_{1.2\pm0.2}$, $\text{Fe/Mn}=23.1\pm1.5$, $n=10$.

Classification: H6, S1, W1

Specimens: 41 g and one thin section at *ASU*.

Cartersville 34°12'5.8"N, 84°49'57"W

Georgia, USA

Confirmed fall: March 1, 2009

Classification: Ordinary chondrite (L5)

History: In August 2009, Francis Richards of Cartersville, Georgia, brought a suspected meteorite to the Tellus Science Museum. According to Mrs. Richards she found the meteorite on March 8, 2009, on the floor of an empty rental house she owned. She observed a hole in the bedroom ceiling which aligned with a hole in the roof. Curator then Julian Gray confirmed the identification of the stone as a meteorite. Observations made by Gray and others, and the markings on the stone, determined that the meteorite came through the roof, bounced off a joist, continued through the ceiling of the bedroom and finally bounced off of a painted door before coming to rest on the bedroom floor. Later a neighbor revealed hearing what might have been a sonic boom on March 1, 2009, making this the probable fall date. The meteorite is now in display at Tellus along with other items from the house illustrating its impact. (Dr. Marc Fries, NASA ARES) The Cartersville fall event appears in imagery from two NEXRAD

radars operated by NOAA. The radars are KHTX (Huntsville, AL), and KFFC (Atlanta, GA). The KFFC radar signature appears at 4.8 km above sea level (ASL) in the 2.5 degree elevation sweep, at 0353 UTC, 02 March 2009. This is 10:53 PM local time. This radar signature appears approximately 9 km laterally from the meteorite find site. It is a prominent image feature that appears in a radar image with very little noise and is separated by more than 70 km from the nearest other radar feature. This is consistent with a radar signature of a meteorite fall that is small in terms of both total mass and total areal extent. The KHTX signature appears in the 1.48 degree sweep at 0350 UTC and 5.4 km ASL, and consists of two proximal radar reflections in the same area as the KFFC signature. The radar data indicate that one of these reflections may be a "range folding" error, and so the KHTX signature alone is not strong stand-alone evidence of a meteorite fall. However, the location of the KHTX feature at the same place and time as the KFFC provides supporting evidence that the object seen on radar is a meteorite fall.

Physical characteristics: The meteorite weighs 295 g and measures 6 cm at its widest dimension. It has a chip that was broken off in flight. Its outer surface is a fused, blackened crust and on its surface are wood fibers from striking the wood joist, gypsum streaks from the ceiling, and paint from the bedroom door.

Petrography: Meteorite is weakly shocked (S3) with minor weathering of grade W1. The ferromagnesian minerals are uniform in size and chondrules and can be readily delineated. The matrix is recrystallized.

Geochemistry: (C. Corrigan, *SI*) Olivine $\text{Fa}_{23.48 \pm 0.17}$ (n=11), Pyroxene $\text{Fs}_{19.31 \pm 0.61}\text{Wo}_{0.85 \pm 0.79}$ (n=9).

Classification: Ordinary Chondrite (L5)

Specimens: A sample of 20 g and a thin section are on deposit at *SI*. *TSM* holds the main mass.

Catalina 107 ~25°14'S, ~69°43'W

Antofagasta, Chile

Find: 2014 May 17

Classification: Iron meteorite (IIIAB)

History: The meteorite was found in May 2014 by R. Martinez in the Atacama desert.

Physical characteristics: A single stone with remnant of fusion crust. Cut surface shows an unweathered metallic interior. After etching the meteorite displays Widmanstätten patterns with the outer 2 mm showing a recrystallized texture.

Petrography: (J. Gattacceca, *CEREGE*) Coarse octahedrite structure with kamacite lamellae about 2 mm wide, interstitial ribbons of taenite in some places, plessite and schreibersite.

Geochemistry: Composition: Co, 5.04 mg/g; Ni, 80.0 mg/g; Ga, 20.0 µg/g; As, 5.55 µg/g; Ir 3.34 µg/g; Au, 0.743 µg/g

Classification: The meteorite is a IIIAB iron based on composition and structure. It is resolved from all other South American iron meteorites by its chemical composition. Minimal weathering.

Specimens: 21.3 g at *CEREGE*. Main mass at *MMC*.

Catalina 108 ~25°14'S, ~69°43'W

Antofagasta, Chile

Find: 2014 May 17

Classification: Mesosiderite (group B)

History: A single fragment was found by Rodrigo Martinez in May 2014 while he was looking for meteorites.

Physical characteristics: Irregular brownish fragment.

Petrography: (J. Gattacceca, *CEREGE*) Coarse crystalline rock with recrystallized texture (triple junctions). Main minerals are pyroxene, plagioclase to 500 μm , metal (typical size 250 μm , to 1.2 mm), chromite to 50 μm , silica polymorph to 200 μm . Modal abundances (by point counting, N=491): pyroxene 51%, plagioclase 14%, metal 12%, troilite 5%, oxides (from weathering) 19%.

Geochemistry: Pyroxenes: orthopyroxene $\text{Fs}_{34.4\pm0.3}\text{Wo}_{3.1\pm0.3}$ (N=3), augite $\text{Fs}_{18.9}\text{Wo}_{33.4}$ (N=1), $\text{FeO/MnO}=26.6$ (N=5). Plagioclase $\text{An}_{91.6}\text{Ab}_{8.1}\text{Or}_{0.3}$, chromite Cr#=81. Magnetic susceptibility $\log \chi = 5.45$ (χ in $10^{-9} \text{ m}^3/\text{kg}$).

Classification: Mesosiderite (type B). Likely paired with [Catalina 079](#) that was found 1.6 km away. Moderate weathering.

Specimens: 21 g at *CEREGE*. Main mass at *MMC*.

Catalina 131 $\sim 25^{\circ}14'S$, $\sim 69^{\circ}43'W$

Antofagasta, Chile

Find: 2015 Jan

Classification: Ordinary chondrite (L4)

History: Found by Luc Labenne while searching for meteorites in the Atacama desert.

Physical characteristics: A single partly crusted stone. Cut surface reveals a brecciated texture with light-gray clast (up to several cm) with well-delineated chondrules, set in a dark lithology with less discernible chondrules. Metal grains up to 5 mm long are visible.

Petrography: The host lithology and the clasts are both of petrologic type 4. The host lithology is shock darkened.

Geochemistry: Olivine $\text{Fa}_{24.8\pm0.3}$ (PMD 1%, N=5), orthopyroxene $\text{Fs}_{17.5\pm2.5}\text{Wo}_{1.0\pm0.6}$ ($\text{Fs}_{14.4-21.1}$, PMD 12%, N=4).

Classification: L4, brecciated.

Specimens: 35 g at *CEREGE*. Main mass with *Labenne*

Catalina 132 $\sim 25^{\circ}14'S$, $\sim 69^{\circ}43'W$

Antofagasta, Chile

Find: 2012 Feb

Classification: Ordinary chondrite (L3)

Petrography: Abundant closely packed, well-delineated chondrules

Geochemistry: Olivine in the range $\text{Fa}_{0.6-31.6}$ (mean $\text{Fa}_{16.7\pm9.5}$, PMD=46%, N=14). Cr_2O_3 in ferroan olivine $0.04\pm0.04 \text{ wt.}\%$ (N=13). Low-Ca pyroxene $\text{Fs}_{20.8\pm10.1}\text{Wo}_{1.8\pm1.2}$ (PMD Fs = 41%, N=7). Magnetic susceptibility $\log \chi = 4.69$ (χ in $10^{-9} \text{ m}^3/\text{kg}$).

Classification: L3. L classification based on magnetic susceptibility.

Cedar Lake $32^{\circ}50.67'N$, $102^{\circ}28.28'W$

Texas, United States

Find: 1998

Classification: Ordinary chondrite (H5-6)

History: Finder sent the stone to B. Barnett (submitter) for identification

Physical characteristics: One mass of 509 g was located during cultivation for farming. The piece has a partially intact, brown, weathered fusion crust.

Petrography: This meteorite contains barred olivene(BO) and radiating pyroxene (RP) chondrules, many of which contain igneous rims. Chondrule size measurements showed a large

range from 250-600 μm ; however, most chondrules are hard to delineate in this sample due to recrystallization. Plagioclase is around 50 μm in some areas, however, it is not completely uniform and there are smaller grains in the section as well.

Geochemistry: Average compositions are as follows Olivine (N = 25) $\text{Fa}_{19.5\pm 2}$, Orthopyroxene (N = 28) $\text{Fs}_{17.0\pm 0.2}\text{En}_{81.7\pm 0.2}\text{Wo}_{1.30\pm 0.22}$, Clinopyroxene (N = 7) $\text{Fs}_{7.1\pm 1.6}\text{En}_{48.8\pm 0.4}\text{Wo}_{44.1\pm 1.4}$, and Plagioclase (N = 11) $\text{Ab}_{82.8\pm 1.3}\text{An}_{11.5\pm 0.2}\text{Or}_{5.7\pm 1.3}$.

Classification: Ordinary chondrite (H5-6); the sample is heavily weathered (W3). This is apparent both in hand sample and thin section; most of the native metal has been oxidized. Shock stage, S1.

Specimens: Only one mass is known. It is in the possession of Brian Barnett, 4091 Mather, Kyle, Texas.

Cedar Station 29°54.4'N, 101°54.0'W

Texas, United States

Find: 2001 Apr

Classification: Iron meteorite (ungrouped)

History: This meteorite was found in 2001 by Mr. Daniel Cantu. He brought it into the Monnig Meteorite Collection at TCU for identification in late 2011. After its positive identification as a meteorite, an end cut was provided to Dr. John Wasson at UCLA for INAA analyses. The rest of the meteorite, with the exception of a few slices kept by the finder, was purchased by TCU.

Physical characteristics: (R.G. Mayne, TCU) One 6.51 kg fusion-crust individual. This sample, although weathered on the outside, shows only minor oxidation in its interior.

Petrography: (R.G. Mayne, TCU) This meteorite is an octahedrite. It has fine kamacite lamellae, with a bandwidth estimated at 0.3 mm. One cm-sized bleb of troilite is present in the cut face of the meteorite.

Classification: (J. Wasson, UCLA) This meteorite is an ungrouped iron. It has no close relatives. Chemical composition: Cr=21 $\mu\text{g/g}$; Co=5.96 mg/g; Ni= 103.1 mg/g; Cu= 258 $\mu\text{g/g}$; Ga= 16.7 $\mu\text{g/g}$; As= 6.21 $\mu\text{g/g}$; Sb= 52 ng/g; W= 0.99 $\mu\text{g/g}$; Ir= 4.39 $\mu\text{g/g}$; Pt= 15.0 $\mu\text{g/g}$; Au= 0.805 $\mu\text{g/g}$.

Specimens: The main mass (5.74 kg) is held by the Monnig Meteorite Collection at TCU.

Coyote Dry Lake 334 (CyDL 334) 35°4.136'N, 116°45.134'W

California, USA

Find: 2013 Dec 06

Classification: Ordinary chondrite (LL3)

History: Found by April Ables while walking with her family on a dry lake. They were searching for meteorites.

Physical characteristics: Round-shaped stone; distinct chondrules visible on weathered exterior.

Petrography: Very little metallic Fe-Ni is present, consistent with an LL classification. The average chondrule size is 500-600 μm , consistent with LL.

Geochemistry: The kamacite Co content is 1.8 wt.% (n=1), consistent with LL. Low-Ca pyroxene grains exhibit abundant polysynthetic twins, consistent with type 3. The Cr_2O_3 content of ferroan olivine grains is 0.05 ± 0.08 (n=16), consistent with type ~3.2. No clear, isotropic glass is present in the chondrules, consistent with type ~3.5. The heterogeneity of the olivine is appreciably greater than that of H3.8 [Dhajala](#), suggesting type <3.8. These data suggest type 3.6-3.7.

Classification: An ordinary chondrite from the LL group that is petrologic type 3.6 to 3.7

Specimens: 2.87 g type specimen at *UCLA*; main mass with *Verish*.

Creston 35°34'13"N, 120°28'21"W

California, United States

Confirmed fall: 2015 Oct 23

Classification: Ordinary chondrite (L6)

History: (Robert Ward, Anne Marie Ward, Robert Matson, Marc Fries) On 23 October at 22:47 PDT (24 October 2015, at 05:47 UTC) a large fireball lit up the rolling hills of wine country east of Paso Robles. The bolide displayed a multitude of colors as it broke up. The fireball was captured on at least four all-sky cameras in Parker, Arizona; Riverside, California; El Segundo, California; and the *SETI* Institute CAMS all-sky system in Sunnyvale, California. Dozens of witnesses close to the ground path heard sonic booms shortly after the fireball terminated. Confirming these accounts, sonic boom signatures were recorded by three California seismic stations, allowing triangulation of the approximate fall zone. Six Doppler radar returns acquired from the NOAA NEXRAD weather radar network were used to further constrain the fall location. The earliest radar signature appears in imagery from the KVTX (Los Angeles, California) radar at an altitude of 16.2 km above sea level (ASL) at 05:47:57.6 UTC - just 12 s after the meteor first appears in the Riverside video. KVBX (Vandenberg AFB, California) recorded signatures of falling meteorites at 05:49:40.3, 05:51:08.9 and 05:53:43.3 UTC at altitudes of 5.6 km, 6.7 km and 1.2 km, respectively; KHNX (San Joaquin, California) recorded several returns at 05:51:57.3 at an altitude of 3.9 km. Finally, KMUX (San Francisco) recorded a pair of returns at 16.2-km altitude at 06:00:41.7. This last return is likely the signature of fine dust, given its altitude and timing, which correlates with eyewitness accounts of a visible smoke trail left by the fireball. Based on the relative timing and altitude of the earlier five radar returns, the estimated masses of falling meteorites at those locations vary from sub-gram to as much as 10 kg for the earliest return. Equipped with the radar-cued search area, Robert and Anne Marie Ward located the first stone on 27 October, along the road (California Route 41), 7.3 km northeast of Creston, San Luis Obispo County. The stone broke upon impact, with a total mass of 395.7 g. As of 10 November, 108 g, 102 g and 82 g stones have also been recovered.

Physical characteristics: Stone covered with matte to shiny black fusion crust up to 1 mm thick. Exterior rounded with a few broad regmaglypts. Interior is light grey and sprinkled with small (<1 mm metal and troilite). Chondrules not visible. Stone criss-crossed with shock veins, some to 2 mm thick. Sample also broke along well-developed slickenside surfaces that are shiny and black.

Petrography: (L. Garvie, ASU) A polished microprobe section shows dominantly coarse-grained recrystallized minerals. Only two BO chondrules were recognizable in the section. Plagioclase abundant to 200 μm . Chromite grains to 300 μm are anhedral with rounded outlines. Troilite grains to 300 μm and largely single crystal and lacking shock lamellae except where near shock veins. Scattered Ca-Cl and Ca-Mg-Na phosphates to 200 μm . Fe-Ni metal grains to 400 μm . Metal grains range from kamacite with weakly developed Neumann bands, to polycrystalline, to those with tetrataenite rims and cores of dark-etching plessite or acicular kamacite. Section shows a well-developed 1-mm thick shock vein with 50- μm blebs and spheres of Fe/Fe-S. Fine-grained melt pockets are present but rare.

Geochemistry: (L. Garvie, ASU) Olivine, $\text{Fa}_{24.8 \pm 0.4}$ ($n=11$), $\text{Fe/Ni}=47.3 \pm 2.5$, and low Ca pyroxene, $\text{Fs}_{21.1 \pm 0.2}\text{Wo}_{1.3 \pm 0.2}$ ($n=14$), $\text{Fe/Mn}=28.1 \pm 1.3$.

Classification: Ordinary chondrite, L6.

Specimens: 21 g and one polished mount at ASU.

Csátalja 46.006°N, 18.991°E

Bacs-Kiskun, Hungary

Find: 2012 Aug

Classification: Ordinary chondrite (H4)

History: Excavated during plowing of a cultivated field on a farm near Csátalja, Hungary, in August 2012. The farm owner brought the stone to Dr. Tibor Hegedűs at the *BajaAO*, who sent small samples to scientists at the University of Bratislava, University of Eötvös Lóránd and University of Pécs, where initial optical and X-ray diffraction testing confirmed it to be a chondrite. The find location is 4.8 km SE of the village of Csátalja.

Physical characteristics: A single brown, roughly equidimensional stone originally weighing ~16 kg. The average value of the magnetic susceptibility is 5136×10^{-5} SI, with 7448×10^{-5} SI within the metal of chondrules of the cut and polished surface and $4279\text{--}4626 \times 10^{-5}$ SI within the uncut original surface.

Petrography: (A. Irving and S. Kuehner, *UWS*) The specimen consists of relatively small, round chondrules (0.8 ± 0.3 mm, some up to 2.1 mm) in a recrystallized matrix rich in stained metal. Primary minerals are olivine, orthopyroxene, clinopyroxene, sodic plagioclase, chromite, merrillite, chlorapatite, troilite and kamacite (partially altered to iron hydroxides).

Geochemistry: Olivine ($\text{Fa}_{18.6\text{--}18.9}$, N = 3), orthopyroxene ($\text{Fs}_{15.8\text{--}16.3}\text{Wo}_{1.1\text{--}1.2}$, N = 3), clinopyroxene ($\text{Fs}_{5.7\text{--}5.8}\text{Wo}_{45.6\text{--}46.4}$).

Classification: Ordinary chondrite (H4).

Specimens: A total of 13700 g of material (including the main mass) at *BajaAO*; one polished thin section at *UWB*.

Dar al Gani 1065 (DaG 1065) 26°58.00'N, 16°22.00'E

Al Jufrah, Libya

Find: 16 May 1999

Classification: Ureilite

Physical characteristics: Olivine and pyroxene crystals have sizes up to about 1.3 mm in longest dimension. The olivines contain planar fractures. Dark areas with abundant tiny sulfide grains are common.

Petrography: The cores of the olivines have $\text{Fa}_{20.1\text{--}21.1}$ (n=7), the rims are Fe-poor ($\text{Fa}_{3\text{--}4}$, n=7); total range: $\text{Fa}_{3.6\text{--}21.1}$. The pyroxenes (cores) are uniform in composition.

Dar al Gani 1066 (DaG 1066) 27°09.11'N, 16°16.20'E

Al Jufrah, Libya

Find: 1999 Feb

Classification: Ureilite (polymict)

History: A fragmented stone, totally weighing 125 g, was found by Romano Serra, *OAM*, during an expedition to search for meteorites.

Physical characteristics: Four fragments, each one partially covered by fusion crust

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): A thin section of the meteorite shows a coarse-grained matrix surrounding various inclusions of different lithologies. The matrix is mainly composed by olivine crystals from 0.2 to 1.5 mm of size and minor pyroxene and feldspar. Olivine crystals are zoned, with Mg-rich rims. Opaque phases are pyrrhotite, FeNi

metal, suessite FeSi, hapkeite, present as tiny inclusions along olivine grain boundaries, and graphite. Most of the inclusions are fine-grained ureilitic aggregates, consisting of 90% olivine crystals separated by a diopsidic, Al-rich clinopyroxene. Two inclusions display fine grained (max. width 50 μm) textures and contain 60% vol. Fe-rich olivine crystals, 20 % Al-rich clinopyroxene and 20 % opaques, consisting of equal parts of Fe-Ni alloy and pentlandite. Two inclusions are chondrules made of forsteritic olivine and enstatitic pyroxene, with minor plagioclase and no opaques.

Geochemistry: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): Matrix: olivine ($\text{Fa}_{3.0-26.8}$, mean $\text{Fa}_{15.4}$; $\text{Fe/Mn} = 50.9$, $n = 7$); pigeonite ($\text{Fs}_{14.1}\text{En}_{78.6}\text{Wo}_{7.3}$; $\text{Fe/Mn} = 20.5$, $n = 5$); Ureilitic inclusions: olivine ($\text{Fa}_{26.4}$; $\text{Fe/Mn} = 58.8$, $n = 8$); pigeonite ($\text{Fs}_{22.6}\text{En}_{70.1}\text{Wo}_{7.3}$; $\text{Fe/Mn} = 16.2$, $n = 6$); Al-rich clinopyroxene (SiO_2 42.6, TiO_2 0.9, Al_2O_3 10.3, Cr_2O_3 1.9, FeO 11.4, MgO 14.5, CaO 10.8, Na_2O 4.0, all in Wt.%); Metal-rich inclusions: ($\text{Fa}_{39.8}$; $\text{Fe/Mn} = 94.7$, $n = 7$); Al-rich clinopyroxene (SiO_2 45.9, TiO_2 0.3, Al_2O_3 8.4, Cr_2O_3 2.1, FeO 9.6, MgO 15.9, CaO 10.4, Na_2O 4.2, all in Wt.%); Fo,En-rich chondrules: olivine ($\text{Fa}_{0.3-3.0}$, mean $\text{Fa}_{1.2}$; $\text{Fe/Mn} = 9.4$, $n = 6$); enstatite ($\text{Fs}_{0.8}\text{En}_{97.7}\text{Wo}_{2.5}$; $\text{Fe/Mn} = 1.3$, $n = 5$); sodic plagioclase ($\text{An}_{52.3}\text{Ab}_{41.1}\text{Or}_{6.0}$, $n=5$).

Oxygen isotopes: (I.Franchi, R.Greenwood, *OU*) $\delta^{17}\text{O} = 3.92\text{‰}$, $\delta^{18}\text{O} = 8.79\text{‰}$, $\Delta^{17}\text{O} = -0.66\text{‰}$.

Classification: Ureilite (polymict) with high degree of shock and low degree of weathering.

Specimens: A total of 21.3 g specimen is on deposit at *MSN-FI*. The main mass is on deposit at *OAM*.

Dar al Gani 1067 (DaG 1067) 27°23.06'N, 16°05.77'E

Al Jufrah, Libya

Find: Feb 2006

Classification: Carbonaceous chondrite (CK5)

History: A single stone weighing 260 g was found by Romano Serra, *OAM*, during an expedition for meteorite search.

Physical characteristics: A single stone, almost completely covered by a fusion crust with several cracks.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): The thin section displays a texture composed of sparse, millimeter-sized chondrules (mostly granular olivine) in a recrystallized matrix mainly consisting of olivine, with minor augite and intermediate plagioclase. Opaques are mainly Cr-rich magnetite, with minor troilite and rare altered kamacite.

Geochemistry: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): Olivine ($\text{Fa}_{33.3\pm 1.3}$, $\text{Fe/Mn} = 158\pm 10$, $N = 7$), augite ($\text{Fs}_{10.7\pm 0.4}\text{Wo}_{45.8\pm 1.3}$, $\text{Al}_2\text{O}_3 = 1.06$ Wt.%, $N = 7$). Feldspar $\text{An}_{46.5}\text{Or}_{2.6}$. Magnetite contains 4.5 wt.% Cr_2O_3 . Oxygen isotopes: (I.Franchi, R.Greenwood, *OU*) $\delta^{17}\text{O} = -4.62\text{‰}$, $\delta^{18}\text{O} = -0.70\text{‰}$, $\Delta^{17}\text{O} = -4.26\text{‰}$.

Classification: Carbonaceous chondrite (CK5). Moderate weathering

Specimens: A total of 21.0 g specimen is on deposit at *MSN-FI*. The main mass is on deposit at *OAM*.

Dhofar 1769 (Dho 1769) 18°20.4'N, 54°12.8'E

Zufar, Oman

Find: 2012 Oct. 28

Classification: Lunar meteorite

History: A single stone was found by an anonymous finder Oct. 28, 2012

Petrography: The anorthositic highland breccia contains clasts up to 1 cm, which are mainly anorthositic lithologies and crystalline impact melt breccias. It also contains glassy fragments, some of which are highly vesicular, veins, and impact spherules (mostly devitrified) embedded in a fine-grained, clastic matrix. The spherules indicate an origin at the lunar surface. Accessory minerals: ilmenite (abundant), troilite, FeNi metal (rare), and zircon (very rare).

Geochemistry: SEM-EDS-analyses revealed that plagioclase in the bulk rock is anorthitic with a mean of $An_{93.4\pm5.1}$ (total range: An_{70-97} ; $n = 32$). Olivine is highly variable in composition Fo_{20-60} (mean: $Fo_{40\pm9}$; $n = 16$; $Fe/Mn = \text{approx. } 110$ (EDS)). Low-Ca pyroxene also shows variable composition with $Fs_{20-58}En_{29-77}Wo_{2.5-15}$ (mean: $Fs_{37.5\pm10}En_{54.6\pm10}Wo_{7.8\pm3.3}$; $n = 28$; $Fe/Mn = \text{approx. } 60$ (EDS)). Some analyzed Ca-pyroxenes have $Fs_{18-34}En_{28-45}Wo_{33-41}$. The meteorite is moderately weathered.

Classification: Lunar meteorite (anorthositic breccia)

Dhofar 1842 (Dho 1842) $18^{\circ}49.834'N$, $54^{\circ}35.538'E$

Zufar, Oman

Find: 2001 Jan 15

Classification: Ordinary chondrite (H5)

History: Discovered on a desert expedition on Jan. 1, 2001.

Physical characteristics: One dark brown stone of 73.89 g. Magnetic susceptibility $\log \chi = 4.80$.

Petrography: (R. Bartoschewitz, *Bart*) various types of chondrules up to 1.2 mm (avg. 0.6 mm) set in a matrix with iron-hydroxide-filled cracks.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $Fa_{19.2}$ ($Fa_{18.4-21.3}$, $n=11$); low-Ca pyroxene $Fs_{17.1}Wo_{1.3}$ ($Fs_{16.3-17.9}Wo_{1.1-1.6}$, $n=7$).

Classification: Ordinary chondrite (H5, shock stage S2)

Specimens: 14.8 g on deposit at *Kiel*, main mass anonymous

Dhofar 1854 (Dho 1854) $18^{\circ}50.035'N$, $54^{\circ}35.47'E$

Zufar, Oman

Find: 2001 Jan 24

Classification: Ordinary chondrite (H4, melt breccia)

History: Discovered on a desert expedition on Jan. 24, 2001.

Physical characteristics: 17 dark brown fragments, in total 339.4 g. Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.66$.

Petrography: (R. Bartoschewitz, *Bart*) Nearly black opaque melt veins (~0.5 mm) with relict chondrite and mineral fragments, partly oxidized matrix. Olivine shows mosaicism and recrystallization. Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.66$.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $Fa_{15.3\pm0.7}$ (14.6-17.3, $n=13$); low-Ca pyroxene: $Fs_{14.2\pm1.7}Wo_{0.9}$ ($Fs_{13.0-17.9}Wo_{0.3-2.7}$, $n=7$). (average of whole section)

Classification: Ordinary chondrite, melt breccia (H5)

Specimens: 22.5 g on deposit at *Kiel*, main mass anonymous

Dhofar 1858 (Dho 1858) $18^{\circ}48.417'N$, $54^{\circ}03.087'E$

Zufar, Oman

Find: 2001 Jan 26

Classification: Ordinary chondrite (H4)

History: Discovered while desert expedition on Jan. 26th, 2001.

Physical characteristics: One dark brown stone of 441.79 g. Magnetic susceptibility $\log \chi = 4.84$.

Petrography: (R. Bartoschewitz, *Bart*) various types of chondrules form 0.1 to 1.2 mm (avg. 0.8 mm) set in a iron hydroxide interspersed matrix.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{18.2}$ (17.7-18.8, $n=23$); low-Ca pyroxene $\text{Fs}_{15.4}\text{Wo}_{1.6}$ ($\text{Fs}_{11.1-24.3}\text{Wo}_{0.1-1.2}$, $n=9$). Kamacite Ni 4.1-4.5, Co 0.7 wt.% ($n=3$).

Classification: Ordinary chondrite (H/L4, shock stage S2). H/L based on H silicate composition, H/L kamacite composition and L chondrule size.

Specimens: 14.8 g on deposit at *Kiel*, main mass anonymous

Dhofar 1860 (Dho 1860) 18°56.633'N, 54°06.96'E

Zufar, Oman

Find: 2001 Jan 27

Classification: Ordinary chondrite (H5)

History: Discovered on a desert expedition on Jan. 27, 2001.

Physical characteristics: Two dark brown stones of 1773.8 g in total. Magnetic susceptibility $\log \chi = 5.22$.

Petrography: (R. Bartoschewitz, *Bart*) recrystallised chondrules form 0.2 to 1.0 mm (avg. 0.5 mm) set in iron hydroxide interspersed in a recrystallized matrix.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{18.6}$ ($\text{Fa}_{17.9-19.7}$, $n=12$); low-Ca pyroxene $\text{Fs}_{17.0}\text{Wo}_{1.6}$ ($\text{Fs}_{15.9-19.4}\text{Wo}_{1.1-2.0}$, $n=11$). Kamacite Ni 5.0-6.7, Co 0.6 wt.% ($n=12$).

Classification: Ordinary chondrite (H5, shock stage S2)

Specimens: 20.3 g on deposit at *Kiel*, main mass anonymous

Dhofar 1866 (Dho 1866) 18°51.42'N, 54°37.323'E

Zufar, Oman

Find: 2001 Jan 29

Classification: Ordinary chondrite (L5)

History: Discovered on a desert expedition on Jan. 29th, 2001.

Physical characteristics: One dark brown stone of 1712.8 g. Magnetic susceptibility $\log \chi = 4.51$.

Petrography: (R. Bartoschewitz, *Bart*) recrystallized chondrules form 0.4 to 1.8 mm (avg. 0.8 mm) set in a recrystallized matrix.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{25.0}$ ($\text{Fa}_{24.4-27.3}$, $n=13$); pyroxene $\text{Fs}_{18.7}\text{Wo}_{10.7}$ ($\text{Fs}_{6.4-26.6}\text{Wo}_{1.1-47.6}$, $n=14$); feldspar $\text{An}_{12}\text{Or}_8$ ($n=3$); chromite CRAL=86, FFM=89, Fe/Mg=8 ($n=1$). Taenite, tetrataenite, troilite, Ni-pyrrhotite, smythite.

Classification: Ordinary chondrite (H5, shock stage S2)

Specimens: 20.3 g on deposit at *Kiel*, main mass anonymous

Dhofar 1869 (Dho 1869) 18°50.196'N, 54°34.748'E

Zufar, Oman

Find: 2003 Mar 02

Classification: Ordinary chondrite (H5, melt breccia)

History: Discovered on a desert expedition on March 2, 2003.

Physical characteristics: 18 dark brown fragments, in total 1594.2 g. Magnetic susceptibility $\log \chi = 4.51$.

Petrography: (R. Bartoschewitz, *Bart*) Very fine-grained translucent melt rock with relict chondrules and mineral fragments. Olivine shows mosaicism and recrystallization, feldspar is transformed to maskelynite.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{15.9 \pm 1.0}$ ($\text{Fa}_{14.5-18.7}$, $n=18$); low-Ca pyroxene: $\text{Fs}_{13.8 \pm 1.0}\text{Wo}_{1.3}$ ($\text{Fs}_{12.2-14.7}\text{Wo}_{0.8-2.1}$, $n=5$). Kamacite Ni 6.8-7.5, Co 0.6 ($n=4$); smythite Ni 1.5 ($n=1$) wt.%.

Classification: Ordinary chondrite, melt breccia (H5)

Specimens: 23.1 g on deposit at *Kiel*, main mass anonymous

Dhofar 1929 (Dho 1929) 18°50.792'N, 54°52.412'E

Zufar, Oman

Find: 2003 Mar 10

Classification: Ordinary chondrite (H3)

History: Discovered on a desert expedition on March 10, 2003.

Physical characteristics: One dark brown stone of 32.5 g. Magnetic susceptibility $\log \chi = 5.07$.

Petrography: (R. Bartoschewitz, *Bart*) various types of chondrules from 0.2 to 0.9 mm (avg. 0.5 mm) set in a fine-grained matrix.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{17.5}$ ($\text{Fa}_{0.2-24.4}$, $n=20$); low-Ca pyroxene: $\text{Fs}_{15.7}\text{Wo}_{1.2}$ ($\text{Fs}_{1.7-18.4}\text{Wo}_{0.9-1.2}$, $n=10$).

Classification: Ordinary chondrite (H3, shock stage S4)

Specimens: 6.5 g on deposit at *Kiel*, main mass anonymous

Dhofar 1934 (Dho 1934) 18°50.147'N, 54°52.724'E

Zufar, Oman

Find: 2003 Mar 12

Classification: Ordinary chondrite (H4)

History: Discovered on a desert expedition on March 12, 2003.

Physical characteristics: One dark brown stone of 107.9 g. Magnetic susceptibility $\log \chi = 5.04$.

Petrography: (R. Bartoschewitz, *Bart*) various types of chondrules from 0.2 to 1.6 mm (avg. 0.6 mm) set in a fine-grained, transparent matrix.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{15.3}$ ($\text{Fa}_{14.5-18.0}$, $n=22$); low-Ca pyroxene: $\text{Fs}_{14.1}\text{Wo}_{0.8}$ ($\text{Fs}_{12.9-15.4}\text{Wo}_{0.3-1.5}$, $n=5$). Kamacite Ni 5.3-7.7, Co 0.5-0.6 wt.% ($n=5$).

Classification: Ordinary chondrite (H4, shock stage S4)

Specimens: 20.8 g on deposit at *Kiel*, main mass anonymous

Dhofar 1981 (Dho 1981) 18°38.252'N, 54°8.640'E

Zufar, Oman

Found: 2008 Feb 9

Classification: Carbonaceous chondrite (CM2)

History: Four small black individuals partly covered with matte fusion crust were found during a field trip to the Dhofar region of Oman.

Petrography: The meteorite has an almost black interior and is composed of small (about 0.1-0.3 mm in diameter) chondrules, chondrule pseudomorphs and rare CAIs set into an abundant dark matrix of mainly phyllosilicates, Ca-carbonates, and pyrrhotite; poorly-characterized-phase lumps are present. Most components are surrounded by fine-grained accretionary rims. No pyroxenes were found, attesting to a rather high degree of aqueous alteration.

Dhofar 1988 (Dho 1988) 19°4.865'N, 54°46.024'E

Zufar, Oman

Find: 2011 Dec 2

Classification: Carbonaceous chondrite (C2, ungrouped)

History: The meteorite was found 2011 during a field trip in the Oman desert.

Physical characteristics: Small almost black stone partly covered with fusion crust.

Petrography: The meteorite is a breccia displaying an dark gray to black interior. It is composed of relatively large chondrule pseudomorphs (mean 550 μm in diameter) and rare isolated mineral grains set into an abundant matrix of phyllosilicates, Ca-carbonate, and pyrrhotite. Chondrule pseudomorphs are typically surrounded by fine-grained accretionary rims. Anhydrous silicates are almost exclusively forsteritic olivine. Very rarely more Fe-rich olivine (up to Fa_{26}) has been encountered; no pyroxene was found.

Geochemistry: Oxygen isotopes (K. Ziegler, *UNM*): acid-washed material analyzed in replicate by laser fluorination gave, respectively: $\delta^{18}\text{O}=16.424, 21.864, 20.095$; $\delta^{17}\text{O}=7.032, 10.751, 9.582$; $\Delta^{17}\text{O}= -1.64, -0.793, -1.028$ (all per mil).

Classification: Oxygen isotopes plot close to Tagish Lake (C2-ungrouped), between CI and the ungrouped C2 chondrites Y86720, Y82162 and B7904.

Dhofar 1989 (Dho 1989) 19°13.558'N, 54°55.030'E

Zufar, Oman

Find: 2010 Apr 21

Classification: Ureilite

History: The meteorite was found in 2010 during a field trip in the Oman desert.

Petrography: The meteorite displays a cumulate texture of predominant olivine grains and less abundant orthopyroxene. Olivine displays characterisitic reduced rims. Graphite flakes are abundant.

Geochemistry: reduced rims in olivine: $\text{Fa}_{2.2-6.7}$; Cr_2O_3 in ol: ~ 0.7 wt%

Dhofar 1991 (Dho 1991) 18°38.149'N, 54°43.908'E

Zufar, Oman

Find: 2010 Apr 23

Classification: Ordinary chondrite (H, melt rock)

Petrography: The meteorite displays a melt texture of sometimes euhedral olivine, orthopyroxene, rare augite and abundant FeNi metal and FeS spherules. Rarely, poorly defined relict chondrules have been found. FeNi-metal or sulfide veins are absent. Olivine and orthopyroxene are compositional homogeneous.

Dhofar 1994 (Dho 1994) 18°23.399'N, 54°19.047'E

Zufar, Oman

Find: 2010 Apr 25

Classification: Carbonaceous chondrite (CM2)

History: The meteorite was found in 2010 during a field trip in the Oman desert.

Petrography: The dark-gray meteorite is composed of 0.1-0.3 mm sized chondrules, chondrule pseudomorphs and rare CAIs set into an abundant fine-grained matrix of mainly phyllosilicates, Ca-carbonates, and pyrrhotite. Most components are surrounded by fine-grained accretionary rims. The lack of Fe-rich anhydrous silicates attests to a high degree of aqueous alteration.

Dhofar 2002 (Dho 2002) 18°50.265'N, 54°52.33'E

Zufar, Oman

Find: 2003 Mar 06

Classification: Ordinary chondrite (H5, melt breccia)

History: Discovered on a desert expedition on March 6, 2003.

Physical characteristics: One dark brown stone of 302.36 g. Magnetic susceptibility $\log \chi = 4.88$.

Petrography: (R. Bartoschewitz, *Bart*) Dominantly very fine-grained melt with a few rounded chondrite and mineral fragments. Olivine shows mosaicism and recrystallization, feldspar is transformed to maskelynite.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{15.2 \pm 1.0}$ ($\text{Fa}_{14.3-18.8}$, $n=20$); low-Ca pyroxene: $\text{Fs}_{12.7 \pm 0.5} \text{Wo}_{1.0}$ ($\text{Fs}_{12.2-13.1} \text{Wo}_{0.8-1.3}$, $n=3$). Kamacite Ni 5.3-7.5, Co 0.5-0.6 ($n=5$); troilite Ni 0.5 ($n=1$); smythite Ni 2.6 ($n=1$) wt.%.

Classification: Ordinary chondrite, melt breccia (H5)

Specimens: 21.0 g on deposit at *Kiel*, main mass anonymous

Dhofar 2003 (Dho 2003) 18°49.915'N, 54°51.924'E

Zufar, Oman

Find: 2003 Mar 09

Classification: Ordinary chondrite (H4, melt breccia)

History: Discovered on a desert expedition on March 9, 2003.

Physical characteristics: One dark brown stone of 14.2 g. Magnetic susceptibility $\log \chi = 4.61$.

Petrography: (R. Bartoschewitz, *Bart*) Very fine-grained translucent melt rock with mineral and relict chondrule fragments. Olivine shows mosaicism and recrystallization, feldspar is transformed to maskelynite.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{16.1 \pm 1.7}$ ($\text{Fa}_{14.1-18.9}$, $n=22$); low-Ca pyroxene: $\text{Fs}_{14.6 \pm 1.4} \text{Wo}_{1.4}$ ($\text{Fs}_{12.3-16.2} \text{Wo}_{0.4-3.7}$, $n=7$); chromite CRAL=84, FFM=85, Fe/Mg=5.5($n=1$). Kamacite Ni 7.0-7.9, Co 0.6 ($n=5$) wt.%.

Classification: Ordinary chondrite, melt breccia (H5)

Specimens: 3.2 g on deposit at *Kiel*, main mass anonymous

Dhofar 2004 (Dho 2004) 18°48.9'N, 54°51.907'E

Zufar, Oman

Find: 2003 Mar 10

Classification: Ordinary chondrite (H5, melt breccia)

History: Discovered on a desert expedition on March 10, 2003.

Physical characteristics: 43 dark brown fragments, in total 954.5 g. Magnetic susceptibility $\log \chi = 4.82$.

Petrography: (R. Bartoschewitz, *Bart*) Rounded chondrite and mineral fragments in nearly opaque, black-brown melt veins. Analyses are of the rounded chondrite and mineral fragments. Olivine shows mosaicism and recrystallization, feldspar is transformed to maskelynite.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{15.0 \pm 0.3}$ ($\text{Fa}_{14.5-15.7}$, $n=13$); low-Ca pyroxene: $\text{Fs}_{13.6 \pm 0.9}\text{Wo}_{0.9}$ ($\text{Fs}_{14.6-15.4}\text{Wo}_{0.3-3.8}$, $n=13$); chromite $\text{CRAL}=88$, $\text{FFM}=81$, $\text{Fe/Mg}=4.4$ ($n=2$). Kamacite Ni 6.1-7.1, Co 0.6 ($n=3$); troilite Ni 0.2-0.5 ($n=2$); Ni-prrrhotite Ni 4.0 ($n=1$) wt.%.

Classification: Ordinary chondrite, melt breccia (H5)

Specimens: 21.1 g on deposit at *Kiel*, main mass anonymous

Dhofar 2006 (Dho 2006) 18°51.705'N, 54°53.815'E

Zufar, Oman

Find: 2003 Mar 01

Classification: Ordinary chondrite (H4)

History: Discovered on a desert expedition on March 1, 2003.

Physical characteristics: One dark brown stone of 116.2 g. Magnetic susceptibility $\log \chi = 4.96$.

Petrography: (R. Bartoschewitz, *Bart*) various types of chondrules up to 1.2 mm (avg. 0.7 mm) set in an iron-hydroxide-bearing matrix.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{17.4}$ ($\text{Fa}_{16.8-17.8}$, $n=24$); low-Ca pyroxene: $\text{Fs}_{17.7}\text{Wo}_{0.9}$ ($\text{Fs}_{4.6-20.9}\text{Wo}_{0.3-1.3}$, $n=17$); chromite $\text{CRAL}=91$, $\text{FFM}=87$, $\text{Fe/Mg}=6.2$ ($n=3$); merrillite. Kamacite Ni 6.0, Co 0.6 ($n=1$).

Classification: Ordinary chondrite (H4, shock stage S3)

Specimens: 21.6 g on deposit at *Kiel*, main mass anonymous

Dhofar 2007 (Dho 2007) 18°51.821'N, 54°52.047'E

Zufar, Oman

Find: 2003 Mar 04

Classification: Ordinary chondrite (H5, melt breccia)

History: Discovered on a desert expedition on March 4, 2003.

Physical characteristics: 296 dark brown fragments, in total 1599 g. Magnetic susceptibility $\log \chi = 4.64$.

Petrography: (R. Bartoschewitz, *Bart*) Very fine-grained translucent melt rock with relict chondrule and mineral fragments and nearly black opaque melt veins. Olivine shows mosaicism and recrystallization, feldspar is transformed to maskelynite.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{15.0}$ ($\text{Fa}_{14.4-15.3}$, $n=20$); low-Ca pyroxene: $\text{Fs}_{14.4}\text{Wo}_{0.8}$ ($\text{Fs}_{13.6-17.0}\text{Wo}_{0.3-1.8}$, $n=5$); chromite $\text{CRAL}=87$, $\text{FFM}=82$, $\text{Fe/Mg}=4.7$ ($n=2$); spinel $\text{CRAL}=8$, $\text{FFM}=28$, $\text{Fe/Mg}=0.4$ ($n=1$). Kamacite Ni 4.6-8.1, Co 0.5-0.6 ($n=5$).

Classification: Ordinary chondrite, melt breccia (H5)

Specimens: 20.4 g on deposit at *Kiel*, main mass anonymous

Dhofar 2008 (Dho 2008) 19°07.387'N, 54°56.209'E

Zufar, Oman

Find: 2002 Mar 02

Classification: Ordinary chondrite (H4)

History: Discovered on a desert expedition on March 2, 2002.

Physical characteristics: Two dark brown stones of 228.79 g in total. Magnetic susceptibility $\log \chi = 4.83$.

Petrography: (R. Bartoschewitz, *Bart*) various types of chondrules up to 1 mm (avg. 0.5 mm) set in recrystallized iron-hydroxide-permeated matrix.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{17.7}$ ($\text{Fa}_{16.9-20.8}$, $n=16$); pyroxene: $\text{Fs}_{11.3}\text{Wo}_{2.6}$ ($\text{Fs}_{5.3-19.9}\text{Wo}_{0.2-5.9}$, $n=9$). Kamacite $\text{Ni}_{5.0-6.7}$, Co 0.6 ($n=10$).

Classification: Ordinary chondrite (H4, shock stage S3)

Specimens: 20.3 g on deposit at *Kiel*, main mass anonymous

Dhofar 2032 (Dho 2032) $18^{\circ}13'33.8''\text{N}$, $54^{\circ}11'55.1''\text{E}$

Zufar, Oman

Find: 2008

Classification: Ordinary chondrite (H5)

History: Found by Shauna Russell on 14 Nov 2008.

Physical characteristics: Single stone with weathered, dark exterior. A saw cut shows many small chondrules set in a brown matrix.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows many distinct, small chondrules, abundant metal, and plagioclase grains up to 20 μm .

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{18.5\pm 0.5}$, $\text{Fe/Mn}=37\pm 5$, $n=13$; low-Ca pyroxene $\text{Fs}_{16.9\pm 0.3}\text{Wo}_{1.3\pm 0.1}$, $n=12$.

Classification: Ordinary chondrite (H5)

Specimens: 23.2 g including a probe mount on deposit at *UNM*, Dave Gheesling holds the main mass.

Dhofar 2033 (Dho 2033) $18^{\circ}46'08.8''\text{N}$, $54^{\circ}41'16.1''\text{E}$

Zufar, Oman

Find: 2008

Classification: Ordinary chondrite (L6)

History: Found by Shauna Russell on 26 Nov 2008.

Physical characteristics: Single stone with weathered, dark exterior. A saw cut shows a few faint chondrules set in a brown matrix; some oxidation of metal is observed.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows a texturally equilibrated ordinary chondrite with scattered chondrules, most of the meteorite recrystallized, and plagioclase grains up to 100 μm .

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{25.6\pm 0.5}$, $\text{Fe/Mn}=52\pm 3$, $n=6$; low-Ca pyroxene $\text{Fs}_{22.3\pm 1.1}\text{Wo}_{1.3\pm 0.2}$, $n=6$.

Classification: Ordinary chondrite L6

Specimens: 20.86 g including a probe mount on deposit at *UNM*, Dave Gheesling holds the main mass.

Dhofar 2036 (Dho 2036) 18.541°N , 54.430°E

Zufar, Oman

Find: 2009

Classification: HED achondrite (Eucrite, monomict)

History: Found in 2009 by an anonymous prospector.

Petrography: (A. Irving and S. Kuehner, *UWS*) Composed of relatively large microgabbroic eucrite clasts set in a finer grained matrix (~20 vol.%). Minerals are calcic plagioclase, exsolved pigeonite, silica polymorph (some intergrown with clinopyroxene), Al-Ti-chromite, Ti-rich chromite, ilmenite, merrillite, troilite and rare zircon.

Geochemistry: Orthopyroxene host ($\text{Fs}_{60.0-61.3}\text{Wo}_{2.8-2.1}$, $\text{FeO/MnO} = 31-32$, $N = 3$), clinopyroxene exsolution lamellae ($\text{Fs}_{25.6-26.8}\text{Wo}_{43.6-43.3}$, $\text{FeO/MnO} = 30-32$, $N = 3$).

Classification: Eucrite (monomict microgabbroic breccia).

Specimens: 20.2 g including one polished thin section at *ROM*; remainder with anonymous owner.

Dhofar 2037 (Dho 2037) 18.753°N, 54.377°E

Zufar, Oman

Find: 2009

Classification: Carbonaceous chondrite (CV3)

History: Found in 2009 by an anonymous prospector.

Petrography: (A. Irving and S. Kuehner, *UWS*) Separated granular chondrules (apparent diameter 2.4 ± 1.9 mm) and amoeboid fine-grained CAI are set in a deep brown matrix (~40 vol.%).

Geochemistry: Olivine ($\text{Fa}_{0.3-59.1}$, $N = 3$), orthopyroxene ($\text{Fs}_{0.7-1.7}\text{Wo}_{1.2-0.9}$, $N = 2$), augite ($\text{Fs}_{24.3}\text{Wo}_{45.2}$), Al-Ti-diopside ($\text{Fs}_{4.8}\text{Wo}_{53.9}$, $\text{Al}_2\text{O}_3 = 15.9$ wt.%, $\text{TiO}_2 = 1.0$ wt.%).

Classification: Carbonaceous chondrite (CV3).

Specimens: 20.1 g including one polished thin section at *ROM*; remainder with anonymous owner.

Diepenveen 52° 17' 35"N, 6° 7' 30"E

Overijssel, Netherlands

Probable fall: 1873

Classification: Carbonaceous chondrite (CM2, anomalous)

History: (M. Langbroek, *Naturalis* and DMS, N. de Kort, *KNVWS*): A single 68-g stone in private ownership of Mrs. Leida Kiers was recognized as a meteorite by retired Royal Eise Eisinga director Henk Nieuwenhuis in 2012. A late 19th century handwritten card signed by D. H. Te Wechel, son of the 1873 Diepenveen village teacher, is preserved with the meteorite. It describes how the meteorite fell on 27 October 1873, near 3 pm local time, in an agricultural field near Diepenveen village. It fell near farmhand A. Bos and his wife, who reportedly recovered it within minutes of the fall. The owner of the land is mentioned as J. W. IJsinck, allowing to trace the fall location to within a few hundred meters through historic archives. The meteorite entered the curiosity collection of the Rijks Hogere Burgerschool (Higher Civilian State School) of Deventer shortly after the fall and resided there for over a century. When the school permanently closed down in the 1970s, the meteorite and accompanying documentation were rescued from destruction by a teacher, Mr. Jager. After his death, it entered the private rock collection of Mrs. Kiers, who donated the meteorite to *NBC* in October 2013. All persons and places mentioned have been traced in historical archives.

Physical characteristics: (M. Langbroek, *NBC*): Upon rediscovery in 2012, the single preserved stone consisted of a fresh-looking 68.4 g half individual with a break surface and approximately 50% mostly shiny black fusion crust. The interior is dark grey-black with light spots. It is very

crumbly. A small several grams detached fragment of the individual stone was glued back to it at an unknown date (perhaps shortly after the fall).

Petrography (L.M. Kriegsman, Naturalis): The meteorite is a breccia with angular clasts of different lithologies measuring up to 1 mm. The different lithologies vary with regards to chondrule rim thickness, and hydration level of matrix. Chondrules make up 15–20 vol% of the mass. Chondrule size is mostly between 0.05 and 0.7 mm with a mean of 0.35 mm, one measured as large as 1.8 mm. Most chondrules are porphyritic, only very few barred chondrules are present. They have fine grained dust mantles, locally showing alteration to tochilinite. The matrix contains Fo grains up to 0.4 mm, as well as amoeboid olivine aggregates and CAIs dominated by fassaite with perovskite in the core. Pyroxenes show two types: low-Ca pyroxene (monoclinic state confirmed by Raman) and fassaite. Matrix metals: 2-6 vol% of the matrix is metal and sulfides. FeNi grains occasionally measure up to 0.5 mm. All FeNi metal is kamacite with up to 2 wt% Cr and 1 wt% P. Magnetite is absent. Rare, tiny carbonate grains are present.

Geochemistry: Mineral compositions (EPMA and SEM-EDS) and geochemistry (L.M. Kriegsman, *NBC*; K. Ziegler, *UNM*; M. Zolensky, *JSC*; W. van Westrenen, VU Amsterdam;): $Fa_{9\pm 13}$ (chondrules, $N=23$), $Fa_{35\pm 10}$ (matrix, $N=5$), 70 (barred, rare, $N=1$); $Fs_{2\pm 1}Wo_{2\pm 2}$ (low-Ca pyroxene, $N=8$), $Fs_{1.8\pm 0.2}Wo_{4\pm 4}$ (fassaite, $N=5$). Oxygen isotopes (17 measurements): $\delta^{17}O$ = range -12.7 to +0.3, $\delta^{18}O$ = range -10.3 to +7.7, $\Delta^{17}O$ = range -7.4 to -2.7. Some lithologies have more Fe-rich olivine: Fa_{38-64} (average Fa_{53} , $N=9$), and their matrices contain significantly less phyllosilicates than the remainder of the meteorite.

Classification: CM2-anomalous. The classification as anomalous is based on the oxygen isotopic data, which are outside the range of CM bulk samples. This meteorite also hosts metal in the matrix, rarely observed in normal CM2 chondrites, suggesting a more reduced character for this meteorite.

Specimens: Main mass (66.6 g) at *NBC*. Thin section at *JSC*.

El Médano 262 ~24°51'S, ~70°32'W

Antofagasta, Chile

Find: 2015 Jan 5

Classification: Carbonaceous chondrite (CO3)

History: The stones were found in the Atacama desert by E. Christensen while looking for meteorites

Physical characteristics: Dark brownish irregular stones without fusion crust. Cut surface reveals a dark brown interior with abundant small chondrules.

Petrography: (J. Gattacceca, *CEREGE*) Abundant chondrules (predominantly of type I) and CAIs in a fine-grained Fe rich matrix. Chondrule:matrix ratio is 57:43. Average chondrule apparent size $180\pm 120\ \mu m$ ($N=24$).

Geochemistry: Olivine in the range $Fa_{0.5-52.9}$ (mean $Fa_{19.3\pm 16.6}$, $PMD=73\%$, $N=18$). Cr_2O_3 in ferroan olivine $0.08\pm 0.05\ wt.\%$ ($N=15$). Low-Ca pyroxene $Fs_{2.3\pm 1.2}Wo_{1.5\pm 0.8}$ ($N=10$). Magnetic susceptibility $\log \chi = 4.41$ (χ in $10^{-9}\ m^3/kg$).

Classification: Carbonaceous chondrite (CO3). Minimal weathering

Specimens: 52 g at *CEREGE*. Main mass with Eric Christensen.

El Tiro 30.279230°N, 111.817131°W

Sonora, Mexico

Find: Jan 2013

Classification: Ordinary chondrite (L3)

History: A single stone showing weathering cracks, some remnant fusion crust, and shallow regmaglypts was found by a gold prospector close to the settlement of El Tiro in Sonora, Mexico.

Physical characteristics: Single stone. A saw cut and polished slices reveal many densely packed chondrules of variable size set in a dark brown groundmass. This meteorite also contains breccia clasts and fragments up to ~1 cm in size.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous unequilibrated chondrules, apparent mean diameter many with porphyritic, igneously zoned olivines and pyroxenes. Some scattered, opaque, fine-grained matrix is present. A few high-Ca pyroxenes were observed. Only small amounts of very fine-grained plagioclase were observed.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Chondrule olivine $\text{Fa}_{21.4 \pm 8.8}$, $\text{Fe/Mn} = 65 \pm 26$, $\text{Cr}_2\text{O}_3 = 0.06 \pm 0.05$ wt%, $n=10$, chondrule low-Ca pyroxene $\text{Fs}_{20.4 \pm 1.0} \text{Wo}_{2.0 \pm 1.2}$, $\text{Fe/Mn} = 29 \pm 2$, $n=7$.

Classification: Ordinary chondrite L3, estimated type 3.4-3.6 based on mean values and 1-sigma of Fa and Cr_2O_3 -content of ferroan olivines.

Specimens: 23.1 g including a probe mount on deposit at *UNM*, Aerolite Meteorites holds the main mass.

Eldorado Valley 003 (EV 003) $35^\circ 55.35' \text{N}$, $114^\circ 47.53' \text{W}$

Nevada, United States

Find: 2 April 2014

Classification: Ordinary chondrite (L6)

History: This stone was found by J. Franske while he was hunting for meteorites on open desert.

Physical characteristics: This stone is essentially pyramidal in shape, approximately 80% fusion crusted, and exhibits regmaglypts.

Petrography: A. Rubin and J. Breen, *UCLA*. Plagioclase grains are typically 60-100 μm in size. The rock exhibits weak mosaicism but does not exhibit maskelynite.

Famenin $35^\circ 7.12' \text{N}$, $48^\circ 58.50' \text{E}$

Hamadan, Iran

Confirmed fall: 2015 June 27

Classification: Ordinary chondrite (H/L3)

History: Around 08:30 am local time (GMT+3.5) on 27 June 2015, Reza Salimi, living in Famenin town of Hamedan Province, Iran, heard the sound of an impacting object onto the roof of his house. He discovered that part of the roof was damaged and fragments of a stone were spread on the roof. He found some other fragments in his yard. News of the meteorite fall propagated quickly via the local media. With the help of a local journalist, Hamed Pourkhorsandi (*CEREGE*) received a total of 25 g of fragments two weeks after the fall. Gamma spectroscopy of the two larger fragments were carried out from 16 to 24 July 2015 in LSCE, France. The data show the presence of ^7Be , ^{54}Mn , ^{22}Na and ^{26}Al . The presence of these short-lived nuclides, and the detailed reports in the media support with a recent fall event.

Physical characteristics: Upon its impact to the roof, the meteorite broke into two large and eight smaller fragments. The meteorite is covered by fusion crust. The interior is light gray and chondrules are visible with the naked eye.

Petrography: Petrographic observations, performed by optical microscopy and SEM, show different types of chondrules set in a clastic matrix. Chondrule average apparent diameter is

615±380 µm (N=32). Some chondrules exhibit well-preserved troilite rims. Olivine and low-Ca orthopyroxene are not completely equilibrated. Type I chondrules containing metal grains are present. Sub-spherical Fe-Ni metal grains are present in the matrix and show intergrowths with troilite. Troilite is finely polycrystalline with domains of about 10 µm. No melt veins nor shock darkening are visible.

Geochemistry: Olivine $\text{Fa}_{17.4\pm3.7}$ ($\text{Fa}_{6.4-24.9}$, PMD 14%, N=23), low-Ca pyroxene $\text{Fs}_{17.1\pm9.0}\text{Wo}_{1.8\pm1.5}$ ($\text{Fs}_{5.4-31.0}$, PMD 41%, N=7). Cr_2O_3 content of olivine is 0.12±0.16 wt%. Magnetic susceptibility (measured on 25 g) $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.08$. Saturation magnetization is 26.0 Am²/kg, indicating a bulk metal content similar to L chondrites (see [Gattacceca et al. 2014](#)).

Classification: H/L3. Olivine composition is in the range of H chondrites. However magnetic susceptibility is intermediate between H ($\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.32\pm0.10$, N=145 falls) and L chondrites ($\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.87\pm0.10$, N=144 falls in [Rochette et al. 2003](#)). The bulk metal content determined by hysteresis measurements is in the L range. Chondrule size is closer to the range for L chondrites than for H chondrites. Based on this, Famenin is classified in the intermediate category H/L (as defined in [Kallemeyn et al. 1989](#)). The petrographic subtype (3.8/3.9) is based on petrographic observations and the scatter of olivine composition.

Specimens: 24 g and a polished section at *CEREGE*.

High Island Creek 44°35.763'N, 94°01.809'W

Minnesota, United States

Find: 2011 Apr

Classification: Iron meteorite (IIIAB)

History: Plowed up in April 2011 by Bruce Lilienthal on his farm east of Arlington, Minn. Recognized immediately as "unusual" and separated from other glacial erratics. In May 2013, the Lilienthals contacted E. Calvin Alexander, Jr., at the University of Minnesota. Alexander identified the object as an iron meteorite based on its Ni content and micro-structure. Object purchased by Alexander in Feb 2014. Samples sent to Wasson for classification.

Physical characteristics: Thick, oval, highly flattened shape meteorite, 41 × 28 × 4 cm. Bulk density = 7.23 g/cc. Rusty orange surface with 2-3 cm darker spots on surface. Similar shape to [Arlington](#) which was found 3.4 km to the northwest.

Petrography: Structure is Om, typical of a IIIAB. Moderate weathering near the surface.

Geochemistry: Composition: Co, 5.10 mg/g; Ni, 78.6 mg/g; Ga, 21.2 µg/g; Ge, <50 µg/g; As, 5.42 µg/g; Ir 2.25 µg/g; Au, 0.727 µg/g. The meteorite is compositionally a member of IIIAB. The only closely similar IIIAB is [al-Ghanim \(iron\)](#). No other iron has both a Au value within 5% and an Ir value within 10% of this composition.

Classification: Iron, IIIAB based on composition and structure.

Specimens: 1518 g at *UCLA*, 12077 g at *UMin*

Huacachina 14°4'59"S, 75°48'54"W

Ica, Peru

Found: March 2014

Classification: Ordinary chondrite (LL3)

History: Antonio Vasquez found the meteorite while driving a car from the Huacachina lake to the ocean. The stone was identified as a meteorite by José M. Monzon, who provided samples for further analysis to Andre L. R. Moutinho.

Physical characteristics: Single stone, weathered exterior. Saw cut reveals numerous chondrules, some up to 3 mm, brecciation and some melt veins present.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished epoxy mount shows numerous porphyritic chondrules, many with mesostasis or glass. Mean apparent chondrule size $750 \pm 420 \mu\text{m}$, $n=54$.

Geochemistry: (C. Agee and N. Muttik, *UNM*) EMPA. Chondrule olivine $\text{Fa}_{21.9 \pm 9.9}$, $\text{Fe/Mn} = 63 \pm 30$, $\text{Cr}_2\text{O}_3 = 0.05 \pm 0.04$ (wt%), $n=17$; low-Ca pyroxene $\text{Fs}_{14.8 \pm 7.8}\text{Wo}_{1.7 \pm 1.8}$, $\text{Fe/Mn} = 34 \pm 21$, $n=13$.

Classification: Ordinary chondrite (LL3, W2, S4), Olivine Fa mean value and sigma, and Cr_2O_3 mean value and sigma similar to Chainpur (LL3.4) in [Grossman and Brearley \(2005\)](#).

Specimens: Main mass with finder, 368 g with José M. Monzon, 620 g with Andre L. R. Moutinho and 25.2 g including microprobe mount on deposit *UNM*.

Ivanpah Dry Lake 35°29.14'N, 115°20.47'W

California, United States

Find: 1 Jan 2014

Classification: Ordinary chondrite (H4)

History: This stone was found by J. Franske while he was hunting for meteorites on a dry lake bed.

Physical characteristics: This rounded, 1128 g stone was found in two pieces about 40 feet apart. Both halves are covered in fresh, black fusion crust. It would appear the stone broke in half upon impact.

Petrography: A. Rubin, J. Breen, *UCLA*, Low-Ca pyroxene exhibits polysynthetic twins. Chondrules contain no clear, isotropic glass. There is abundant metallic Fe-Ni and troilite.

Izarzar 30°08.33'N, 07°57.75'W

South, Morocco

Probable fall: 2012 Oct 23

Classification: Ordinary chondrite (H5)

History: (H. Chennaoui, *FSAC*). On 23 October 2012 at 00:30 GMT, people from the cities of Tata, Ighrem, Taghmout, and Faddouks in southern Morocco witnessed a large fireball illuminating the night sky. They saw the meteor fragmentation. Inhabitants from Izarzar and Beni Yacoub village reported to have been awakened by a thunder-like blast followed by a tremor. The fall was also reported by newspapers. A number of local hunters proceeded to the fall area and the first piece was discovered on October 30, broken apart after landing on rocks on Azaghzaf mountain, about 6 km SW of Izarzar. The first discovery was made by Mohamed Azeroual. Very few pieces have been reported. This fall is also known as "Beni Yacoub". The concordance between the testimonies on the place of the fall and the real find of pieces in this area are consistent with the fact that this meteorite corresponds to the eyewitnessed fall. When the rock was found, powder of the meteorite was still adhering to the rock with which it collided.

Physical characteristics: Stones covered with a dull-gray fusion crust, except where they hit the ground.

Petrography: (A. Jambon, O. Boudouma, D. Badia *UPVI*; H. Chennaoui-Aoudjehane *FSAC*). Equilibrated texture, chondrules 0.1 to 1 mm. Large olivine phenocrysts, low-Ca microcrysts surrounded by a thin rim of diopside. Interstitial sodic plagioclase. Abundant mm-sized metal patches (mostly kamacite with subsidiary taenite). Minor merrillite, chromite, and troilite.

Geochemistry: Olivine: $\text{Fa}_{18\pm0.3}$ (N=22); Low calcium pyroxene $\text{Fs}_{16\pm0.4}\text{Wo}_{0.9\pm0.2}$ (N=8).

Classification: Ordinary chondrite (H5).

Specimens: 18.9 g and one thin section at *FSAC*.

Jiddat al Harasis 805 (JaH 805) 19.588°N, 55.131°E

Zufar, Oman

Find: 2011 Feb

Classification: Ordinary chondrite (L(H)3)

History: Found by an anonymous prospector in February 2011.

Petrography: (A. Irving and S. Kuehner, *UWS*) Unequilibrated chondrite composed of well-formed, small to medium-sized chondrules (mostly 0.3-0.8 mm; some up to 1.1 mm) in a dark brown, highly altered matrix.

Geochemistry: Olivine ($\text{Fa}_{12.6-34.2}$), orthopyroxene ($\text{Fs}_{7.7-15.7}\text{Wo}_{0.8-1.9}$), clinopyroxene ($\text{Fs}_{7.1-7.6}\text{Wo}_{41.5-38.6}$). Oxygen isotopes (K. Ziegler, *UNM*) Analysis of an acid-washed subsample by laser fluorination gave $\delta^{17}\text{O}$ 3.448; $\delta^{18}\text{O}$ 5.637; $\Delta^{17}\text{O}$ 0.472 per mil.

Classification: Ordinary chondrite L(H)3. Oxygen isotopes plot in the L chondrites field, but an H affinity is suggested by the relatively small chondrule size, abundance of (altered) metal and the low maximum Fs content in orthopyroxene.

Specimens: Type specimen plus one polished thin section at *PSF*; main mass with anonymous collector.

Jiddat al Harasis 838 (JaH 838) 19°22.044'N, 55°28.855'E

Al Wusta, Oman

Find: 2003 Feb 28

Classification: Lunar meteorite

History: One stone of 34.36 g was discovered about 28 km south of Al Ghaftain on a desert expedition on Feb. 28, 2003.

Physical characteristics: (R. Bartoschewitz, *Bart*) The meteorite lacks an obvious fusion crust but has the frosted, ablated exterior typical of Omani lunar stones. The interior is black-gray with many white, brown, and gray inclusions. Terrestrial weathering is negligible.

Petrography: (R. Bartoschewitz, *Bart*; P. Appel, B. Mader, *Kiel*) Fragmental breccia composed of a variety of lithic clasts and mineral fragments of plagioclase, augite, pigeonite, poor-Ca pyroxene, and olivine set in a fine-grained matrix. Lithic clasts include anorthosite, fragmental breccia, gabbro, norite, basalt, pyroxenite, and regolith (chondritic and lunar metal; HASP spherule) set in a fine-grained dark gray matrix, and with Ni-iron, troilite, pyrrhotine, pentlandite, ilmenite, chromite, zirconolite, baddeleyite, and zircon.

Geochemistry: (R. Bartoschewitz, *Bart.*, P. Appel and B. Mader, *Kiel*) $\text{Fa}_{39.7}$ (mg# = 74-53, Fe/Mn = 90, n=3); low-Ca pyroxene $\text{Fs}_{56}\text{Wo}_3$ (mg# = 51-32); pigeonite $\text{Fs}_{36}\text{Wo}_{11}$ (mg# = 36-58, n=13); subcalcic augite $\text{Fs}_{32}\text{Wo}_{17}$ (n=1); augite $\text{Fs}_{22}\text{Wo}_{33}$ (mg# = 52-44, n=7); ferro-augite $\text{Fs}_{41}\text{Wo}_{27}$ (mg# = 29-33, n=9; Fe/Mn = 55); $\text{An}_{93}\text{Or}_1$ (An_{63-97} , n=63). Kamacite Ni 5-76, Co 12-5 (mg/g, n=3); taenite Ni 192, Co 15 (mg/g); awaruite Ni 636, Co 18 (mg/g); pyrrhotite; troilite; pentlandite Ni 331, Co 11 (mg/g). Bulk composition (R. Korotev, *WUSL*): FeO 4.9, K_2O 0.3 wt%; Sc 8.99, Ni 229, Zr 138, La 9.8, Ce 24.5, Nd 14.9, Sm 4.43, Eu 0.986, Ta 0.447, Ir 0.0094, Au 0.0074, Th 2.3, U 0.64 (all in ppm).

Classification: Lunar (mingled regolith breccia). Classified as a mingled regolith breccia rather than a feldspathic fragmental breccia based as well on the presence of mare and KREEPy material as of HASP and chondritic metal.

Specimens: A total of 6.9 g is on deposit at *Kiel*. Thin section and 3.5 g at *Bart*. The main mass is held by the finder.

Jiddat al Harasis 858 (JaH 858) 19°24.193'N, 55°48.35'E

Al Wusta, Oman

Find: 2003 Feb 28

Classification: Ordinary chondrite (H6)

History: Discovered on a desert expedition on Feb. 28, 2003.

Physical characteristics: Two dark brown stones of 42.2 g. Magnetic susceptibility $\log \chi = 4.62$.

Petrography: (R. Bartoschewitz, *Bart*) various types of chondrules from 0.2 to 0.9 mm (avg. 0.5 mm) set in iron hydroxide interspersed in recrystallized matrix.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{18.47}$ ($\text{Fa}_{18.1-19.0}$, $n=13$); low-Ca pyroxene: $\text{Fs}_{16.2}\text{Wo}_{1.0}$ ($15.6-16.5\text{Wo}_{0.9-1.2}$, $n=6$). Kamacite Ni 5.3-7.7, Co 0.5-0.6 wt.% ($n=5$).

Classification: Ordinary chondrite (H6, shock stage S3)

Specimens: 8.7 g on deposit at *Kiel*, main mass anonymous

Jiddat al Harasis 874 (JaH 874) 19°58.897'N, 56°25.0'E

Al Wusta, Oman

Found: 2007 Mar 10

Classification: Rumuruti chondrite (R5)

History: A small, dark-brownish colored individual lacking any fusion crust was recovered from the Arabian Desert, Oman.

Petrography: The meteorite is composed of readily delineated chondrules set into an olivine-rich brecciated matrix. Olivine, Ca-pyroxene and rare orthopyroxenes are equilibrated in chondrules as well as in the matrix. Albitic feldspar shows wide compositional range and typically occurs in 10-40 μm sized patches. Opaque phases are sulfides; metal is virtually absent.

Geochemistry: Olivine, $\text{Fa}_{38.2\pm0.3}$ ($\text{Fa}_{37.7-38.8}$, $n=15$); Ca-pyroxene, $\text{Fs}_{11.1\pm0.7}\text{Wo}_{45\pm1.1}$ ($\text{Fs}_{10.2-12.9}$, $n=21$); low-Ca pyroxene, $\text{Fs}_{29.7}\text{Wo}_1$; plagioclase, $\text{An}_{7.6-15.9}\text{Ab}_{79.2-87.6}\text{Or}_{3.3-6.8}$ ($n=27$)

Jiddat al Harasis 910 (JaH 910) 19°43.14'N, 55°48.52'E

Al Wusta, Oman

Find: 2011 Feb 25

Classification: Martian meteorite (Shergottite)

History: The meteorite was found in 2011 during a field trip in the Oman desert.

Petrography: The meteorite displays a speckled black-greenish interior and is dominantly composed of blocky, up to 0.5 mm-sized clinopyroxene and plagioclase grains. Pyroxene shows complex patchy zoning, fine exsolution lamella and strong mosaicism. Plagioclase is intermediate in composition and recrystallized to tiny grains with strong undulatory extinction. There is no maskelynite present. Plagioclase is largely anisotropic showing a crystalline fibrous appearance similar to that observed in [Dhofar 378](#), suggesting recrystallization after shock.

Accessory minerals include ilmenite, ulvöspinel, pyrrhotite, and merrillite; shock-melt pockets are present.

Geochemistry: pigeonite: $\text{Fs}_{52.8 \pm 5.2} \text{Wo}_{14.5 \pm 1.8}$ ($\text{Fs}_{41.4-60.4} \text{Wo}_{12-20.6}$, $n=20$), $\text{FeO/MnO}=30-36$; augite: $\text{Fs}_{31.1 \pm 7} \text{Wo}_{31.9 \pm 2.1}$ ($\text{Fs}_{19.5-41} \text{Wo}_{28.6-35.9}$, $n=20$), $\text{FeO/MnO}=25-35$; plagioclase: $\text{An}_{51.5 \pm 2.9} \text{Or}_{1.4 \pm 0.8}$ ($\text{An}_{45.4-57.1} \text{Or}_{0.4-3.6}$, $n=18$).

Jiddat al Harasis 911 (JaH 911) $19^{\circ}49.52' \text{N}$, $55^{\circ}53.373' \text{E}$

Al Wusta, Oman

Find: 2003 Feb 26

Classification: Ordinary chondrite (H5)

History: Discovered on a desert expedition on March 26, 2003.

Physical characteristics: One dark brown stone of 31.63 g. Magnetic susceptibility $\log \chi = 5.00$.

Petrography: (R. Bartoschewitz, *Bart*) various types of chondrules fro 0.3 to 1.0 mm (avg. 0.5 mm) set in recrystallized matrix.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{18.7}$ ($\text{Fa}_{18.1-19.5}$, $n=8$); low-Ca pyroxene: $\text{Fs}_{16.5} \text{Wo}_{1.2}$ ($\text{Fs}_{15.8-21.1} \text{Wo}_{0.7-1.4}$, $n=16$); chromite $\text{CRAL}=85$, $\text{FFM}=84$, $\text{Fe/Mg}=5$; ilmenite. Kamacite Ni 4.6-8.1, Co 0.5-0.6 wt.% ($n=5$).

Classification: Ordinary chondrite (H5, shock stage S3)

Specimens: 6.4 g on deposit at *Kiel*, main mass anonymous

Jiddat al Harasis 935 (JaH 935) $19^{\circ}44.439' \text{N}$, $55^{\circ}40.591' \text{E}$

Al Wusta, Oman

Find: 11 Jan 2012

Classification: Carbonaceous chondrite (CV3)

History: Found by Edwin Gnos, Beda Hofmann, Karl Wimmer, Elise Wimmer and Florian Zurfluh during a search for meteorites on January 11, 2012.

Physical characteristics: Single wind-ablated stone of 19.36 g, no fusion crust preserved.

Petrography: (E. Gnos, *MHNGE* and B. Hofmann, *NMBE*) The meteorite consists of up to 1.5 mm sized chondrules (approx. 45 vol%; average size 0.75 ± 0.33 mm, $n=48$) with partially recrystallized glass, CAIs (0.2 - 3.0 mm; approx. 5 vol%), and dark matrix (approx. 50 vol%). Magnetite is rather rare, troilite is largely oxidized. Some Fe-hydroxides probably resulted from oxidation of iron metal.

Geochemistry: (N. Greber, *Bern*) Olivine compositions are $\text{Fa}_{24.1 \pm 18.2}$ ($\text{Fa}_{0.1-50.1}$ $n=34$), pyroxene compositions ($n=9$) are $\text{Fs}_{24.1 \pm 18.2} \text{Wo}_{2.2 \pm 1.8}$ ($\text{Fs}_{0.1-50.1} \text{Wo}_{0.9-5.7}$). Oxygen isotopes: (R. Greenwood, *OU*) analysis of a sample leached with ethanolamine thioglycollate gave $\delta^{18}\text{O}=3.67$, $\delta^{17}\text{O}=-1.14$, $\Delta^{17}\text{O}=-3.04$.

Classification: CV3 based on petrography, variability of mineral compositions, matrix abundance, mean chondrule size, presence of large CAIs and oxygen isotopes. Unshocked (S1). Strongly weathered based on high degree of troilite oxidation.

Specimens: All at *NMBE*.

Jiddat al Harasis 938 (JaH 938) $19^{\circ}44.950' \text{N}$, $55^{\circ}51.419' \text{E}$

Al Wusta, Oman

Find: 28 Jan 2013

Classification: Rumuruti chondrite (R4-5)

History: Found by Edwin Gnos, Beda Hofmann, Urs Eggenberger, Thomas Burri, Pete Stephenson and Mohammed Al Battashi during a search for meteorites on January 28, 2013.

Physical characteristics: 54 dark brown, wind-ablated fragments ranging from 246 g to less than one gram, total mass 1477 g. Found close together, they probably represent a single, strongly weathered individual. No fusion crust preserved.

Petrography: (B. Hofmann, *NMBE* and E. Gnoss, *MHNGE*) The meteorite is a breccia. Mean apparent chondrule size is 0.51 ± 0.26 mm ($n=163$), maximum size 0.9 mm. Bimodal feldspar grain size <5 μm and 20-30 μm . Iron sulfides are largely oxidized.

Geochemistry: (N. Greber, *Bern*) Mineral compositions: olivines are $\text{Fa}_{38.4 \pm 0.8}$ ($\text{Fa}_{36.7-39.4}$, $n=15$). Average olivine composition by XRD is $\text{Fa}_{38.0 \pm 1.0}$ ($n=3$). Average low-Ca pyroxene is $\text{Fs}_{8.6}\text{Wo}_{0.6}$ ($\text{Fs}_{4.6-14.3}\text{Wo}_{0.3-1.2}$, $n=5$), average high-Ca pyroxene is $\text{Fs}_{12.2}\text{Wo}_{43.2}$ ($\text{Fs}_{10.8-16.2}\text{Wo}_{29.2-52.7}$, $n=4$). Feldspar compositions are $\text{An}_{11.3}\text{Or}_{2.2}$ ($\text{An}_{4.6-14.3}\text{Or}_{1.9-2.4}$, $n=4$). Oxygen isotopes (R. Greenwood, *OU*): $\delta^{18}\text{O}=7.43$, $\delta^{17}\text{O}=6.07$, $\Delta^{17}\text{O}=2.21$ (sample leached with ethanolamine thioglycollate to remove Fe-hydroxides).

Classification: Based on mineral compositions, oxygen isotopes and plagioclase grain size this is a brecciated Rumuruti chondrite with petrographic grades 4 and 5. Shock grade ranges from S1 to S3 in different clasts. Strongly weathered.

Specimens: All at *NMBE*

Jingshan 31°7.07'N, 113°9.23'E

Hubei, China

Find, doubtful fall: 2006 June 15

Classification: Ordinary chondrite (H5)

History: At about 9:00 AM local time on June 15, 2006, a stone reportedly fell into a pond of Jingshan county, Hubei province. Several people near the pond may have witnessed the fall. After pumping out water from the pond, one piece of stone of 2.3 kg was recovered on June 17, 2006 by Mr. Xiang Mingjin.

Physical characteristics: A single stone with a complete fresh fusion crust.

Petrography: A few chondrules are visible. Major phases are olivine and low-Ca pyroxene. Accessory phases include troilite, albite, and FeNi metal.

Geochemistry: Olivine ($\text{Fa}_{15-17.5}$), low-Ca pyroxene ($\text{Fs}_{14.6-17}\text{Wo}_{0-1.2}$).

Classification: Ordinary chondrite (H5).

Specimens: 20 g at *PMO*.

Kerman 003 30° 26.80'N, 58° 27.00'E

Kerman, Iran

Find: 2014 Aug 07

Classification: Ordinary chondrite (L5)

History: A single stone was found during an expedition in the Lut desert in August 2014, in a corridor within the Kalout formation (Chale-h Gachi). The stone was given to Hamed Pourkhorsandi at Tehran on 2014 Nov 10 and the type specimen cut at *CEREGE*.

Physical characteristics: An angular brown rock without fusion crust. The shape suggests that it has been fragmented during atmospheric entry and that it was a part of a larger meteorite. Magnetic susceptibility $\log \chi = 4.52$ (χ in $10^{-9} \text{ m}^3/\text{kg}$).

Petrography: Petrographic observation of a polished section shows chondrules in a recrystallized matrix. Most of the FeNi grains have been weathered to Fe oxy-hydroxides. Some myrmekitic oxide fillings within FeNi metal grains are present. Troilite is mostly fresh although some troilite alteration to pyrite/marcasite occurs. Plagioclase is smaller than 50 μm .

Geochemistry: Olivine $\text{Fa}_{25.3\pm0.2}$ (N=4), low-Ca pyroxene $\text{Fs}_{22.0\pm0.2}\text{Wo}_{1.9\pm0.7}$ (N=4).

Classification: Ordinary chondrite (L5)

Specimens: Type specimen (25.5 g) and a polished section at *CEREGE*. Main mass with Bahman Izadi (Fars Green Center, Iran)

Knardna 001 31° 0'18.70"S, 130°54'18.60"E

South Australia, Australia

Purchased: 2012 May 16

Classification: Ordinary chondrite (H4)

History: Fragment found by J. Kuyken on claypan.

Physical characteristics: Broken desert-red fragment with 15% fusion crust.

Petrography: (L. Bowlt, *Monash*) This sample contains chondrules that are highly fragmented and poorly defined, as well as chondrules that make sharp contact with the surrounding matrix. The chondrules range in size up to 2 mm (average 0.2-1 mm). There are distinct light/dark areas at the sub-centimeter scale corresponding to two differing types of matrix; the majority of the sample contains recrystallised matrix and there are two areas that have an optically opaque matrix associated with shock blackening. Minerals include olivine, pyroxene, plagioclase (1-2 microns), Fe-Ni metal and troilite. Chondrules are relatively abundant (20-25%) and chondrule types include RP, BO, PO, PP and POP. Olivine grains show undulose extinction and shock lamellae. 60-70% of metal and troilite have been oxidised with the remaining 30-40% divided up between 30-35% sulphides and 5-10% metal grains.

Geochemistry: (L. Bowlt, *Monash*) Microprobe analyses show that olivine and pyroxene compositions are uniform: olivine $\text{Fa}_{16.9-17.7}$, mean= 17.3 mol%, std= 0.38, n=4; Low-Ca pyroxene $\text{Fs}_{14.8-15.9}$, mean= 15.48 mol%, std= 0.45, n=4.

Classification: Ordinary Chondrite (H4 , S3, W3)

Specimens: Specimen and one thin-section held by A. Tomkins.

Komin Yanga 11.69972°N, 0.13694°E

Gourma, Burkina Faso

Find, doubtful fall: 2014

Classification: Ordinary chondrite (H5)

History: The sample was collected ~45 km southwest of Fada N'Gourma in 1984 and there are unconfirmed reports of it being a witnessed fall. It was brought by local villagers through an intermediary to geologist Demetrius Pohl in 2014. The single piece had a broken face and must have originally been about 20% larger.

Petrography: The sample is brecciated; it contains centimeter-sized H-chondrite clasts and has a light/dark structure. There are centimeter-long metal veins and dark glassy shock veins. There are a few metal nodules up to 4 mm in maximum dimension. Also present are metal grains containing small irregular wormy grains of troilite and 1-15- μm -size grains of metallic Cu. Plagioclase grains are 6-10 μm in size. Also present are grains of Ca-pyroxene ($\text{Fs}_{5.8\pm0.3}\text{Wo}_{46.0\pm0.3}$; n=4). Chondrules are readily delineated in thin section.

Lahmada 019 27°38'54.1"N, 9°27'11.1"W

Saguia el Hamra, Western Sahara

Find: 2014 Dec 16

Classification: Ordinary chondrite (LL4)

Physical characteristics: Two stones without fusion crust. Cut surface reveals a weathered interior with large chondrules.

Petrography: Well-defined, closely packed chondrules. Chondrule mesostasis devitrified.

Licking 37°28.804'N, 91°52.283'W

Missouri, United States

Find: June 2015

Classification: Iron meteorite (IVA)

History: A single specimen was found in June 2015 by Dan and James Goes while they were using a metal detector on their property. Found just below the surface in a bank beside an old road.

Physical characteristics: The 8068 g mass has a shape similar to a flattened loaf of bread. The dark brown to black exterior, shiny surface is locally rusty red to light orange.

Petrography: (C. Herd and Y. Orui, *UAb*): Optical investigation and bandwidth measurement of a 2 × 3.5 cm polished and etched slice reveals a well-developed Widmanstätten pattern consistent with a fine octahedrite (average bandwidth = 0.4±0.1 mm, n = 26). Plessite is common. Inclusions were not observed.

Geochemistry: Bulk composition: ICP-MS data (G. Chen and C. Herd, *UAb*): Ni = 9.29 wt%, Co = 4.1 mg/g; Ir = 1.0, Pt = 4.4, Os = 0.4, Ru = 2.6, Rh = 0.7, Pd = 5.5, Au = 1.9, Ga = 2.9, As = 13.8, W = 0.4, Re = 0.1, Cu = 139 (all µg/g), obtained by solution ICP-MS using North Chile (Filomena) as a calibration standard.

Classification: (C. Herd, *UAb*): Iron, IVA, fine octahedrite.

Specimens: Type specimen of 23.6 g, including a single, 17 g etched slice, a smaller 4 g piece, and several 0.5 g pieces (one of which was used for ICP-MS analysis), at *UAb*. Main mass R. Garcia and R. Cucchiara.

Limón Verde 004 ~22°35'S, ~68°45'W

Antofagasta, Chile

Find: 2014

Classification: Ordinary chondrite (H6)

History: A single stone was found by Rodrigo Martinez in 2014

Physical characteristics: A single stone with remnants of fusion crust. Cut surface reveals a dark interior with abundant finely interspersed metal grains.

Petrography: Examination of a polished sections reveals a strongly recrystallized texture with relict chondrules. Modal abundances (vol%, from point counting, N=470): olivine + pyroxene 72%, plagioclase 12%, FeNi 9%, troilite 6%, chromite 1%. Typical grain size: plagioclase 100 µm, FeNi metal and troilite 200 µm (but there is also a population of micrometer-sized metal grains), chromite 100 µm (up to 300 µm). Micrometer-thick metal and sulfide veins are found interstitial to some silicates. Weathering products are basically absent.

Geochemistry: Olivine $\text{Fa}_{19.8 \pm 0.2}$ (N=4), orthopyroxene $\text{Fs}_{17.5 \pm 0.4}\text{Wo}_{1.4 \pm 0.1}$ (N=2), plagioclase $\text{An}_{12.0}\text{Ab}_{84.2}\text{Or}_{3.8}$, chromite Cr# (Cr/Cr+Al) 87%. Magnetic susceptibility $\log \chi = 5.15$ (χ in $10^{-9} \text{ m}^3/\text{kg}$).

Classification: H6. Despite the highly equilibrated texture and large plagioclase grain size, the low Wo content of orthopyroxene rules out a type 7 classification.

Specimens: 100 g and a polished section at *CEREGE*. Main mass with *MMC*.

Lindong 45°30.49'N, 119°3.47'E

Nei Mongol, China

Find: 2012 Oct

Classification: Ordinary chondrite (LL5-6)

History: The meteorite was found by Y. Wang in Oct. 2012 on the west side of a hill when he was herding sheep. The rock was not taken home until the next year, when he realized it was a meteorite while watching a TV program about meteorites.

Physical characteristics: The meteorite was a single piece with most of the surface covered by black fusion crust. It was later broken into one large fragment and tens of small ones. Dark gray clasts up to 6 cm in length are obvious on the exposed surface.

Petrography: (S. Hu and Y. Lin, *IGGCAS*) The meteorite shows a brecciated texture, consisting of various lithic clasts in porous fine-grained matrix. The loosely packed, fine-grained matrix consists mainly of olivine, pyroxene and plagioclase, with less abundant troilite and Fe-Ni metal, similar to L or LL chondrites. The clasts include coarse-grained lithic fragments, whole chondrules with sharp boundaries, and fragments of various types of chondrules. The lithic fragments have the similar modal composition of the fine-grained matrix. Three large plagioclase fragments (~200 μm) were also found in the section.

Geochemistry: Mineral compositions and geochemistry: (S. Hu and Y. Lin, *IGGCAS*) The matrix and lithic breccias have homogeneous chemical compositions. Olivine: $\text{Fa}_{28.1\pm0.3}$, orthopyroxene: $\text{Fs}_{21.3\pm0.4}\text{Wo}_{1.8\pm0.6}$, clinopyroxene: $\text{Fs}_{10.7\pm1.2}\text{Wo}_{40.2\pm3.4}$, plagioclase: $\text{An}_{10.1\pm0.7}\text{Ab}_{85.8\pm0.9}$, Co content in kamacite: 2.3 wt%. The three plagioclase fragments share similar chemical compositions ($\text{An}_{8.7\pm0.2}\text{Ab}_{87.0\pm0.4}$) with those in the matrix.

Classification: (S. Hu and Y. Lin, *IGGCAS*) LL5-6 breccia, but it is possible that clasts of petrologic type lower than 5 are present.

Specimens: The main mass was hold by Z. Wang.

Los Vientos 098 (LoV 098) ~24°41'S, ~69°46'W

Antofagasta, Chile

Find: 2010 Oct 25

Classification: Ordinary chondrite (L3)

Petrography: Closely packed chondrules with average apparent diameter $460\pm310\ \mu\text{m}$ (N=49). Dusty olivines are present.

Geochemistry: Olivine $\text{Fa}_{10.5\pm7.3}$ (0.6-23.5, PMD=58%, N=9), low-Ca pyroxene $\text{Fs}_{12.8\pm4.4}\text{Wo}_{0.6\pm0.5}$ ($\text{Fs}_{5.5-19.3}$, PMD 29%, N=6). Cr_2O_3 in ferroan olivine $0.18\pm0.14\ \text{wt\%}$ (N=8). $\log \chi (\times 10^{-9}\ \text{m}^3/\text{kg}) = 4.81$.

Classification: L3. Cr_2O_3 content in ferroan olivine suggests subtype 3.15.

Los Vientos 099 (LoV 099) 24°41'S, 69°46'W

Antofagasta, Chile

Find: 2014 Oct

Classification: Ordinary chondrite (H3)

History: Found by Luc Labenne in the Atacama desert

Physical characteristics: A single brown stone

Petrography: Brecciated chondrite with closely packed chondrules, some rimmed with troilite and metal. Average apparent chondrule diameter $460\pm260\ \mu\text{m}$ (N=34).

Geochemistry: Olivine $\text{Fa}_{18.7\pm3.8}$ (PMD=15%, range 10.7-24.7, N=8), low-Ca pyroxene $\text{Fs}_{13.0\pm3.9}\text{Wo}_{0.4\pm0.1}$ (PMD=26%, N=4). $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.06$.

Classification: H3, brecciated

Specimens: 72 g at *CEREGE*, main mass with *Labenne*

Lut 009 30°20.38' N, 59°09.04' E

Kerman, Iran

Find: 2012 March

Classification: Ordinary chondrite (H4)

Specimens: Type specimen, main mass and a polished section at *CEREGE*. Polished thin section at *CalTech*. 13.5 g and a polished thin section at *IfP*.

Lut 010 30°28.038'N, 59°23.183'E

Kerman, Iran

Find: 2015 Mar 20

Classification: Ordinary chondrite (LL6)

History: Meteorite fragments were found close to each other in March 2015 during an expedition in the Lut desert of Iran, in the Rig-e Yalan region of the desert. A sample was sent to H. Pourkhorsandi in July 2015.

Physical characteristics: No fusion crust is preserved. The fragments are dark brown, some of them with a black coating. Cut surfaces reveal rare metal grains and fractures.

Petrography: Strongly recrystallized chondrite. Plagioclase up to 100 μm . Observation of polished sections prepared from three different fragments show variable weathering grade from W2 to W4. The larger fragments are the less weathered.

Geochemistry: Olivine $\text{Fa}_{26.3\pm0.8}$ (N=5), orthopyroxene $\text{Fs}_{22.3\pm0.4}\text{Wo}_{1.6\pm0.2}$ (N=3). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.18$.

Classification: LL6

Specimens: Type specimen 30 g and a polished section at *CEREGE*. Main mass with finder.

Misfits Flat 001 39°20.88'N, 119°22.92'W

Nevada, USA

Find: 22 Sept 2013

Classification: Ordinary chondrite (LL5)

History: (P. Jenniskens, *SETI*): A meteorite was found by Scot Harlan of Salinas on Misfits Flat dry lake near Stagecoach, Nevada on Sept. 22, 2013. In 18 subsequent visits up to November 11, 2014, a total of 56 stones of weathering stage W2/3 were found with a combined mass of 326 g in a small 350 $\times$ 180 m area.

Physical characteristics: (P. Jenniskens, *SETI*): Most were fragments from broken up individuals and found near each other in a small 350 $\times$ 180 m area. At least one meteorite in that area (MF7) was fully crusted and fresh looking.

Petrography (M. Zolensky, NASA *JSC*): Sample MF1 contained 7-10 mm sized, well- to poorly-defined chondrules. MF16 shows only a few chondrules. Undulatory extinction was observed for the majority of the olivine crystals. Samples MF16, MF10, and MF13 were found to be the same type.

Geochemistry: Mineralogy and Geochemistry (M. Zolensky, *JSC*): MF16 had an average olivine composition of $\text{Fa}_{25.8}$ (8 best analyses). The percentage mean deviation (PMD) was 1.5%.

The CaO content of olivine ranged from 0.02 to 0.04 wt%. Low-Ca pyroxene had an average composition of $\text{Fs}_{23.2}\text{Wo}_{1.8}$ (4 best analyses), with PMD of 0.4%. Kamacite was observed as well as coarse-grained plagioclase.

Classification (M. Zolensky, *JSC*): LL5, S2, W2

Specimens: Type specimens (MF16 and MF33) at *UCLA*. Main mass (45.7 g) with finder.

Misfits Flat 002 39°20.69'N, 119°23.44'W

Nevada, USA

Find: 2013 Nov 13

Classification: Ordinary chondrite (LL5)

History: (P. Jenniskens, *SETI*): This meteorite was found by Scott Harlan of Salinas on Misfits Flat dry lake near Stagecoach, Nevada on Nov. 11, 2013, following the first find at Misfit Flats dry lake on Sept. 22. The meteorite was found 0.8 km west from other meteorites found on the dry lake up to that point, and appeared to be different from the other recovered stones.

Physical characteristics: (P. Jenniskens, *SETI*): This meteorite looks fresher than others found prior.

Petrography (M. Zolensky, *JSC*): Olivine displays mosaicism and planar fractures. The specimen contains pockets of melted material and a few interconnected shock veins. No maskelynite was observed. Only a few well-defined chondrules are present.

Geochemistry: Mineralogy and Geochemistry (M. Zolensky, *JSC*): Olivine has the average composition $\text{Fa}_{29.8}$ ($n=5$), with PMD of 0.9%. The CaO content of olivine ranges from 0.02 to 0.04 wt%. The Low-Ca pyroxene has an average composition of $\text{Fs}_{27.3}\text{Wo}_{1.9}$ ($n = 5$) with PMD of 1.3%. No coarse-grained diopside was noted. Coarse-grained plagioclase was present. Ni-rich metal (up to 44 mole% Ni) was observed.

Classification (M. Zolensky, *JSC*): LL5, and shock stage S4/5.

Specimens: Half of sample with owner of property. 0.7 g fragment with *UCLA*.

Nkayi 18°56'S, 28°36'E

Matabeleland North, Zimbabwe

Confirmed fall: 1 Mar 2009

Classification: Ordinary chondrite (L6)

History: An approximately 100 kg meteorite fell at around 5 pm on the 1 March 2009 in the Nkayi District, at the eastern side of Matabeleland North province in Zimbabwe. According to an article in the 19 March 2009 edition of *The Zimdiaspora*, "The stone ... fell with a thunderous noise in Madlilika Village in the Mjena area of Lukampa..." An ~15 kg chunk was removed and taken by the government for testing. This piece was later acquired by Michael Farmer via a meteorite dealer in Pretoria, South Africa.

Physical characteristics: The description is based on the 15 kg chunk. Surface covered with broad shallow regmaglypts and thick matte black fusion crust. Interior is a uniform light gray.

Petrography: Stone is largely recrystallized with sparse chondrules. Probe section shows three BO chondrules, one to 2.5 mm. Plagioclase, to 100 μm , is abundant. Chromite irregularly shaped, to 500 μm . Scattered Ca-phosphate with up to 5 wt% Cl, relatively abundant, for example a 3×3 mm area contains five grains. Kamacite irregularly shaped to 1 mm, with a frosty etch. Rare, weakly developed Neumann bands. Some grains polycrystalline. Troilite exhibits mosaic texture - finely polycrystalline, typically 10 μm (crossed polars), with scattering of fine silicates giving the grains a dusty appearance. Many of the composite metal-sulfide grains

show complex finely intergrown mixture of troilite and metal. Some metal grains show zoned tetratenite-taenite-kamacite/plessite textures. Opaque, fine-grained melt pockets adjacent to troilite rare. Native Cu not found.

Geochemistry: (L. Garvie, ASU) Olivine $\text{Fa}_{24.5 \pm 0.3}$, $\text{FeO/MnO} = 49.4 \pm 3.5$, $n=12$; low Ca pyroxene $\text{Fs}_{20.7 \pm 0.2} \text{Wo}_{1.5 \pm 0.3}$, $\text{FeO/MnO} = 29.5 \pm 2.1$, $\text{Cr}_2\text{O}_3 = 0.11 \pm 0.04 \text{wt\%}$, $n=10$; high Ca pyroxene $\text{Fs}_{8.3} \text{Wo}_{44.5}$, $\text{Fs}_{7.4} \text{Wo}_{45.5}$; and feldspar $\text{An}_{25.9} \text{Or}_{14.2}$ and $\text{An}_{20.8} \text{Or}_{8.7}$.

Classification: Ordinary chondrite, L6, S5, W0.

Specimens: 85 g at ASU; *MFarmer* ~2 kg, and *Boudreaux* 8 kg.

Northwest Africa 568 (NWA 568)

(Northwest Africa)

Purchased: 2000

Classification: Ordinary chondrite (H5)

History: 1 stone weighing 25.8 g was found in Morocco in 2000. Thomas *Webb* acquired the sample from Michael Cottingham in November 2000.

Physical characteristics: The oriented stone is brown and flattened in shape. A weathered, dark brown fusion crust covers approximately 60% of the exterior of the stone and displays a continuous rollover lip around the trailing edge. The cut face of the interior of the stone is brown and displays small chondrules, chondrule fragments and fresh and weathered flakes of metal.

Petrography: Description and classification (A. Love, *App*): Sample is a breccia composed of rounded clasts of recrystallized chondrite, chondrules, chondrule fragments and metal grains. Chondrules within clasts and surrounding clasts have an average diameter of 353 μm .

Geochemistry: (A. Love, *App*) Olivine $\text{Fa}_{18.2 \pm 0.2}$, $N=8$; Low Ca pyroxene $\text{Fs}_{16.9 \pm 0.3} \text{Wo}_{1.6 \pm 0.2}$, $N=8$

Classification: Ordinary chondrite (H5, S3, W1)

Specimens: An endcut weighing 5.8 g, and a polished thin section are currently on deposit at *App*.

Northwest Africa 584 (NWA 584)

(Northwest Africa)

Purchased: 2000

Classification: Ordinary chondrite (H3-5)

History: One stone weighing 187 g was found in Morocco in 2000. Thomas *Webb* acquired the sample from a Michael Cottingham in 2000.

Physical characteristics: The oriented stone is brown and ovoid in shape. A weathered, dark brown fusion crust covers approximately 35% of the exterior of the stone. The cut face of the interior of the stone is brown and displays small chondrules, chondrule fragments and fresh and weathered flakes of metal.

Petrography: Description and classification (A. Love, *App*): Sample is composed of well-defined chondrules, chondrule fragments, mineral clasts metallic grains and sulfides set within a recrystallized matrix. CL and SEM petrography indicate sample is a mixture chondrules and fragments. Chondrules contain turbid to devitrified mesostases and have an average diameter of 392 μm .

Geochemistry: (A. Love, *App*) Unequilibrated regions: Olivine $\text{Fa}_{14.2 \pm 6.6}$ ($\text{Fa}_{0.8-26.2}$ $N=23$); Low Ca pyroxene $\text{Fs}_{12.3 \pm 5.2}$ ($\text{Fs}_{2.9-18.6}$ $N=12$)

Specimens: 25.9 g and 1 polished thin section are on deposit at *App*.

Northwest Africa 628 (NWA 628)

(Northwest Africa)

Find: 2000

Classification: Ordinary chondrite (H6)

History: 1 stone weighing 176.6 g was found in Morocco and sold to Michael Cottingham.

Thomas Webb acquired the sample in November of 2000.

Physical characteristics: The oriented stone is brown and flattened in shape. A weathered, dark-brown fusion crust covers approximately 35% of the exterior of the stone and displays a continuous rollover lip around the trailing edge. The cut face of the interior of the stone is brown and displays small chondrules, chondrule fragments and fresh and weathered flakes of metal.

Petrography: Description and classification (A. Love, *App*): Sample displays recrystallized chondritic texture with a few remaining relict chondrules. Relict chondrules have an avg. diameter of 607 μm . Porphyritic chondrules have completely recrystallized mesostasis regions.

Geochemistry: (A. Love, *App*): Olivine $\text{Fa}_{19.2\pm0.2}$, N=6; Low Ca pyroxene $\text{Fs}_{17.1\pm0.2}\text{Wo}_{1.9\pm0.2}$, N=9

Classification: Based on olivine and pyroxene compositions and texture, this is an ordinary chondrite (H6, S3, W2).

Specimens: A polished thin section, an endcut, several slices and small fragments weighing 22.3 g are currently on deposit at *App*.

Northwest Africa 637 (NWA 637)

(Northwest Africa)

Purchased: 2000

Classification: Ordinary chondrite (H5)

History: 1 stone weighing 82 g was found in Morocco in 2000. Thomas Webb acquired the sample from a Michael Cottingham in 2000.

Physical characteristics: The stone is brown and tabular in shape. A weathered, brown fusion crust covers approximately 40% of the exterior of the stone. The cut face of the interior of the stone is brown and displays small chondrules, chondrule fragments and fresh and weathered flakes of metal.

Petrography: Description and classification (A. Love, *App*): Sample displays recrystallized chondritic texture composed of numerous well-defined chondrules with an average diameter of 325 μm set in a recrystallized matrix.

Geochemistry: (A. Love, *App*) Olivine $\text{Fa}_{17.9\pm0.3}$, N=10; Low Ca pyroxene $\text{Fs}_{16.1\pm0.2}\text{Wo}_{1.4\pm0.2}$, N=8

Classification: Ordinary chondrite (H5, S2, W2)

Specimens: Two slices weighing 16.8 g, and a polished thin section are currently on deposit at *App*.

Northwest Africa 3345 (NWA 3345)

(Northwest Africa)

Purchased: 2003

Classification: Ordinary chondrite (L3-6)

Physical characteristics: Shock veins, breccia; only few unequilibrated components.

Classification: Compositions: Olivine $\text{Fa}_{23.5\pm1.2}$ (N = 10) and pyroxene $\text{Fs}_{18\pm4.5}$ (N = 13). The olivine composition of the unequilibrated, type 3 portions, analyzed separately, is $\text{Fa}_{17\pm5}$ (range: Fa_{12-27} ; N = 10).

Specimens: Ordinary chondrite breccia L3-6, containing fragments of various petrologic types.

Northwest Africa 3346 (NWA 3346)

(Northwest Africa)

Purchased: 2003

Classification: Ordinary chondrite (H3-5)

Physical characteristics: Breccia

Geochemistry: Random analyses of olivine and pyroxene revealed mean compositions of $\text{Fa}_{18\pm 2.5}$ ($n = 28$; range: Fa_{14-29}) and $\text{Fs}_{14\pm 5}$ ($n = 29$; Fs_{2-20}), respectively.

Specimens: Ordinary chondrite breccia H3-5, containing fragments of various petrologic types.

Northwest Africa 5049 (NWA 5049)

(Northwest Africa)

Purchased: 2006 May

Classification: Carbonaceous chondrite (CO3)

History: Purchased by Thomas Webb in May 2006 from a dealer in Agadir, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Small, separated, rounded chondrules and rare CAI in a dark brown, very fine grained matrix (~25 vol.%) containing ferroan silicates, altered kamacite, troilite and pentlandite. Chondrules have granular textures and some have finer grained rims.

Geochemistry: Olivine ($\text{Fa}_{0.9-71.4}$; Cr_2O_3 in ferroan examples = 0.02-0.08 wt.%, mean = 0.06 ± 0.02 wt.%, $N = 8$), orthopyroxene ($\text{Fs}_{1.5-1.6}\text{Wo}_{0.9-0.8}$), clinopyroxene ($\text{Fs}_{1.6-2.7}\text{Wo}_{49.1-47.6}$). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively $\delta^{17}\text{O} = -4.964$, -5.342 ; $\delta^{18}\text{O} = -1.313$, -1.946 ; $\Delta^{17}\text{O} = -4.271$, -4.315 per mil (for a TFL slope of 0.528).

Classification: Carbonaceous chondrite (CO3).

Specimens: 18.4 g at *App*, 1.8 g at *UWS*, 1.2 g at *AMSA*. The remaining material is held by *Webb*.

Northwest Africa 5144 (NWA 5144)

(Northwest Africa)

Purchased: 2007 Sept

Classification: Ureilite

History: Purchased by Thomas Webb in September 2007 from a dealer in Taliouine, Morocco.

Physical characteristics: A dense, dark brown stone that was very difficult to cut.

Petrography: (A. Irving and S. Kuehner, *UWS*) Equigranular aggregate of olivine (exhibiting reduced rims associated with fine-grained iron metal) and pigeonite. Minor secondary barite is present on some grain boundaries.

Geochemistry: Olivine (cores $\text{Fa}_{15.5-15.7}$, rim $\text{Fa}_{4.7}$; $\text{Cr}_2\text{O}_3 = 0.7$ wt.%), pigeonite ($\text{Fs}_{12.8-13.0}\text{Wo}_{8.7-8.6}$).

Classification: Ureilite

Specimens: 13.7 g at *App*, 1.5 g are at *UWB*, 0.1 g at *AMSA*. The remaining material is held by *Webb*.

Northwest Africa 5517 (NWA 5517)

Northwest Africa

Purchased: 2004

Classification: Ungrouped achondrite

History: Purchased from a dealer in Erfoud, Morocco, in 2004 by David Gregory.

Physical characteristics: The dark brown stone (369 g) is fully crusted with light to moderate desert ablation and minimal surface chemical weathering.

Petrography: (T. Bunch and J. Wittke. *NAU*) Fine-grained (<0.3 mm) with poikiloblastic texture, and composed of essentially equigranular olivine grains and clinopyroxene (Cr-diopside) oikocrysts enclosing small (< 0.03 mm) olivine chadacrysts. Orthopyroxene is absent. Mineral mode (in vol.%): olivine 56; clinopyroxene 42, metal+FeS 2. Most metal is stained by terrestrial weathering.

Geochemistry: Olivine grains and chadacrysts ($\text{Fa}_{12.3-12.6}$, $N = 4$; $\text{Cr}_2\text{O}_3 = 0.51-0.65$ wt %; $\text{CaO} = 0.28$ wt %; $\text{FeO/MnO} = 22$), clinopyroxene ($\text{Fs}_{6.0-6.2}\text{Wo}_{39.0-39.3}$, $N = 3$; $\text{Cr}_2\text{O}_3 = 1.35$ wt %; $\text{Al}_2\text{O}_3 = 1.25$ wt %; $\text{FeO/MnO} = 10$), metal ($\text{Ni} = 0.7$ to 1.3 wt %). Oxygen isotopes (D. Rumble, *CIW*): an acid-washed and metal-free sample was analyzed in triplicate by laser fluorination and gave, respectively, $\delta^{17}\text{O} = 2.570, 2.651, 3.117$; $\delta^{18}\text{O} = 6.618, 6.807, 7.681$; $\Delta^{17}\text{O} = -0.911, -0.929, -0.923$ (all per mil).

Classification: Achondrite (ungrouped). Mineral and oxygen isotopic compositions indicate that this specimen has affinities to acapulcoites, but the poikiloblastic texture, complete lack of orthopyroxene and paucity of metal are anomalous features.

Specimens: 20.1 g including one polished thin section at *UWB*. The main mass is held by Gregory.

Northwest Africa 5589 (NWA 5589)

(Northwest Africa)

Purchased: 2008

Classification: HED achondrite (Eucrite, brecciated)

History: The meteorite was bought from the Moroccan meteorite dealer Ismaily (Erfoud) at the mineral fair in Ste-Marie-aux-Mines, France.

Petrography: The rock displays a greyish to brownish interior and is composed of up to one cm sized basaltic clasts, melt fragments and mineral clasts set into a fine-grained clastic matrix. Dominant minerals in basaltic clasts and matrix are pyroxenes with fine exsolution lamellae and calcic plagioclase. Accessory phases include chromite, SiO_2 polymorphs, and trolite.

Geochemistry: low-Ca pyroxene, $\text{Fs}_{55.7\pm2}\text{Wo}_{5.1\pm2.4}$ ($\text{Fs}_{52-58.3}\text{Wo}_{2.8-9.8}$, $n=15$, $\text{FeO/MnO}=24-28$); Ca-pyroxene, $\text{Fs}_{27.3\pm1.2}\text{Wo}_{41.6\pm1.7}$ ($\text{Fs}_{25.5-29.6}\text{Wo}_{37.3-43}$, $n=15$, $\text{FeO/MnO}=23-28$); calcic plagioclase, $\text{An}_{79.5\pm11}$ ($\text{An}_{68.4-91.9}$, $n=10$).

Northwest Africa 5685 (NWA 5685)

(Northwest Africa)

Purchased: 2008

Classification: Ureilite

History: The meteorite was bought from a Moroccan meteorite dealer in 2008.

Petrography: The meteorite displays a characteristic cumulate texture with blocky up to 2 mm sized olivine and pigeonite grains. Olivine shows reduced rims and carbon occurs as graphite flakes.

Geochemistry: Olivine reduced rims: $\text{Fa}_{8.9-14.3}$; olivine contains about 0.7 wt% Cr_2O_3

Northwest Africa 5686 (NWA 5686)

(Northwest Africa)

Purchased: 2008

Classification: HED achondrite (Eucrite, brecciated)

History: The meteorite was bought from a Moroccan meteorite dealer in 2008.

Petrography: The meteorite shows a grayish to slightly greenish interior and is brecciated. It is composed of lithic and mineral clasts set into a fine-grained clastic matrix. Clasts are basaltic lithologies and impact melt fragments. Dominant minerals in clasts and matrix are exsolved pyroxene and calcic plagioclase. Minor phases include SiO₂ polymorphs and chromite.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{30.6\pm2.2}\text{Wo}_{4.2\pm1.1}$ ($\text{Fs}_{26.1-33.2}\text{Wo}_{1.9-7.7}$, n=41, FeO/MnO=26-36); Ca-pyroxene: $\text{Fs}_{13\pm1.3}\text{Wo}_{42\pm1.8}$ ($\text{Fs}_{11.6-16.8}\text{Wo}_{37.9-44.2}$, n=21, FeO/MnO=20-31); calcic plagioclase: $\text{An}_{93.1\pm0.5}$ ($\text{An}_{92.5-93.9}$, n=12)

Northwest Africa 5687 (NWA 5687)

(Northwest Africa)

Purchased: 2008

Classification: Rumuruti chondrite (R3-6)

History: The meteorite was bought from a Moroccan meteorite dealer in 2008.

Petrography: The meteorite displays a dark brownish interior and is a chondritic breccia consisting of small heterogeneously distributed lithic fragments embedded into a fine-grained clastic matrix. Clasts are of type 3-6, the clastic matrix of type 3. Low-Ca pyroxene occurs only in unequilibrated lithologies. Opaque phases are chromite and FeNi-sulfides; metallic FeNi has not been found.

Geochemistry: Olivine in type 6 lithologies, $\text{Fa}_{38.5}$; olivine in type 3 lithologies, $\text{Fa}_{29\pm12.7}$ (0.9-41.9, n=36); low-Ca pyroxene in type 3 lithologies, $\text{Fs}_{13.8\pm5.7}\text{Wo}_{0.9\pm0.7}$ ($\text{Fs}_{7.4-29.9}\text{Wo}_{0.3-3.2}$, n=34).

Northwest Africa 5700 (NWA 5700)

(Northwest Africa)

Purchased: 2008

Classification: Ordinary chondrite (LL3-6)

Petrography: Chondritic breccia with LL3 to LL6 clasts in a fine-grained clastic matrix. Plagioclase grain size in LL5 clasts is ~30 µm and in LL6 clasts ~80 µm.

Geochemistry: Olivine in equilibrated lithologies, $\text{Fa}_{27.9\pm0.2}$, n=12; low-Ca pyroxene in equilibrated lithologies $\text{Fe}_{23.7\pm0.3}\text{Wo}_{1.6\pm0.1}$, n=12. Olivine in type 3 lithology, $\text{Fa}_{16.7\pm9.1}$ ($\text{Fa}_{0.8-30.2}$, n=42); low-Ca pyroxene in type 3 lithology, $\text{Fs}_{12.8\pm7.9}\text{Wo}_{1\pm0.6}$ ($\text{Fs}_{4.1-25.5}\text{Wo}_{0.2-2.2}$), n=21.

Northwest Africa 5927 (NWA 5927)

(Northwest Africa)

Purchased: 2009

Classification: Ordinary chondrite (L3)

History: The meteorite was bought from a Moroccan meteorite dealer in 2009.

Petrography: The meteorite displays an overall light brownish interior and contains abundant and sharply defined chondrules of various types (POP, BO, RP, cryptocrystalline) with mean diameter of about 0.7 mm; low abundance of FeNi metal grains.

Northwest Africa 5928 (NWA 5928)

(Northwest Africa)

Purchased: 2009

Classification: Ureilite

History: The meteorite was purchased in 2009 from a local meteorite dealer in Agadir, Morocco.

Petrography: The meteorite displays a pronounced cumulate texture of up to 1-mm pigeonite and olivine crystals. It contains abundant flaky graphite; olivine displays characteristic reduced rims. It is less coarse-grained than [NWA 6069](#), and thus the two meteorites are likely not paired.

Geochemistry: Reduced rims in olivine: $\text{Fa}_{6.3-9.2}$; Cr_2O_3 in ol: ~ 0.6 wt%.

Northwest Africa 6028 (NWA 6028)

(Northwest Africa)

Purchased: 2009

Classification: HED achondrite (Eucrite)

History: The meteorite was bought in 2009 from a Swiss meteorite dealer who had originally obtained it in Morocco.

Physical characteristics: The meteorite partly covered by fusion crust.

Petrography: The meteorite displays an unbrecciated basaltic texture of lath shaped up to 4 mm sized pyroxene and calcic plagioclase crystals. Pyroxenes are frequently exsolved; minor phases include chromite, troilite and SiO_2 polymorphs.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{57.3\pm 1.9}\text{Wo}_{5.4\pm 2.2}$ ($\text{Fs}_{53.9-60.2}\text{Wo}_{2.2-8.6}$, $n=14$, $\text{FeO/MnO}=31-33$); Ca-pyroxene: $\text{Fs}_{25.7\pm 0.7}\text{Wo}_{44.8\pm 0.8}$ ($\text{Fs}_{24.7-27.1}\text{Wo}_{43.1-45.7}$, $n=15$, $\text{FeO/MnO}=29-36$); calcic plagioclase: $\text{An}_{87.8\pm 0.4}$ ($\text{An}_{86.9-88.4}$, $n=13$)

Northwest Africa 6029 (NWA 6029)

(Northwest Africa)

Purchased: 2009

Classification: HED achondrite (Eucrite)

History: The meteorite was bought from a Moroccan meteorite dealer in 2009.

Petrography: The meteorites displays a basaltic texture and is dominantly composed of calcic plagioclase and exsolved pyroxene with variable grain sizes; plagioclase crystals are up to 2.5 mm in size; meteorite appears to be unbrecciated. Minor phases include SiO_2 polymorphs and chromite.

Geochemistry: Low-Ca pyroxene, $\text{Fs}_{55\pm 1.2}\text{Wo}_{3.3\pm 1.4}$ ($\text{Fs}_{51.4-56.2}\text{Wo}_{2-7.7}$, $n=18$, $\text{FeO/MnO}=29-33$); Ca-pyroxene, $\text{Fs}_{24.2\pm 0.9}\text{Wo}_{42.3\pm 1.3}$ ($\text{Fs}_{22.9-27.5}\text{Wo}_{37.3-43.7}$, $n=30$, $\text{FeO/MnO}=29-39$); calcic plagioclase: $\text{An}_{89.8\pm 0.6}$ ($\text{An}_{88.9-90.7}$, $n=12$)

Northwest Africa 6064 (NWA 6064)

(Northwest Africa)

Purchased: 2009

Classification: Carbonaceous chondrite (CV3)

History: The meteorite was bought from a Moroccan dealer at a mineral fair in St. Marie aux Mines, France.

Petrography: The meteorite is composed of large up to 2.5 mm sized chondrules, CAIs, and olivine amoeboids set into a fine-grained almost opaque matrix. Some chondrules show orange staining due to terrestrial weathering. No type II chondrules were found.

Geochemistry: Individual matrix olivines have up to $\text{Fa}_{63.5}$

Northwest Africa 6069 (NWA 6069)

(Northwest Africa)

Purchased: 2009

Classification: Ureilite

History: The meteorite was purchased in 2009 from a local meteorite dealer in Agadir, Morocco.

Petrography: The meteorite shows a cumulate texture of 0.1 to 1 mm olivine and pigeonite grains that typically join at 120 degree grain boundaries. Carbon is present as flaky graphite attesting to a rather low degree of shock metamorphism. Olivine displays characteristic reduced rims. It is more coarse-grained than [NWA 5928](#), and thus the two meteorites are likely not paired.

Geochemistry: Reduced rims in olivine: $\text{Fa}_{7.5-9.4}$; Cr_2O_3 in ol: ~ 1 wt%.

Northwest Africa 6070 (NWA 6070)

(Northwest Africa)

Purchased: 2009

Classification: Ureilite

History: The meteorite was purchased in 2009 from a local meteorite dealer in Agadir, Morocco.

Petrography: The meteorite displays a cumulate texture of blocky mm-sized olivine and augite crystals often showing 120 degree grain boundaries. It contains abundant flaky graphite and olivine shows typical reduced rims.

Geochemistry: Reduced rims in olivine: $\text{Fa}_{4.2-9.8}$; Cr_2O_3 in ol: ~ 0.35 wt%

Northwest Africa 6112 (NWA 6112)

(Northwest Africa)

Purchased: 2000

Classification: Ungrouped achondrite

Physical characteristics: A 1040 g stone, partially covered by fusion crust.

Petrography: The section shows a granular texture composed of elongate to rounded olivine grains (0.3-0.5 mm, ~ 90 vol%) and minor anhedral plagioclase (~ 0.2 -0.5 mm) and augite (~ 1 -2 mm). Large augite grains (~ 1 -2 mm) poikilitically enclose rounded olivine grains. Fine-grained (partly-weathered) FeNi-FeS and orthopyroxene occur along grain boundaries of the silicate minerals.

Geochemistry: Olivine (Fa_{25-28} , $\text{FeO/MnO} \sim 53$), Pyroxenes: Augite ($n = 12$),

$\text{Fs}_{10.9 \pm 0.3} \text{En}_{46.2 \pm 0.3} \text{Wo}_{42.9 \pm 0.4}$ ($\text{Fs}_{10.2-11.2} \text{En}_{45.8-46.4} \text{Wo}_{42.1-43.6}$) and Low-Ca pyroxene, $\text{Fs}_{22.6} \text{En}_{76.6} \text{Wo}_{0.8}$ ($n = 2$), and plagioclase ($\text{Or}_{2-3} \text{An}_{20-21}$).

Classification: The coarse-grained granular texture indicates that this meteorite is not a chondritic meteorite, but an achondrite or primitive achondrite. The composition of olivine (Fa_{25-29}) is similar to L chondrites. However, the scarcity of orthopyroxene indicates that this meteorite is not related to ordinary chondrites. The mode of olivine (~ 90 vol%) and the presence of minor augite indicate that this meteorite is petrologically similar to brachinite group. However, the Fa composition of olivine is slightly outside the range of brachinite group (Fa_{30-35}) and similar to those of an ungrouped achondrite, Divnoe (Fa_{20-28}). On the basis of the petrologic data presented above, this meteorite is classified as an ungrouped achondrite.

Specimens: 38 g type specimen at *NIPR*.

Northwest Africa 6226 (NWA 6226)

(Northwest Africa)

Purchased: 2008

Classification: Ordinary chondrite (LL3)

History: Purchased in 2008 by Derick Bowers from a dealer in Midelt, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (apparent diameter 1.1 ± 0.7 mm) are set in a sparse finer-grained matrix containing altered metal.

Geochemistry: Olivine ($\text{Fa}_{24.9-28.7}$, Cr_2O_3 in ferroan olivine 0.01-0.03 wt.%, N = 6), orthopyroxene ($\text{Fs}_{3.8-41.6}\text{Wo}_{0.3-3.3}$, N = 3), clinopyroxene ($\text{Fs}_{15.9-22.0}\text{Wo}_{18.0-31.6}$, N = 2).

Classification: Ordinary chondrite (LL3).

Specimens: 28 g at *UWB*; remainder with Mr. D. Bowers.

Northwest Africa 6304 (NWA 6304)

(Northwest Africa)

Purchased: 2009

Classification: Carbonaceous chondrite (CO3)

History: The meteorite was bought from a Moroccan dealer on a mineral fair in Ensisheim, France.

Petrography: The dark brownish meteorite exhibits chondritic texture of abundant small chondrules, CAIs, chondrule and mineral fragments set into a fine-grained matrix. Chondrules are typically 0.1-0.2 mm in diameter and few of them are surrounded by dust rims.

Northwest Africa 6401 (NWA 6401)

(Northwest Africa)

Purchased: 2010

Classification: Ordinary chondrite (L3)

History: The meteorite was bought from a local meteorite dealer in Erfoud, Morocco.

Petrography: The meteorite is composed of well defined chondrules of various petrological types about 0.6 in diameter set into a fine-grained matrix of chondrule and mineral fragments and FeNi metal.

Northwest Africa 6406 (NWA 6406)

(Northwest Africa)

Purchased: 2010

Classification: Ordinary chondrite (LL4-6)

History: The meteorite was bought from a local meteorite dealer in Erfoud, Morocco.

Petrography: Chondritic breccia composed of L4, L5 and L6 clasts. Plagioclase grain size in L5 clasts is about 25 μm and in L6 clasts about 70 μm .

Geochemistry: olivine in type 6 lithology, $\text{Fa}_{29.7}$; olivine in type 4 lithology, $\text{Fa}_{28 \pm 1.1}$ (26.5-29.4, n=17); low-Ca pyroxene in type 4 lithology, $\text{Fs}_{21.1 \pm 3}\text{Wo}_{1.2 \pm 0.8}$ ($\text{Fs}_{14.9-24.4}\text{Wo}_{0.3-2}$, n=16)

Northwest Africa 6407 (NWA 6407)

(Northwest Africa)

Purchased: 2010

Classification: Mesosiderite

History: The meteorite was bought from a local meteorite dealer in Erfoud, Morocco.

Petrography: The meteorite is a breccia composed of silicate clasts separated from each other by broad veins and patches of iron-oxides and -hydroxides. Assuming that these alteration products formerly were FeNi metal, the metal portion would have been initially about 40% and the silicate portion about 60% of the rock. The silicate portion studied displays a cumulate texture of large compositionally zoned orthopyroxene crystals and less abundant calcic plagioclase. Minor phases include olivine, chromite, merillite and troilite.

Geochemistry: low-Ca pyroxene, $\text{Fs}_{34.2\pm7.9}\text{Wo}_{5.3\pm3.8}$ ($\text{Fs}_{22.7-49.5}\text{Wo}_{1.6-14.4}$, $n=29$, $\text{FeO/MnO}=24-32$); calcic plagioclase, $\text{An}_{91\pm4.5}$ (84.7-95.1, $n=22$)

Northwest Africa 6433 (NWA 6433)

(Northwest Africa)

Purchased: 2007 Oct

Classification: Ordinary chondrite (LL3)

History: Purchased by Blaine Reed in October 2007 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Very fresh, unequilibrated specimen composed of small to medium sized chondrules (0.5-2.1 mm) in a finer matrix. Minerals are olivine, orthopyroxene, subcalcic augite, pigeonite, sodic plagioclase, chromite, altered kamacite and troilite.

Geochemistry: Olivine ($\text{Fa}_{1.3-40.2}$; Cr_2O_3 in ferroan olivine = 0.08 ± 0.02 wt.%), orthopyroxene ($\text{Fs}_{1.0-21.9}\text{Wo}_{0.5-0.6}$), subcalcic augite ($\text{Fs}_{1.3}\text{Wo}_{29.4}$), pigeonite ($\text{Fs}_{23.0}\text{Wo}_{17.6}$). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.29$.

Classification: Ordinary chondrite (LL3). LL group designation based on magnetic susceptibility.

Specimens: Type specimen plus one polished thick section are at *PSF*; main mass with *Reed*.

Northwest Africa 6496 (NWA 6496)

(Northwest Africa)

Purchased: Nov 2009

Classification: Ordinary chondrite (LL3)

Physical characteristics: A rounded, desert-varnished stone was found. Abundant chondrules are visible on its surface.

Petrography: (A.E. Rubin, *UCLA*) Average chondrule diameter of $\sim 600 \mu\text{m}$ is indicative of LL. Heterogeneity of olivine and pyroxene is indicative of type 3. Absence of isotropic glass indicates high type 3. Abundant polysynthetically twinned low-Ca pyroxene.

Northwest Africa 6859 (NWA 6859)

(Northwest Africa)

Purchased: 2010

Classification: Carbonaceous chondrite (CV3)

Petrography: (R. Andreasen, *UHou*) In thin section, $\sim 55\%$ chondrules of different types (PO, BO, and to a lesser extent POP) with an apparent diameter of about 1 mm, $\sim 3\%$ CAIs of different morphologies, small 1-2 mm irregular CAIs common, larger ~ 10 mm near spherical CAIs less common, $\sim 1\%$ Fe-Ni sulfide (pentlandite), weathered in places ($\sim 10\%$) and replaced by oxides. Contains $\sim 40\%$ light-gray, fine-grained crystalline matrix that appears fresh. No metal (or replacement products of metal weathering) was observed and no opaque phases were seen in the chondrules studied.

Geochemistry: Mineral Composition and Geochemistry: (R. Andreasen, *UHou* - EPMA analyses performed on the *JSC* microprobe) Chondrule olivine $\text{Fo}_{98.3 \pm 1.5}$ ($\text{Fo}_{93.7-99.8}$, $n=45$). Matrix olivine, variable in composition, mean $\text{Fo}_{56.6 \pm 4.8}$ ($\text{Fo}_{51.3-60.3}$, $n=7$). Chondrule pyroxene, $\text{En}_{93.5 \pm 1.0} \text{Fs}_{1.3 \pm 0.6} \text{Wo}_{4.8 \pm 1.0}$. Sulfides (pentlandite) Ni 18.1 ± 0.6 wt%, Co 0.9 ± 0.1 wt%, ($n=19$)
Classification: Carbonaceous chondrite (CV3, oxidized subgroup).
Specimens: Thin section at *UHou*. 20.7 g at the *AMSA*.

Northwest Africa 7021 (NWA 7021)

(Northwest Africa)

Purchased: 2009 Sep

Classification: Carbonaceous chondrite (CO3)

History: Purchased by Blaine Reed in September 2009 from a Moroccan dealer at the Denver Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Relatively small chondrules (apparent diameter up to 500 μm , mean 150 μm) and small CAI are set in a much finer grained matrix (~30 vol.%) containing accessory kamacite.

Geochemistry: Olivine ($\text{Fa}_{0.5-46.7} \text{Cr}_2\text{O}_3$ in ferroan examples = 0.07-0.20, mean 0.11 ± 0.06 wt.%, $N = 7$), orthopyroxene ($\text{Fs}_{1.6-3.7} \text{Wo}_{0.8-0.9}$, $N = 3$), subcalcic augite ($\text{Fs}_{26.6} \text{Wo}_{36.3}$), diopside ($\text{Fs}_{1.0} \text{Wo}_{44.3}$).

Classification: Carbonaceous chondrite (CO3).

Specimens: 20.3 g including one polished thin section and a polished slice at *PSF*; main mass with *Reed*.

Northwest Africa 7028 (NWA 7028)

(Northwest Africa)

Purchased: 2010 Feb

Classification: Ordinary chondrite (LL6)

History: Purchased by Blaine Reed in February 2010 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare chondrule remnants.

Geochemistry: Olivine ($\text{Fa}_{27.1-28.0}$, $N = 3$), orthopyroxene ($\text{Fs}_{22.9-22.6} \text{Wo}_{1.2-1.6}$, $N = 3$), augite ($\text{Fs}_{6.2-6.3} \text{Wo}_{46.2-46.8}$, $N = 2$).

Classification: Ordinary chondrite (LL6).

Specimens: 21.3 g including one polished thin section and a polished slice at *PSF*; main mass with *Reed*.

Northwest Africa 7123 (NWA 7123)

(Northwest Africa)

Purchased: 2011 Sep

Classification: Ordinary chondrite (H3)

History: Purchased by John Higgins in September 2011 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, relatively small chondrules in a finer grained matrix containing abundant altered metal.

Geochemistry: Olivine ($\text{Fa}_{2.4-38.4}$; Cr_2O_3 contents in ferroan olivine 0.04-0.11 wt.%, mean 0.07 ± 0.03 wt.%, $N = 6$), orthopyroxene ($\text{Fs}_{3.0-36.0}\text{Wo}_{1.0-2.2}$, $N = 3$), subcalcic augite ($\text{Fs}_{7.5-18.7}\text{Wo}_{23.6-28.3}$, $N = 2$)

Classification: Ordinary chondrite (H3).

Specimens: 62 g including one polished thin section at *UWB*; the remainder is held by Mr. J. Higgins.

Northwest Africa 7130 (NWA 7130)

(Northwest Africa)

Purchased: 2011 Sep

Classification: Ordinary chondrite (LL3)

History: Purchased by Gary Fujihara in September 2011 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fairly closely packed, well-formed, relatively large chondrules (apparent diameter 1.2 ± 0.8 mm, some with thin opaque rims) are set in a finer grained matrix.

Geochemistry: Olivine ($\text{Fa}_{1.9-81.6}$; Cr_2O_3 in ferroan examples is 0.02-0.27 wt.%, mean 0.11 ± 0.10 wt.%, $N = 8$), orthopyroxene ($\text{Fs}_{12.0-24.3}\text{Wo}_{2.8-1.3}$, $N = 3$), clinopyroxene ($\text{Fs}_{8.9-12.0}\text{Wo}_{41.8-39.0}$, $N = 2$)

Classification: Ordinary chondrite (LL3).

Specimens: 20 g including one polished thin section at *UWB*; the remainder is held by Mr. G. Fujihara.

Northwest Africa 7135 (NWA 7135)

(Northwest Africa)

Purchased: 2010 Oct

Classification: Ungrouped chondrite

History: Purchased by Fabien Kuntz in October 2010 from a Moroccan dealer at the Munich Show.

Physical characteristics: Brown stone (51.3 g) lacking fusion crust and with evident light-colored, round chondrules.

Petrography: (A. Irving and S. Kuehner, *UWS*) Composed of separated, mostly spherical, relatively small chondrules (mean 0.69 ± 0.53 mm, $n=40$) in a matrix (~ 30 vol.%) rich in altered kamacite. Some chondrules contain interstitial feldspathic glass. Minerals are olivine, zoned orthopyroxene, pigeonite, diopside, subcalcic augite, Cr-rich chromite, pyrrhotite, pentlandite, daubreelite, oldhamite, schreibersite and rare barite. The presence of highly reduced sulfides and phosphides suggest an atypical ordinary chondrite.

Geochemistry: Olivine, predominantly $\text{Fa}_{4.8-6.3}$ ($N = 15$), with some more ferroan grains $\text{Fa}_{19.8-19.9}$ ($N = 2$); orthopyroxene, $\text{Fs}_{7.0-21.8}\text{Wo}_{0.4-1.5}$ ($N = 3$); pigeonite, $\text{Fs}_{17.3}\text{Wo}_{6.9}$; subcalcic augite, $\text{Fs}_{13.3-22.2}\text{Wo}_{25.4-29.9}$ ($N = 2$). The mean olivine composition (Fa_6) is much more magnesian than for H chondrites of similar subtype. Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O} = 3.207, 3.649, 3.262, 3.379, 3.859$; $\delta^{18}\text{O} = 5.175, 6.072, 5.326, 5.333, 6.450$; $\Delta^{17}\text{O} = 0.475, 0.443, 0.450, 0.563, 0.453$ (all per mil). Oxygen isotopes plot in a region above the TFL and at relatively high $\delta^{18}\text{O}$ values.

Classification: Ungrouped chondrite, high metamorphic type 3 or type 4.

Specimens: 10.44 g including one polished thin section at *PSF*; main mass with *Kuntz*.

Northwest Africa 7157 (NWA 7157)

(Northwest Africa)

Purchased: 2011

Classification: Ordinary chondrite (L7)

History: Purchased by Marcin Cimala in 2011 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Recrystallized with triple grain junctions. Equigranular aggregate of olivine, orthopyroxene, sodic plagioclase, clinopyroxene, chromite, troilite and metal.

Geochemistry: Olivine (Fa_{22.6-22.7}, N = 3), orthopyroxene (Fs_{18.8-19.1}Wo_{2.8-3.1}, N = 3), clinopyroxene (Fs_{7.7-8.1}Wo_{44.1-42.6}, N = 2).

Classification: Ordinary chondrite (L7).

Specimens: 20.5 g including one polished thin section at *PSF*; main mass with Mr. M. Cimala.

Northwest Africa 7158 (NWA 7158)

(Northwest Africa)

Purchased: 2011

Classification: Ordinary chondrite (LL3)

History: Purchased by Marcin Cimala in 2011 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (mean apparent diameter 1.2 mm) in a finer matrix.

Geochemistry: Olivine (Fa_{0.9-74.1}, Cr₂O₃ in ferroan examples 0.09-0.23 wt.%, mean 0.14±0.05 wt.%, N = 8), orthopyroxene (Fs_{2.1-14.5}Wo_{0.2-1.7}, N = 3), subcalcic augite (Fs_{17.7}Wo_{25.6}), augite (Fs_{0.9-2.6}Wo_{44.5-47.9}, N = 2). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.91$.

Classification: Ordinary chondrite (LL3). LL group designation based on magnetic susceptibility.

Specimens: 20.2 g including one polished thin section at *PSF*; main mass with Mr. M. Cimala.

Northwest Africa 7159 (NWA 7159)

(Northwest Africa)

Purchased: 2011

Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Marcin Cimala in 2011 from a dealer in Erfoud, Morocco.

Petrography: (T. Bunch and J. Wittke, *NAU*; A. Irving and S. Kuehner, *UWS*) Brecciated cumulate eucrite consisting of exsolved pigeonite and anorthite with accessory silica polymorph, ilmenite and metal.

Geochemistry: Orthopyroxene host (Fs_{56.6-57.1}Wo_{2.0-1.9}, FeO/MnO = 28-30, N = 3), clinopyroxene exsolution lamellae (Fs_{24.1-24.5}Wo_{42.6-41.3}, FeO/MnO = 30-31, N = 3).

Classification: Eucrite (cumulate, monomict breccia).

Specimens: 20.1 g including one polished thin section at *PSF*; main mass with Mr. M. Cimala.

Northwest Africa 7161 (NWA 7161)

(Northwest Africa)

Purchased: 2011

Classification: Ordinary chondrite (L3)

History: Purchased by Marcin Cimala in 2011 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (1.4 ± 0.9 mm) in a finer matrix.

Geochemistry: Olivine ($\text{Fa}_{0.9-48.7}$, Cr_2O_3 in ferroan olivine 0.09-0.57 wt.%, mean 0.19 ± 0.19 wt.%, $N = 8$), orthopyroxene ($\text{Fs}_{1.1-21.2}\text{Wo}_{4.8-1.1}$, $N = 3$), augite ($\text{Fs}_{9.0}\text{Wo}_{45.1}$).

Classification: Ordinary chondrite (L3).

Specimens: 20.3 g including one polished thin section at *PSF*; main mass with Mr. M. Cimala.

Northwest Africa 7162 (NWA 7162)

(Northwest Africa)

Purchased: 2011

Classification: Ordinary chondrite (L3)

History: Purchased by Marcin Cimala in 2011 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (1.2 ± 0.7 mm) in a finer matrix.

Geochemistry: Olivine ($\text{Fa}_{0.7-34.9}$, Cr_2O_3 in ferroan olivine 0.06-0.08 wt.%, mean 0.07 ± 0.01 wt.%, $N = 8$), orthopyroxene ($\text{Fs}_{2.8-19.9}\text{Wo}_{0.4-1.1}$, $N = 3$), subcalcic augite ($\text{Fs}_{25.8}\text{Wo}_{30.1}$).

Classification: Ordinary chondrite (L3).

Specimens: 26.2 g including one polished thin section at *PSF*; main mass with Mr. M. Cimala.

Northwest Africa 7163 (NWA 7163)

(Northwest Africa)

Purchased: 2011

Classification: Ordinary chondrite (LL3)

History: Purchased by Marcin Cimala in 2011 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely-packed, well-formed chondrules (1.5 ± 0.6 mm) in a finer matrix.

Geochemistry: Olivine ($\text{Fa}_{7.4-56.7}$, Cr_2O_3 in ferroan olivine 0.09-0.30 wt.%, mean 0.13 ± 0.07 wt.%, $N = 9$), orthopyroxene ($\text{Fs}_{0.3-16.9}\text{Wo}_{0.9-1.3}$, $N = 3$), pigeonite ($\text{Fs}_{21.5}\text{Wo}_{16.4}$), augite ($\text{Fs}_{14.9}\text{Wo}_{39.1}$).

Classification: Ordinary chondrite (LL3).

Specimens: 18.9 g including one polished thin section at *PSF*; main mass with Mr. M. Cimala.

Northwest Africa 7164 (NWA 7164)

(Northwest Africa)

Purchased: 2011

Classification: Ordinary chondrite (L5)

History: Purchased by Marcin Cimala in 2011 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules (1.2 ± 0.3 mm) in a finer grained, recrystallized matrix.

Geochemistry: Olivine ($\text{Fa}_{25.0-25.8}$, $N = 4$), orthopyroxene ($\text{Fs}_{21.6-22.3}\text{Wo}_{0.9-1.5}$, $N = 3$), clinopyroxene ($\text{Fs}_{7.7-8.2}\text{Wo}_{45.3-44.5}$, $N = 2$).

Classification: Ordinary chondrite (L5).

Specimens: 42.4 g including one polished thin section at *PSF*; main mass with Mr. M. Cimala.

Northwest Africa 7166 (NWA 7166)

(Northwest Africa)

Purchased: 2011

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Marcin Cimala in 2011 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Separated, granular chondrules plus CAI are set in a finer grained, orange to red-brown matrix. Some CAI consist of Ti-Al-rich clinopyroxene, K-bearing nepheline, ilmenite and troilite with a partial chlorapatite rim.

Geochemistry: Olivine (Fa_{1.0-38.2}, N = 3), orthopyroxene (Fs_{2.7-8.0}Wo_{0.8-2.2} N = 3), subcalcic augite (Fs_{22.0}Wo_{22.5}).

Classification: Carbonaceous chondrite (CV3).

Specimens: 8.7 g including one polished thin section at *PSF*; main mass with Mr. M. Cimala.

Northwest Africa 7168 (NWA 7168)

(Northwest Africa)

Purchased: 2011

Classification: Ordinary chondrite (LL4)

History: Purchased by Marcin Cimala in 2011 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of angular clasts containing well formed chondrules (up to 2.5 mm in diameter) in finer grained, recrystallized matrix.

Geochemistry: Olivine (Fa_{28.8-29.4}, N = 3), orthopyroxene (Fs_{23.3-23.9}Wo_{3.3-1.6}, N = 3), clinopyroxene (Fs_{10.3-11.0}Wo_{43.7-43.9}, N = 2).

Classification: Ordinary chondrite (LL4 breccia)).

Specimens: 20.4 g including one polished thin section at *PSF*; main mass with Mr. M. Cimala.

Northwest Africa 7170 (NWA 7170)

(Northwest Africa)

Purchased: 2011

Classification: Ordinary chondrite (L3)

History: Purchased by Marcin Cimala in 2011 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (1.8±0.9 mm) in a finer matrix.

Geochemistry: Olivine (Fa_{0.4-39.2}, Cr₂O₃ in ferroan olivine 0.06-0.11 wt.%, mean 0.09±0.02 wt.%, N = 8), orthopyroxene (Fs_{3.3-22.2}Wo_{0.2-2.9}, N = 3), subcalcic augite (Fs_{15.3}Wo_{27.2}), augite (Fs_{13.2}Wo_{40.8}).

Classification: Ordinary chondrite (L3).

Specimens: 20.3 g including one polished thin section at *PSF*; main mass with Mr. M. Cimala.

Northwest Africa 7187 (NWA 7187)

Northwest Africa

Purchased: 2011 Sep

Classification: Ordinary chondrite (L3)

History: Purchased by Eric Twelker in September 2011 from a Moroccan dealer at the Denver Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh specimen composed of closely packed, well-formed chondrules (apparent diameter mostly 1.2±0.9 mm, one 4 mm) in a matrix containing a moderate amount of fresh metal grains, troilite, chlorapatite and merrillite. Some chondrules have multiple thick dust rims.

Geochemistry: Olivine ($\text{Fa}_{0.5-35.3}$; Cr_2O_3 in ferroan olivine 0.02-0.08 wt.%, mean 0.04 ± 0.02 wt.%, $N = 7$), orthopyroxene ($\text{Fs}_{4.9-20.5}\text{Wo}_{0.4-1.5}$, $N = 3$), clinopyroxene ($\text{Fs}_{6.8-6.9}\text{Wo}_{38.1-45.3}$, $N = 2$).
Classification: Ordinary chondrite (L3).

Specimens: 27.4 g including one polished thin section at *UWB*; the remainder is held by *welker*.

Northwest Africa 7264 (NWA 7264)

Northwest Africa

Purchased: 2012 Mar

Classification: Ordinary chondrite (LL3)

History: Purchased by in Temara, Morocco by Adam Aaronson in March 2012.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, fairly closely packed, relatively large chondrules (apparent diameter 2.0 ± 1.6 mm, some with opaque rims) in a finer grained, reddish-brown matrix.

Geochemistry: Olivine ($\text{Fa}_{12.7-38.9}$; Cr_2O_3 in ferroan olivines = 0.04-0.08 wt.%, mean 0.06 ± 0.02 wt.%, $N = 7$), orthopyroxene ($\text{Fs}_{5.2-11.4}\text{Wo}_{0.1-0.9}$, $N = 3$), subcalcic augite ($\text{Fs}_{7.8}\text{Wo}_{38.0}$).

Classification: Ordinary chondrite (LL3).

Specimens: 20 g including one polished thin section at *UWB*; the remainder is held by *Aaronson*.

Northwest Africa 7324 (NWA 7324)

(Northwest Africa)

Purchased: 2012

Classification: EH-melt rock

History: Purchased by Stefan Ralew in April and November 2012 from a dealer in Erfoud, Morocco.

Physical characteristics: A group of dark brown, dense stones comprising two larger pieces (one 3250 g) and many small fragments (total 4490 g). Fresh interiors are black with abundant metal and sulfide visible, and the specimens emit a very strong sulfurous smell upon cutting.

Petrography: (A. Irving and S. Kuehner, *UWS*) Entire specimen consists of a fine grained aggregates of highly magnesian silicates and abundant metal and sulfides with no interstitial glass. Minerals are euhedral enstatite, some forsterite, ragged grains of Si-bearing metal, rare euhedral graphite laths, Cr-bearing troilite, niningerite and rare oldhamite. Portions of the matrix consist of silica-rich glass (K-bearing) containing tiny crystals of a very Si-rich mineral (silica or possibly sinoite). A few relict chondrules were observed.

Geochemistry: Enstatite ($\text{Fs}_{0.4-0.7}\text{Wo}_{0.3-0.9}$, $N = 3$), forsterite ($\text{Fa}_{0.5}$, $N = 1$), metal (Si = 2.5 wt.%, Ni = 6.6 wt.%).

Classification: EH-melt rock.

Specimens: A total of 20.6 g of type material and one polished thin section are on deposit at *UWB*. The remaining material is held by *Ralew*.

Northwest Africa 7402 (NWA 7402)

(Northwest Africa)

Purchased: 2010 August 26

Classification: Ordinary chondrite (L3.1)

History: NWA 7402 was purchased on August 26, 2010, by Eric Twelker from a meteorite trader in Morocco.

Physical characteristics: A 4013.4 g individual stone, with fusion crust intact and partially rusted. Rust-colored, apparently weathered areas with orange-brown chondrules surround less-weathered regions containing light-gray chondrules set within a darker gray groundmass. The meteorite is a breccia, with occasional clasts of different lithologies present (up to ~5 mm width). The transition from weathered to unweathered lithology is abrupt, and does not correlate with clast boundaries.

Petrography: (C. E. Jilly-Rehak, *UH*) Transmitted and reflected light optical microscopy reveal a high abundance of chondrules embedded in a clastic, sulfide-rich matrix. Chondrules range from ~0.2 - 2 mm in apparent diameter, and an anomalously large barred olivine chondrule of 8 mm exists in one thin section. Chondrule types found in the meteorite include porphyritic olivine, barred olivine, porphyritic pyroxene, radial pyroxene, and cryptocrystalline. The porphyritic olivine chondrules comprise both type I ($Fa < 2$) and type II (Fa_{10-25}). Fine-grained FeO-rich silicate rims are observed surrounding some (but not all) chondrules. The rims are typically embedded with μm -sized Fe sulfides. The matrix contains abundant Fe,Ni metal and sulfides, as well as chondrule fragments and isolated silicate grains. Large opaque assemblages (~300 μm in diameter) are found in the matrix, containing both kamacite and taenite, Fe sulfides, and Fe oxides. Optical microscopy reveals moderate shock and weathering, corresponding to maximum stages S2 and W2, respectively. The studied sections do not contain any calcium-aluminum inclusions (CAIs), although one aluminous chondrule was found. The pre-weathering metal abundance could have been up to 10.7 wt%, placing the meteorite in the L-chondrite range, also in agreement with the magnetic susceptibility.

Geochemistry: Olivine is highly variable in composition, ranging from $Fa < 1$ to Fa_{36} (mean, $Fa_{12.9 \pm 8.7}$, $N=102$). Low-Ca pyroxene is $Fs_{8.4 \pm 7.6}$ ($N=71$). Cr_2O_3 in 140 ferroan olivine grains is $= 0.41 \pm 0.13$ wt.%. Separated matrix material (<50 mg) was measured via Raman spectroscopy; peak intensities (I) for the D and G bands have $\text{FWHM}=181 \pm 16$ and $\text{ID/IG}=0.93 \pm 0.04$.

Classification: Ordinary chondrite (L3.1-anom), S2, W2. It is possibly paired with [NWA 5717](#). Raman spectroscopy of organic matter in the fine-grained matrix indicates that the sample is petrologic type 3.1, plotting within analytical error of [Bishunpur](#). EPMA of chromium contents in olivine shows that NWA 7402 lies between types 3.00 and 3.15, but anomalously falls off the trend for typical UOCs in [Grossman and Brearley \(2005\)](#). However, analyses of control specimens [Semarkona](#) and Bishunpur generally agree with the literature values. Furthermore, NWA 7402 has an elevated sulfide abundance (>15 wt%).

Specimens: The main mass of NWA 7402 (3987.9 g) is held by *Twelker*. The type specimen (25.5 g) is held at *UNM*.

Northwest Africa 7405 (NWA 7405)

Morocco

Purchased: Jan 2008

Classification: Ordinary chondrite (L3)

Petrography: Chondrules average ~400 μm in apparent diameter; none of them contains clear colorless glass. There are a lot of broken chondrules visible in thin section. Many low-Ca pyroxene grains exhibit polysynthetic twins. The rock is moderately recrystallized and is about as equilibrated as H3.8 [Dhajala](#).

Classification: Ordinary chondrite (L3).

Northwest Africa 7406 (NWA 7406)

Morocco

Purchased: Dec 2010

Classification: Enstatite chondrite (EL3)

Physical characteristics: A single, complete, desert-varnished stone was found.

Petrography: (A.E. Rubin, *UCLA*) Chondrules average ~500 μm in apparent diameter which is very close to the 550- μm average chondrule diameter found for EL3 ([Rubin, 2010](#)); most are RP and PP types, but there are also rare POP chondrules and chondrule fragments. Many low-Ca pyroxene grains exhibit polysynthetic twins. The rock is so weathered that almost no opaque grains have survived -- only a few grains of troilite and metal. Kamacite: 94.2% Fe, 4.6% Ni, 0.55% Si, 0.30% Co, 0.10% P, 0.09% Cr, 0.07% Mg (n=3). Ti and Mn were below detection limits. Abundant grains of metallic copper <5 μm were observed, usually within matrix enstatite grains.

Northwest Africa 7409 (NWA 7409)

(Northwest Africa)

Purchased: Feb 2011

Classification: Carbonaceous chondrite (CO3)

Petrography: (A.E. Rubin, *UCLA*) Chondrules average ~150 μm in apparent diameter, as expected for a CO3 chondrite. None of the chondrules contains clear, transparent, colorless glass. Some low-Ca pyroxene grains exhibit polysynthetic twinning. A few percent of the rock consists of CAIs and AOIs.

Northwest Africa 7411 (NWA 7411)

(Northwest Africa)

Purchased: Nov 2010

Classification: Carbonaceous chondrite (CV3)

Petrography: (A.E. Rubin, *UCLA*) There are large (2-3 cm) type A fluffy CAIs and 1-2 cm type B CAIs visible in hand sample. Chondrules average about 900 μm in apparent diameter, characteristic of CV chondrites. Many chondrules have thick igneous rims. There are a few percent AOIs, which have a mean size of ~700 μm . The rock has moderately abundant magnetite and little metallic Fe-Ni. Some of the low-Ca pyroxene grains exhibit polysynthetic twins.

Northwest Africa 7436 (NWA 7436)

(Northwest Africa)

Purchased: 2004

Classification: Ordinary chondrite (H5)

Petrography: Chondrules are identifiable, but many are not well-defined. Plagioclase grains are often 10s of μm across and occasionally up to 50 μm .

Geochemistry: Olivine, $\text{Fa}_{19.7 \pm 1.5}$ (N=50); pyroxene, $\text{Fs}=16.9 \pm 1.1$ $\text{Wo}_{1.2 \pm 0.3}$ (N=57, EMPA).

Classification: Ordinary Chondrite H5, S4, W3.

Specimens: The specimen includes a thin section and two pieces of 6.5 and 1.4 g.

Northwest Africa 7556 (NWA 7556)

(Northwest Africa)

Purchased: 2010 Dec

Classification: Ordinary chondrite (L4-6)

History: Purchased by Dr. David Gregory in December 2010 from a Moroccan dealer.

Physical characteristics: A single, large brown stone (17.509 kg) lacking fusion crust.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia consisting of clasts and some discrete well-formed chondrules set in a sparse matrix. Some clasts have discernible chondrules whereas others have been almost completely recrystallized. All components are compositionally equilibrated.

Geochemistry: Olivine ($\text{Fa}_{25.2-25.3}$, $N = 3$), orthopyroxene ($\text{Fs}_{20.4-20.9}\text{Wo}_{1.9-1.4}$, $N = 3$), augite ($\text{Fs}_{8.9-9.9}\text{Wo}_{42.0-42.4}$, $N = 2$). Oxygen isotopes (K. Ziegler, *UNM*): analyses of three acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ 3.882, 3.618, 4.101; $\delta^{18}\text{O}$ 5.367, 5.043, 5.664; $\Delta^{17}\text{O}$ 1.048, 0.955, 1.110 per mil.

Classification: Ordinary chondrite (L4-6 breccia).

Specimens: 76 g including one polished thin section at *UWB*; main mass with Dr. D. Gregory.

Northwest Africa 7604 (NWA 7604)

(Northwest Africa)

Purchased: 2012

Classification: Ordinary chondrite (LL7)

History: Purchased by Stefan Ralew in 2012 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fairly fresh specimen with poikiloblastic texture characterized by multiple, very small olivine chadacrysts enclosed within larger orthopyroxene oikocrysts, together with subordinate clinopyroxene, sodic plagioclase, kamacite and troilite.

Geochemistry: Olivine ($\text{Fa}_{28.6-28.9}$, $N = 3$), orthopyroxene ($\text{Fs}_{22.9-23.2}\text{Wo}_{4.5-3.3}$, $N = 3$), clinopyroxene ($\text{Fs}_{10.7-11.7}\text{Wo}_{43.4-43.2}$, $N = 2$).

Classification: Ordinary chondrite (LL7).

Specimens: 9.8 g including one polished thin section at *UWB*. The remaining material is held by Ralew.

Northwest Africa 7767 (NWA 7767)

(Northwest Africa)

Purchased: 2011

Classification: Ordinary chondrite (L, melt rock)

History: Purchased by Nicola Castellano at the Torino Mineral Show, Italy.

Physical characteristics: A single piece weighing 31 g, partially covered with fusion crust.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *MSP*); The thin section displays two lithologies: an equilibrated chondritic one and a melted one. The chondritic portion has a fine-grained matrix dominated by olivine, plagioclase, and orthopyroxene. Opaque phases are metal and troilite. The melted portion shows diffuse melt features such as metal veins, μm -sized metal grains and glass.

Geochemistry: Olivine ($\text{Fa}_{24.5}$, $N = 20$), orthopyroxene ($\text{Fs}_{20.8}\text{En}_{78.0}\text{Wo}_{1.2}$).

Classification: Ordinary chondrite (L-melt rock).

Specimens: A total of 14.62 g of sample, one polished thin section and a block are on deposit at *MSP* (*MSP* 5235). Castellano holds the main mass.

Northwest Africa 7801 (NWA 7801)

(Northwest Africa)

Purchased: Sep 2011

Classification: Carbonaceous chondrite (CK5)

Physical characteristics: A complete, desert-varnished stone was found. The fusion crust was eroded along contraction cracks and appears leathery.

Petrography: (A.E. Rubin, *UCLA*) Thin section contains 2-15 μm grains of pyrrhotite and magnetite. Average groundmass grain size is approximately 50 μm , plagioclase grains average 25 μm . Chondrules lack primary glass but are readily discernible.

Geochemistry: Olivine $\text{Fa}_{33.4\pm0.2}$ (n=14), Pyroxene $\text{Fs}_{9.6\pm1.6}$ and $\text{Wo}_{48.3\pm1.8}$ (n=12).

Classification: (A.E. Rubin, *UCLA*) Olivine and pyroxene homogeneity is consistent with type 4-6, plagioclase grain size is indicative of type 5.

Northwest Africa 7804 (NWA 7804)

(Northwest Africa)

Purchased: Sep 2011

Classification: Mesosiderite

History: Purchased from A. Bouragaa.

Physical characteristics: A mostly complete stone was found. Fusion crust is textured and black, broken surfaces are light green with exposed crystals up to 2 cm in diameter.

Petrography: (J. Utas and A.E. Rubin, *UCLA*) The sample is composed of approximately 35% metal by volume, with 5-10% accessory troilite. Silicate minerals consisted of pyroxene (75%) and anorthite (25%), with rare olivine (<1% vol). Some kamacite exhibits disseminated silica and rounded taenite grains. A few 20-60 μm grains of olivine were found petrographically.

Geochemistry: Mineral compositions and geochemistry: (J. Utas, *UCLA*) Anorthite:

$\text{An}_{89.7}\text{Ab}_{9.8}\text{Or}_{0.49}$ (n=7)

Northwest Africa 7810 (NWA 7810)

(Northwest Africa)

Purchased: Feb 2013

Classification: Carbonaceous chondrite (CV3)

Physical characteristics: Many weathering veins were observed throughout the stone; metal is nearly absent and has been replaced almost entirely by oxides. A few opaque-rich chondrules contain terrestrial oxides. Fine sulfide grains are present in the matrix and in a few chondrules. Weathering is equivalent to W4; the stone is moderately to heavily weathered. Fusion crust is patchy, but present on all sides.

Petrography: (A.E. Rubin, *UCLA*) A fine-grained, fluffy type-A CAI measuring $800 \times 910 \mu\text{m}$ was observed in the thin section. It contains 10-30 μm spinels. One particularly large amoeboid olivine inclusion present in thin section ($5 \times 3 \text{ mm}$), large for CV3. Several others 0.8 to 2 mm are present. Most chondrules are type I with igneous rims, average diameter $\sim 750 \mu\text{m}$.

Heterogeneity of olivine and polysynthetically twinned low-Ca clinopyroxene are indicative of an unequilibrated chondrite.

Northwest Africa 7967 (NWA 7967)

(Northwest Africa)

Purchased: 2006 Feb

Classification: HED achondrite (Eucrite, brecciated)

History: Purchased by Mike Silver in February 2006 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Matrix-poor breccia containing angular eucrite clasts with variable textures (subophitic, intersertal, variolitic). Minerals are calcic plagioclase, finely-exsolved pigeonite, silica polymorph, ilmenite, Ti-chromite, troilite and stained Ni-free metal.

Geochemistry: Orthopyroxene ($\text{Fs}_{63.3-64.0}\text{Wo}_{4.1-4.7}$, $\text{FeO/MnO} = 28-30$, $N = 3$), clinopyroxene ($\text{Fs}_{31.8-32.2}\text{Wo}_{41.0-39.8}$, $\text{FeO/MnO} = 30-33$, $N = 3$).

Classification: Eucrite (breccia).

Specimens: 17.9 g including one polished thin section at *ROM*; remainder with Mr. M. Silver.

Northwest Africa 7968 (NWA 7968)

(Northwest Africa)

Purchased: 2011 Sep

Classification: HED achondrite (Howardite)

History: Purchased by Dr. David Gregory in September 2011 from a dealer at the Denver Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia consisting mostly of shocked diogenitic clasts plus ~30 vol.% eucritic clasts (with fine intersertal to gabbroic textures) and some angular grains of olivine (with variable composition). Diogenite clasts consist predominantly of orthopyroxene (exhibiting marked undulose extinction and strong cataclasis) with accessory chromite. Eucritic clasts consist of exsolved pigeonite and calcic plagioclase (mostly converted to maskelynite, but some polycrystalline) with accessory silica polymorph, ilmenite, Ti-chromite and troilite.

Geochemistry: Diogenitic orthopyroxene ($\text{Fs}_{26.2-26.7}\text{Wo}_{2.8-2.9}$, $\text{FeO/MnO} = 30$, $N = 2$), eucritic orthopyroxene host ($\text{Fs}_{49.8}\text{Wo}_{4.3}$, $\text{FeO/MnO} = 32$), clinopyroxene exsolution lamella ($\text{Fs}_{20.6}\text{Wo}_{44.0}$, $\text{FeO/MnO} = 24$), orthopyroxene ($\text{Fs}_{42.7}\text{Wo}_{4.1}$; $\text{Fs}_{50.4}\text{Wo}_{1.8}$, $\text{FeO/MnO} = 30-31$), augite ($\text{Fs}_{28.6}\text{Wo}_{39.7}$, $\text{FeO/MnO} = 28$), olivine ($\text{Fa}_{36.6-48.1}$, $\text{FeO/MnO} = 50-52$, $N = 3$), plagioclase ($\text{An}_{84.7}\text{Or}_{0.6}$; $\text{An}_{78.4}\text{Or}_{1.3}$, $N = 2$).

Classification: Howardite (shocked).

Specimens: 11.55 g including one polished thin section and one polished mount at *ROM*; remainder with *Gregory*.

Northwest Africa 8050 (NWA 8050)

(Northwest Africa)

Purchased: 2013 Apr

Classification: Carbonaceous chondrite (CV3)

History: Purchased by A. Gren in April 2013 from a dealer in Tan Tan, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Irregularly shaped, granular chondrules (mean 1.4 ± 1.1 mm; some with multiple dust rims) and fairly abundant, fine grained ~3.2 mm CAI in a brown matrix.

Geochemistry: Olivine ($\text{Fa}_{1.2-45.9}$, $N = 3$), orthopyroxene ($\text{Fs}_{0.7}\text{Wo}_{1.0}$, $N = 2$), pigeonite ($\text{Fs}_{1.0}\text{Wo}_{6.2}$), augite ($\text{Fs}_{0.5}\text{Wo}_{40.6}$), ferroan diopside ($\text{Fs}_{47.8}\text{Wo}_{51.3}$).

Classification: Carbonaceous chondrite (CV3).

Specimens: 38.7 g including one polished thin section at *UWB*. The remaining material is held by *Gren*.

Northwest Africa 8053 (NWA 8053)

(Northwest Africa)

Purchased: 2013 Apr

Classification: Carbonaceous chondrite (CV3)

History: Purchased by A. Gren in April 2013 from a dealer in Sidi Ifni, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Irregularly shaped, granular chondrules (mean 1.5 ± 1.0 mm; some with multiple dust rims) and sparse, fine grained 2.8 mm CAI in a brown matrix.

Geochemistry: Olivine ($\text{Fa}_{0.3-53.0}$, $N = 3$), orthopyroxene ($\text{Fs}_{0.7-1.5}\text{Wo}_{5.0-1.3}$, $N = 3$), subcalcic augite ($\text{Fs}_{1.1-2.0}\text{Wo}_{36.4-39.3}$), diopside ($\text{Fs}_{0.6}\text{Wo}_{46.4}$).

Classification: Carbonaceous chondrite (CV3).

Specimens: 39.4 g including one polished thin section at *UWB*. The remaining material is held by *Gren*.

Northwest Africa 8059 (NWA 8059)

(Northwest Africa)

Purchased: 2013 Sep

Classification: Ordinary chondrite (LL3.05)

History: Purchased by Gary Fujihara in September 2013 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, mostly medium-sized chondrules in a much finer grained matrix. Chondrules contain interstitial regions composed of glass plus very small, indeterminate quench-textured microlites.

Geochemistry: Olivine ($\text{Fa}_{0.4-39.4}$, $N = 24$; Cr_2O_3 in ferroan olivine = 0.13-0.69 wt.%, mean 0.43 ± 0.14 wt.%, $N = 22$), orthopyroxene ($\text{Fs}_{1.1-42.8}\text{Wo}_{1.1-0.9}$, $N = 3$), pigeonite ($\text{Fs}_{13.2}\text{Wo}_{19.2}$), subcalcic augite ($\text{Fs}_{10.4}\text{Wo}_{27.9}$). Oxygen isotopes (K. Ziegler, *UNM*): analyses by laser fluorination of acid-washed subsamples gave, respectively $\delta^{17}\text{O}$ 2.688, 2.228, 2.349, 2.915; $\delta^{18}\text{O}$ 5.277, 4.702, 3.273, 4.361; $\Delta^{17}\text{O}$ -0.098, -0.255, 0.621, 0.612 per mil (for a TFL slope of 0.528). Magnetic susceptibility is $\log \chi = 3.80$ (χ in $10^{-9} \text{ m}^3/\text{kg}$)

Classification: Ordinary chondrite (LL3.05). Magnetic susceptibility indicates LL. Estimation of subtype based on Cr_2O_3 distribution in ferroan olivine per Fig. 15a of [Grossman and Brearley \(2005\)](#).

Specimens: 11.0 g including one polished thin section at *UWB*. The remainder is held by G. Fujihara.

Northwest Africa 8060 (NWA 8060)

(Northwest Africa)

Purchased: 2013 Sep

Classification: Carbonaceous chondrite (CM2)

History: Purchased by G. Fujihara in September 2013 from a Moroccan dealer at the Denver Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Small (0.6 ± 0.3 mm), separated chondrules, mineral fragments and rare amoeboid CAI are set in a very fine-grained, dark brown matrix containing cronstedtite-tochilinite, kamacite, pentlandite and anorthite. Some chondrules have concentric dust rims and some CAI contain diopside + spinel.

Geochemistry: Olivine ($\text{Fa}_{0.6-62.8}$, $N = 3$), orthopyroxene ($\text{Fs}_{1.1-1.7}\text{Wo}_{1.2-3.3}$, $N = 3$), subcalcic augite ($\text{Fs}_{2.4-4.2}\text{Wo}_{32.2-38.8}$).

Classification: Carbonaceous chondrite (CM2).

Specimens: 11 g including one polished thin section at *UWB*. The remaining material is held by G. Fujihara.

Northwest Africa 8073 (NWA 8073)

(Northwest Africa)

Purchased: 2012 Jun 30

Classification: Ordinary chondrite (H3)

Petrography: The overall brownish rock is composed of small, well defined chondrules (mean diameter about 0.3 mm) set into a more fine-grained brownish to reddish matrix. FeNi metal is fairly abundant although often altered to Fe-oxides.

Northwest Africa 8086 (NWA 8086)

(Northwest Africa)

Purchased: 2012 Jun 30

Classification: HED achondrite (Eucrite, polymict)

Physical characteristics: The small individual is partly covered with fusion crust and displays a bright interior.

Petrography: (A. Greshake, *MNB*) The meteorite consists of basaltic and less abundant dark melt clasts set into a fine-grained clastic groundmass. Minor phases are SiO₂ polymorphs, chromite, and pyrrhotite.

Geochemistry: low-Ca pyroxene: Fs_{56.4-60.8}Wo_{1.8-6.1}; FeO/MnO=29-33; augite: Fs_{25-27.5}Wo_{42.2-44.6}; FeO/MnO=28-33; calcic plagioclase: An_{84.2-89.3}

Northwest Africa 8087 (NWA 8087)

(Northwest Africa)

Purchased: 2012 Jun 30

Classification: HED achondrite (Diogenite)

Physical characteristics: Many small individuals partially covered with fusion crust were found.

Petrography: (A. Greshake, *MNB*) The meteorite shows a light gray interior and displays a cumulate texture of dominantly large orthopyroxene crystals with less abundant calcic plagioclase. Accessory minerals include chromite and troilite.

Geochemistry: Low-Ca pyroxene: Fs_{26.9-27.5}Wo_{2.8-3.5}, FeO/MnO=26.3-29.8, calcic plagioclase: An_{90.3-93}

Northwest Africa 8089 (NWA 8089)

(Northwest Africa)

Purchased: 2013 July

Classification: Carbonaceous chondrite (CM2)

Petrography: (A. Greshake, *MNB*) The small almost black stones are composed of small (about 0.3 mm in diameter) chondrules and rare CAIs set into a dark matrix of mainly phyllosilicates. Matrix dominates over chondrules, CAIs, and rare Fe,Ni-metal grains and most chondrules and CAIs are surrounded by fine-grained accretionary rims.

Northwest Africa 8091 (NWA 8091)

(Northwest Africa)

Purchased: 2013 July

Classification: Ureilite

Petrography: (A. Greshake, *MNB*) The meteorite shows a characteristic cumulate texture of up to 2-mm sized blocky olivine, orthopyroxene, and rare augite grains. Olivine shows characteristic reduced rims. Carbon is present as graphite.

Geochemistry: Reduced rims in olivine: $\text{Fa}_{6.3-9.1}$; low-Ca pyroxene: $\text{Fs}_{10.6}\text{Wo}_{4.6}$; augite: $\text{Fs}_{6.5}\text{Wo}_{36.7}$

Northwest Africa 8092 (NWA 8092)

(Northwest Africa)

Purchased: 2013 July

Classification: HED achondrite (Howardite)

Petrography: (A. Greshake, *MNB*) The small grayish colored individuals contain abundant diagenetic and less abundant coarse-grained basaltic eucrite clasts set into a fine-grained clastic matrix. Some dark melt clasts were encountered. Basaltic eucrite clasts are composed of exsolved pyroxene and calcic plagioclase. Accessory minerals include silica polymorphs, pyrrhotite, and chromite.

Geochemistry: Low-Ca pyroxene: $\text{Fs}_{20.7-56.7}\text{Wo}_{1.7-5.8}$; $\text{FeO/MnO}=24-32$; augite: $\text{Fs}_{23-29.2}\text{Wo}_{39.6-41.7}$; $\text{FeO/MnO}=27-32$; calcic plagioclase: $\text{An}_{68-87.7}$

Northwest Africa 8093 (NWA 8093)

(Northwest Africa)

Purchased: 2013

Classification: HED achondrite (Diogenite)

Petrography: (A. Greshake, *MNB*) The small grayish individuals are partly covered with black fusion crust and display a light gray interior. The meteorite displays a cumulate texture of predominantly large heavily fractured orthopyroxene crystals. Accessory minerals include chromite and troilite.

Geochemistry: Low-Ca pyroxene: $\text{Fs}_{15.9-16.4}\text{Wo}_{1.3}$; $\text{FeO/MnO} = 28.4-33.4$

Northwest Africa 8096 (NWA 8096)

(Northwest Africa)

Purchased: 2013

Classification: Carbonaceous chondrite (CK6)

Petrography: (A. Greshake, *MNB*) The meteorite displays a thorough recrystallized texture with only few chondrule fragments discernible. Fe-rich olivine is the most abundant mineral phase. Less abundant are low-Ca pyroxene, augite and plagioclase. Opaque phase include Cr-bearing magnetite and pyrrhotite; metal is virtually absent.

Geochemistry: plagioclase: $\text{An}_{56.8}\text{Ab}_{41.9}$

Northwest Africa 8107 (NWA 8107)

(Northwest Africa)

Purchased: 2013

Classification: HED achondrite (Diogenite)

Petrography: (A. Greshake, *MNB*) The very small grey individuals lack any fusion crust and display a cumulate texture of dominantly large orthopyroxene crystals, less abundant calcic plagioclase, and rare Ca-rich pyroxene. Opaque phases include chromite and troilite.

Geochemistry: Ca-poor pyroxene: $\text{Fs}_{22.9-46.4}\text{Wo}_{1.4-9.8}$; $\text{FeO/MnO}=27-34$; augite: $\text{Fs}_{17.1-21.5}\text{Wo}_{37.4-43.2}$; $\text{FeO/MnO}=23-28$; calcic plagioclase: $\text{An}_{91-93.1}$

Northwest Africa 8123 (NWA 8123)

(Northwest Africa)

Purchased: 2013 Feb

Classification: H(L)3.1

History: Purchased by Sergey Vasiliev and Marc Jost in February 2013 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed glass-bearing chondrules are set in a heavily stained, metal-bearing matrix.

Geochemistry: Olivine ($\text{Fa}_{0.3-97.1}$, $N = 14$; Cr_2O_3 in ferroan examples is 0.12-0.65 wt.%, mean 0.32 ± 0.25 wt.%, $N = 12$), orthopyroxene ($\text{Fs}_{2.0-12.7}\text{Wo}_{0.5-3.8}$, $N = 3$), subcalcic augite ($\text{Fs}_{4.7-24.0}\text{Wo}_{35.4-32.8}$). Oxygen isotopes (K. Ziegler, *UNM*): analyses by laser fluorination of acid-washed subsamples gave, respectively $\delta^{17}\text{O}$ 2.883, 2.644, 2.289; $\delta^{18}\text{O}$ 4.494, 3.478, 3.942; $\Delta^{17}\text{O}$ 0.510, 0.808, 0.208 per mil (for a TFL slope of 0.528). Magnetic susceptibility, $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.02$.

Classification: Ordinary chondrite H(L)3.1. The wide range in olivine compositions and the distribution of Cr_2O_3 in ferroan olivine establish this specimen as a highly unequilibrated ordinary chondrite of Type 3.1, based on the scheme of [Grossman and Brearley \(2005\)](#). The relatively small average chondrule size and oxygen isotopes appear to establish affinity with H chondrites (despite some scatter in results for acid-washed subsamples of this relatively weathered specimen), but magnetic susceptibility is too low.

Specimens: 24.7 g including one polished thin section at *UWB*. The remainder is held jointly by Mr. S. Vasiliev and Mr. M. Jost.

Northwest Africa 8124 (NWA 8124)

(Northwest Africa)

Purchased: 2013 Apr

Classification: Ordinary chondrite (LL3)

History: Purchased by Sergey Vasiliev and Marc Jost in April 2013 from a dealer in Laayoune, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Large, well-formed, very closely packed chondrules within a sparse, relatively metal-poor matrix. Minerals are olivine, orthopyroxene, pigeonite, subcalcic augite, sodic plagioclase, chromite, altered kamacite and troilite.

Geochemistry: Olivine ($\text{Fa}_{0.6-43.6}$, $N = 8$; Cr_2O_3 in ferroan examples is 0.08-0.13 wt.%, mean 0.10 ± 0.02 wt.%, $N = 6$), orthopyroxene ($\text{Fs}_{2.3-8.1}\text{Wo}_{0.2-0.6}$, $N = 3$), pigeonite ($\text{Fs}_{29.0}\text{Wo}_{14.6}$), subcalcic augite ($\text{Fs}_{42.3}\text{Wo}_{27.0}$). Oxygen isotopes (K. Ziegler, *UNM*): analyses by laser fluorination of acid-washed subsamples gave, respectively $\delta^{17}\text{O}$ 3.326, 2.568, 3.348, 3.292; $\delta^{18}\text{O}$ 5.242, 4.718, 5.190, 5.470; $\Delta^{17}\text{O}$ -0.558, 0.077, 0.608, 0.404 per mil (for a TFL slope of 0.528). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.80$.

Classification: Ordinary chondrite (LL3). Chondrule sizes and metal content (magnetic susceptibility) are consistent with LL.

Specimens: 24.6 g including one polished thin section at *UWB*. The remainder is held jointly by S. Vasiliev and M. Jost.

Northwest Africa 8126 (NWA 8126)

(Northwest Africa)

Purchased: 2013 Feb

Classification: Carbonaceous chondrite (CO3)

History: Purchased by S. Vasiliev and M. Jost in February 2013 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Small chondrules, mineral fragments and CAI are present in a dark brown, anhydrous matrix. Minerals are olivine, orthopyroxene, pigeonite, subcalcic augite, troilite and rare taenite. One small aggregate of djerfisherite grains was found.

Geochemistry: Olivine (Fa_{0.9-57.3}; Cr₂O₃ in ferroan examples is 0.19-0.43 wt.%, mean 0.30 wt.%, s.d. 0.10 wt.%, N = 9), orthopyroxene (Fs_{1.1-15.7}Wo_{0.9-3.2}, N = 3), pigeonite (Fs_{15.9}Wo_{10.3}), subcalcic augite (Fs_{0.9-25.3}Wo_{39.9-36.8}).

Classification: Carbonaceous chondrite (CO3).

Specimens: 10.5 g including one polished thin section at *UWB*. The remaining material is held jointly by S. Vasiliev and M. Jost.

Northwest Africa 8128 (NWA 8128)

(Northwest Africa)

Purchased: 2013 Sep

Classification: Ordinary chondrite (L4)

History: Purchased by Sergey Vasiliev in September 2013 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well formed, closely packed, medium sized (1.5±0.7 mm) chondrules.

Geochemistry: Olivine (Fa_{25.3-25.5}, N = 3), orthopyroxene (Fs_{20.8-20.9}Wo_{1.7-1.4}, N = 2), clinopyroxene (Fs_{7.2-7.4}Wo_{45.86-44.6}, N = 2).

Classification: Ordinary chondrite (L4)

Specimens: 25.9 g including one polished thin section at *UWB*. The remainder is held by Mr. S. Vasiliev.

Northwest Africa 8130 (NWA 8130)

(Northwest Africa)

Purchased: 2013 Sep

Classification: Ordinary chondrite (H4)

History: Purchased by Sergey Vasiliev in September 2013 from a dealer in Midelt, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well formed, closely packed chondrules in a sparse matrix rich in stained metal.

Geochemistry: Olivine (Fa_{15.0-15.3}, N = 3), orthopyroxene (Fs_{13.3-14.8}Wo_{0.4-0.6}, N = 2), subcalcic augite (Fs_{10.8}Wo_{35.5}; Fs_{14.1}Wo_{27.1}; N = 2).

Classification: Ordinary chondrite (H4)

Specimens: 25.3 g including one polished thin section at *UWB*. The remainder is held by Mr. S. Vasiliev.

Northwest Africa 8131 (NWA 8131)

(Northwest Africa)

Purchased: 2013 Sep

Classification: Carbonaceous chondrite (CO3)

History: Purchased by S. Vasiliev in September 2013 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fairly abundant, small chondrules together with mineral fragments and fine-grained CAI occur in a brown, fine-grained matrix. Minerals are olivine, orthopyroxene, clinopyroxene, Ni-poor kamacite, rare kirschsteinite and minor barite. No sulfides were detected.

Geochemistry: Olivine ($\text{Fa}_{0.8-75.5}$; Cr_2O_3 in ferroan examples is 0.14-0.29 wt.%, mean 0.17 wt.%, s.d. 0.06 wt.%, $N = 9$), orthopyroxene ($\text{Fs}_{0.9-39.0}\text{Wo}_{1.0-0.9}$, $N = 3$), clinopyroxene ($\text{Fs}_{0.9}\text{Wo}_{41.8}$).

Classification: Carbonaceous chondrite (CO3).

Specimens: 8.4 g including one polished thin section at *UWB*. The remaining material is held by S. Vasiliev.

Northwest Africa 8165 (NWA 8165)

Mauritania

Find: 2012

Classification: Ordinary chondrite (LL6)

History: Discovered by local people in the NW area of Mauritania in 2012, purchased in Nouadhibou in 2012 Oct.

Physical characteristics: (R. Bartoschewitz, *Bart*) One fragment of 125 g covered about 75% by dark-brown fusion curst with contraction cracks. Saw-cut shows brecciation of darker fragments in light brown matrix and few metallic spots. Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.36$.

Petrography: (R. Bartoschewitz, *Bart*) Microprobe examination of a thin section shows fine recrystallized matrix of olivine, pyroxene, feldspar, and poor developed barred olivine and granular chondrules and chondrule fragments.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{30.9 \pm 0.5}$ ($\text{Fa}_{29.9-31.8}$; $n=21$). Pyroxene: $\text{Fs}_{25.1}\text{Wo}_{2.0}$ ($\text{Fs}_{24.7-26.1}$, $n=12$). Feldspar: $\text{An}_{9-11}\text{Or}_{3-7}$ ($n=8$). Kamacite: $\text{Ni}=3.7$, $\text{Co}=9.0$ wt.% ($n=2$).

Classification: Ordinary chondrite (LL6)

Specimens: 20.3 g on deposit at *Kiel*, main mass *Bart*.

Northwest Africa 8166 (NWA 8166)

Mauritania

Find: 2012

Classification: Ordinary chondrite (L6)

History: Discovered by local people in the NW area of Mauritania in 2012, purchased in Nouadhibou in 2012 Oct.

Physical characteristics: (R. Bartoschewitz, *Bart*) One piece of 225 g completely covered with dark brown fusion curst. Saw-cut shows gray-brown matrix with light brown chondrules and metallic spots. Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.71$.

Petrography: (R. Bartoschewitz, *Bart*) Microprobe examination of a thin section shows recrystallized matrix of olivine, pyroxene, feldspar, and poor developed barred olivine and granular chondrules.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{24.8 \pm 0.3}$ ($\text{Fa}_{24.3-25.3}$; $n=15$). Ca-poor pyroxene: $\text{Fs}_{20.7-21.5}\text{Wo}_{1.6}$ ($n=11$); Ca-rich pyroxene: $\text{En}_{48}\text{Wo}_{44}$ ($n=1$). Feldspar: $\text{An}_{10-11}\text{Or}_{4-7}$ ($n=9$). Kamacite: $\text{Ni}=3.7-6.4$, $\text{Co}=0.9-1.2$ wt.% ($n=5$).

Classification: Ordinary chondrite (L6)

Specimens: 20.5 g on deposit at *Kiel*, main mass *Bart*.

Northwest Africa 8167 (NWA 8167)

Mauritania

Find: 2012

Classification: Ureilite

History: Discovered by local people in the NW area of Mauritania in 2012, purchased in Nouadhibou in 2012 Oct.

Physical characteristics: (R. Bartoschewitz, *Bart*) One brown fragment of 435 g. Saw-cut shows brown close packed grains and tiny lustrous needles. Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.59$.

Petrography: (R. Bartoschewitz, *Bart*) Microprobe examination of a thin section shows olivine and pyroxene crystallites with triple junctions, grain size 0.4-2 mm. Grain boundaries occupied with graphite and metal.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{17.5 \pm 4.8}$ ($\text{Fa}_{5.7-22.3}$; $\text{Cr}_2\text{O}_3=0.6-0.8$ wt.%; $\text{Fe}/\text{Mn}=35$, $n=21$). Pyroxene: $\text{Fs}_{14-18}\text{Wo}_5$ ($n=14$). Kamacite: $\text{Ni}=3.9$, $\text{Co}=0.5$, $\text{Si}<0.02$ wt.% ($n=4$).

Classification: Ureilite

Specimens: 20.1 g on deposit at *Kiel*, main mass *SBuhl*.

Northwest Africa 8168 (NWA 8168)

Mauritania

Find: 2012

Classification: Ureilite

History: Discovered by local people in the NW area of Mauritania in 2012, purchased in Nouadhibou in 2012 Oct.

Physical characteristics: (R. Bartoschewitz, *Bart*) One brown fragment of 1200 g. Saw cut shows brown close packed grains. Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.48$.

Petrography: (R. Bartoschewitz, *Bart*) Microprobe examination of a thin section shows olivine and pyroxene grains with triple junctions, grain size 0.5-6 mm. Grain boundaries occupied with graphite and metal. Graphite occurs as elongated areas up to 2×7 mm.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine: $\text{Fa}_{21.0 \pm 2.0}$ ($\text{Fa}_{14.7-22.1}$; $\text{Cr}_2\text{O}_3=0.6-0.7$ wt.%; $\text{Fe}/\text{Mn}=44$, $n=15$). Ca-poor pyroxene: $\text{Fs}_{7.0}$ ($n=1$). Ca-rich pyroxene: $\text{Fs}_{15}\text{En}_{72}\text{Wo}_{13}$ ($n=26$). Kamacite: $\text{Ni}=5.0$, $\text{Co}=0.35$, $\text{Si}<0.3$ wt.% ($n=6$).

Classification: Ureilite

Specimens: 21.9 g on deposit at *Kiel*, main mass *Bart*.

Northwest Africa 8194 (NWA 8194)

(Northwest Africa)

Purchased: 10/2010

Classification: HED achondrite (Eucrite, polymict)

Petrography: The rock displays a light grayish interior and is composed of up to several mm-sized basaltic, melt, and mineral clasts set into a fine-grained clastic matrix. Mineral clasts and dominant matrix minerals are calcic plagioclase and pyroxenes with exsolution lamellae. Accessory phases include chromite, SiO₂ polymorphs, and troilite. Diagenetic component is about 5%.

Geochemistry: Low-Ca pyroxene: $\text{Fs}_{47.3\pm 9}\text{Wo}_{5.5\pm 2.1}$ ($\text{Fs}_{32.7-57.5}\text{Wo}_{2.6-8.7}$, $n=21$, $\text{FeO/MnO}=26-32$); Ca-pyroxene: $\text{Fs}_{21.4\pm 0.2}\text{Wo}_{43.5\pm 0.3}$ ($\text{Fs}_{21.1-21.7}\text{Wo}_{42.9-43.8}$, $n=10$, $\text{FeO/MnO}=27-30$); calcic plagioclase: $\text{An}_{91.5\pm 2.3}$ ($\text{An}_{88.4-93.9}$, $n=14$)

Northwest Africa 8195 (NWA 8195)

(Northwest Africa)

Purchased: 10/2011

Classification: HED achondrite (Eucrite, polymict)

Physical characteristics: The meteorite is partly covered with black fusion crust and shows a light grayish interior.

Petrography: It displays a typical basaltic texture of lath-shaped plagioclase and exsolved pyroxene. Lithic clasts of differently textured basaltic lithologies and dark melt clast are rarely encountered. Chromite, SiO₂ polymorphs, and FeNi metal constitute minor phases.

Geochemistry: Low-Ca pyroxene: $\text{Fs}_{60.6\pm 0.5}\text{Wo}_{2.3\pm 0.3}$ ($\text{Fs}_{59.5-61.6}\text{Wo}_{1.8-2.9}$, $n=12$, $\text{FeO/MnO}=27-30$); Ca-pyroxene: $\text{Fs}_{25.8\pm 0.5}\text{Wo}_{43.8\pm 0.5}$ ($\text{Fs}_{25.1-26.8}\text{Wo}_{42.8-44.5}$, $n=11$, $\text{FeO/MnO}=29-34$); calcic plagioclase: $\text{An}_{88.7\pm 1.5}$ ($\text{An}_{84.7-90.2}$, $n=13$)

Northwest Africa 8198 (NWA 8198)

(Northwest Africa)

Purchased: 04/2013

Classification: HED achondrite (Eucrite, polymict)

Physical characteristics: The single fragment is partly covered with shiny fusion crust and displays a light-grayish interior.

Petrography: It is composed of mineral and lithic clasts including basaltic and melt lithologies set into a more fine-grained clastic matrix. Mineral fragments are large mostly exsolved pyroxenes and calcic plagioclase. Minor phases include chromite, troilite, and SiO₂ polymorphs.

Geochemistry: Low-Ca pyroxene: $\text{Fs}_{57.3\pm 2.1}\text{Wo}_{4.8\pm 2.5}$ ($\text{Fs}_{53.3-59.7}\text{Wo}_{1.7-9.5}$, $n=13$, $\text{FeO/MnO}=30-32$); Ca-pyroxene: $\text{Fs}_{26.6\pm 1.1}\text{Wo}_{43.3\pm 1.3}$ ($\text{Fs}_{25-29.4}\text{Wo}_{39.8-44.6}$, $n=13$, $\text{FeO/MnO}=28-33$); calcic plagioclase: $\text{An}_{88.8\pm 0.6}$ ($\text{An}_{88-90.5}$, $n=14$)

Northwest Africa 8217 (NWA 8217)

(Northwest Africa)

Purchased: 2013 Dec

Classification: Ordinary chondrite (L5)

History: Purchased by Adam Aaronson in Temara, Morocco in December 2013.

Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse, medium-sized chondrules (ellipsoidal and stained brown).

Geochemistry: Olivine ($\text{Fa}_{25.1-25.4}$, $N = 3$), orthopyroxene ($\text{Fs}_{20.2-21.0}\text{Wo}_{1.4-1.3}$, $N = 2$), augite ($\text{Fs}_{7.9-10.4}\text{Wo}_{44.7-43.3}$, $N = 2$).

Classification: Ordinary chondrite (L5).

Specimens: 23.6 g including one polished thin section at *UWB*. The remainder is held by *Aaronson*.

Northwest Africa 8218 (NWA 8218)

(Northwest Africa)

Purchased: 2013 Dec

Classification: Carbonaceous chondrite (CK4)

History: Purchased in Temara, Morocco by A. Aaronson in December 2013.

Petrography: (A. Irving and S. Kuehner, *UWS*) Unaltered specimen composed of separated, granular chondrules (mean 1.4 ± 0.6 mm; containing abundant magnetite) in a recrystallized matrix. Minerals are olivine, orthopyroxene, subcalcic augite, augite, intermediate plagioclase, Cr-bearing magnetite, Ti-Cr-Al-bearing spinel, pentlandite and Co-Ni-Fe sulfide (some in intergrowths with ferroan olivine and magnetite).

Geochemistry: Olivine ($\text{Fa}_{32.2-32.7}$, $\text{FeO/MnO} = 108-116$, $N = 3$), orthopyroxene ($\text{Fs}_{26.4}\text{Wo}_{0.7}$, $N = 3$), subcalcic augite ($\text{Fs}_{17.6}\text{Wo}_{23.8}$), augite ($\text{Fs}_{10.6-12.3}\text{Wo}_{48.0-45.8}$).

Classification: Carbonaceous chondrite (CK4).

Specimens: 13.6 g including one polished thin section at *UWB*. The remaining material is held by *Aaronson*.

Northwest Africa 8220 (NWA 8220)

(Northwest Africa)

Purchased: 2013 Dec

Classification: Ordinary chondrite (H6)

History: Purchased by Adam Aaronson in Temara, Morocco in December 2013.

Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare small chondrule remnants; the specimen is crosscut by subparallel veinlets of goethite.

Geochemistry: Olivine ($\text{Fa}_{19.9-20.0}$, $N = 3$), orthopyroxene ($\text{Fs}_{17.0-17.2}\text{Wo}_{1.6-1.4}$, $N = 2$), augite ($\text{Fs}_{6.5-7.5}\text{Wo}_{44.2-44.8}$, $N = 2$).

Classification: Ordinary chondrite (H6).

Specimens: 20.1 g including one polished thin section at *UWB*. The remainder is held by *Aaronson*.

Northwest Africa 8221 (NWA 8221)

(Northwest Africa)

Purchased: 2013 Nov

Classification: Carbonaceous chondrite (CK5)

History: Purchased by Marcin Cimala and Lukasz Smula in November 2013 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Very fresh specimen composed of sparse, separated, medium-sized, granular chondrules (containing abundant magnetite) in a pale brown matrix. Minerals are olivine, clinopyroxene, intermediate plagioclase, Cr-bearing magnetite and pentlandite.

Geochemistry: Olivine ($\text{Fa}_{33.5-34.6}$; $\text{FeO/MnO} = 123-142$, $N = 3$), clinopyroxene ($\text{Fs}_{11.1-12.9}\text{Wo}_{43.9-47.4}$; $\text{FeO/MnO} = 53-120$, $N = 3$).

Classification: Carbonaceous chondrite (CK5).

Specimens: 22 g including one polished thin section at *UWB*. The remaining material is held jointly by Mr. M. Cimala, Mr. L. Smula and Ms. M. Skirzewska.

Northwest Africa 8223 (NWA 8223)

(Northwest Africa)

Purchased: 2013 Dec

Classification: Carbonaceous chondrite (CO3)

History: Purchased in Temara, Morocco by Adam Aaronson in December 2013.

Petrography: (A. Irving and S. Kuehner, *UWS*) Small, separated chondrules and sparse fine-grained CAI occur in a pale brown, fine-grained matrix.

Geochemistry: Olivine ($\text{Fa}_{0.2-36.1}$, $N = 3$), orthopyroxene ($\text{Fs}_{0.7-2.2}\text{Wo}_{4.5-5.2}$, $N = 3$), diopside ($\text{Fs}_{0.9}\text{Wo}_{42.3}$).

Classification: Carbonaceous chondrite (CO3).

Specimens: 7.3 g including one polished thin section at *UWB*. The remaining material is held by Aaronson.

Northwest Africa 8225 (NWA 8225)

(Northwest Africa)

Purchased: 2013-Dec

Classification: Ordinary chondrite (H4)

History: Purchased by Adam Aaronson in Temara, Morocco in December 2013.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well developed, relatively small chondrules in a matrix rich in stained metal.

Geochemistry: Olivine ($\text{Fa}_{18.2-18.3}$, $N = 3$), orthopyroxene ($\text{Fs}_{15.6-15.9}\text{Wo}_{1.3-1.2}$, $N = 2$), augite ($\text{Fs}_{5.2-5.6}\text{Wo}_{45.7-44.3}$, $N = 2$).

Classification: Ordinary chondrite (H4).

Specimens: 20.1 g including one polished thin section at *UWB*. The remainder is held by Aaronson.

Northwest Africa 8227 (NWA 8227)

(Northwest Africa)

Purchased: 2013 Dec

Classification: Ordinary chondrite (H4)

History: Purchased by Adam Aaronson in Temara, Morocco, in December 2013.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-developed chondrules in a matrix rich in stained metal. Most chondrules are relatively small, but some have diameters up to 3 mm.

Geochemistry: Olivine ($\text{Fa}_{19.4-19.5}$, $N = 3$), orthopyroxene ($\text{Fs}_{17.1-17.4}\text{Wo}_{0.9-1.0}$, $N = 2$), augite ($\text{Fs}_{5.3-6.5}\text{Wo}_{47.1-46.3}$, $N = 2$).

Classification: Ordinary chondrite (H4).

Specimens: 20.1 g including one polished thin section at *UWB*. The remainder is held by Aaronson.

Northwest Africa 8228 (NWA 8228)

(Northwest Africa)

Purchased: 2013 Dec

Classification: Carbonaceous chondrite (CM2)

History: Purchased by Adam Aaronson in Temara, Morocco in February 2014, and subsequently acquired by the Field Museum of Natural History.

Physical characteristics: Exceptionally fresh, very fine-grained black specimen (45 g) found as a group of five fragments.

Petrography: (M. Zolensky, *JSC*; A. Irving and S. Kuehner, *UWS*) Abundant matrix-supported chondrules (up to 1 mm across) and sparse angular olivine grains occur in an opaque matrix. The chondrules have thick fine-grained rims, and are very circular in thin section. Most chondrules have been partially to entirely pseudomorphed by serpentine, pyrrhotite, pentlandite, tochilinite, dolomite and Ca carbonate. Discrete olivine grains have thin serpentine rims. The matrix consists of serpentine with accessory pyrrhotite, pentlandite, dolomite and Ca carbonate.

Geochemistry: Olivine in chondrules (Fa_{1-2} , $\text{CaO} = 0.1\text{--}0.8$ wt.%, $N = 8$), discrete olivine grains ($\text{Fa}_{0.5-0.6}$, $N = 3$). Oxygen isotopes (K. Ziegler, *UNM*): analyses of five acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ -0.900, -1.715, -1.882, 3.087, 2.853; $\delta^{18}\text{O}$ 4.730, 3.136, 4.246, 9.209, 9.117; $\Delta^{17}\text{O}$ -3.397, -3.371, -4.124, -1.775, -1.961 per mil.

Classification: Carbonaceous chondrite (CM2)

Specimens: 9.1 g including one polished thin section at *UWB*; remainder at *FMNH*.

Northwest Africa 8252 (NWA 8252)

(Northwest Africa)

Purchased: 2013 Oct

Classification: Ordinary chondrite (LL5)

History: Purchased by Adam Aaronson in Temara, Morocco, in October 2013.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of distorted chondrule-bearing clasts plus sparse individual chondrules in an unusually black matrix.

Geochemistry: Olivine ($\text{Fa}_{28.0-28.8}$, $N = 3$), orthopyroxene ($\text{Fs}_{23.3}\text{Wo}_{1.5}$; some more magnesian cores $\text{Fs}_{8.1}\text{Wo}_{1.2}$), subcalcic augite ($\text{Fs}_{16.9}\text{Wo}_{29.5}$).

Classification: Ordinary chondrite (LL5 breccia).

Specimens: 11.0 g including one polished thin section at *UWB*. The remainder is held by Aaronson.

Northwest Africa 8253 (NWA 8253)

(Northwest Africa)

Purchased: 2013 Oct

Classification: Ordinary chondrite (L3)

History: Purchased by Adam Aaronson in Temara, Morocco in October 2013.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely-packed, well-formed, medium-sized (0.6-2.1 mm, mean 1.3 ± 0.5 mm) chondrules and relatively sparse altered metal. Minerals are olivine, orthopyroxene, augite, sodic plagioclase, altered kamacite, chromite, taenite and troilite.

Geochemistry: Olivine ($\text{Fa}_{2.9-39.9}$, $N = 9$; Cr_2O_3 in ferroan examples = 0.03-0.11 wt.%, mean 0.06 ± 0.03 wt.%, $N = 7$), orthopyroxene ($\text{Fs}_{3.0-19.2}\text{Wo}_{0.2-3.7}$, $N = 3$), augite ($\text{Fs}_{2.9-6.3}\text{Wo}_{41.4-38.9}$).

Classification: Ordinary chondrite L3. Estimation of subtype 3.5 based on histograms of Cr_2O_3 distribution in ferroan olivine given in Fig. 4 of [Grossman and Brearley \(2005\)](#).

Specimens: 13.7 g including one polished thin section at *UWB*. The remainder is held by Aaronson.

Northwest Africa 8255 (NWA 8255)

(Northwest Africa)

Purchased: 2013 Nov

Classification: Ordinary chondrite (H5)

History: Purchased by Zsolt Kereszty in November 2013 from a Moroccan dealer.

Physical characteristics: A single brown stone (1248 g) with weathered fusion crust on one side.

Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules and fairly abundant altered metal. Composed of olivine, orthopyroxene, clinopyroxene, sodic plagioclase, chromite, troilite and altered kamacite.

Geochemistry: Olivine ($\text{Fa}_{19.1-19.4}$), orthopyroxene ($\text{Fs}_{16.1-16.6}\text{Wo}_{0.6-0.5}$), clinopyroxene ($\text{Fs}_{7.1-8.8}\text{Wo}_{42.1-40.0}$).

Classification: Ordinary chondrite (H5).

Specimens: 41.8 g including one polished thin section at *BajaAO*. The main mass is held by Mr. Z. Kereszty.

Northwest Africa 8256 (NWA 8256)

(Northwest Africa)

Purchased: 2013

Classification: Ordinary chondrite (L5)

History: Purchased by Zsolt Kereszty in 2013 from a Moroccan dealer.

Physical characteristics: A single brown stone (816 g) lacking fusion crust.

Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules and a moderate amount of altered metal. Composed of olivine, orthopyroxene, sodic plagioclase, chromite, troilite and altered kamacite.

Geochemistry: Olivine ($\text{Fa}_{24.8-25.4}$), orthopyroxene ($\text{Fs}_{20.5-20.8}\text{Wo}_{1.2-1.7}$), clinopyroxene ($\text{Fs}_{7.3-7.4}\text{Wo}_{46.2-44.6}$).

Classification: Ordinary chondrite (L5).

Specimens: 44.1 g including one polished thin section at *BajaAO*. The main mass is held by Mr. Z. Kereszty.

Northwest Africa 8257 (NWA 8257)

(Northwest Africa)

Purchased: 2013 Dec

Classification: Ordinary chondrite (L3)

History: Purchased by Darryl Pitt in December 2013 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, well-formed, glass-bearing chondrules are set in a sparse finer grained matrix.

Geochemistry: Olivine ($\text{Fa}_{0.5-72.9}$; Cr_2O_3 in ferroan examples ranges from 0.06-0.52 wt.%, mean 0.18 ± 0.17 wt.%, $N = 13$), orthopyroxene ($\text{Fs}_{2.2-19.9}\text{Wo}_{0.3-4.9}$, $N = 3$), subcalcic augite ($\text{Fs}_{10.9}\text{Wo}_{35.9}$; $\text{Fs}_{22.3}\text{Wo}_{24.9}$). Oxygen isotopes (K. Ziegler, *UNM*): analyses of three acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ 2.950, 3.615, 3.246; $\delta^{18}\text{O}$ 4.356, 4.840, 4.723; $\Delta^{17}\text{O}$ 0.650, 1.059, 0.752 per mil.

Classification: Ordinary chondrite (L3). The wide range in Fa content in olivine coupled with the range of Cr content in ferroan olivine imply a very low subtype <3.2.

Specimens: 38 g including one polished thin section at *UWB*; the remainder is held by *DPitt*.

Northwest Africa 8258 (NWA 8258)

Northwest Africa

Purchased: 2013 Dec

Classification: Ordinary chondrite (L3)

History: Purchased by Darryl Pitt in December 2013 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Unequilibrated chondrite consisting of fairly closely-packed, round to ellipsoidal chondrules (apparent diameter 1.3 ± 0.9 mm, many rimmed by sulfide, some glass-bearing) in a sparse, black, very fine-grained matrix composed of indeterminate silicates, pentlandite, troilite, rare taenite and goethite. No kamacite was found. An unusual 2.7 cm round object (not a CAI) is an equigranular aggregate of monticellite, Al-Fe-Cr-Mg spinel, olivine, anorthite and troilite surrounded by a rim of more magnesian olivine.

Geochemistry: Olivine (Fa_{1.3-46.3}; Cr₂O₃ in ferroan examples is 0.10-0.22 wt.%, mean 0.16 ± 0.05 wt.%, N = 7), orthopyroxene (Fs_{2.0-23.8}Wo_{0.4-1.5}, N = 3), pigeonite (Fs_{18.7}Wo_{16.7}), subcalcic augite (Fs_{20.4}Wo_{37.6}), monticellite in inclusion (Fa_{28.9}Ln_{7.4}). Oxygen isotopes (K. Ziegler, *UNM*): analyses of three acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ 3.339, 4.005, 3.635; $\delta^{18}\text{O}$ 5.098, 5.582, 5.465; $\Delta^{17}\text{O}$ 0.647, 1.058, 0.749 per mil.

Classification: Ordinary chondrite (L3, anomalous).

Specimens: 24 g including one polished thin section at *UWB*; the remainder is held by *DPitt*.

Northwest Africa 8260 (NWA 8260)

(Northwest Africa)

Purchased: 2013 Dec

Classification: Ordinary chondrite (LL3)

History: Purchased by Sergey Vasiliev in December 2013 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, medium-sized (0.5-3 mm, mean 1.7 ± 1.0 mm) chondrules in a dark matrix containing altered metal. Minerals are olivine, orthopyroxene, subcalcic augite, sodic plagioclase, chromite, altered kamacite and troilite.

Geochemistry: Olivine (Fa_{2.2-50.4}, N = 9; Cr₂O₃ in ferroan examples is 0.06-0.15 wt.%, mean 0.09 ± 0.03 wt.%, N = 7), orthopyroxene (Fs_{0.8-15.7}Wo_{0.6-4.9}, N = 3), subcalcic augite (Fs_{6.8-12.1}Wo_{31.6-34.9}).

Classification: Ordinary chondrite LL3. Estimation of subtype 3.4 based on histograms of Cr₂O₃ distribution in ferroan olivine given in Fig. 4 of [Grossman and Brearley \(2005\)](#).

Specimens: 21 g including one polished thin section at *UWB*. The remainder is held by S. Vasiliev.

Northwest Africa 8262 (NWA 8262)

(Northwest Africa)

Purchased: 2014 Jan

Classification: Ordinary chondrite (L, melt breccia)

History: Purchased by Fabien Kuntz in January 2014 from a dealer in Tagounite, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrule-bearing L5 clasts in a predominant fine-grained matrix containing rounded metal and troilite blebs.

Geochemistry: Olivine (Fa_{24.1-24.8}, N = 3), orthopyroxene (Fs_{20.4-20.5}Wo_{1.6-1.3}, N = 3), clinopyroxene (Fs_{6.9-7.8}Wo_{45.5-44.8}).

Classification: Ordinary chondrite (L melt breccia).

Specimens: 20.7 g including one polished thick section at *UWB*. The remainder is held by *Kuntz*.

Northwest Africa 8263 (NWA 8263)

(Northwest Africa)

Purchased: 2014 Jan

Classification: Ordinary chondrite (L3)

History: Purchased by Fabien Kuntz in January 2014 from a dealer in Ouarzazate, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Relatively closely-packed, medium-sized (0.6-3 mm, mean 1.7 ± 0.9 mm), well-formed chondrules in a fine matrix. Minerals are olivine, orthopyroxene, pigeonite, subcalcic augite, augite, sodic plagioclase, chromite, troilite and altered kamacite.

Geochemistry: Olivine ($\text{Fa}_{5.6-38.6}$, $N = 8$; Cr_2O_3 in ferroan olivine = 0.05-0.11 wt.%, mean 0.07 ± 0.03 wt.%, $N = 6$), orthopyroxene ($\text{Fs}_{3.3-30.0}\text{Wo}_{0.2-2.1}$, $N = 3$), pigeonite ($\text{Fs}_{5.4}\text{Wo}_{7.8}$), subcalcic augite ($\text{Fs}_{23.7}\text{Wo}_{26.0}$), augite ($\text{Fs}_{5.9}\text{Wo}_{47.8}$).

Classification: Ordinary chondrite L3. Estimation of subtype L3.5 based on histograms of Cr_2O_3 distribution in ferroan olivine given in Fig. 4 of [Grossman and Brearley \(2005\)](#).

Specimens: 25.4 g including one polished thin section at *UWB*. The remainder is held by *Kuntz*.

Northwest Africa 8267 (NWA 8267)

(Northwest Africa)

Purchased: 2014 Jan

Classification: Carbonaceous chondrite (CM2)

History: Purchased by F. Kuntz in January 2014 from a dealer in Rissani, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Very small (0.4 ± 0.2 mm) chondrules, mineral fragments and sparse CAI in a deep brown, very fine grained matrix containing cronstedtite and pentlandite.

Geochemistry: Olivine ($\text{Fa}_{0.4-40.0}$, $N = 3$), orthopyroxene ($\text{Fs}_{0.8-0.9}\text{Wo}_{1.0-3.2}$, $N = 3$), clinopyroxene ($\text{Fs}_{1.2-3.7}\text{Wo}_{36.5-41.4}$).

Classification: Carbonaceous chondrite (CM2).

Specimens: 13.4 g including one polished thin section at *UWB*. The remaining material is held by *Kuntz*.

Northwest Africa 8303 (NWA 8303)

(Northwest Africa)

Purchased: 2013 Feb

Classification: Ordinary chondrite (L3)

History: Purchased by Marcin Cimala in February 2013 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely-packed, medium sized, well-formed chondrules (most 0.6-2.8 mm, some up to 4 mm, mean 1.8 ± 1.2 mm). Minerals are olivine, orthopyroxene, clinopyroxene, sodic plagioclase, altered kamacite, troilite and chromite.

Geochemistry: Olivine ($\text{Fa}_{3.9-32.7}$, $N = 10$; Cr_2O_3 content of ferroan olivine = 0.02 ± 0.02 wt.%, $N = 8$), orthopyroxene ($\text{Fs}_{2.5-8.7}\text{Wo}_{0.3-0.5}$, $N = 3$), clinopyroxene ($\text{Fs}_{3.3-5.2}\text{Wo}_{41.9-46.0}$)

Classification: Ordinary chondrite L3. Estimation of subtype 3.6 based on histograms of Cr_2O_3 distribution in ferroan olivine given in Fig. 4 of [Grossman and Brearley \(2005\)](#).

Specimens: 20.2 g including one polished thin section at *UWB*. The remainder is held by M. Cimala.

Northwest Africa 8305 (NWA 8305)

(Northwest Africa)

Purchased: 2013 Dec

Classification: Ordinary chondrite (L3)

History: Purchased by Marcin Cimala in December 2013 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely-packed, medium to large sized (0.6-3.3 mm), well-formed chondrules. Minerals are olivine, orthopyroxene, pigeonite, subcalcic augite, sodic plagioclase, troilite, chromite, chlorapatite and altered kamacite.

Geochemistry: Olivine ($\text{Fa}_{3.1-57.9}$, $N = 9$; Cr_2O_3 content of ferroan olivine = 0.02-0.12 wt.%, mean 0.07 ± 0.03 wt.%, $N = 7$), orthopyroxene ($\text{Fs}_{2.7-7.7}\text{Wo}_{0.8-0.9}$, $N = 3$), pigeonite ($\text{Fs}_{23.4}\text{Wo}_{12.3}$), subcalcic augite ($\text{Fs}_{5.6}\text{Wo}_{34.2}$). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.94$.

Classification: Ordinary chondrite L3. L group designation based on magnetic susceptibility.

Specimens: 20.3 g including one polished thin section at *UWB*. The remainder is held by M. Cimala.

Northwest Africa 8310 (NWA 8310)

(Northwest Africa)

Purchased: 2012 Jun

Classification: Ordinary chondrite (LL5-7)

History: Purchased in Brugg, Switzerland, in June 2012 by Marc Jost from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia consisting of angular clasts of predominantly LL7 material (completely recrystallized) with less amounts of chondrule-bearing type 5 and 6 lithologies. Minerals are olivine, orthopyroxene, subcalcic augite, augite, sodic plagioclase, chromite, troilite, chlorapatite and stained metal (composite grains of low-Ni kamacite and taenite).

Geochemistry: Olivine ($\text{Fa}_{30.6-31.3}$, $N = 3$), orthopyroxene ($\text{Fs}_{16.9-24.9}\text{Wo}_{1.8-1.9}$, $N = 3$), clinopyroxene ($\text{Fs}_{9.6-12.1}\text{Wo}_{43.2-37.6}$, $N = 2$).

Classification: Ordinary chondrite (LL5-7) breccia.

Specimens: 21.1 g including one polished thin section at *UWB*. The remaining material is held by Mr. M. Jost.

Northwest Africa 8312 (NWA 8312)

(Northwest Africa)

Purchased: 2014 Jan

Classification: Ordinary chondrite (L, melt breccia)

History: Purchased by *GHupé* in January 2014 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Unaltered specimen composed of sparse chondrule-bearing L5 clasts within a dominant very fine grain size black matrix of fine grained mafic silicates with accessory sodic plagioclase, chromite and dispersed blebs of kamacite and troilite.

Geochemistry: Olivine ($\text{Fa}_{23.9-24.3}$, $N = 3$), orthopyroxene ($\text{Fs}_{13.8}\text{Wo}_{2.0}$; $\text{Fs}_{20.5-20.8}\text{Wo}_{1.6-1.5}$, $N = 2$), subcalcic augite ($\text{Fs}_{16.3-17.3}\text{Wo}_{26.1-22.0}$).

Classification: Ordinary chondrite (L melt breccia).

Specimens: 22.4 g including one polished thick section at *UWB*. The remainder is held by *GHupé*.

Northwest Africa 8314 (NWA 8314)

(Northwest Africa)

Purchased: 2014 Jan

Classification: Carbonaceous chondrite (CO3)

History: Purchased by GHupé in February 2014 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Small chondrules accompanied by amoeboid CAI and mineral fragments are set in slightly brownish, fine grained matrix (comprising ~50 vol.% of the specimen).

Geochemistry: Olivine ($\text{Fa}_{0.4-56.6}$; Cr_2O_3 in ferroan olivine = 0.08-0.13 wt.%, one grain contains 0.46 wt.% Cr_2O_3 , mean 0.16 wt.%, s.d. 0.15, $N = 9$), orthopyroxene ($\text{Fs}_{1.3-1.4}\text{Wo}_{1.0-1.9}$, $N = 3$), subcalcic diopside ($\text{Fs}_{1.6}\text{Wo}_{33.0}$), diopside ($\text{Fs}_{1.1}\text{Wo}_{41.1}$).

Classification: Carbonaceous chondrite (CO3).

Specimens: 6.03 g including one polished thin section at *UWB*. The remaining material is held by *GHupé*.

Northwest Africa 8315 (NWA 8315)

(Northwest Africa)

Purchased: 2014 Jan

Classification: Carbonaceous chondrite (CK4)

History: Purchased by *GHupé* in February 2014 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Composed of separated, well-formed chondrules (mean 1.8 ± 1.0 mm) containing slightly stained Cr-magnetite in a finer matrix. Minerals are olivine, orthopyroxene, subcalcic diopside, subcalcic augite, augite, intermediate plagioclase, Cr-magnetite, ilmenite and minor altered kamacite.

Geochemistry: Olivine ($\text{Fa}_{32.8-33.5}$, $\text{FeO/MnO} = 108-127$, $N = 3$), orthopyroxene ($\text{Fs}_{27.0-28.2}\text{Wo}_{0.7-0.8}$, $N = 3$), subcalcic diopside ($\text{Fs}_{2.6}\text{Wo}_{32.8}$), subcalcic augite ($\text{Fs}_{12.7}\text{Wo}_{28.7}$), augite ($\text{Fs}_{13.5}\text{Wo}_{48.8}$).

Classification: Carbonaceous chondrite (CK4).

Specimens: 20.1 g including one polished thin section at *UWB*. The remaining material is held by *GHupé*.

Northwest Africa 8319 (NWA 8319)

(Northwest Africa)

Purchased: 2014 Feb

Classification: Carbonaceous chondrite (CK4)

History: Purchased by D. Pitt in February 2014 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Separated, well-formed, granular chondrules (mean 1.3 ± 0.6 mm) containing abundant Cr-bearing magnetite in a finer grained matrix. Magnetite is partly altered to reddish brown hydroxides.

Geochemistry: Olivine ($\text{Fa}_{31.1-31.3}$, $\text{FeO/MnO} = 101-102$, $N = 3$), orthopyroxene ($\text{Fs}_{26.1-27.3}\text{Wo}_{0.8-0.7}$, $N = 3$), pigeonite ($\text{Fs}_{24.9}\text{Wo}_{7.2}$), augite ($\text{Fs}_{9.3}\text{Wo}_{44.6}$).

Classification: Carbonaceous chondrite (CK4).

Specimens: 24 g including one polished thin section at *UWB*. The remaining material is held by *DPitt*.

Northwest Africa 8320 (NWA 8320)

(Northwest Africa)

Purchased: 2014 Feb

Classification: Carbonaceous chondrite (CV3)

History: Purchased by D. Pitt in February 2014 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Separated granular chondrules (mean 1.4 ± 1.1 mm) and white, amoeboid 3 mm CAI in an orange-brown oxidized matrix.

Geochemistry: Olivine ($\text{Fa}_{0.3-7.3}$, $N = 3$), orthopyroxene ($\text{Fs}_{0.9-4.5}\text{Wo}_{1.4-3.3}$, $N = 3$), Al-Ti diopside in CAI ($\text{Fs}_{0.6-0.9}\text{Wo}_{54.2-46.3}$; Al_2O_3 11.1-10.9 wt.%, TiO_2 0.7-0.9 wt.%).

Classification: Carbonaceous chondrite (CV3).

Specimens: 10.5 g including one polished thin section at *UWB*. The remaining material is held by *DPitt*.

Northwest Africa 8356 (NWA 8356)

(Northwest Africa)

Purchased: 2014 Feb

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Matthew Martin in February 2014 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Granular chondrules and irregularly shaped, fine- to medium-grained CAI are set in a very fine-grained, brown matrix.

Geochemistry: Olivine ($\text{Fa}_{0.5-40.2}$, $N = 3$), orthopyroxene ($\text{Fs}_{0.3-0.8}\text{Wo}_{1.0-0.9}$, $N = 3$), diopside ($\text{Fs}_{0.4-0.7}\text{Wo}_{44.6-42.7}$).

Classification: Carbonaceous chondrite (CV3).

Specimens: 23 g including one polished thin section at *UWB*. The remaining material is held by Mr. M. Martin.

Northwest Africa 8357 (NWA 8357)

(Northwest Africa)

Purchased: 2014 Feb

Classification: Ordinary chondrite (L3)

History: Purchased by Matthew Martin in February 2014 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, spheroidal chondrules (1.5 ± 0.8 mm) together with some angular, recrystallized clasts are set in a finer grained matrix.

Geochemistry: Olivine, $\text{Fa}_{3.2-34.1}$; Cr_2O_3 in ferroan olivine = 0.03-0.08 wt.%, mean 0.05 ± 0.02 wt.%, $N = 7$; orthopyroxene, $\text{Fs}_{1.6-20.8}\text{Wo}_{0.6-2.0}$, $N = 3$; subcalcic augite, $\text{Fs}_{4.1}\text{Wo}_{16.4}$; augite, $\text{Fs}_{8.0-8.2}\text{Wo}_{45.9-46.3}$.

Classification: Ordinary chondrite (L3).

Specimens: 21 g including one polished thin section at *UWB*. The remainder is held by Mr. M. Martin.

Northwest Africa 8358 (NWA 8358)

(Northwest Africa)

Purchased: 2014 Feb

Classification: Carbonaceous chondrite (CO3)

History: Purchased by Matthew Martin in February 2014 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Separated, small chondrules together with some crystal fragments and rare fine grained CAI are set in an orange fragmental matrix. Minerals are olivine, orthopyroxene, subcalcic augite, augite, Ti-bearing chromite, pyrrhotite, pentlandite and altered kamacite.

Geochemistry: Olivine ($\text{Fa}_{6.6-22.8}$, $N = 3$), orthopyroxene ($\text{Fs}_{1.2-29.8}\text{Wo}_{0.9-0.8}$, $N = 3$), subcalcic augite ($\text{Fs}_{16.3}\text{Wo}_{36.8}$), augite ($\text{Fs}_{10.6}\text{Wo}_{46.3}$).

Classification: Carbonaceous chondrite (CO3).

Specimens: 20.1 g including one polished thin section at *UWB*. The remaining material is held by Mr. M. Martin.

Northwest Africa 8359 (NWA 8359)

(Northwest Africa)

Purchased: 2014 Feb

Classification: Ordinary chondrite (LL6)

History: Purchased by Matthew Martin in February 2014 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with some relatively large chondrule remnants.

Geochemistry: Olivine ($\text{Fa}_{31.3-31.7}$, $N = 3$), orthopyroxene ($\text{Fs}_{25.2-25.3}\text{Wo}_{1.9-1.6}$, $N = 2$), clinopyroxene ($\text{Fs}_{9.8-10.1}\text{Wo}_{44.0-43.8}$, $N = 2$).

Classification: Ordinary chondrite (LL6).

Specimens: 21 g including one polished thin section at *UWB*. The remainder is held by Mr. M. Martin.

Northwest Africa 8361 (NWA 8361)

(Northwest Africa)

Purchased: 2014 Feb

Classification: Ordinary chondrite (L4)

History: Purchased by Matthew Martin in February 2014 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well formed, closely packed chondrules exhibiting a wide range in diameter (1.8 ± 1.0 mm; one 6 mm).

Geochemistry: Olivine ($\text{Fa}_{24.5-24.6}$, $N = 3$), orthopyroxene ($\text{Fs}_{20.4-20.6}\text{Wo}_{2.0-1.0}$, $N = 2$), clinopyroxene ($\text{Fs}_{7.1-7.3}\text{Wo}_{46.4-44.9}$, $N = 2$).

Classification: Ordinary chondrite (L4).

Specimens: 28 g including one polished thin section at *UWB*. The remainder is held by Mr. M. Martin.

Northwest Africa 8363 (NWA 8363)

(Northwest Africa)

Purchased: 2013 Dec

Classification: Ordinary chondrite (L, melt rock)

History: Purchased by John Higgins in December 2013 from a dealer in Guelmin, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) This specimen consists almost entirely of fine, lath-shaped silicate grains (i.e., a melt texture) with ragged and wispy grains of melted metal; hence S6. Fine-grained aggregate of lath-shaped grains of olivine, orthopyroxene, clinopyroxene sodic plagioclase, chromite, merrillite, and troilite, plus ragged shred-like grains of kamacite and primary pores. Rare objects that may be relict chondrules are present in places.

Geochemistry: Olivine (Fa_{24.6-25.2}, N = 3), orthopyroxene (Fs_{19.8-20.7}Wo_{1.2-2.5}, N = 3), clinopyroxene (Fs_{7.3-7.7}Wo_{44.8-44.7}).

Classification: Ordinary chondrite (L melt rock).

Specimens: 29 g including one polished thick section at *UWB*. The remainder is held by J. Higgins.

Northwest Africa 8364 (NWA 8364)

(Northwest Africa)

Purchased: 2013 Jun

Classification: Ordinary chondrite (L3)

History: Purchased by John Higgins in June 2013 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Very closely packed, medium-sized chondrules (1.2±0.6 mm) with very little matrix.

Geochemistry: Olivine, Fa_{11.0-38.9}; Cr₂O₃ in ferroan olivine 0.03-0.14 wt.%, N = 6; orthopyroxene, Fs_{5.4-18.3}Wo_{0.3-0.7}, N = 3; clinopyroxene, Fs_{7.5-8.8}Wo_{37.0-37.2}; sodic plagioclase, chromite, troilite and altered kamacite.

Classification: Ordinary chondrite (L3).

Specimens: 25.2 g including one polished thin section at *UWB*. The remainder is held by Mr. J. Higgins.

Northwest Africa 8366 (NWA 8366)

(Northwest Africa)

Purchased: 2014 Apr

Classification: Ordinary chondrite (L3)

History: Purchased by John Higgins in April 2014 from a dealer in Tagounite, Morocco.

Physical characteristics: Two similar stones lacking fusion crust (543 g and 446 g).

Petrography: (A. Irving and S. Kuehner, *UWS*) Fairly closely-packed, well-formed chondrules exhibiting a wide range in size (0.3-3.2 mm, mean 2.1 mm) within a sparse matrix containing altered metal (altered to varying degree in different stones).

Geochemistry: Olivine, Fa_{0.5-43.4}; Cr₂O₃ in ferroan olivine 0.06-0.19 wt.%, N = 12, one grain with 0.83 wt.% Cr₂O₃; orthopyroxene, Fs_{2.3-23.9}Wo_{0.5-3.1}, N = 3; subcalcic augite, Fs_{15.3-15.8}Wo_{37.7-32.7}; augite, Fs_{10.8-18.3}Wo_{40.5-43.8}.

Classification: Ordinary chondrite (LL3).

Specimens: 48 g including two polished thin sections at *UWB*. The remainder is held by Mr. J. Higgins.

Northwest Africa 8408 (NWA 8408)

(Northwest Africa)

Purchased: 2013 Feb

Classification: Ordinary chondrite (LL3)

History: Purchased by Marc Jost in February 2013 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Medium to large sized (1.6 ± 1.0 mm), well-formed chondrules are set in a fine grained matrix containing altered metal.

Geochemistry: Olivine, $\text{Fa}_{0.6-56.4}$; Cr_2O_3 in ferroan olivine = 0.06-0.23 wt.%, mean 0.14 ± 0.07 wt.%, $N = 7$; orthopyroxene, $\text{Fs}_{3.0-30.6}\text{Wo}_{0.3-1.1}$, $N = 3$; subcalcic augite, $\text{Fs}_{18.6}\text{Wo}_{36.7}$; augite, $\text{Fs}_{7.1}\text{Wo}_{48.1}$.

Classification: Ordinary chondrite (LL3).

Specimens: 25.9 g including one polished thin section at *UWB*. The remainder is held by *SJS*.

Northwest Africa 8418 (NWA 8418)

(Northwest Africa)

Purchased: 2014 Apr

Classification: Carbonaceous chondrite (C3)

History: Purchased by Darryl Pitt in April 2014 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Relatively fresh specimen composed of relatively large, separated granular chondrules in a finer grained metal-bearing matrix.

Chlorapatite occurs throughout the matrix, along with Ni-poor kamacite, Ni-bearing lawrencite, Si-bearing Fe metal and rare merrillite. Some portions of this specimen contain large (up to 15.5 mm by 12 mm), ellipsoidal CAI consisting of porous aggregates (grainsize ~ 0.5 mm) of mainly Al-Ti-diopside, olivine and anorthite, with accessory spinel, troilite and taenite, surrounded by complete circumferential rims (~ 1 mm thick) of chlorapatite (each one rimmed in turn by a thin outer band of calcite). Phosphate and carbonate mineralogy was established by a combination of electron microprobe analysis and cathodoluminescence microscopy.

Geochemistry: Olivine ($\text{Fa}_{0.3-36.2}$; $\text{FeO/MnO} = 130-131$, $N = 4$), orthopyroxene ($\text{Fs}_{1.9-2.3}\text{Wo}_{1.0-0.9}$, $N = 3$), pigeonite ($\text{Fs}_{1.7}\text{Wo}_{9.5}$; $\text{Fs}_{24.9}\text{Wo}_{5.5}$), augite ($\text{Fs}_{5.7}\text{Wo}_{48.2}$), Al-Ti-diopside in CAI ($\text{Fs}_{0.1}\text{Wo}_{59.7}$; Al_2O_3 15.4 wt.%, TiO_2 3.5 wt.%). Oxygen isotopes (K. Ziegler, *UNM*): analyses of three acid-washed subsamples by laser fluorination gave $\delta^{17}\text{O}$ -3.994, -5.750, -5.299; $\delta^{18}\text{O}$ 0.444, -1.773, -0.823; $\Delta^{17}\text{O}$ -4.228, -4.814, -4.864. These values fall on the trend for CV and CK chondrites.

Classification: Carbonaceous chondrite (C3) with affinities to CV chondrites. The abundance of apatite in this specimen is an anomalous feature for carbonaceous chondrites.

Specimens: 22.2 g including one polished thin section at *UWB*. The remaining material is held by *DPitt*.

Northwest Africa 8420 (NWA 8420)

(Northwest Africa)

Purchased: 2014 Mar

Classification: Ordinary chondrite (L3)

History: Purchased in Temara, Morocco by Adam Aaronson in March 2014.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely-packed, medium-sized (1.7 ± 0.8 mm), well-formed, spheroidal to ellipsoidal chondrules (some with metal-rich rims) are set in a very sparse matrix containing stained metal.

Geochemistry: Olivine, $\text{Fa}_{9.0-40.6}$; Cr_2O_3 in ferroan olivine = 0.07-0.31 wt.%, mean 0.13 ± 0.10 wt.%, $N = 8$; orthopyroxene, $\text{Fs}_{2.3-10.0}\text{Wo}_{0.4-2.2}$, $N = 3$; subcalcic augite, $\text{Fs}_{19.1-28.2}\text{Wo}_{30.6-23.9}$; augite, $\text{Fs}_{4.5}\text{Wo}_{44.3}$.

Classification: Ordinary chondrite (L3).

Specimens: 20.1 g including one polished thin section at *UWB*. The remainder is held by *Aaronson*.

Northwest Africa 8421 (NWA 8421)

(Northwest Africa)

Purchased: 2014 Mar

Classification: Ordinary chondrite (H3)

History: Purchased in Temara, Morocco by Adam Aaronson in March 2014.

Petrography: (A. Irving and S. Kuehner, *UWS*) Small (0.9 ± 0.6 mm), well-formed chondrules in a stained metal-rich matrix.

Geochemistry: Olivine, $\text{Fa}_{0.3-26.9}$; Cr_2O_3 in ferroan olivine = 0.05-0.10 wt.%, mean 0.07 ± 0.02 wt.%, $N = 7$; orthopyroxene, $\text{Fs}_{2.1-25.5}\text{Wo}_{0.7-1.4}$, $N = 3$; pigeonite, $\text{Fs}_{12.9}\text{Wo}_{17.2}$; subcalcic augite, $\text{Fs}_{11.6}\text{Wo}_{30.6}$.

Classification: Ordinary chondrite (H3).

Specimens: 21 g including one polished thin section at *UWB*. The remainder is held by *Aaronson*.

Northwest Africa 8423 (NWA 8423)

(Northwest Africa)

Purchased: 2014 Mar

Classification: Ordinary chondrite (L/LL3)

History: Purchased in Temara, Morocco by Adam Aaronson in March 2014.

Petrography: (A. Irving and S. Kuehner, *UWS*) Medium-sized (1.4 ± 0.8 mm), very closely packed, well-formed ellipsoidal chondrules are set in a fine grained matrix containing altered metal.

Geochemistry: Olivine, $\text{Fa}_{15.0-43.5}$; Cr_2O_3 in ferroan olivine = 0.12-0.29 wt.%, mean 0.19 ± 0.06 wt.%, $N = 7$; orthopyroxene, $\text{Fs}_{2.3-16.4}\text{Wo}_{0.3-0.4}$, $N = 3$; subcalcic augite, $\text{Fs}_{9.0-31.1}\text{Wo}_{28.5-35.2}$.

Classification: Ordinary chondrite (L/LL3).

Specimens: 21.9 g including one polished thin section at *UWB*. The remainder is held by *Aaronson*.

Northwest Africa 8424 (NWA 8424)

(Northwest Africa)

Purchased: 2014 Mar

Classification: Ordinary chondrite (L3)

History: Purchased in Temara, Morocco by Adam Aaronson in March 2014.

Petrography: (A. Irving and S. Kuehner, *UWS*) Medium sized (1.3 ± 0.8 mm), separated, well-formed chondrules are set in a fine grained matrix containing altered metal.

Geochemistry: Olivine, $\text{Fa}_{0.4-36.3}$; Cr_2O_3 in ferroan olivine = 0.05-0.06 wt.%, mean 0.05 ± 0.01 wt.%, $N = 7$; orthopyroxene, $\text{Fs}_{2.1-29.2}\text{Wo}_{0.5-0.8}$, $N = 3$; subcalcic augite, $\text{Fs}_{18.6}\text{Wo}_{36.7}$; augite, $\text{Fs}_{7.1}\text{Wo}_{48.1}$.

Classification: Ordinary chondrite (L3).

Specimens: 10.5 g including one polished thin section at *UWB*. The remainder is held by *Aaronson*.

Northwest Africa 8427 (NWA 8427)

(Northwest Africa)

Purchased: 2014 Mar

Classification: Carbonaceous chondrite (CO3)

History: Purchased in Temara, Morocco by Adam Aaronson in March 2014.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fairly closely-packed chondrules and sparse, very small, fine grained CAI are set in a fine grained orange matrix.

Geochemistry: Olivine ($\text{Fa}_{0.7-40.6}$; Cr_2O_3 in ferroan olivine = 0.06-0.68 wt.%, mean 0.16 ± 0.20 wt.%, $N = 10$), orthopyroxene ($\text{Fs}_{2.1-41.8}\text{Wo}_{1.1-1.3}$, $N = 3$), subcalcic augite ($\text{Fs}_{5.9}\text{Wo}_{36.8}$), augite ($\text{Fs}_{35.6}\text{Wo}_{42.8}$).

Classification: Carbonaceous chondrite (CO3).

Specimens: 22 g including one polished thin section at *UWB*. The remaining material is held by Aaronson.

Northwest Africa 8428 (NWA 8428)

(Northwest Africa)

Purchased: 2014 Mar

Classification: HED achondrite (Eucrite, polymict)

History: Purchased in Temara, Morocco by Adam Aaronson in March 2014 and subsequently sold to Fredric Stephan.

Petrography: (A. Irving and S. Kuehner, *UWS*) Complex fragmental breccia composed of basaltic eucrite clasts, microgabbroic eucrite clasts, ~5 vol.% diagenitic orthopyroxene grains (of several different compositions) and sparse dark, metal-bearing, fragmental genomict breccia clasts within a matrix of finer related mineral debris. Minerals are calcic plagioclase, orthopyroxene, exsolved pigeonite, fayalite, ferropigeonite, ilmenite, troilite and kamacite (as irregularly shaped grains).

Geochemistry: Diagenitic orthopyroxene ($\text{Fs}_{20.9}\text{Wo}_{2.3}$; $\text{Fs}_{25.0}\text{Wo}_{1.9}$; $\text{Fs}_{33.4}\text{Wo}_{2.5}$; $\text{FeO/MnO} = 30-32$ $N = 3$), fayalite ($\text{Fa}_{87.4-87.5}$; $\text{FeO/MnO} = 40-45$, $N = 2$), ferropigeonite ($\text{Fs}_{58.7}\text{Wo}_{22.5}$; $\text{FeO/MnO} = 31$). Pigeonite grains consist of exsolution lamellae of clinopyroxene ($\text{Fs}_{24.8-25.2}\text{Wo}_{43.0-43.7}$; $\text{FeO/MnO} = 29-32$; $N = 2$) within host orthopyroxene ($\text{Fs}_{61.1-61.0}\text{Wo}_{1.5-1.6}$; $\text{FeO/MnO} = 33$; $N = 2$).

Classification: Eucrite (polymict breccia).

Specimens: 21.4 g including one polished thin section at *UWB*. The remainder is held by Mr. F. Stephan.

Northwest Africa 8429 (NWA 8429)

(Northwest Africa)

Purchased: 2014 Mar

Classification: Carbonaceous chondrite (CK5)

History: Purchased in Temara, Morocco by Adam Aaronson in March 2014.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh specimen composed of sparse, separated, medium-sized, granular chondrules (containing abundant magnetite) in a pale brown matrix. Minerals are olivine, clinopyroxene, intermediate plagioclase, stained Cr-bearing magnetite and pentlandite.

Geochemistry: Olivine ($\text{Fa}_{35.3-35.5}$; $\text{FeO/MnO} = 112-145$, $N = 3$), clinopyroxene ($\text{Fs}_{9.3-9.6}\text{Wo}_{45.9-46.3}$; $\text{FeO/MnO} = 69$, $N = 3$).

Classification: Carbonaceous chondrite (CK5).

Specimens: 23.5 g including one polished thin section at *UWB*. The remaining material is held by *Aaronson*.

Northwest Africa 8480 (NWA 8480)

(Northwest Africa)

Purchased: 2012 Dec

Classification: Iron meteorite

History: Purchased in Agadir in December 2012

Physical characteristics: A single dark smooth ellipsoidal mass.

Petrography: (J. Gattacceca, *CEREGE*): Quench texture with dendritic/cellular metallic FeNi set in a troilite matrix. Typical metal islands are 100-150 μm in size. 67 vol% FeNi, 33 vol% FeS. Spherical droplets of phosphates up to 50 μm in diameter. Rare euhedral chromite up to 50 μm .

Geochemistry: Metal $\text{Fe}_{93}\text{Ni}_{6.4}\text{Co}_{0.6}$ (N=5), Co content of metal (0.61 wt%), sulfides $\text{Fe}_{0.50}\text{S}_{0.50}$ (N=3), chromite $\text{Cr}\#=1.00$, $\text{FeO/MnO}=70$ (N=4), phosphate $\text{Fe}_{3.05}\text{P}_{1.95}\text{O}_8$ (N=2).

Classification: Iron. Minimal weathering. This meteorite is probably a nodule from a larger one. Co content of metal and MnO/MnO of chromite are a priori not compatible with provenance from an ordinary chondrite.

Specimens: 5.5 g in *CEREGE*. Main mass with *Labenne*.

Northwest Africa 8583 (NWA 8583)

(Northwest Africa)

Purchased: 2014 Jun 25

Classification: HED achondrite (Eucrite, polymict)

History: Purchased from a moroccan meteorite dealer in Sainte-Marie aux Mines

Petrography: (K. Metzler, *IfP*) Chemically different basaltic and granulitic eucrite clasts and mineral fragments set in a brownish matrix. The matrix represents a crystallized melt, consisting of tiny pyroxene and plagioclase crystals. Plagioclase fragments are polycrystalline, some showing fluidal textures. Small amounts of maskelynite. Most pyroxene fragments show augite exsolution lamellae. Accessories are ilmenite, chromite, silica polymorph and isolated olivine fragments.

Geochemistry: Low-Ca pyroxene: $\text{Fs}_{62.0\pm 4.94.2\pm 1.9}$ ($\text{Fs}_{54-68}\text{Wo}_{2-9}$, Fe/Mn=29, n=15). Augite lamellae: $\text{Fs}_{29.2\pm 2.9}\text{Wo}_{42.9\pm 0.7}$ ($\text{Fs}_{23-32}\text{Wo}_{41-44}$, Fe/Mn=31, n=14). Plagioclase: $\text{An}_{89.2\pm 1.9}$ (An_{86-92} ; n=10). Isolated olivine grains: Fa_{71-83} , Fe/Mn=40, n=4.

Classification: Polymict eucrite (clast-rich melt rock)

Northwest Africa 8646 (NWA 8646)

(Northwest Africa)

Purchased: 2009

Classification: Ordinary chondrite (L3)

History: One large individual partly covered with fusion crust was bought on a mineral market in Erfoud, Morocco.

Physical characteristics: The meteorite displays a grayish to slightly brownish interior and contains abundant, sharply defined chondrules with a large variety of textural types. Chondrule mean diameter is about 0.7 mm.

Northwest Africa 8647 (NWA 8647)

(Northwest Africa)

Purchased: 2010

Classification: HED achondrite (Eucrite, brecciated)

History: Numerous individuals up to several cm in size, all partly covered with fusion crust, were bought at a mineral market in Erfoud, Morocco.

Petrography: The meteorite is a breccia composed of basaltic lithologies and mineral fragments set into a fine-grained melt-rich matrix. Calcic plagioclase and exsolved pyroxene are dominant minerals; accessories include SiO₂ polymorphs, chromite, and troilite. The rock contains abundant recrystallized shock melt.

Geochemistry: low-Ca pyroxene, $\text{Fs}_{60\pm0.9}\text{Wo}_{2.9\pm0.7}$ ($\text{Fs}_{58.3-61.3}\text{Wo}_{2.2-4.7}$, n=15, FeO/MnO=30-34); Ca-pyroxene, $\text{Fs}_{26.3\pm1.1}\text{Wo}_{43.5\pm0.4}$ ($\text{Fs}_{23.5-27.2}\text{Wo}_{42.9-44}$, n=15, FeO/MnO=29-35); calcic plagioclase, $\text{An}_{90.5\pm0.7}$ ($\text{An}_{89.5-91.5}$, n=15)

Northwest Africa 8655 (NWA 8655)

(Northwest Africa)

Purchased: 2014 Oct

Classification: LL5-melt breccia

History: Purchased by Jason Phillips in October 2014 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Composed of recrystallized clasts containing sparse, relatively large (up to 2.8 mm) remnant chondrules within a dark, very fine-grained matrix. The very fine-grained matrix is black (almost opaque in thin section) and contains shred-like grains of metal and rounded troilite blebs (both indicative of melting). Shock stages were S2 for clasts, and S6 for matrix.

Geochemistry: Olivine ($\text{Fa}_{26.8-27.1}$, N = 3), orthopyroxene ($\text{Fs}_{21.7-22.0}\text{Wo}_{1.4-1.3}$, N = 3), clinopyroxene ($\text{Fs}_{7.3-7.7}\text{Wo}_{45.9-46.0}$). Analyses were done for both clasts and matrix.

Classification: Ordinary chondrite (LL5 melt breccia).

Specimens: 38 g including one polished thin section at *UWB*; main mass with J. Phillips.

Northwest Africa 8658 (NWA 8658)

(Northwest Africa)

Purchased: Nov 2013

Classification: HED achondrite (Eucrite, polymict)

Petrography: (P. Warren, *UCLA*) This meteorite is a polymict eucrite with many distinct, sharply bounded clasts, including one that is uncommonly rich in silica. Minor Fe-metal.

Geochemistry: Clasts, and thus mineral compositions, are diverse. Pyroxene compositions extend to $\text{En}_{65.1}\text{Wo}_{5.6}$, $\text{En}_{35.3}\text{Wo}_{2.5}$, $\text{En}_{30.5}\text{Wo}_{43.4}$, $\text{En}_{7.5}\text{Wo}_{11.5}$ and $\text{En}_{5.5}\text{Wo}_{44.5}$; plagioclase ranges from An_{71} to An_{94} , minor olivine from Fa_{62} to Fa_{87} . Averages of the disparate clasts are: low-Ca pyroxene $\text{En}_{50.4\pm12.2}\text{Wo}_{7.6\pm1.7}$, FeO/MnO wt. ratio 30.1 ± 1.2 , n=28; med-Ca pyroxene $\text{En}_{27.6\pm7.0}\text{Wo}_{18.5\pm5.1}$, n=19; high-Ca pyroxene $\text{En}_{20.4\pm6.5}\text{Wo}_{39.0\pm4.5}$, n=8; plagioclase $\text{An}_{85.0\pm5.7}$, n=97; olivine $\text{Fa}_{80.3\pm4.5}$, n=30.

Classification: Eucrite (polymict).

Northwest Africa 8659 (NWA 8659)

(Northwest Africa)

Purchased: Oct 2013

Classification: HED achondrite (Eucrite)

History: The meteorite was found as a single mass of 45.8 g in 2013 by an anonymous searcher, and was purchased by A. Jonikas in Dec 2013.

Physical characteristics: The stone has a distinct dark crust, but this appears to be almost entirely desert varnish, not fusion crust.

Petrography: (P. Warren, *UCLA*) Slices through the stone indicate that most of the material is thoroughly brecciated, yet a single large clast comprising about 40% of the stone is essentially unbrecciated. The unbrecciated material shows a subophitic texture with grain size typically 2 mm. Minor Fe-metal. The pyroxenes are to an unusual extent pervaded by secondary olivine-dominated veins.

Geochemistry: Pyroxene is mostly equilibrated to a tie-line between low-Ca pyroxene $\text{En}_{32.0 \pm 0.7} \text{Wo}_{3.4 \pm 0.4}$, FeO/MnO wt ratio 33.6 ± 1.5 , $n=11$, and high-Ca pyroxene $\text{En}_{26.6 \pm 0.1} \text{Wo}_{42.3 \pm 0.2}$, $n=6$, but in the cores of a few large grains a low-Ca zoning trend survives with composition as magnesian as $\text{En}_{58} \text{Wo}_7$; primary-igneous plagioclase $\text{An}_{81.3 \pm 2.4}$, $n=40$; secondary veins within pyroxenes have An_{98} plagioclase, along with olivine $\text{Fa}_{83.5 \pm 0.5}$, $n=11$. Oxygen isotopes: (I. Kohl and E. Young, *UCLA*) $\delta^{17}\text{O}$ 2.083, $\delta^{18}\text{O}$ 4.376, $\Delta^{17}\text{O}$ -0.227 (all normalized). Bulk composition: (fused-bead EPMA, in wt%, derived from a 0.28 g powder) SiO_2 49.5, TiO_2 1.28, Al_2O_3 11.5, Cr_2O_3 0.24, MgO 5.5, FeO 18.2, MnO 0.51; mg# 0.349.

Classification: Eucrite (monomict-brecciated). Unusually ferroan, Ti-rich, and rich in secondary metasomatic veins.

Specimens: The main mass, 34 g, is held by Aras Jonikas.

Northwest Africa 8660 (NWA 8660)

(Northwest Africa)

Purchased: Jan 2012

Classification: HED achondrite (Eucrite)

Petrography: (P. Warren, *UCLA*) This eucrite is mildly brecciated and essentially monomict. Clasts are subophitic with typical grain size of 0.5 mm. Minor Fe-metal.

Geochemistry: Low-Ca pyroxene $\text{En}_{37.4 \pm 0.9} \text{Wo}_{2.2 \pm 0.4}$, FeO/MnO wt. ratio 31.7 ± 1.2 , $n=20$; high-Ca pyroxene $\text{En}_{30.2 \pm 0.4} \text{Wo}_{43.8 \pm 0.3}$, $n=11$; plagioclase $\text{An}_{88.3 \pm 2.6}$, $n=23$.

Classification: Eucrite (monomict breccia).

Northwest Africa 8661 (NWA 8661)

(Northwest Africa)

Purchased: June 2011

Classification: HED achondrite (Eucrite)

Petrography: (P. Warren, *UCLA*) This eucrite shows a typical medium-subophitic texture of an unbrecciated noncumulate eucrite, except pyroxene shows no perceptible exsolution. Minor Fe-metal.

Geochemistry: Pyroxene, starting from $\text{En}_{61} \text{Wo}_7$ cores, shows continuous zoning toward Mg-poor and Ca-diverse compositions such as $\text{En}_6 \text{Wo}_{13}$, $\text{En}_6 \text{Wo}_{32}$. Average pyroxene $\text{En}_{37.8 \pm 17.6} \text{Wo}_{16.1 \pm 8.6}$, FeO/MnO wt. ratio 29.8 ± 2.7 , $n=60$; plagioclase $\text{An}_{80.5 \pm 2.7}$, $n=45$. Oxygen isotopes: (I. Kohl and E. Young, *UCLA*) $\delta^{17}\text{O}$ 1.868, $\delta^{18}\text{O}$ 3.914, $\Delta^{17}\text{O}$ -0.209 (all normalized). EPMA, in wt.%, derived from a 0.28 g powder) SiO_2 49.5, TiO_2 1.28, Al_2O_3 11.5, Cr_2O_3 0.24, MgO 5.5, FeO 18.2, MnO 0.51; mg# 0.349.

Classification: Eucrite (unbrecciated). Low thermal metamorphism.

Northwest Africa 8662 (NWA 8662)

(Northwest Africa)

Purchased: Oct 2014

Classification: HED achondrite (Eucrite)

Petrography: (P. Warren, *UCLA*) This eucrite shows a mildly brecciated version of typical medium-subophitic eucrite texture, including thoroughly exsolved pyroxenes. Minor Fe-metal.

Geochemistry: Low-Ca pyroxene $\text{En}_{36.1\pm0.8}\text{Wo}_{2.2\pm0.3}$, FeO/MnO wt ratio 30.1 ± 1.2 , $n=8$; high-Ca pyroxene $\text{En}_{29.5\pm0.4}\text{Wo}_{43.3\pm0.5}$, $n=7$; plagioclase $\text{An}_{84.8\pm4.6}$, $n=21$.

Classification: Eucrite (monomict breccia).

Northwest Africa 8663 (NWA 8663)

(Northwest Africa)

Purchased: Oct 2014

Classification: HED achondrite (Eucrite, polymict)

Petrography: (P. Warren, *UCLA*) This eucrite is a fine-grained polymict breccia with a minor (slightly less than 10%, based on the fusion crust composition) diogenite component. Minor Fe-metal.

Geochemistry: Pyroxene ranges from diogenitic ($\text{En}_{67}\text{Wo}_3$) to ferroan-eucritic ($\text{En}_{38}\text{Wo}_2$).

Averages: low-Ca pyroxene $\text{En}_{50.0\pm13.1}\text{Wo}_{2.5\pm1.1}$, FeO/MnO wt ratio 30.5 ± 2.7 , $n=10$; high-Ca pyroxene $\text{En}_{31.4\pm1.2}\text{Wo}_{42.8\pm1.0}$, $n=5$; plagioclase $\text{An}_{89.5\pm3.0}$, $n=5$. The fusion crust has 18.4 wt% FeO, 9.8 wt% MgO and 11.1 wt.% Al_2O_3 , indicating the diogenite component is slightly less than the howardite threshold of 10 wt%.

Classification: Eucrite (polymict).

Northwest Africa 8664 (NWA 8664)

(Northwest Africa)

Purchased: 2014 Apr

Classification: Ordinary chondrite (L3)

History: Purchased by Eric *Twelker* in April 2014 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, very closely packed chondrules occur in a very sparse metal-bearing matrix.

Geochemistry: Olivine ($\text{Fa}_{3.9-37.1}$; Cr_2O_3 in ferroan olivine 0.04-0.17 wt.%, $N = 7$), orthopyroxene ($\text{Fs}_{2.0-20.6}\text{Wo}_{0.5-0.8}$, $N = 3$), augite ($\text{Fs}_{4.3}\text{Wo}_{37.7}$, $N = 2$). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.86$.

Classification: Ordinary chondrite (L3). L designation based on magnetic susceptibility.

Specimens: 23.3 g plus one polished thin section at *UWB*. The remainder is held by *Twelker*.

Northwest Africa 8666 (NWA 8666)

(Northwest Africa)

Purchased: 2014 May

Classification: Ordinary chondrite (LL(L)3)

History: Purchased by John Higgins in May 2014 from a dealer in Laayoune, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules occur in a finer grained, metal-bearing matrix.

Geochemistry: Olivine (Fa_{0.8-42.3}; Cr₂O₃ in ferroan olivine 0.08-0.15 wt.%, N = 7), orthopyroxene (Fs_{1.7-18.3}Wo_{0.6-3.5}, N = 3), subcalcic augite (Fs_{8.5-27.1}Wo_{30.0-29.1}, N = 2). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.35$.

Classification: Ordinary chondrite LL(L)3.

Specimens: 23.5 g including one polished thin section at *UWB*. The remainder is held by J. Higgins.

Northwest Africa 8667 (NWA 8667)

(Northwest Africa)

Purchased: 2009 Mar

Classification: Ordinary chondrite (L3)

History: Purchased by Eric *Twelker* in March 2009 from a dealer in Pohlheim, Germany.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, fairly closely packed chondrules occur in a finer grained, metal-bearing matrix.

Geochemistry: Olivine (Fa_{0.4-92.1}; Cr₂O₃ in ferroan olivine 0.11-0.61 wt.%, mean 0.23 wt.%, sd 0.12 wt.%, N = 16), orthopyroxene (Fs_{0.5-19.1}Wo_{4.3-5.5}, N = 3), subcalcic augite (Fs_{19.3}Wo_{25.1}, N = 1), augite (Fs_{7.4}Wo_{38.7}, N = 1). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.84$.

Classification: Ordinary chondrite (L3). L group designation based on magnetic susceptibility. The very wide range in Fa content of olivine, along with the mean value and standard deviation for Cr₂O₃ content of ferroan olivines, indicate that this unequilibrated specimen is of a subtype <3.2 (according to the criteria of Grossman and Brearley, 2005).

Specimens: 21.2 g plus one polished thin section at *UWB*. The remainder is held by E. *Twelker*.

Northwest Africa 8691 (NWA 8691)

(Northwest Africa)

Purchased: 2014

Classification: Ordinary chondrite (LL4-6)

History: One subrounded stone weighing 66 g was found in Morocco in 2014. David Holden acquired the sample from a meteorite prospector in Erfoud 2014.

Physical characteristics: The stone is orangish-brown and has a rounded-angular shape. There is no relict fusion crust remaining on the exterior. The cut face of the interior of the stone is orangish-brown and shows chondrules, clasts and fresh flakes of metal.

Petrography: Description and classification (A. Love, *App*): Sample displays brecciated structure containing chondrules, chondrule fragments and light and dark-colored clasts of various petrologic grades set within an oxidized, fine-grained fragmental matrix containing ~1.5 vol% FeNi metals. Clasts display weakly to totally recrystallized chondritic textures and shock-darkened and shock melted textures. Weakly recrystallized clasts display distinct chondrules in a recrystallized matrix. Totally recrystallized clasts lack distinct chondrules and have plagioclase grains with an average largest dimension of 43.45 μm . Chondritic host rock contains well-defined chondrules with average diameter of 0.7 mm. Three porphyritic pyroxene chondrules with zoned phenocrysts and low Fs compositions (Fs_{7.25-17.09}) were observed within the matrix.

Geochemistry: (A. Love, *App*) Olivine Fa_{34.2±0.7}, N=16; Low Ca pyroxene Fs_{24.3±0.9}Wo_{3.4±1.9}, N=7; Fs_{10.7±4.5}Wo_{1.0±0.2}, N=3. Mean olivine composition is outside normal range for LL chondrites. Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O} = 3.963, 4.079, 3.892$; $\delta^{18}\text{O} = 5.916, 5.731, 5.349$; $\Delta^{17}\text{O} = 0.839, 1.053, 1.068$ (all per mil). Average of triplicate analyses of acid-washed subsamples by

laser fluorination gave, respectively, $\delta^{17}\text{O} = 3.978$; $\delta^{18}\text{O} = 5.665$; $\Delta^{17}\text{O} = 0.987$ (all per mil). Oxygen isotopes plot in LL region above the TFL.

Specimens: An endcut slice and small fragments weighing 12.99 g, a polished mount and polished thin section are currently on deposit at *App*.

Northwest Africa 8694 (NWA 8694)

Morocco

Purchased: 14 July 2014

Classification: Martian meteorite (Chassignite)

Physical characteristics: A single flattened spherical stone, almost entirely covered by fusions crust.

Petrography: (R. Hewins, S. Pont, B. Zanda, *MNHNP*) This meteorite is a cumulate dunite with 85% highly fractured olivine. It has an adcumulate texture with small patches rich in interstitial material having an orthocumulate texture. The main intercumulus phases are pigeonite and augite, both with very fine (1 μm) exsolution lamellae, and glass. Minor phases include chromite, partly enclosed by olivine, and ilmenite. The olivine contains largely crystalline melt inclusions, surrounded by radial fractures. The main phases in melt inclusions are orthopyroxene and glass; rare phases include apatite, amphibole and mica.

Geochemistry: Mineral compositions: (R. Hewins, *MNHNP*) The olivine composition is $\text{Fo}_{53.2 \pm 0.3}\text{Fa}_{46.8 \pm 0.3}$, with an FeO/MnO ratio of 50.0 ± 1.6 , $n=24$. The crystals are equilibrated in Fe-Mg, but retain a weak depletion of Ca towards crystal rims, with a total range of 0.8–0.29 wt. % CaO. The pigeonite composition is $\text{En}_{55.8 \pm 0.9}\text{Fs}_{37.5 \pm 1.0}\text{Wo}_{6.7 \pm 1.3}$, $n=26$, and FeO/MnO of 28.7 ± 1.9 ; the orthopyroxene is $\text{En}_{59.9 \pm 0.4}\text{Fs}_{37.7 \pm 0.9}\text{Wo}_{2.4 \pm 0.8}$ and FeO/MnO ratio of 30.2 ± 3.0 ; and the augite is $\text{En}_{40.6 \pm 0.2}\text{Fs}_{16.1 \pm 0.6}\text{Wo}_{43.3 \pm 0.5}$, with an FeO/MnO ratio of 27.4 ± 3.2 , (neglecting overlap compositions). The orthopyroxene in the melt inclusions varies from En_{56} to En_{59} , with Al_2O_3 up to 4 wt.%, whereas interstitial orthopyroxene has only 0.4 ± 0.3 wt.% Al_2O_3 . The amphibole is calcium-rich with 3% TiO_2 and the mica is phlogopitic. Apatite has about 2.5 wt.% of each of F and Cl. Geochemistry: (N. Asseyag, P. Cartigny, *IPGP*). Oxygen isotope analysis gives $\delta^{18}\text{O}=4.45, 4.55, 4.18$, $\delta^{17}\text{O}=2.71, 2.68, 2.49$, $\Delta^{17}\text{O}=0.38, 0.30, 0.30$, (standard errors: $\pm 0.10, \pm 0.07, \pm 0.04$ respectively), corresponding to an average composition of $\delta^{18}\text{O}=4.39 \pm 0.19$, $\delta^{17}\text{O}=2.63 \pm 0.12$, and $\Delta^{17}\text{O}=0.33 \pm 0.05$.

Classification: (R. Hewins, S. Pont and B. Zanda, *MNHNP*) The meteorite is classified as a chassignite. The textures and mineral assemblages are almost identical to those of [Chassigny](#) and [NWA 2737](#). The olivine and pyroxene compositions are intermediate between those of [Chassigny](#) and [Nakhla](#). The Fe/Mn ratios of olivine grains fall on to just above the Papike reference line for Mars.

Specimens: Specimen: 12.3 g at *MNHNP*

Northwest Africa 8702 (NWA 8702)

(Northwest Africa)

Purchased: 2012

Classification: Mesosiderite

History: Purchased by Stefan Ralew in 2012 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Recrystallized breccia composed of larger angular grains of orthopyroxene (up to 2.8 mm), anorthite (up to 1.1 mm) and holly leaf-shaped

grains of metal (kamacite plus taenite; ~18 vol.%) in a matrix of interlocking grains of the same minerals plus minor chromite and troilite.

Geochemistry: Orthopyroxene ($\text{Fs}_{27.2-27.6}\text{Wo}_{1.8-3.3}$, $\text{FeO/MnO} = 29-30$, $N = 3$).

Classification: Mesosiderite.

Specimens: 5.6 g including one polished thin section at *UWB*; main mass with *Ralew*.

Northwest Africa 8707 (NWA 8707)

Morocco

Purchased: Feb 2012

Classification: Ordinary chondrite (L, melt rock)

History: Purchased by T. Ono in Tucson in Feb. 2012

Physical characteristics: A single stone of 64.5 g, ~70% covered with fresh black fusion crust. Broken surfaces reveal a light gray interior with abundant shock melt veins.

Petrography: (T. Mikouchi, *UTok*). Faintly brecciated (cm-to-mm scale) igneous rock mainly composed of olivine, pyroxene and feldspathic glass with variable grain sizes ranging from 0.05 mm to 1 mm. Most pyroxenes are larger than 0.5 mm and poikilitically enclose olivine chadacrysts. Olivine is rounded in shape and its size ranges 0.05-0.5 mm. Feldspathic glass is interstitial to olivine and pyroxene. There are some areas where feldspar is birefringent under petrographic microscope. Both olivine and pyroxene exhibit undulatory extinction and shock veins (~0.2 mm wide) cut through the section, suggesting severe shock metamorphism. In shock melt veins some olivine grains are transformed to ringwoodite. Although the shock metamorphism is extensive, the original igneous texture is well preserved. Mineral abundances are 53 olivine, 18 feldspathic glass, 15 low-Ca pyroxene, 4 high-Ca pyroxene, 4 Fe-Ni metal, 4 troilite, 1 chromite and 1 apatite (in vol%).

Geochemistry: (T. Mikouchi, *UTok*). All phases show fairly homogeneous compositions. Olivine is $\text{Fa}_{23.6\pm0.9}$ and its FeO/MnO ratio is 35-60 ($N=256$). CaO and Cr_2O_3 are <0.05 wt%, respectively. Low-Ca pyroxene is $\text{Fs}_{19.7\pm0.9}\text{Wo}_{3.3\pm1.0}$ with 0.3-0.4wt% Al_2O_3 and 0.3-0.6 wt% Cr_2O_3 ($N=89$). Its FeO/MnO ratio (wt%) is 25-40. High-Ca pyroxene is $\text{Fs}_{9.0\pm1.0}\text{Wo}_{42.0\pm1.9}$ with 0.5-1.0 wt% Al_2O_3 , 0.3-0.4 wt% TiO_2 , 0.7-1.0 wt% Na_2O and 1.1-1.7 wt% Cr_2O_3 ($N=34$). Feldspathic glass is Si-rich (71 ± 2.2 wt% SiO_2 , 23.2 ± 1.1 wt% Al_2O_3) and does not show a stoichiometric composition of feldspar ($N=144$). CaO , Na_2O and K_2O are 1.5-3.5, 1.0-1.5 and 0.4-0.9 wt%, respectively. There is no compositional difference between optically isotropic and anisotropic areas. Chromite contains 58-59 wt% Cr_2O_3 , 28-29 wt% FeO , 4.5 wt% Al_2O_3 , 3 wt% MgO and 2 wt% TiO_2 ($N=18$). Kamacite has 6 wt% Ni and 0.9 wt% Co. Taenite contains 18 wt% Ni and 0.7 wt% Co.

Classification: L melt rock (strongly shocked). Texturally similar to acapulcoite/lodranite, but mineral compositions are in the range of equilibrated L chondrites.

Specimens: 15.4 g at *UTok*. Main mass with T. Ono

Northwest Africa 8709 (NWA 8709)

(Northwest Africa)

Purchased: 2003 Nov 23

Classification: Ordinary chondrite (L3, melt breccia)

History: An already cut individual of an NWA meteorite was purchased by Dick Pugh in November 2003 and May 2004 from a Portland, Oregon, vendor and donated to *Cascadia*.

Physical characteristics: An irregularly shaped specimen with a dark, bumpy exterior, which locally has remnant fusion crust and a reddish brown weathering patina. Cut faces are dark gray and show distinct chondrules.

Petrography: (M. Hutson and A. Ruzicka, *Cascadia*) Tightly packed and commonly ellipsoidal chondrules in thin section (mean diameters in two thin sections are 0.72 ± 0.36 mm, N=30; and 1.0 ± 0.4 mm, N=23) with long axes roughly aligned, are embedded in an igneous-textured matrix composed of fine-grained ($< 5\text{-}10$ μm) olivine, low-Ca pyroxene, glass, Ca-pyroxene, sulfide, and metal (or weathered metal), with sulfide and metal sometimes forming larger globules (to 40 μm). Chondrules consist chiefly of olivine and low-Ca pyroxene containing many small sulfide or metal inclusions and veinlets, set in glass or fine grained mesostasis. Olivine grains in chondrules show undulose-mosaic extinction and planar fractures consistent with shock stage S4. 80-90% of opaque minerals are replaced by terrestrial weathering products. Weathering products and remaining metal and troilite constitute ~ 5 area % (visual estimate) of the coarser grains in thin sections. No clasts of different chondrite types are apparent.

Geochemistry: Olivine $\text{Fa}_{15.6 \pm 2.9}$ ($\text{Fa}_{2.1\text{-}20.8}$, N=99) and low-Ca pyroxene $\text{Fs}_{11.1 \pm 5.2}$ $\text{Wo}_{1.5 \pm 1.4}$ ($\text{Fs}_{2.2\text{-}21.7}$, N=39) in chondrules. Oxygen isotopic composition (R. Greenwood, *OU*) of untreated bulk sample, $\delta^{17}\text{O}$ 3.482, $\delta^{18}\text{O}$ 5.033, $\Delta^{17}\text{O}$ 0.865 (0.842 linearized), all permil.

Classification: Based on texture and mineral chemistry this stone is a type 3 chondritic melt breccia. Group affinity is likely L chondrite based on oxygen isotope composition (most consistent with L chondrite), chondrule size (consistent with L or LL chondrite), and overall amount of metal and sulfide and associated weathering products (consistent with L or LL chondrite). Mineral chemistry is not fully consistent with established chondrite groups and most closely resembles H chondrites.

Specimens: 70.8 g as well as polished thin section are on deposit at *Cascadia*, which holds the main mass. The original specimen is estimated to have been at least 79 g.

Northwest Africa 8710 (NWA 8710)

(Northwest Africa)

Purchased: 2014

Classification: Ordinary chondrite (H3)

History: One subrounded stone weighing 210 g was found in Morocco in 2014. David Holden acquired the sample from a meteorite prospector in Erfoud 2014.

Physical characteristics: The stone is dark brown and has a rounded-angular shape and displays a few shallow regmaglypts and a discontinuous rollover lip on the trailing edge. The oriented stone is $\sim 60\%$ covered by weathered fusion crust. The cut face of the interior of the stone is dark brown and shows numerous well-defined chondrules, clasts, a solitary lithic fragment and fresh flakes of metal.

Petrography: Description and classification (A. Love, *App*): Sample displays numerous close-packed unequilibrated chondrules of varying size (avg. diameter 482.35 μm , n=131, 106-1935 μm). FeNi and FeS metals grains set in a fine-grained matrix. Many porphyritic chondrules display turbid mesostasis while some chondrules contain isotropic glass, rounded nuggets of FeNi and FeS metals and relict grains. Many chondrules display fine grained rims of FeS. The clastic matrix contains mixed metal assemblages.

Geochemistry: (A. Love, *App*) $\text{Fa}_{15.4 \pm 5.6}$ ($\text{Fa}_{1.0\text{-}25.3}$, N=18, Fe/Mn=44.8); Low Ca pyroxene, $\text{Fs}_{16.3 \pm 9.8}$ $\text{Wo}_{1.3 \pm 1.2}$ ($\text{Fs}_{4.4\text{-}34.0}$ $\text{Wo}_{0.5\text{-}4.3}$, N=15).

Classification: Ordinary Chondrite (H3, S3, W2). Based on ranges of Fa and Fs values of olivines and pyroxenes, sample is an H chondrite. Presence of isotropic glass and zoned olivines in some porphyritic chondrules, dark red and magenta CL of olivines and pyroxenes, indicate the sample is an unequilibrated H chondrite.

Specimens: Five slices weighing 26.31 g, a polished mount and one polished thin section are currently on deposit at *App*.

Northwest Africa 8711 (NWA 8711)

Morocco, (Northwest Africa)

Purchased: May 2014

Classification: Ordinary chondrite (L6, melt breccia)

History: Purchased by Nicola Castellano at the Genova Mineral Fair in May 2014 from a Moroccan dealer.

Physical characteristics: Single stone, dark brown crust. A cut surface shows two different areas: angular fragments up to 2 cm of light gray, coarse grained chondritic material and dark-gray, very fine-grained, shock-melted veins up to 2 mm wide intersecting the matrix.

Petrography: (V. Moggi Cecchi) Microprobe examination of a thin polished section displays two distinct domains: the shock-melted domain shows a crystalline portion consisting of ringwoodite, deep blue in plane polars and 20-200 μm wide, plus rare majorite crystals, and a microcrystalline to glassy portion, green in plane polars, made of quenched silicates (mainly augite) with scattered rounded metal and troilite blebs, up to 30 μm wide; the L6 host domain shows an equilibrated chondritic texture with few chondrules not clearly detectable set in a crystalline matrix of olivine, orthopyroxene, minor plagioclase and diopside, Fe-Ni metal, troilite.

Geochemistry: (V. Moggi Cecchi, G. Pratesi, S. Caporali, M. Zoppi, *UniFi*) Chondritic portion: olivine, $\text{Fa}_{25.1\pm0.1}$ ($\text{Fe/Mn}=48\pm2$, $n=8$); low-Ca pyroxene, $\text{Fs}_{22.2\pm0.1}\text{Wo}_{1.4\pm0.1}$ (0.18 TiO_2 , 0.18 Al_2O_3 , 0.13 Cr_2O_3 , all wt. %, $\text{Fe/Mn}=28\pm2$, $n=9$); diopside, $\text{En}_{8.9\pm0.0}\text{Fs}_{47.0\pm0.3}\text{Wo}_{44.3\pm0.3}$ (0.40 TiO_2 , 0.50 Al_2O_3 , 0.88 Cr_2O_3 , 0.29 MnO , 0.54 Na_2O , all wt. %); ringwoodite, $\text{Fa}_{27.8\pm0.7}$ ($\text{Fe/Mn}=182\pm3$, $n=10$); majorite, $\text{Fs}_{21.3\pm0.3}\text{Wo}_{1.2\pm0.1}$ ($\text{Fe/Mn}=27\pm2$, $n=11$). Shock melt (broad beam electron microprobe): 47.59 SiO_2 , 27.17 MgO , 16.64 FeO , 2.60 CaO , 3.19 Al_2O_3 , 0.38 MnO , 0.10 TiO_2 , 0.33 Cr_2O_3 , 1.20 Na_2O , 0.13 K_2O , 0.17 NiO , all wt. %, $n=7$.

Classification: L6-melt breccia, W2, S5

Specimens: 21.2 g and one PTS are on deposit at *MSP*, Nicola Castellano holds the main mass.

Northwest Africa 8712 (NWA 8712)

Morocco

Purchased: Feb. 2014

Classification: HED achondrite (Howardite)

Petrography: The thin section shows mineral and lithic clasts (up to 4 mm in the longest dimension) of pigeonite ($\text{Fs}_{46.1\pm5.2}\text{Wo}_{10.5\pm3.3}$; $n=13$) and plagioclase set in a matrix of angular pyroxene (mainly orthopyroxene ($\text{Fs}_{30.1\pm9.7}\text{Wo}_{2.5\pm0.7}$; $n=18$) and pigeonite with a variation of Fe content) and plagioclase. Plagioclase are bytownite and anorthite. Some pigeonite grains have augite exsolution lamella. Melted clasts are observed with euhedral recrystallized olivine, pyroxene and interstitial plagioclase. Minor phases are troilite, chromite, FeNi metal and SiO_2 polymorphs. Eucritic component is approximately 40 vol.%.

Geochemistry: Orthopyroxene (Fs_{23.6-57.5}Wo_{1.5-3.6}), Fe/Mn=28.9-34; pigeonite (Fs_{35.7-52.4}Wo_{5.5-16.7}), Fe/Mn=27.2-32.7; augite lamella (Fs_{26.8-39.7}Wo_{24.1-34.5}); plagioclase (An_{82.8-95.9}, n=12).

Classification: Howardite

Specimens: 20 g at PMO.

Northwest Africa 8713 (NWA 8713)

Morocco

Purchased: Nov 2014

Classification: HED achondrite (Eucrite, polymict)

Petrography: This sample is brecciated with mineral and lithic fragments set in a fine-grained fragmental matrix. The major minerals are angular pyroxene (70 vol.%, mostly orthopyroxene (Fs_{38.9±17.4}Wo_{2.4±0.7}) and minor pigeonite (Fs_{50.6±3.1}Wo_{7.7±1.8}) with a variation of Fe content and plagioclase (20 vol.%, An_{88.2-95.1}; n=11) ranging from 20-850 µm. A few cumulate eucrite clasts have coarse-grained pyroxene and calcic plagioclase. The presence of large pyroxene grains with relatively uniform composition of Fs₂₃₋₂₈Wo_{1.4-2.3} suggests the presence of a diagenetic composition, but it only accounts for approximately 7 vol.%. A number of hypersthene grains have augite exsolution lamella 1 to 30 µm wide. Melted clasts are present with recrystallized augite, orthopyroxene and interstitial plagioclase. Silica is commonly present. Minor phases include ilmenite, troilite, chromite, and FeNi metal.

Geochemistry: Orthopyroxene (Fs_{14.9-65.5}Wo_{1.2-3.5}), pigeonite (Fs_{29.1-48.4}Wo_{5.5-8.9}), Fe/Mn=25.2-31.8; augite lamella (Fs_{26.6-31.4}Wo_{40.7-42.4}); anorthite (An_{88.2-95.1}).

Northwest Africa 8714 (NWA 8714)

Morocco

Purchased: Nov. 2014

Classification: Ordinary chondrite (H5)

Petrography: Chondrules with diameters ranging from 250 to 680 µm are visible.

Recrystallization is extensive. Major phases are olivine and low-Ca pyroxene. Minor phases include plagioclase, troilite, chromite and FeNi metal.

Geochemistry: Olivine (Fa_{17.4-18.4}), low-Ca pyroxene (Fs_{15.6-16.2}Wo_{1.2-1.5}).

Northwest Africa 8715 (NWA 8715)

Morocco

Purchased: Feb 2013

Classification: Carbonaceous chondrite (CO3)

Petrography: Abundant chondrules (48 vol.%) with diameters ranging from 70 to 380 µm are visible. A few chondrules are 400-700 µm. A large number of individual olivine and pyroxene grains (9 vol.%) occur in the matrix. Major phases are olivine and low-Fe pyroxene (Fs<10). Minor phases include plagioclase, troilite and FeNi metal. A relative low abundance of matrix (37 vol.%). Abundant fine-grained inclusions (6 vol.%).

Geochemistry: Olivine (Fa_{0.1-39.6}); orthopyroxene (Fs_{0.1-3.4}Wo_{0.8-2.8}); pigeonite (Fs_{1.9-8.8}Wo_{6.9-14.1}); augite (Fs_{1.6-3.4}Wo_{36.9-49.2}); plagioclase (An₇₂₋₇₆).

Northwest Africa 8716 (NWA 8716)

Morocco

Purchased: Dec 2014

Classification: Martian meteorite (Shergottite)

Petrography: Olivine macrocrysts (up to 1.8 mm) and microphenocrysts (up to 420 μm) are set in a fine groundmass of patchily zoned pyroxene, maskelynite, chromite, troilite. Large olivine macrocrysts and some microphenocrysts show zoning with ferroan rims and magnesium cores. Other olivine microphenocrysts are relatively homogeneous and have higher Fe contents. Tiny chromite inclusions and melt inclusions are observed within olivine grains.

Geochemistry: Olivine (cores of large macrocryst $\text{Fa}_{16.9-22.1}$, rims $\text{Fa}_{32.4-36.2}$, microphenocrysts $\text{Fa}_{41.7-47.8}$) $\text{Fe/Mn}=45.1-64.2$; orthopyroxene ($\text{Fs}_{18.2-21.4}\text{Wo}_{2.2-4.4}$), pigeonite ($\text{Fs}_{25-35.8}\text{Wo}_{6.7-16.3}$), $\text{Fe/Mn}=28.4-38.8$; maskelynite ($\text{An}_{58.7-65.7}\text{Ab}_{40.7-34.1}$)

Specimens: Olivine-phyric shergottite

Northwest Africa 8718 (NWA 8718)

(Northwest Africa)

Purchased: 2014

Classification: Ordinary chondrite (L6)

History: One subrounded stone weighing 98 g was found in Morocco in 2014. David Holden acquired the sample from a meteorite prospector in Erfoud, 2014.

Physical characteristics: The stone is brown and has a rounded shape displaying several small, shallow regmaglypts. There is no relict fusion crust remaining on the exterior. A prominent shock vein is visible on the outer surface. The cut face of the interior of the stone is orangish-brown and shows chondrules, clasts and fresh flakes of metal.

Petrography: Description and classification (A. Love, *App*): Sample displays recrystallized chondritic texture crosscut by glassy, ringwoodite-bearing shock veins. Few chondrules are defined yet have maskelynitized mesostasis and have an average diameter of 1154 μm . Sample contains maskelynite and troilite showing strong polycrystallinity.

Geochemistry: (A. Love, *App*) $\text{Fa}_{25.4\pm0.3}$, $N=18$; Low Ca pyroxene $\text{Fs}_{21.8\pm0.4}\text{Wo}_{2.3\pm0.3}$, $N=12$.

Classification: Ordinary Chondrite (L6, S6, W2).

Specimens: Two slices weighing 23.34 g and a polished thin section are currently on deposit at *App*.

Northwest Africa 8719 (NWA 8719)

(Northwest Africa)

Purchased: 2011 Nov 9

Classification: Iron meteorite (IIIAB)

Petrography: Structure shows minor deformation, some rust-filled short cracks. Meteorite moderately rusty, seems to be prone to rusting. Very few inclusions. No FeS recognized nor is schreibersite recognizable, even at intersections of kamacite lamellae. Medium octahedrite structure.

Geochemistry: Composition: Co, 5.04 mg/g; Ni, 77.8 mg/g; Ga, 19.6 $\mu\text{g/g}$; Ge, n.d.; As, 4.8 $\mu\text{g/g}$; Ir 3.94 $\mu\text{g/g}$; Au, 0.668 $\mu\text{g/g}$.

Classification: The meteorite is a IIIAB based on composition and structure. This meteorite is paired with [NWA 1430](#).

Northwest Africa 8720 (NWA 8720)

Morocco

Purchased: Oct 2014

Classification: Rumuruti chondrite (R4)

History: Purchased from a dealer in Morocco in October 2014 by A. Jonikas.

Physical characteristics: One stone with black fusion crust. Cut surface reveals well defined chondrules scattered within a light-brown matrix.

Petrography: (A. Rubin and J. Breen, *UCLA*) Microprobe examination of a polished mount shows low-Ca pyroxene exhibits only minor polysynthetic twinning. Small grains of pyrrhotite are present. The rock is moderately recrystallized, consistent with type 4. The mean olivine Fa content indicates that it is an R chondrite. Mean chondrule size is ~400 μm , also consistent with R.

Geochemistry: Olivine, $\text{Fa}_{38.5\pm0.3}$ (n=16); low-Ca pyroxene, $\text{Fs}_{23.4\pm5.4}\text{Wo}_{1.0\pm0.6}$ (n=10); Ca-pyroxene, $\text{Fs}_{9.5}\text{Wo}_{46.3}$ (n=2)

Classification: Rumuruti Chondrite (R4), Wi2 based on weathering index as published in [Rubin and Huber \(2005\)](#)

Specimens: 16.40 g on deposit at *UCLA*, A. Jonikas holds the main mass.

Northwest Africa 8721 (NWA 8721)

Morocco

Purchased: Oct 2014

Classification: Carbonaceous chondrite (CK5)

History: Purchased from a dealer in Morocco in October of 2014 by A. Jonikas.

Physical characteristics: One stone fragment with black fusion crust on one side. Cut surface reveals scattered chondrules within a grayish-brown matrix.

Petrography: (A. Rubin and J. Breen, *UCLA*) Microprobe examination of a polished mount shows plagioclase grains average 20 μm in size. The groundmass grain size is 70 μm , consistent with CK5. There are readily discernable chondrules and small rounded magnetite grains.

Geochemistry: Mineral compositions and geochemistry: olivine: $\text{Fa}_{32.5\pm0.3}$ (n=18); there is no low-Ca pyroxene; Ca-pyroxene: $\text{Fs}_{10.2\pm2.3}\text{Wo}_{48.0\pm0.6}$ (n=5)

Classification: Carbonaceous Chondrite (CK5), Wi4 based on weathering index as published in [Rubin and Huber \(2005\)](#).

Specimens: 22.07 g on deposit at *UCLA*, A. Jonikas hold the main mass.

Northwest Africa 8722 (NWA 8722)

Morocco

Purchased: 2006

Classification: Carbonaceous chondrite (CV3)

History: A single 8.1 kg stone was purchased in Erfoud by an anonymous person.

Physical characteristics: The main mass is partially crusted.

Petrography: The meteorite consists of ca. 40% diverse chondrules (typically mm-sized), 8% refractory inclusions, 2% lithic inclusions/fragments of mm to cm-size, and 50% matrix. The lithic inclusion are of dark or CO chondrite-like texture. The matrix is light brown and somewhat weathered with no visible metal.

Geochemistry: Olivine, $\text{Fa}_{23\pm13}$ (Fa_{2-40} , n=38); low-Ca pyroxene, $\text{Fs}_{5\pm1}$ (Fs_{1-21} ; n= 12).

Northwest Africa 8723 (NWA 8723)

(Northwest Africa)

Found: 2014

Classification: Ordinary chondrite (L5)

History: Recovered in April 2014 near the borders of Mauritania, Western Sahara and Algeria. Purchased in Mauritania in June 2014.

Physical characteristics: Single stone. Weathered fusion crust. Saw cut reveals fine-grained metal/sulfide set in a fine-grained brown matrix, also metal veinlet ~1 mm thick.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows scattered equilibrated chondrules, plagioclase with grain size up to 50 μm , kamacite, taenite, troilite, chromite, and augite.

Geochemistry: C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{25.0\pm1.1}$, $\text{Fe/Mn}=50\pm5$, $n=15$; low-Ca pyroxene $\text{Fs}_{21.1\pm0.7}\text{Wo}_{2.7\pm0.7}$, $\text{Fe/Mn}=31\pm2$, $n=12$; plagioclase $\text{Ab}_{83.4\pm0.3}$, $n=4$.

Classification: Ordinary chondrite (L5, W1, S3).

Specimens: 23.2 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 8724 (NWA 8724)

(Northwest Africa)

Found: 2014

Classification: Carbonaceous chondrite (CO3.2)

History: Recovered in April 2014 near the borders of Mauritania, Western Sahara and Algeria. Purchased in Mauritania in June 2014.

Physical characteristics: Single stone. Shiny dark brown weathered exterior. Saw cut reveals small chondrules set in a dark brown matrix.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous chondrules, some fragmental or irregular, most in the size range 50-200 μm , a few up to 400 μm . Scattered metal/sulfide blebs, fine-grained matrix makes up about 40% of this meteorite.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Ferroan chondrule olivine $\text{Fa}_{31.9\pm9.8}$, $\text{Fe/Mn}=116\pm26$, $\text{Cr}_2\text{O}_3=0.09\pm0.09$, $n=33$; Type I chondrule low-Ca pyroxene $\text{Fs}_{1.9\pm0.7}\text{Wo}_{1.6\pm1.1}$, $n=5$; Type II chondrule low-Ca pyroxene $\text{Fs}_{13.2\pm13.2}\text{Wo}_{1.9\pm1.3}$, $\text{Fe/Mn}=60\pm34$, $n=12$; aluminous diopside $\text{Fs}_{3.5\pm1.3}\text{Wo}_{40.9\pm1.4}$, $n=2$; pigeonite $\text{Fs}_{52.7}\text{Wo}_{15.9}$, $\text{Fe/Mn}=74$, $n=1$.

Classification: Carbonaceous chondrite (CO3.2) based on mean value and sigma of Cr_2O_3 in ferroan olivine, similar values to Kainsaz and Rainbow (both CO3.2) as reported in [Grossman and Brearley \(2005\)](#). Moderately weathered, low shock stage.

Specimens: 20.7 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 8725 (NWA 8725)

(Northwest Africa)

Found: 2014

Classification: Carbonaceous chondrite (CR2)

History: Recovered in April 2014 near the borders of Mauritania, Western Sahara and Algeria. Purchased in Mauritania in June 2014.

Physical characteristics: Single stone. Shiny black, irregular weathered exterior with some CAIs visible. A saw cut reveals many distinct chondrules (850 ± 500 μm , $n=17$) and scattered small CAIs set in a brown matrix.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous porphyritic chondrules, many mantled by, or including, Fe-Ni metal blebs or grains which make up ~10% of this meteorite; AOA's present, ~40% fine-grained matrix with phyllosilicates, FeNi-sulfide and troilite detected.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Ferroan chondrule olivine $\text{Fa}_{9.4\pm15.4}$, $n=27$, $\text{Fe/Mn}=51\pm29$, $\text{Cr}_2\text{O}_3=0.19\pm0.09$, $n=23$; Forsteritic chondrule olivine $\text{Fa}_{0.9\pm0.5}$, $\text{Cr}_2\text{O}_3=0.28\pm0.19$, $n=4$; enstatite $\text{Fs}_{2.0\pm0.7}\text{Wo}_{2.0\pm3.2}$, $n=16$; aluminous diopside $\text{Fs}_{1.6\pm0.5}\text{Wo}_{35.5\pm6.9}$, $n=8$.

Classification: Carbonaceous chondrite (CR2). Moderately weathered, low shock stage.

Specimens: 21 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 8726 (NWA 8726)

(Northwest Africa)

Found: 2014

Classification: Ordinary chondrite (L5)

History: Recovered in April 2014 near the borders of Mauritania, Western Sahara and Algeria.

Purchased in Mauritania in June 2014.

Physical characteristics: Single stone. Weathered partial fusion crusted exterior. A saw cut reveals metal/sulfide and chondrules set in an orange matrix.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows equilibrated chondrules, plagioclase grain size up to 25 μm . Kamacite, taenite, troilite, chromite, and Cl-rich apatite.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{25.3\pm0.6}$, $\text{Fe/Mn}=51\pm3$, $n=20$; low-Ca pyroxene $\text{Fs}_{21.7\pm1.4}\text{Wo}_{1.5\pm0.2}$, $\text{Fe/Mn}=31\pm2$, high-Ca pyroxene $\text{Fs}_{10.3\pm2.9}\text{Wo}_{39.2\pm9.0}$, $\text{Fe/Mn}=28\pm7$, $n=4$; anomalous ferroan olivine $\text{Fa}_{39.8\pm1.7}$, $\text{Fe/Mn}=113\pm5$, $n=2$.

Classification: Ordinary chondrite (L5, W1, S3).

Specimens: 23.2 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 8727 (NWA 8727)

(Northwest Africa)

Purchased: 2014

Classification: Lunar (olivine gabbro)

History: Purchased from a Moroccan meteorite dealer in September 2014

Physical characteristics: Single stone, smooth weathered fusion crust. Saw cut and polished surface reveals fine-grained, light gray interior with fine shock melt veining.

Petrography: (C. Agee, *UNM*) Microprobe examination of the deposit sample, shows a monomict breccia with approximately 75% plagioclase, 10% olivine, 10% pigeonite. Primarily fine-grained plagioclase, olivine, and pigeonite 5-50 μm , scattered larger plagioclase clasts 200-500 μm . Shock melt veins are found throughout. Accessory phases include Fe-metal, ilmenite, and apatite.

Geochemistry: (C. Agee and N. Muttik, *UNM*). olivine $\text{Fa}_{26.3\pm0.6}$, $\text{Fe/Mn}=95\pm1$, $n=26$; pigeonite $\text{Fs}_{22.3\pm1.1}\text{Wo}_{7.4\pm2.3}$, $\text{Fe/Mn}=61$, $n=21$; plagioclase $\text{An}_{95.0\pm1.1}\text{Ab}_{4.5\pm0.9}\text{Or}_{0.5\pm0.2}$, $n=8$; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): $\text{SiO}_2=44.35\pm0.66$, $\text{TiO}_2=0.93\pm0.28$, $\text{Al}_2\text{O}_3=29.06\pm1.06$, $\text{Cr}_2\text{O}_3=0.09\pm0.01$, $\text{MgO}=5.93\pm0.71$, $\text{FeO}=4.82\pm0.44$, $\text{MnO}=0.06\pm0.02$, $\text{CaO}=15.50\pm0.49$, $\text{NiO}=0.08\pm0.03$, $\text{Na}_2\text{O}=0.55\pm0.03$, $\text{K}_2\text{O}=0.12\pm0.01$ (all wt%), $\text{Fe/Mn}=84\pm29$, $\text{Mg\#}=68.6\pm1.8$, $n=5$.

Classification: Achondrite (lunar olivine leuco-gabbro), low weathering grade, high shock stage.

Specimens: A total of 20.6 g including a probe mount on deposit at *UNM*. *DPitt* holds the main mass.

Northwest Africa 8728 (NWA 8728)

(Northwest Africa)

Found: 2014

Classification: Primitive achondrite (Lodranite)

History: Recovered in April 2014 near the borders of Mauritania, Western Sahara and Algeria. Purchased in Mauritania in June 2014.

Physical characteristics: Single stone, weathered exterior. A saw cut reveals coarse-grains (up to 5 mm) of green chrome diopside, orange to dark-red grains also present, some metal grains up to 3 mm.

Petrography: (C. Agee, *UNM*) Microprobe examination of the deposit sample, shows a breccia with fragmental olivine and pyroxene grains, some mm-size. Accessory phases include Fe-Ni metal, iron oxide, troilite, and chromite. No plagioclase present.

Geochemistry: (C. Agee and N. Muttik, *UNM*). olivine $\text{Fa}_{11.2\pm0.1}$, $\text{Fe/Mn}=36\pm2$, $n=12$; low-Ca pyroxene $\text{Fs}_{10.2\pm0.2}\text{Wo}_{2.3\pm0.7}$, $\text{Fe/Mn}=21\pm1$, $n=4$; diopside $\text{Fs}_{4.4\pm0.2}\text{Wo}_{44.4\pm0.5}$, $\text{Fe/Mn}=14\pm2$, $\text{Cr}_2\text{O}_3=0.93\pm0.23$ (wt%), $n=6$.

Classification: Primitive achondrite (lodranite), moderate weathering grade, high shock stage.

Specimens: A total of 21.2 g including a probe mount on deposit at *UNM*. *DPitt* holds the main mass.

Northwest Africa 8729 (NWA 8729)

(Northwest Africa)

Found: 2014

Classification: HED achondrite (Eucrite, monomict)

History: Recovered in April 2014 near the borders of Mauritania, Western Sahara and Algeria. Purchased in Mauritania in June 2014.

Physical characteristics: A single stone with irregular exterior. A saw cut reveals white feldspar grains up to 3 mm, green-brown pyroxene grains, all set in a fine-grained light-gray groundmass.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows approximately equal amounts of pyroxene and plagioclase, slightly brecciated, numerous shock fractures. Accessory troilite, chromite, ilmenite, and silica.

Geochemistry: (C. Agee and N. Muttik, *UNM*). Low-Ca pyroxene $\text{Fs}_{55.4\pm1.5}\text{Wo}_{2.1\pm1.4}$, $\text{Fe/Mn}=32\pm1$, $n=15$; augite $\text{Fs}_{24.3\pm1.4}\text{Wo}_{41.8\pm1.9}$, $\text{Fe/Mn}=30\pm2$, $n=17$; plagioclase $\text{An}_{86.2\pm4.0}\text{Ab}_{13.1\pm3.7}\text{Or}_{0.7\pm0.3}$, $n=5$.

Classification: Achondrite (eucrite). Equilibrated, clear separation of high-Ca and low-Ca pyroxene, no pigeonite present. Moderate weathering grade, high shock stage.

Specimens: 20.7 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 8730 (NWA 8730)

(Northwest Africa)

Found: 2014

Classification: HED achondrite (Eucrite, cumulate)

History: Recovered in April 2014 near the borders of Mauritania, Western Sahara and Algeria. Purchased in Mauritania in June 2014.

Physical characteristics: A single stone with fusion crusted exterior. A saw cut reveals cumulate texture of mm-size white feldspar and green pyroxene grains.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows approximately equal amounts of pyroxene and plagioclase, unbrecciated, numerous shock fractures. Glassy fusion crust up to 30 μm thick. Accessory chromite.

Geochemistry: (C. Agee and N. Muttik, *UNM*). Low-Ca pyroxene $\text{Fs}_{49.7\pm1.8}\text{Wo}_{2.7\pm2.2}$, $\text{Fe/Mn}=29\pm0$, $n=10$; augite $\text{Fs}_{19.9\pm0.7}\text{Wo}_{44.0\pm1.4}$, $\text{Fe/Mn}=25\pm1$, $n=11$; plagioclase $\text{An}_{93.4\pm0.4}\text{Ab}_{6.2\pm0.4}\text{Or}_{0.4\pm0.1}$, $n=5$; fusion crust (proxy for bulk composition) $\text{SiO}_2=46.9\pm1.1$, $\text{TiO}_2=0.01\pm0.01$, $\text{Al}_2\text{O}_3=15.4\pm3.0$, $\text{Cr}_2\text{O}_3=0.25\pm0.06$, $\text{MgO}=9.5\pm1.5$, $\text{FeO}=15.5\pm2.5$, $\text{MnO}=0.57\pm0.08$, $\text{NiO}=0.02\pm0.04$, $\text{CaO}=10.4\pm0.9$, $\text{Na}_2\text{O}=0.25\pm0.04$, $\text{K}_2\text{O}=0.04\pm0.01$ (all wt%), $\text{Mg\#}=52.1\pm1.1$.

Classification: Achondrite (cumulate eucrite). Equilibrated, clear separation of high-Ca and low-Ca pyroxene. Low weathering grade, high shock stage.

Specimens: 10.5 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 8731 (NWA 8731)

(Northwest Africa)

Find: 2014

Classification: Ureilite

History: Recovered in April 2014 near the borders of Mauritania, Western Sahara and Algeria. Purchased in Mauritania in June 2014.

Physical characteristics: A single stone with irregular, dark exterior. A saw cut reveals a fine-grained cumulate texture of pyroxene and olivine grains (0.5-2 mm).

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows approximately 70% pyroxene with exsolution lamellae (inverted pigeonite) and 25% olivine with very fine iron-reduction zonation, accessory Fe-Ni metal and iron oxide. There is graphite phase on grain boundaries and triple junctions.

Geochemistry: (C. Agee and N. Muttik, *UNM*). Olivine $\text{Fa}_{5.7\pm0.7}$, $\text{Fe/Mn}=11\pm1$, $\text{Cr}_2\text{O}_3=0.60\pm0.02$ $\text{CaO}=0.32\pm0.02$ (wt%), $n=14$; low-Ca pyroxene $\text{Fs}_{5.6\pm0.7}\text{Wo}_{4.9\pm0.1}$, $\text{Fe/Mn}=8\pm1$, $n=4$; augite $\text{Fs}_{3.2\pm0.1}\text{Wo}_{36.9\pm0.3}$, $\text{Fe/Mn}=6\pm0$, $n=6$.

Classification: Achondrite (augite-bearing ureilite). Moderate weathering grade, low shock stage.

Specimens: 21.3 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 8732 (NWA 8732)

(Northwest Africa)

Found: 2014

Classification: Primitive achondrite (Acapulcoite/Lodranite)

History: Recovered in April 2014 near the borders of Mauritania, Western Sahara and Algeria. Purchased in Mauritania in June 2014.

Physical characteristics: A single stone with weathered exterior. A saw cut reveals a mixture of coarse-grained light colored (>1 mm), but also fine grained material, metal and oxidized metal.

Petrography: (C. Agee, *UNM*) Microprobe examination of the deposit sample, shows a brecciated texture with highly variable pyroxene and olivine grain size. Plagioclase makes up approximately 10-20% of this meteorite. Accessory phases include Fe-Ni metal, iron oxide, and chromite.

Geochemistry: (C. Agee and N. Muttik, *UNM*). olivine $\text{Fa}_{13.2\pm0.1}$, $\text{Fe/Mn}=25\pm1$, $n=12$; low-Ca pyroxene $\text{Fs}_{11.4\pm0.6}\text{Wo}_{1.5\pm0.5}$, $\text{Fe/Mn}=15\pm0$, $n=8$; diopside $\text{Fs}_{5.2\pm1.3}\text{Wo}_{44.5\pm1.6}$, $\text{Fe/Mn}=12\pm2$,

$\text{Cr}_2\text{O}_3=0.69\pm0.09$ (wt%), $n=4$; oligoclase plagioclase $\text{An}_{15.7\pm3.0}\text{Ab}_{81.3\pm2.7}\text{Or}_{3.0\pm0.4}$, $n=6$; andesine plagioclase $\text{An}_{49.4}\text{Ab}_{49.7}\text{Or}_{1.0}$, $n=1$.

Classification: Primitive achondrite, transitional between acapulcoite and lodranite. Some domains contain coarse pyroxene crystals >1 mm (lodranite-like) whereas other domains are fine grained $\sim 100\text{-}300$ μm (acapulcoite-like); also there is a significant amount of plagioclase present indicative of acapulcoite ([Goodrich et al., 2010](#)), moderate weathering grade, high shock stage.

Specimens: A total of 22 g including a probe mount on deposit at *UNM*. *DPitt* holds the main mass.

Northwest Africa 8733 (NWA 8733)

(Northwest Africa)

Found: 2014

Classification: Lunar meteorite (basalt/anorthosite)

History: Recovered in April 2014 near the borders of Mauritania, Western Sahara and Algeria. Purchased in Mauritania in June 2014.

Physical characteristics: Six similar stones with irregular dark exteriors. Saw cuts on two of the stones reveal identical textures: a few white plagioclase grains and lithic clasts, set in a dark-gray matrix, also some bright metallic grains up to 1 mm.

Petrography: (C. Agee, *UNM*) Microprobe examination polished mount shows a polymict breccia with numerous fragmental olivine, pyroxene, and plagioclase crystals; anorthositic and basaltic clasts throughout. Accessory Fe-metal, ilmenite, chromite, silica, and troilite. Calcite weathering products detected.

Geochemistry: (C. Agee and N. Muttik, *UNM*). Olivine $\text{Fa}_{35.0\pm10.4}$, $\text{Fe/Mn}=96\pm9$, range $\text{Fa}_{17.9-64.0}$, $n=22$; clinopyroxene $\text{Fs}_{36.4\pm11.1}\text{Wo}_{17.0\pm7.5}$, $\text{Fe/Mn}=57\pm6$, range $\text{Fs}_{22.3}\text{Wo}_{5.6}\text{Fs}_{56.6}\text{Wo}_{29.0}$, $n=18$; plagioclase $\text{An}_{95.0\pm1.4}\text{Ab}_{4.5\pm1.3}\text{Or}_{0.4\pm0.2}$, $n=7$. Shock melt (proxy for bulk composition) $\text{SiO}_2=44.0\pm1.1$, $\text{TiO}_2=0.37\pm0.10$, $\text{Al}_2\text{O}_3=25.1\pm4.3$, $\text{Cr}_2\text{O}_3=0.20\pm0.12$, $\text{MgO}=7.9\pm1.7$, $\text{FeO}=7.3\pm3.0$, $\text{MnO}=0.09\pm0.04$, $\text{NiO}=0.01\pm0.01$, $\text{CaO}=14.5\pm1.6$, $\text{Na}_2\text{O}=0.28\pm0.27$, $\text{K}_2\text{O}=0.08\pm0.03$ (wt%), $n=3$.

Classification: Achondrite (lunar basaltic/anorthositic breccia), moderate weathering grade, high shock stage.

Specimens: A total of 10.5 g including a probe mount on deposit at *UNM*. *DPitt* holds the main mass.

Northwest Africa 8734 (NWA 8734)

(Northwest Africa)

Found: 2014

Classification: Primitive achondrite (Lodranite)

History: Recovered in April 2014 near the borders of Mauritania, Western Sahara and Algeria. Purchased in Mauritania in June 2014.

Physical characteristics: A single stone with weathered exterior. A saw cut reveals primarily dark colored, coarse grains ($\sim 1\text{-}2$ mm), with a few scattered lighter grains in a dark matrix.

Petrography: (C. Agee, *UNM*) Microprobe examination of the deposit sample, shows a poikilitic to granulitic texture of pyroxene and olivine grains. Plagioclase makes up approximately 10% of this meteorite. Accessory phases include Fe-Ni metal, iron oxide veinlets, chromite, apatite, and Fe-P blebs.

Geochemistry: (C. Agee and N. Muttik, *UNM*). olivine $\text{Fa}_{12.6 \pm 0.1}$, $\text{Fe/Mn} = 23 \pm 1$, $n = 11$; low-Ca pyroxene $\text{Fs}_{11.5 \pm 0.6} \text{Wo}_{1.9 \pm 0.5}$, $\text{Fe/Mn} = 14 \pm 0$, $n = 8$; diopside $\text{Fs}_{3.3 \pm 1.3} \text{Wo}_{46.3 \pm 1.0}$, $\text{Fe/Mn} = 9 \pm 3$, $\text{Cr}_2\text{O}_3 = 1.33 \pm 0.03$ (wt%), $n = 6$; subcalcic augite $\text{Fs}_{5.6 \pm 0.6} \text{Wo}_{28.0 \pm 0.4}$, $\text{Fe/Mn} = 17 \pm 2$, $n = 4$; plagioclase $\text{An}_{14.6 \pm 4.6} \text{Ab}_{82.1 \pm 3.6} \text{Or}_{3.3 \pm 1.1}$, $n = 6$.

Classification: Primitive achondrite (lodranite). Classification based on relatively coarse grain-size compared to acapulcoites. Moderate weathering grade, low shock stage.

Specimens: A total of 13 g including a probe mount on deposit at *UNM*. *DPitt* holds the main mass.

Northwest Africa 8735 (NWA 8735)

Northwest Africa

Purchased: 2014

Classification: Ordinary chondrite (H5)

History: One subrounded stone weighing 244 g was found in Morocco in 2014. David Holden acquired the sample from a meteorite prospector in Erfoud, 2014.

Physical characteristics: The oriented stone is dark brown and has a sub-rounded shape displaying many shallow regmaglypts and a discontinuous rollover lip on the trailing edge. There is no relict fusion crust remaining on the exterior. The cut face of the interior of the stone is orangish-brown and shows chondrules, clasts and fresh flakes of metal.

Petrography: Description and classification (A. Love, *App*): Sample displays recrystallized chondritic texture composed of chondrules and fragments in a recrystallized matrix of silicates and grains of weathered FeNi and FeS. Chondrules are well-defined, have turbid to recrystallized mesostasis and have an average diameter of 648 μm ($N = 30$).

Geochemistry: (A. Love, *App*) Olivine $\text{Fa}_{18.8 \pm 0.2}$, $N = 18$; Low Ca pyroxene $\text{Fs}_{16.7 \pm 0.9} \text{Wo}_{2.0 \pm 0.2}$, $N = 14$

Classification: Ordinary chondrite (H5, S1, W3)

Specimens: An endpiece and 3 slices weighing 21.67 g and a thin section are currently on deposit at *App*.

Northwest Africa 8736 (NWA 8736)

(Northwest Africa)

Purchased: Oct 2014

Classification: HED achondrite (Howardite)

History: Purchased by Habib Naji from a Moroccan meteorite hunter in Guelmin, Morocco, October 2014.

Physical characteristics: Single stone with weathered black fusion crust. A broken surface reveals a breccia with white clasts set in a fine-grained, light gray matrix; small (~1 mm) distinctive black CM fragments scattered throughout.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows a highly brecciated howardite with ~30% diagenitic pyroxenes, ~20% equilibrated cumulate eucrite pyroxenes, and ~50% equilibrated basaltic eucrite clasts. Howardite lithologies contain accessory Fe-Ni metal, troilite, chromite, silica, apatite, and ilmenite. CM2 xenoliths show moderate foliation, with scattered type I chondrules, ~70%, phyllosilicate-rich matrix, FeNiS phase, troilite.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Diogenite orthopyroxene $\text{Fs}_{27.4 \pm 6.4} \text{Wo}_{2.4 \pm 0.3}$, $\text{Fe/Mn} = 30 \pm 2$, $n = 7$; cumulate eucrite low-Ca pyroxene $\text{Fs}_{45.7 \pm 4.4} \text{Wo}_{2.1 \pm 1.1}$, $\text{Fe/Mn} = 29 \pm 1$, $n = 3$,

cumulate eucrite augite $\text{Fs}_{18.8}\text{Wo}_{41.8}$, $\text{Fe}/\text{Mn}=23$, $n=1$; cumulate eucrite pigeonite $\text{Fs}_{35.7\pm0.0}\text{Wo}_{14.8\pm0.8}$, $\text{Fe}/\text{Mn}=28\pm2$, $n=2$; basaltic eucrite low-Ca pyroxene $\text{Fs}_{61.0\pm4.0}\text{Wo}_{3.7\pm2.7}$, $\text{Fe}/\text{Mn}=32\pm1$, $n=8$; basaltic eucrite augite $\text{Fs}_{35.6\pm7.7}\text{Wo}_{42.1\pm0.5}$, $\text{Fe}/\text{Mn}=37\pm3$, $n=2$; basaltic eucrite pigeonite $\text{Fs}_{45.7}\text{Wo}_{18.3}$, $\text{Fe}/\text{Mn}=31$, $n=1$; plagioclase $\text{An}_{87.4\pm3.7}$, $n=6$. CM2 xenoliths: type I chondrule olivine $\text{Fa}_{2.3\pm1.1}$, $\text{Cr}_2\text{O}_3=0.44\pm0.11$ (wt%), $n=6$; ferroan olivine $\text{Fa}_{37.9}$, $\text{Fe}/\text{Mn}=111$, $\text{Cr}_2\text{O}_3=0.40$ (wt%), $n=1$; enstatite $\text{Fs}_{1.7}\text{Wo}_{0.7}$, $n=1$; aluminous augite $\text{Fs}_{1.9}\text{Wo}_{29.5}$, $n=1$.

Classification: Achondrite (howardite) with three lithologies: 1) diogenite, 2) equilibrated cumulate eucrite, 3) equilibrated basaltic eucrite. Xenolithic CM2 clasts are present throughout. Low weathering grade, high shock stage.

Specimens: 20.2 g including a probe mount on deposit at UNM, Habib Naji holds the main mass.

Northwest Africa 8737 (NWA 8737)

(Northwest Africa)

Purchased: 2014

Classification: Carbonaceous chondrite (CO3.0)

History: Purchased by Aziz Habibi in Morocco, January 2014.

Physical characteristics: Many identical appearing pieces with dark-brown exterior. A saw cut reveals very small chondrules and scattered small CAIs set in a dark brown matrix.

Petrography: (C. Agee, UNM) Microprobe examination of a polished mount shows numerous chondrules 5-250 μm (155 ± 93 μm , $n=64$), fine-grained matrix makes up about 25% of this meteorite.

Geochemistry: (C. Agee and N. Muttik, UNM) Olivine range $\text{Fa}_{0.6-56.6}$, $n=28$. Type I chondrule olivine $\text{Fa}_{1.0\pm0.3}$, $n=14$; ferroan chondrule olivine $\text{Fa}_{31.3\pm16.0}$, $\text{Fe}/\text{Mn}=83\pm31$, $\text{Cr}_2\text{O}_3=0.29\pm0.11$ wt%, $n=14$; enstatite $\text{Fs}_{2.2\pm1.7}\text{Wo}_{1.7\pm1.3}$, $n=26$; aluminous diopside and Cl-apatite found.

Classification: Carbonaceous chondrite (CO3.0) based on mean $\text{Cr}_2\text{O}_3=0.29\pm0.11$ wt% in ferroan olivines, values plotting close to Colony (CO3.0) as reported by [Grossman and Brearley \(2005\)](#).

Specimens: 20.1 g including a probe mount on deposit at UNM, Aziz Habibi holds the main mass.

Northwest Africa 8739 (NWA 8739)

(Northwest Africa)

Purchased: 2013

Classification: HED achondrite (Eucrite, polymict)

History: Purchased by Blaine Reed from Eegooblago Meteorites at the Denver Gem and Mineral Show 2013.

Physical characteristics: Single stone, smooth brown weathered exterior. A saw cut reveals a breccia with scattered clasts up to ~1 cm set in a fine-grained, gray, groundmass.

Petrography: (C. Agee, UNM) Microprobe examination of a polished mount shows ~55% pyroxene and ~40% plagioclase. Accessory silica, troilite, chromite, ilmenite, and Fe-metal. Several different microtextures are present; there are numerous fragmental pyroxene and plagioclase grains up to ~300 μm , clasts with quench mesostasis and skeletal pyroxenes, clasts with acicular plagioclase or pyroxene intergrowths. Most pyroxenes show strong igneous zoning with En-rich cores and Fs/Wo-rich rims, however there is also a minor population of pyroxenes that appear to be more equilibrated with fine exsolution lamellae.

Geochemistry: (C. Agee and N. Muttik, *UNM*) EMPA. Pyroxene $\text{Fs}_{45.6 \pm 10.9} \text{Wo}_{10.1 \pm 3.0}$, $\text{Fe/Mn} = 31 \pm 2$, $n=25$; plagioclase $\text{Or}_{0.6 \pm 0.4} \text{Ab}_{10.3 \pm 3.6} \text{An}_{89.1 \pm 4.0}$, $n=4$. Oxygen isotopes (K. Ziegler, *UNM*): acid-washed material analyzed in 2 replicates by laser fluorination gave, respectively $\delta^{18}\text{O} = 3.420, 2.990$; $\delta^{17}\text{O} = 1.508, 1.312$; $\Delta^{17}\text{O} = -0.298, -0.267$ (all per mil).

Classification: Achondrite (polymict eucrite) Unequilibrated basalt with a range of pyroxene compositions consistent with Type-2 eucrites ([Takeda and Graham, 1991](#)); a polymict breccia similar in texture and composition to [Pasamonte](#).

Specimens: 20.0 g including a probe mount on deposit at *UNM*, *Reed* holds the main mass.

Northwest Africa 8740 (NWA 8740)

(Northwest Africa)

Purchased: 2014

Classification: Ordinary chondrite (L6)

History: One flattened stone weighing 292 g was found in Morocco in 2014. David Holden acquired the sample from a meteorite prospector in Erfoud, 2014.

Physical characteristics: The stone is dark brown and has a flattened rectangular shape displaying many shallow regmagpylts. There is no relict fusion crust remaining on the exterior. The cut face of the interior of the stone is mottled orangish-brown and shows weathered flakes of metal.

Petrography: (A. Love, *App*) Sample displays recrystallized chondritic texture crosscut by shock veins and fractures containing FeOH weathering products. Chondrules are not defined.

Geochemistry: (A. Love,) Olivine $\text{Fa}_{26.1 \pm 0.4}$, $N=14$; Low Ca pyroxene $\text{Fs}_{21.7 \pm 0.5} \text{Wo}_{1.9 \pm 0.3}$, $N=12$

Classification: Ordinary chondrite (L6, S4, W3)

Specimens: Two slices weighing 22.4 g, and a polished thin section are currently on deposit at *App*.

Northwest Africa 8741 (NWA 8741)

(Northwest Africa)

Purchased: April 2014

Classification: Mesosiderite (group A4)

History: A single stone was purchased by anonymous dealer from nomads.

Physical characteristics: The 22.3 kg stone has isometric shape. A surface is dark brown. Fusion crust is not preserved.

Petrography: The meteorite is composed of (vol%) silicate matrix (71.8) and metal (28.2). The silicate matrix is medium-grained rock of poikilo-ophitic texture. The rock composes of anhedral and subhedral grains of pyroxene (34.9) surrounded by anhedral and subhedral grains of feldspar (38.5), pyroxene, metal (8.7) and prismatic needles of silica phase (17.9). Larger pyroxene grains poikilitically enclose the grains of all other phases. Minor phases are troilite, schreibersite, chromite, ilmenite and phosphate. The meteorite contains minor large xenocrysts of pyroxene, xenoliths of pyroxenites, metal nodules and rare metal veins connecting the large metal grains.

Geochemistry: Pyroxene: $\text{Fs}_{33.9-39.0} \text{Wo}_{1.8-3.7}$ (average $\text{Fs}_{37.3} \text{Wo}_{2.9}$; $\text{Fe/Mn} = 24$) and $\text{Fs}_{15.0-18.1} \text{Wo}_{41.1-42.8}$ (average $\text{Fs}_{17.2} \text{Wo}_{41.9}$; $\text{Fe/Mn} = 18.6$), feldspar $\text{An}_{85.2-90} \text{Ab}_{9.8-14.4}$. Xenocrystic pyroxenes are zoned $\text{Fs}_{30.0} \text{Wo}_{2.1}$ (core) – $\text{Fs}_{35.7} \text{Wo}_{2.7}$ (rim) (average $\text{Fe/Mn} = 29$). Pyroxenite xenoliths: Px is $\text{Fs}_{20.8} \text{Wo}_{1.2}$ ($\text{Fe/Mn} = 30$), interstitial Px is $\text{Fs}_{24.7} \text{Wo}_{2.3}$ ($\text{Fe/Mn} = 30.3$), feldspar $\text{An}_{84.4-93.5} \text{Ab}_{6.3-14.9}$.

Classification: Mesosiderite-A4. Minimal weathering.

Specimens: A type specimen of 118.95 g and five thick polished sections are on deposit at *Vernad*. Anonymous dealer holds a main mass.

Northwest Africa 8742 (NWA 8742)

(Northwest Africa)

Purchased: April 2014

Classification: Mesosiderite-B3

History: One stone found by nomads was received from Mr. Aziz Habibi in Arfoud, Morocco, in April, 2014.

Physical characteristics: A single stone of 85 g total weight is a fractured fragment of meteorite. A surface of the sample is ragged, ~5% of the sample surface is covered by fusion crust

Petrography: (C. A. Lorenz, *Vernad*.) The meteorite is a medium-grained metabreccia of silicates and Fe-Ni metal. The meteorite has poikiloblastic texture and is composed of (vol.%) 100-300 μm anhedral grains of dissolved pyroxene (65.8), 50-200 μm anhedral grains of feldspar (13.1), metal (8.0), hydroxides (13.1) and angular pyroxene megacrysts (up to 5 mm); minor minerals are a silica phase, phosphate, chromite, troilite and schreibersite. Metal is composed of kamacite and taenite.

Geochemistry: (N. N. Kononkova, *Vernad*, EMP) pyroxene $\text{Fs}_{28.6}\text{Wo}_{2.8}$ (Fe/Mn=26.2); $\text{Fs}_{12.8}\text{Wo}_{42.3}$; feldspar $\text{An}_{90.9}\text{Ab}_{8.1}$; kamacite (wt.%) Ni = 5.79, Co = 0.63, P = 0.12; taenite: Ni = 37.2-49.9, Co = 0.11-0.23.

Classification: Mesosiderite-B3. Moderate weathering.

Specimens: A type specimen of 27.37 g, one thin section and one polished thick section are on deposit at *Vernad*. *DMUH* holds the main mass.

Northwest Africa 8743 (NWA 8743)

(Northwest Africa)

Purchased: 2014

Classification: HED achondrite (Eucrite, melt breccia)

History: A stone was found in northwest Africa. Moroccan dealer Mohammed Sbai sold the stone to an anonymous collector at the Changsha mineral show in May 2014.

Physical characteristics: Single pie-shaped stone has patchy dark-gray irregular surface. Fusion crust is not preserved.

Petrography: (C. A. Lorenz, *Vernad*) The rock is a breccia consisting of coarse-grained gabbro fragments (33 vol%) up to 6×3 cm and minor fragments of fine-grained pyroxene-feldspar rocks. The rock fragments are embedded into a fine-grained matrix full of fine mineral and rock fragments. The matrix consists of pyroxene and feldspar needles which form a graphic intergrowth.

Geochemistry: (N. N. Kononkova, *Vernad*, EMP) coarse-grained gabbro-pyroxene $\text{Fs}_{57.6}\text{Wo}_{4.5}$ (N=10; Fe/Mn = 30.6) $\text{Fs}_{55.0-60.3}\text{Wo}_{2.2-7.6}$; feldspar $\text{An}_{91.0}\text{Ab}_{8.6}$ (N=12).

Classification: Eucrite melt breccia

Specimens: A total of 254.1 g (213.3 g cut piece and 40.8 g slice), one thin section and one thick polished section are on deposit at *Vernad*. An anonymous collector holds the main mass.

Northwest Africa 8744 (NWA 8744)

(Northwest Africa)

Purchased: 2014 Sep

Classification: HED achondrite (Diogenite)

History: In September 2014 two large stones were purchased by Aziz Habibi in Agadir, Morocco, and two smaller stones were purchased by Gary Fujihara from a dealer in Zagora, Morocco.

Physical characteristics: The four pieces (11001 g, 1356 g, 185 g, 25.2 g) all share the same distinctive appearance. Domains composed of gray pyroxene plus variable amounts of milky plagioclase occur within a predominant lithology composed of highly vesicular, very fine grained material.

Petrography: (A. Irving and S. Kuehner, *UWS*) Melt-matrix breccia consisting of clasts (~30 vol.%) of orthopyroxenitic diogenite, feldspathic diogenite and noritic diogenite (with 10-40 vol.% plagioclase) plus related crystalline debris within a predominant, very fine grained, vesicular matrix. All orthopyroxene is turbid and pale clove brown in thin section and is notably ferroan; calcic plagioclase (anorthite) is polycrystalline. Some orthopyroxene contains irregular "patches" of clinopyroxene. Accessory phases are chromite, olivine and minor troilite blebs in orthopyroxene.

Geochemistry: Orthopyroxene in clasts ($\text{Fs}_{35.4-37.0}\text{Wo}_{6.5-4.3}$, $\text{FeO/MnO} = 29-31$, $N = 5$), clinopyroxene in clast ($\text{Fs}_{16.1}\text{Wo}_{40.8}$, $\text{FeO/MnO} = 27$), "patchy" pigeonitic pyroxene ($\text{Fs}_{26.4-38.0}\text{Wo}_{6.4-10.8}$, $\text{FeO/MnO} = 29-30$, $N = 3$), pigeonite in vesicular matrix ($\text{Fs}_{42.5}\text{Wo}_{13.4}$, $\text{FeO/MnO} = 27$), olivine ($\text{Fa}_{48.9}$, $\text{FeO/MnO} = 44$, $N = 1$), plagioclase ($\text{An}_{93.5-95.6}\text{Or}_{0.2-0.1}$, $N = 3$).

Classification: Diogenite (feldspathic, shock melted). The amount of plagioclase in some of the remnant diogenitic clasts is higher than in typical diogenites, and low-Ca pyroxene is unusually ferroan. There is evidence for intense shock modification in this material (involving extensive melting and vesiculation).

Specimens: 21.3 g including two polished thin sections and one polished slice at *UWB*; main masses of the large stones are with Mr. A. Habibi; Mr. G. Fujihara owns the 185 g and 25.2 g stones.

Northwest Africa 8746 (NWA 8746)

(Northwest Africa)

Purchased: 2014 Jul

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Darryl Pitt in July 2014 from a dealer in Mauritania.

Physical characteristics: Single stone (69.9 g) composed of pale clasts in a dark-gray matrix.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia composed mainly of mineral clasts (anorthite, pigeonite, olivine, subcalcic augite, minor kamacite) plus rare mare basalt clasts and glass fragments within a finer grained matrix.

Geochemistry: Olivine ($\text{Fa}_{32.0-48.3}$, $\text{FeO/MnO} = 85-91$, $N = 3$), pigeonite ($\text{Fs}_{25.6-33.0}\text{Wo}_{6.2-7.0}$, $\text{FeO/MnO} = 57-66$, $N = 3$), ferroan pigeonite ($\text{Fs}_{60.6}\text{Wo}_{19.3}$, $\text{FeO/MnO} = 79$), subcalcic augite ($\text{Fs}_{51.0}\text{Wo}_{33.4}$, $\text{FeO/MnO} = 66$), plagioclase ($\text{An}_{96.6-97.2}\text{Or}_{0.1-0.3}$, $N = 3$). Bulk composition (R. Korotev, *WUSL*) INAA of subsamples gave the following mean abundances (in wt.%) FeO 8.0, Na_2O 0.33; (in ppm) Sc 18.6, La 5.9, Sm 2.6, Eu 0.77, Yb 2.2, Lu 0.30, Th 1.1.

Classification: Lunar (feldspathic fragmental breccia).

Specimens: 14.1 g including one polished endcut at *UWB*; the remainder is held by *DPitt*.

Northwest Africa 8748 (NWA 8748)

(Northwest Africa)

Purchased: 2014 Jul

Classification: HED achondrite (Howardite)

History: Purchased by Darryl Pitt in July 2014 from a dealer in Mauritania.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh fragmental breccia composed predominantly of eucritic crystalline debris (calcic plagioclase, exsolved pigeonite, silica polymorph, ilmenite, troilite, Ni-free metal), some basaltic eucrite clasts and ~15 vol.% diagenitic orthopyroxene grains (containing inclusions of chromite and troilite).

Geochemistry: Diagenitic orthopyroxene (Fs_{24.6-26.5}Wo_{1.8-3.1}, FeO/MnO = 28-33, N = 3), orthopyroxene host (Fs_{62.9-64.3}Wo_{1.8-1.9}, FeO/MnO = 33-35, N = 3), clinopyroxene exsolution lamellae (Fs_{27.1-28.4}Wo_{43.2-43.3}, FeO/MnO = 28-31, N = 3).

Classification: Howardite.

Specimens: 6.6 g including one polished thin section at *UWB*; the remainder is held by *DPitt*.

Northwest Africa 8749 (NWA 8749)

(Northwest Africa)

Purchased: 2014 Jul

Classification: Ordinary chondrite (H4)

History: Purchased by Darryl Pitt in July 2014 from a dealer in Mauritania.

Petrography: (A. Irving and S. Kuehner, *UWS*) Separated, well-formed, relatively small chondrules (0.6 ± 0.2 mm, several up to 1.4 mm) are set in a metal-rich matrix.

Geochemistry: Olivine (Fa_{16.1-16.3}, N = 4), orthopyroxene (Fs_{14.5-17.4}Wo_{0.4-1.5}, N = 3), subcalcic augite (Fs_{9.5}Wo_{29.2}), augite (Fs_{7.6}Wo_{39.5}).

Classification: Ordinary chondrite (H4).

Specimens: 23.6 g including one polished thin section at *UWB*; the remainder is held by *DPitt*.

Northwest Africa 8750 (NWA 8750)

(Northwest Africa)

Purchased: 2014 Mar

Classification: HED achondrite (Eucrite, polymict)

History: Purchased by Darryl Pitt in March 2014 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia composed predominantly of eucritic crystalline debris (calcic plagioclase, exsolved pigeonite, ilmenite), some gabbroic eucrite clasts and ~5 vol.% diagenitic orthopyroxene grains. Pigeonite is brownish-yellow in thin section and plagioclase is polycrystalline. Small vugs containing calcite were noted, and barite is present in the altered matrix.

Geochemistry: Low-Ca pyroxene (Fs_{56.6-57.0}Wo_{7.0-7.6}, FeO/MnO = 32-34, N = 3), high-Ca pyroxene (Fs_{30.1-31.1}Wo_{39.6-38.8}, FeO/MnO = 30-34, N = 3), diagenitic orthopyroxene (core Fs_{31.6}Wo_{3.9}, FeO/MnO = 34; rim Fs_{45.5}Wo_{4.0}, FeO/MnO = 36).

Classification: Eucrite (polymict breccia).

Specimens: 3.93 g including one polished thin section at *UWB*; the remainder is held by *DPitt*.

Northwest Africa 8752 (NWA 8752)

(Northwest Africa)

Purchased: 2014 Dec

Classification: HED achondrite (Eucrite, brecciated)

History: Purchased by Greg Hupé in December 2014 from a Moroccan dealer.

Physical characteristics: Single stone (51 g) composed of rounded, white clasts (up to 5 mm across) in a pale-gray matrix.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia consisting of clasts of very fine grained, granulitic eucrite in a matrix of related debris. Minerals are calcic plagioclase, exsolved pigeonite, silica polymorph clinopyroxene, chromite, ilmenite and troilite.

Geochemistry: Orthopyroxene host (Fs_{60.9-61.7}Wo_{1.7-1.8}, FeO/MnO = 33-34, N = 3), clinopyroxene exsolution lamellae (Fs_{26.9-28.3}Wo_{42.3-40.8}, FeO/MnO = 33-34, N = 3).

Classification: Eucrite (granulitic breccia).

Specimens: 10.2 g including one polished mount at *UWB*; main mass with *GHupé*.

Northwest Africa 8753 (NWA 8753)

(Northwest Africa)

Purchased: 2014 Sep

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Darryl Pitt in September 2014 from a dealer in Laayoune, Morocco.

Physical characteristics: Single stone (1345 g) consisting of white and dark gray clasts in a medium gray matrix.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia composed of angular mineral clasts (anorthite, olivine, orthopyroxene, augite, exsolved pigeonite, chromite, troilite, kamacite) and sparse glass fragments (with composition equivalent to low-Ca pyroxene + anorthite) in a finer grained matrix. Rare grains of forsteritic olivine are present and are associated with Cr-pleonaste spinel.

Geochemistry: Olivine (Fa_{17.9}; Fa_{35.6}; Fa_{9.8-10.7}; FeO/MnO = 89-146; N = 5), orthopyroxene (Fs_{26.9-44.0}Wo_{3.1-3.6}, FeO/MnO = 65-79, N = 3), augite (Fs_{17.5-17.9}Wo_{44.7-41.7}, FeO/MnO = 43-53, N = 2), plagioclase (An_{95.0-97.4}Or_{0.2-0.1}, N = 3). Bulk composition (R. Korotev, *WUSL*) INAA of subsamples gave the following mean abundances (in wt.%) FeO 3.0, Na₂O 0.36; (in ppm) Sc 4.9, La 1.7, Sm 0.8, Eu 0.79, Yb 0.6, Lu 0.15, Th 0.3.

Classification: Lunar (feldspathic fragmental breccia). This specimen is notably felsic in comparison to other lunar feldspathic breccias, and contains accessory forsteritic olivine associated with Cr-pleonaste..

Specimens: 20.4 g including one polished thin section and a polished endcut at *UWB*; the remainder is held by *DPitt*.

Northwest Africa 8755 (NWA 8755)

(Northwest Africa)

Purchased: Oct 2014

Classification: HED achondrite (Eucrite, brecciated)

History: The meteorite was bought 2014 on a mineral fair in Munich, Germany.

Physical characteristics: The small individual is partly covered with fusion crust.

Petrography: The meteorite is a eucritic breccia composed of coarse- and fine-grained basaltic and impact melt clast set into more fine-grained matrix. Dominant minerals in basaltic clasts and matrix are exsolved pyroxene and calcic plagioclase. Minor phases include chromite and silica polymorphs.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{67.9\pm0.4}\text{Wo}_{2.2\pm0.4}$ ($\text{Fs}_{67-68.6}\text{Wo}_{1.8-3.3}$, $n=26$, $\text{FeO/MnO}=32-37$); Ca-pyroxene: $\text{Fs}_{34.3\pm2.1}\text{Wo}_{40.6\pm2.1}$ ($\text{Fs}_{30.3-40.5}\text{Wo}_{34.8-44.2}$, $n=28$, $\text{FeO/MnO}=32-39$); calcic plagioclase: $\text{An}_{87.4\pm4.7}$ ($\text{An}_{78.4-92.1}$, $n=15$)

Northwest Africa 8758 (NWA 8758)

(Northwest Africa)

Purchased: 2014

Classification: Ordinary chondrite (L3)

History: The meteorite was bought 2014 on a mineral fair in Munich, Germany.

Physical characteristics: The meteorite lacks any fusion crust and displays a light brownish interior.

Petrography: It is composed of sharply defined chondrules of various petrological types about 0.7 in diameter set into a fine-grained matrix of chondrule and mineral fragments and FeNi metal.

Northwest Africa 8760 (NWA 8760)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L3)

History: The meteorite was bought 2005 on a mineral fair in Munich, Germany.

Physical characteristics: The brownish fragment is partly covered with fusion crust and displays a dark grayish interior.

Petrography: It contains sharply defined chondrules of different petrological types about 0.6 mm in diameter and is crosscut by several shock veins.

Northwest Africa 8763 (NWA 8763)

(Northwest Africa)

Purchased: 2014

Classification: Carbonaceous chondrite (CM2)

History: The meteorite was bought 2014 on a mineral fair in Munich, Germany.

Physical characteristics: The small almost black individual is partly covered with fusion crust.

Petrography: The meteorite is composed of small (about 0.1-0.4 mm in diameter) chondrules, chondrule pseudomorphs, mineral fragments and rare CAIs set into an abundant fine-grained matrix dominated by phyllosilicates, carbonates, and pyrrhotite; poorly-characterized-phase lumps are present and many components are surrounded by fine-grained accretionary rims. Few chondrules show light brownish staining due to terrestrial weathering.

Northwest Africa 8764 (NWA 8764)

(Northwest Africa)

Purchased: 2014

Classification: Carbonaceous chondrite (CO3)

History: The meteorite was bought 2014 on a mineral fair in Munich, Germany.

Physical characteristics: The two small brownish individuals lack any fusion crust.

Petrography: The meteorite displays a dark brownish interior and consists predominantly of small 0.1-0.3 mm sized chondrules, and less abundant CAIs and olivine amoeboids set into a

fine-grained almost opaque matrix. The meteorite is severely weathered and contains several calcite-filled cracks.

Northwest Africa 8765 (NWA 8765)

(Northwest Africa)

Purchased: 2014

Classification: Carbonaceous chondrite (CO3)

History: The meteorite was bought 2014 at a mineral fair in Munich, Germany.

Physical characteristics: The small dark brownish individual lacks any fusion crust.

Petrography: It is composed of abundant well defined small chondrules (0.1 to 0.4 mm) and rare CAIs set into a fine-grained dark brownish matrix. Chondrules are highly unequilibrated and mostly of porphyritic types.

Northwest Africa 8766 (NWA 8766)

(Northwest Africa)

Purchased: 2014

Classification: Ureilite

History: The meteorite was bought 2014 at a mineral fair in Munich, Germany.

Petrography: The meteorite shows a cumulate texture of 2 to 3 mm sized olivine, orthopyroxene and pigeonite grains. It contains flaky graphite; olivine displays characteristic reduced rims.

Geochemistry: reduced rims in olivine: $\text{Fa}_{2.5-11}$; Cr_2O_3 in ol: ~ 0.7 wt%

Northwest Africa 8767 (NWA 8767)

(Northwest Africa)

Purchased: 2014

Classification: HED achondrite (Eucrite, brecciated)

History: The meteorite was bought 2014 at a mineral fair in Munich, Germany.

Petrography: The meteorite is a eucritic breccia composed of angular to partly rounded basaltic fragments separated by shock veins and fine-grained cataclastic zones. Dominant minerals are exsolved pyroxenes and calcic plagioclase. Minor phases include chromite, troilite, and silica polymorphs. Shock veins are mostly recrystallized.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{60.6 \pm 1} \text{Wo}_{2.9 \pm 0.9}$ ($\text{Fs}_{58.2-62.2} \text{Wo}_{2-6.2}$, $n=20$, $\text{FeO/MnO}=32-35$); Ca-pyroxene: $\text{Fs}_{26.1 \pm 0.7} \text{Wo}_{44.2 \pm 0.6}$ ($\text{Fs}_{25.3-27.8} \text{Wo}_{41.9-45.1}$, $n=20$, $\text{FeO/MnO}=31-37$); calcic plagioclase: $\text{An}_{88.3 \pm 1.1}$ ($\text{An}_{84.9-91.3}$, $n=19$)

Northwest Africa 8768 (NWA 8768)

(Northwest Africa)

Purchased: 2014

Classification: HED achondrite (Eucrite, brecciated)

History: The meteorite was bought in 2014 from a meteorite dealer in Rissani, Morocco.

Petrography: The meteorite is a fragmental breccia with eucritic clasts set into a fine-grained clastic matrix with abundant shock veins. Dominant minerals are exsolved pigeonite (with variable red-brown staining) and calcic plagioclase; minor phases are silica polymorphs, ilmenite, chromite, and troilite.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{59\pm0.9}\text{Wo}_{4\pm1.1}$ ($\text{Fs}_{58.1-60.9}\text{Wo}_{2.3-6}$, $n=17$, $\text{FeO/MnO}=32-37$); Ca-pyroxene: $\text{Fs}_{27.3\pm1.6}\text{Wo}_{42.9\pm1.5}$ ($\text{Fs}_{25.9-31.1}\text{Wo}_{39.7-44.4}$, $n=16$, $\text{FeO/MnO}=33-38$); calcic plagioclase: $\text{An}_{89.1\pm1.1}$ ($\text{An}_{87.2-90.7}$, $n=20$)

Northwest Africa 8769 (NWA 8769)

(Northwest Africa)

Purchased: 2014

Classification: Ordinary chondrite (L3)

History: The meteorite was bought 2014 on a mineral fair in Munich, Germany.

Physical characteristics: The small sandblasted individuals display a dark-grayish interior.

Petrography: It is dominantly composed of well defined chondrules about 0.7 mm in diameter.

Northwest Africa 8770 (NWA 8770)

(Northwest Africa)

Purchased: 2014

Classification: Martian meteorite (Shergottite)

History: The meteorite was bought 2014 at a mineral fair in Munich, Germany.

Physical characteristics: Tiny greenish-grayish individual partly covered with fusion crust.

Petrography: The meteorite displays a [Shergotty](#)-like intersertal texture of predominantly complex-zoned prismatic clinopyroxene and lath-shaped grains of intermediate plagioclase that has been converted into maskelynite during shock metamorphism. Accessory minerals include ilmenite, ulvöspinel, pyrrhotite, and merrillite; shock-melt pockets are abundant

Geochemistry: pigeonite: $\text{Fs}_{44.7\pm11.6}\text{Wo}_{13.9\pm2.1}$ ($\text{Fs}_{29.6-61.3}\text{Wo}_{11-18.6}$, $n=16$, $\text{FeO/MnO}=29-40$);

augite: $\text{Fs}_{29\pm8.2}\text{Wo}_{32.7\pm2}$ ($\text{Fs}_{20.1-50.5}\text{Wo}_{28.9-36.6}$, $n=24$, $\text{FeO/MnO}=25-41$); maskelynite:

$\text{An}_{51.5\pm4.2}\text{Or}_{2.2\pm0.9}$ ($\text{An}_{42-55.4}\text{Or}_{1.6-4.6}$, $n=16$)

Classification: Pyroxene-phyric shergottite

Northwest Africa 8771 (NWA 8771)

(Northwest Africa)

Purchased: 2011

Classification: Carbonaceous chondrite (CO3)

History: The meteorite was purchased in 2011 at a mineral fair in Ensisheim, France.

Petrography: The meteorite displays a brownish interior and is composed of abundant small chondrules (0.1-0.3 mm in diameter), mineral fragments and rare CAIs set into a fine-grained matrix. Chondrules are dominantly of PO type and sometimes surrounded by accretionary rims. The meteorite is severely weathered and shows intense brownish-orange staining.

Geochemistry: Oxygen isotopes (K. Ziegler, *UNM*): acid-washed material analyzed in replicate by laser fluorination gave, respectively: $\delta^{18}\text{O}=-4.679, -5.888, -4.436, -5.499$; $\delta^{17}\text{O}=-8.838, -9.427, -7.644, -8.934$; $\Delta^{17}\text{O}=-6.367, -6.318, -5.302, -6.031$ (all per mil).

Northwest Africa 8773 (NWA 8773)

(Northwest Africa)

Purchased: 2014 Apr

Classification: Ordinary chondrite (L3)

History: Purchased by Sergey Vasiliev in April 2014 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, round chondrules (1.3 ± 0.7 mm) occur within a finer matrix containing stained metal.

Geochemistry: Olivine, $\text{Fa}_{4.2-39.0}$; Cr_2O_3 in ferroan examples = 0.06-0.15 wt.% Cr_2O_3 , mean 0.09 ± 0.03 wt.%, $N = 8$; orthopyroxene, $\text{Fs}_{2.9-32.9}\text{Wo}_{0.2-1.3}$, $N = 3$; subcalcic augite, $\text{Fs}_{7.2-23.1}\text{Wo}_{33.9-34.5}$, $N = 2$.

Classification: Ordinary chondrite (L3).

Specimens: 27.8 g including one polished thin section at *UWB*; main mass with Mr. S. Vasiliev.

Northwest Africa 8775 (NWA 8775)

Northwest Africa

Purchased: 2014 Oct

Classification: Ordinary chondrite (LL6)

History: Purchased by Stefan Ralew in October 2014 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with poikiloblastic texture, but rare, relatively large (up to 3.5 mm) recrystallized chondrules are present. Minerals are olivine, orthopyroxene, clinopyroxene, sodic plagioclase, Ti-bearing Cr-rich chromite, troilite and taenite. Despite a careful search, no kamacite was found and is presumed to be absent.

Geochemistry: Olivine, $\text{Fa}_{31.4-31.5}$, $N = 3$; orthopyroxene, $\text{Fs}_{25.1-25.4}\text{Wo}_{2.3-2.4}$, $N = 3$; clinopyroxene, $\text{Fs}_{10.1-10.4}\text{Wo}_{43.5-42.9}$, $N = 2$.

Classification: Ordinary chondrite (LL6). Like [NWA 7988](#) this specimen is completely devoid of kamacite, but texturally these stones are different, so pairing between them is unlikely.

Specimens: 20.2 g including one polished thin section at *UWB*; main mass with *Ralew*.

Northwest Africa 8777 (NWA 8777)

(Northwest Africa)

Purchased: 2013 Oct

Classification: Ungrouped achondrite

History: Purchased by Stefan Ralew in October 2013 from a dealer in Agadir, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Metamorphic texture with triple grain junctions. Aggregate of predominantly orthopyroxene (88.6 vol.%), olivine (9.0 vol.%) with accessory calcic plagioclase, Al-bearing chromite, Ni-poor kamacite and troilite.

Geochemistry: Orthopyroxene ($\text{Fs}_{25.5-25.6}\text{Wo}_{3.1-2.7}$, $\text{FeO/MnO} = 29-34$, $N = 3$), olivine ($\text{Fa}_{30.7-31.1}$, $\text{FeO/MnO} = 46-49$, $N = 3$), plagioclase ($\text{An}_{77.3-78.8}\text{Or}_{1.1-0.5}$, $N = 2$). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ 1.078, 1.239, 1.257; $\delta^{18}\text{O}$ 2.659, 2.912, 2.851; $\Delta^{17}\text{O}$ -0.326, -0.299, -0.248 (all per mil).

Classification: Achondrite (ungrouped). Although in texture and oxygen isotopic composition this specimen resembles some brachinites, it is much too orthopyroxene-rich and its constituent plagioclase much too calcic to have an obvious affinity with brachinites.

Specimens: 9.9 g including one polished thin section at *UWB*; main mass with *Ralew*.

Northwest Africa 8778 (NWA 8778)

(Northwest Africa)

Purchased: 2014 Apr

Classification: Ordinary chondrite (H3)

History: Purchased by Darryl Pitt in April 2014 from a dealer in Mauritania.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fairly closely-packed, relatively small, well-formed chondrules occur in a stained metal-rich matrix rich. Minerals are olivine (some with very forsteritic cores), orthopyroxene, pigeonite, augite, sodic plagioclase, chromite, altered kamacite and troilite.

Geochemistry: Olivine (core $\text{Fa}_{0.7}$; predominantly $\text{Fa}_{16.8-17.3}$, mean $\text{Fa}_{17.1}$, $N = 7$), orthopyroxene ($\text{Fs}_{3.8-37.7}\text{Wo}_{0.1-4.3}$, $N = 3$), pigeonite ($\text{Fs}_{4.3}\text{Wo}_{22.7}$), augite ($\text{Fs}_{4.3}\text{Wo}_{40.9}$). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.89$.

Classification: Ordinary chondrite (H3).

Specimens: 24.1 g including one polished thin section at *UWB*; the remainder is held by *DPitt*.

Northwest Africa 8779 (NWA 8779)

(Northwest Africa)

Purchased: 2014 Oct

Classification: Carbonaceous chondrite (CV3)

History: A 490 g portion of this 5472 g stone was purchased from Mohamed Aid by Aras Jonikas in October 2014.

Petrography: (A. Irving and S. Kuehner, *UWS*) Relatively large, granular chondrules (1.4 ± 0.6 , one 3.3 mm) and fine-grained CAI (up to 3.8 mm across) occur in a finer-grained matrix, portions of which are stained orange by alteration of accessory metal.

Geochemistry: Olivine ($\text{Fa}_{0.3-43.3}$, $N = 3$), orthopyroxene ($\text{Fs}_{0.8}\text{Wo}_{0.9}$), pigeonite ($\text{Fs}_{1.1}\text{Wo}_{15.7}$), subcalcic augite ($\text{Fs}_{1.1}\text{Wo}_{34.8}$), augite ($\text{Fs}_{1.9}\text{Wo}_{42.0}$).

Classification: Carbonaceous chondrite (CV3).

Specimens: 29.4 g including one polished thin section at *UWB*; the main mass of 4982 g is held by Mr. M. Aid and 490 g is held by Mr. A. Jonikas.

Northwest Africa 8783 (NWA 8783)

(Northwest Africa)

Purchased: 2014 Sep

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Gary Fujihara in September 2014 from a dealer in Zagora, Morocco.

Physical characteristics: A group of 24 small stones (total weight 27.5 g) lacking fusion crust and characterized by fairly closely packed, white clasts in a gray matrix.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of angular minerals clasts (anorthite, olivine, pigeonite, subcalcic augite, ilmenite, troilite, kamacite, rare baddeleyite) and sparse intersertal basalt clasts in a finer grained matrix containing minor barite. Vesicular glass veins are present in places.

Geochemistry: Olivine ($\text{Fa}_{20.7-26.9}$, $\text{FeO/MnO} = 89-93$, $N = 2$), pigeonite ($\text{Fs}_{19.9-23.8}\text{Wo}_{6.6-5.0}$, $\text{FeO/MnO} = 57-65$; $\text{Fs}_{47.1}\text{Wo}_{10.6}$, $\text{FeO/MnO} = 77$; $N = 3$), subcalcic augite ($\text{Fs}_{17.4}\text{Wo}_{25.9}$, $\text{FeO/MnO} = 77$; $\text{Fs}_{13.9-15.4}\text{Wo}_{37.2-35.9}$, $\text{FeO/MnO} = 56-63$; $N = 3$), plagioclase ($\text{An}_{94.6-96.2}\text{Or}_{0.3}$, $N = 2$). Bulk composition (R. Korotev, *WUSL*) INAA of subsamples gave the following mean abundances (in wt.%) FeO 6.0, Na_2O 0.56; (in ppm) Sc 10.3, La 17.2, Sm 7.8, Eu 1.03, Yb 5.3, Lu 0.72, Th 2.7.

Classification: Lunar (feldspathic breccia). Paired with [NWA 8455](#).

Specimens: 5.5 g in the form of several stones polished on one side at *UWB*; Mr. G. Fujihara holds the remaining material.

Northwest Africa 8784 (NWA 8784)

(Northwest Africa)

Purchased: 2014 Jan

Classification: Ordinary chondrite (L3)

History: Purchased by Fabien Kuntz in January 2014 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, medium-sized chondrules (1.2 ± 0.6 mm) in a finer grained matrix.

Geochemistry: Olivine, $\text{Fa}_{1.0-25.9}$; Cr_2O_3 in ferroan olivine 0.03-0.08 wt.%, mean 0.04 ± 0.02 wt.%, $N = 8$; orthopyroxene, $\text{Fs}_{7.1-23.1}\text{Wo}_{0.2-1.8}$, $N = 3$; pigeonite, $\text{Fs}_{21.0}\text{Wo}_{15.5}$; subcalcic augite, $\text{Fs}_{13.7}\text{Wo}_{34.1}$.

Classification: Ordinary chondrite (L3).

Specimens: 26.3 g including one polished thin section at *PSF*; main mass with *Kuntz*.

Northwest Africa 8786 (NWA 8786)

(Northwest Africa)

Purchased: 2014 Jan

Classification: Ordinary chondrite (L3)

History: Purchased by Fabien Kuntz in January 2014 from a dealer in Rissani, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, round chondrules (1.2 ± 0.8 mm, one 3.6 mm) in a finer grained matrix.

Geochemistry: Olivine, $\text{Fa}_{0.9-31.3}$; Cr_2O_3 in ferroan olivine, 0.04-0.15 wt.%, mean 0.08 ± 0.04 wt.%, $N = 8$; orthopyroxene, $\text{Fs}_{2.5-23.3}\text{Wo}_{0.8-2.4}$, $N = 3$; augite, $\text{Fs}_{9.1-9.9}\text{Wo}_{45.3-42.0}$, $N = 2$.

Classification: Ordinary chondrite (L3).

Specimens: 10.44 g including one polished thin section at *PSF*; main mass with *Kuntz*.

Northwest Africa 8788 (NWA 8788)

(Northwest Africa)

Purchased: 2014 Jul

Classification: Ordinary chondrite (LL3)

History: Purchased by Fabien Kuntz in July 2014 from a dealer in Foug El Hisn, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, well-formed, medium-sized chondrules (1.1 ± 0.7 mm) occur in a matrix containing stained metal.

Geochemistry: Olivine ($\text{Fa}_{1.7-60.9}$; Cr_2O_3 in ferroan examples 0.09-0.81 wt.%, mean 0.19 ± 0.20 wt.%, $N = 15$), orthopyroxene ($\text{Fs}_{4.1-14.9}\text{Wo}_{0.3-2.1}$, $N = 3$), pigeonite ($\text{Fs}_{34.3}\text{Wo}_{5.5}$), subcalcic augite ($\text{Fs}_{4.5-5.1}\text{Wo}_{35.7-37.7}$, $N = 2$). Magnetic susceptibility $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.37$.

Classification: Ordinary chondrite (LL3). LL group designation based on magnetic susceptibility.

Specimens: 5.29 g including one polished thin section at *PSF*; main mass with *Kuntz*.

Northwest Africa 8790 (NWA 8790)

(Northwest Africa)

Purchased: 2014 Jan

Classification: Ordinary chondrite (L3)

History: Purchased by Fabien Kuntz in January 2014 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, round chondrules (1.1 ± 0.6 mm) in a finer-grained matrix.

Geochemistry: Olivine, $\text{Fa}_{0.9-43.7}$; Cr_2O_3 in ferroan olivine, 0.05-0.11 wt.%, mean 0.07 ± 0.02 wt.%, $N = 8$; orthopyroxene, $\text{Fs}_{2.0-16.9}\text{Wo}_{0.4-1.0}$, $N = 3$; subcalcic augite, $\text{Fs}_{9.0-13.0}\text{Wo}_{39.2-34.2}$; ferrosilite, $\text{Fs}_{58.9}\text{Wo}_{1.3}$.

Classification: Ordinary chondrite (L3).

Specimens: 26.81 g including one polished thin section at *PSF*; main mass with *Kuntz*.

Northwest Africa 8794 (NWA 8794)

(Northwest Africa)

Purchased: 2006

Classification: Ordinary chondrite (H5)

Petrography: Plagioclase grains are found to exceed $10\ \mu\text{m}$ and there is relatively low variability in the microprobe data, consistent with an H5. Chondrules are notably numerous and well-defined for such a high petrologic type.

Geochemistry: Olivine, $\text{Fa}_{18.3 \pm 0.5}$ ($N=17$); pyroxene, $\text{Fs}_{16.3 \pm 0.6}\text{Wo}_{1.18 \pm 0.20}$ ($N=15$, EMPA).

Classification: Ordinary Chondrite H5, S2, W2.

Specimens: The type specimen includes the main mass and a thin section.

Northwest Africa 10005 (NWA 10005)

(Northwest Africa)

Purchased: 11/2014

Classification: HED achondrite (Eucrite, brecciated)

History: Purchased by Hanno Strufe from a local meteorite dealer.

Petrography: The meteorite is a breccia composed of basaltic clasts set into a clastic matrix. Exsolved pyroxene and calcic plagioclase are the dominant minerals in clasts and matrix. Minor phases include SiO_2 polymorphs, chromite and troilite.

Geochemistry: low-Ca pyroxene, $\text{Fs}_{63.4}?\text{Wo}_{2.5}?$ (0.8 ($\text{Fs}_{60.9-65.5}\text{Wo}_{1.7-5.8}$, $n=29$, $\text{FeO/MnO}=31-35$); Ca-pyroxene, $\text{Fs}_{29.6 \pm 1.2}\text{Wo}_{41.4 \pm 1.5}$ ($\text{Fs}_{28.3-32.7}\text{Wo}_{37.3-42.6}$, $n=17$, $\text{FeO/MnO}=33-37$); calcic plagioclase, $\text{An}_{86 \pm 2.9}$ ($\text{An}_{80.3-89.9}$, $n=20$)

Northwest Africa 10007 (NWA 10007)

(Northwest Africa)

Purchased: Nov 2014

Classification: Rumuruti chondrite (R3-6)

History: Purchased by Hanno Strufe from a local meteorite dealer Rissani, Morocco.

Petrography: The meteorite is a breccia with heterogeneously distributed lithic fragments of all petrologic types (3 to 6) in a fine-grained clastic groundmass. Olivine is the dominant mineral phase in all lithologies. In type 6 clasts it is Fe-rich (Fa_{38}); in type 3 lithologies it is highly unequilibrated ($\text{Fa}_{9.4-45.4}$). Orthopyroxene displaying typical patchy zoning is only found in unequilibrated lithologies. Minor phases include albitic feldspar, augite, chromite, pentlandite and pyrrhotite. FeNi metal is virtually absent.

Geochemistry: Olivine in type 6 lithology, Fa_{38} ; olivine in type 3 lithology, $\text{Fa}_{27.3 \pm 12.9}$ ($\text{Fa}_{9.4-45.4}$, $n=24$); low-Ca pyroxene in type 3 lithology, $\text{Fs}_{19.1 \pm 9.2}\text{Wo}_{1.4 \pm 0.9}$ ($\text{Fs}_{5.5-30.9}\text{Wo}_{0.5-3.5}$, $n=29$)

Northwest Africa 10009 (NWA 10009)

(Northwest Africa)

Purchased: Nov 2014

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Hanno Strufe from a local meteorite dealer in Agadir, Morocco.

Petrography: The meteorite displays a dark-grayish interior and is composed of large, up to 1 mm, chondrules, olivine amoeboids and CAIs in a fine-grained, almost opaque matrix; chondrules frequently show brownish staining due to terrestrial weathering. No type II chondrules were observed.

Geochemistry: Individual matrix olivines have up to Fa₆₉.

Northwest Africa 10010 (NWA 10010)

(Northwest Africa)

Purchased: 11/2014

Classification: Enstatite chondrite (EL6)

History: Purchased by Hanno Strufe from a local meteorite dealer in Rissani, Morocco.

Petrography: The meteorite displays a recrystallized texture of dominantly large, about 100-μm sized enstatite grains and abundant Fe,Ni metal. Less abundant phases are albitic feldspar, troilite, schreibersite and daubreelite. No relict chondrules were found; metal is heavily altered.

Geochemistry: Albitic feldspar: An_{16.2}Or_{4.3}Ab_{79.5}; metal contains about 1 wt% Si.

Classification: Petrography and 1 wt% Si in metal suggests enstatite chondrite (EL6) classification

Northwest Africa 10011 (NWA 10011)

(Northwest Africa)

Purchased: Nov 2014

Classification: Mesosiderite

History: Purchased by Hanno Strufe from a local meteorite dealer Rissani, Morocco.

Petrography: The meteorite consists of about 60% silicates and 40% FeNi metal. The silicate portion is dominated by low-Ca pyroxene and calcic plagioclase. Minor phases include small compositionally zoned (i.e., Mg-rich core, Fe-rich rim) pyroxenes, silica, and merillite.

Geochemistry: Low-Ca pyroxene, Fs_{29.8}Wo_{3.2}, FeO/MnO=28-33; zoned pyroxene, Fs_{32±8}Wo_{2.4±0.6} (Fs_{25.7-41.8}Wo_{1.9-3.6}, n=15, FeO/MnO=31-40); calcic plagioclase, An_{92±1.2} (An_{90-93.7}, n=11)

Northwest Africa 10014 (NWA 10014)

(Northwest Africa)

Purchased: Nov 2014

Classification: Carbonaceous chondrite (CM2)

History: Purchased by Joachim Lemm from a local meteorite dealer in Agadir, Morocco.

Physical characteristics: The small almost black individual is partly covered by fusion crust.

Petrography: The meteorite displays a black interior and is composed of about 0.1-0.3 mm chondrules, chondrule pseudomorphs, individual mineral fragments and rare CAIs, many surrounded by fine-grained accretionary rims set into an abundant fine-grained matrix. Main matrix phases are phyllosilicates, carbonates, and pyrrhotite. The meteorite is unshocked and shows little sign of terrestrial alteration.

Northwest Africa 10015 (NWA 10015)

Morocco

Purchased: 2010

Classification: Pallasite (Main group)

Physical characteristics: One 306.97 g piece with evident fusion crust.

Petrography (N. Fowler-Gerace, ROM): The meteorite contains ~60% olivine (Fa_{13.4}, N = 6). The grains are rounded to angular and range in size from ~3-15 mm.

Geochemistry: Oxygen isotopes (Banerjee, Ali, Jabeen, *UWO*): laser fluorination of acid washed olivine grain separates gave average values of $\delta^{17}\text{O} = 1.75$; $\delta^{18}\text{O} = 3.70$; $\Delta^{17}\text{O} = -0.160$ per mil (N=3). Values plot with the main group pallasites.

Classification: Pallasite, PMG

Specimens: 20 g at ROM

Northwest Africa 10016 (NWA 10016)

(Northwest Africa)

Purchased: 2014

Classification: Martian meteorite (Shergottite)

History: Purchased by Steve Witt from a meteorite dealer in Morocco in 2014.

Physical characteristics: Three identical appearing pieces, with dark green exterior and patches of weathered black fusion crust. A saw-cut reveals a green-gray interior, black shock melt veins, and some small (<1 mm) vesicles.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows ~60% pyroxene, ~30% maskelynite. Pyroxenes show core-to-rim zonation in BSE images. Pyroxene grain size ranges from 200 μm to >1 mm. Maskelynite domains range from 50 μm to >1 mm. Shock melt veins with vesicles up to 300 μm observed. Accessory Ti-magnetite, iron-sulfide, ilmenite, silica throughout.

Geochemistry: (C. Agee and N. Muttik, *UNM*). There are two distinct pyroxene compositional trends present. Pigeonite trend from Fs_{32.1}Wo_{13.5} to Fs_{65.1}Wo_{15.9}, average: Fs_{52.6±12.0}Wo_{16.5±2.5}, Fe/Mn=37±3, n=12; augite trend from Fs_{21.4}Wo_{34.9} to Fs_{38.0}Wo_{29.3}, average: Fs_{25.7±5.5}Wo_{32.3±1.8}, Fe/Mn=30±3, n=10; maskelynite Or_{1.6±0.3}Ab_{46.5±2.6}An_{51.9±2.8}, n=6; shock melt (proxy for bulk composition) SiO₂=49.9±0.5, Al₂O₃=8.4±4.1, TiO₂=0.63±0.12, Cr₂O₃=0.12±0.03, MgO=7.3±3.1, FeO=20.0±2.8, MnO=0.52±0.10, CaO=10.5Na₂O=1.3±0.6, K₂O=0.17±0.07, CaO/Al₂O₃=1.2 (wt%), Fe/Mn=39±3, Mg#=38.3±5.9, n=6.

Classification: Martian (pyroxene-phyric shergottite), aluminum-depleted basalt, [Shergotty](#)-like pyroxene compositional trends.

Specimens: 2.23 g including a probe mount on deposit at *UNM*, Steve Witt and Mendy Ouzillou hold the main mass.

Northwest Africa 10017 (NWA 10017)

(Northwest Africa)

Purchased: 2012

Classification: Ordinary chondrite (H5)

History: One stone weighing 45.4 g was found in Morocco in 2012. David Holden acquired the sample from a meteorite prospector in Erfoud, 2012.

Physical characteristics: The stone is dark brown and has an angular shape displaying many small, shallow regmaglypts. The stone is completely covered in a weathered fusion crust. The cut face of the interior of the stone is dark brown, porous and displays small, closely packed chondrules and fresh and weathered flakes of metal.

Petrography: (A. Love, *App*): Sample displays recrystallized chondritic texture. Many chondrules are defined yet have turbid to recrystallized mesostasis and have an average diameter of 569 μm . Taken in concert with irregular fractures, sharp optical extinction and monocrystalline troilite, PCAs and metallic Cu suggest sample has been annealed subsequent an impact event with a maximum prior shock level of S3.

Geochemistry: (A. Love, *App*) Olivine $\text{Fa}_{19.7\pm0.2}$, N=14; low Ca pyroxene $\text{Fs}_{17.5\pm0.3}\text{Wo}_{2.7\pm1.1}$, N=12

Classification: Ordinary chondrite (H5, S3, W3)

Specimens: Two slices weighing 9.1 g, and a polished thin section are currently on deposit at *App*.

Northwest Africa 10018 (NWA 10018)

Northwest Africa

Purchased: 2010

Classification: Ordinary chondrite (L5)

History: One stone weighing 199.3 g was found in Morocco in 2010. David Holden acquired the sample from a meteorite prospector in Erfoud 2010.

Physical characteristics: The rounded to angular-shaped stone has a smooth, weathered, brown fusion crust that covers approximately 75% of the exterior of the stone. The surface displays numerous shallow regmaglypts. The cut face of the interior of the stone is tan with mottle orange regions and displays small chondrules, chondrule fragments and fresh and weathered flakes of metal.

Petrography: Description and classification (A. Love, *App*): Sample displays chondritic texture composed of numerous defined, relict chondrules (avg. diameter of 882 μm) and fragments and melt clasts set in a recrystallized matrix with irregularly shaped FeNi and FeS metal grains. Chondrules have turbid to recrystallized mesostasis.

Geochemistry: (A. Love, *App*) Olivine $\text{Fa}_{25.8\pm0.3}$, N=14; Low Ca pyroxene $\text{Fs}_{20.8\pm0.2}\text{Wo}_{2.4\pm0.3}$, N=12

Classification: Ordinary chondrite (L5, S3, W2)

Specimens: An endcut and one slice weighing 21.87 g, and a polished thin section are currently on deposit at *App*.

Northwest Africa 10019 (NWA 10019)

(Northwest Africa)

Purchased: 2015

Classification: Pallasite (ungrouped)

History: Purchased by Steve Arnold from Morocco in January 2015.

Physical characteristics: One 580 g fusion-crust individual and 26 g of several small fusion-crust pieces. Saw cuts and thin slices show angular orange-brown-green, translucent olivines, the largest 28 mm long, with many smaller (0.5-5 mm) angular grains, some of which are darker colored pyroxenes, all set in metal; only minor oxidation.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows approximately ~50% olivine, ~10% orthopyroxene, ~20% taenite, ~15% kamacite, minor calcic plagioclase, troilite, chromite, and calcium-magnesium phosphates.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{16.8\pm0.2}$, Fe/Mn=35 $\pm$ 2, n=7; low Ca pyroxene $\text{Fs}_{15.4\pm0.2}\text{Wo}_{1.0\pm0.2}$, Fe/Mn=23 $\pm$ 1, n=6; plagioclase $\text{An}_{75.9}\text{Ab}_{23.1}\text{Or}_{1.0}$, n=1; kamacite

Fe=93.1±2.0, Ni=6.6±0.2, Co=0.61±0.03 (all wt%), n=4; taenite Fe=72.0±4.0, Ni=27.4±2.4, Co=0.19±0.05 (all wt%), n=5; troilite Fe=59.9, Ni=0.2, Co=0.1, S=35.2 (all wt%), n=1. Likely farringtonite $\text{Mg}_3(\text{PO}_4)_2$ and stanfieldite $\text{Ca}_3\text{Mg}_3(\text{PO}_4)_4$ detected in EDS, chromite also detected. Oxygen isotopes (K. Ziegler, UNM): acid-washed material analyzed in 11 replicates by laser fluorination gave, respectively $\delta^{18}\text{O}= 3.286, 3.782, 3.878, 3.359, 3.548, 3.607, 3.935, 3.871, 3.817, 3.426, 3.516$; $\delta^{17}\text{O}= 1.479, 1.760, 1.760, 1.529, 1.635, 1.630, 1.846, 1.784, 1.763, 1.571, 1.599$; $\Delta^{17}\text{O}= -0.256, -0.237, -0.288, -0.245, -0.238, -0.274, -0.232, -0.260, -0.252, -0.238, -0.257$ (linearized, all per mil).

Classification: Pallasite, ungrouped. This is a pyroxene pallasite with elevated Fa values similar to Fa in [Springwater](#) (PMG-an), ungrouped classification is based on oxygen isotope values similar to the PMG, but unlike any known pyroxene pallasite.

Specimens: 20.6 g including a probe mount on deposit at UNM, Steve Arnold holds the main mass

Northwest Africa 10023 (NWA 10023)

(Northwest Africa)

Purchased: 2014

Classification: Pallasite (Main group, anomalous)

History: Purchased from Rachid Chaoui in December 2014, reportedly found near the Moroccan/Algerian border.

Physical characteristics: One piece. Polished saw cuts show angular, orange-brown-green, translucent olivine; some grains up to ~2 cm in size. Metal makes up approximately 30-40% of this meteorite. There is only minor oxidation present.

Petrography: (C. Agee, UNM) The etched surface of this pallasite shows approximately 98% of the metal consisting of very fine-grained (<1 μm) plessite, whereas kamacite occurs only as a thin mantling around olivine crystals. Olivine is the only silicate phase present. Accessory schreibersite, chromite, Ni-rich sulfide, and Ca-Mg phosphates were observed.

Geochemistry: (C. Agee and N. Muttik, UNM) Olivine $\text{Fa}_{12.7\pm0.6}$, Fe/Mn=47±3, n=8; plessite Fe=84.0±1.2, Ni=15.4±0.7, Co=0.55±0.08 (all wt%), n=4; kamacite Fe=93.1±3.0, Ni=5.9±0.2, Co=0.88±0.13 (all wt%), n=4; schreibersite Fe=58.8±5.1, Ni=27.9±2.1, Co=0.22±0.00, P=14.8±0.08 (all wt%), n=2; Fe-Ni sulfide Fe=49.9, Ni=16.1, Co=0.24, S=33.9 (all wt%), n=1. Likely farringtonite $\text{Mg}_3(\text{PO}_4)_2$ and stanfieldite $\text{Ca}_3\text{Mg}_3(\text{PO}_4)_4$ detected in EDS. Oxygen isotopes (K. Ziegler, UNM): 7 acid-washed fragments analyzed by laser fluorination gave, respectively $\delta^{18}\text{O}= 3.667, 3.554, 3.167, 3.143, 3.608, 3.887, 3.368$; $\delta^{17}\text{O}= 1.693, 1.630, 1.440, 1.458, 1.668, 1.753, 1.572$; $\Delta^{17}\text{O}= -0.243, -0.247, -0.232, -0.202, -0.237, -0.299, -0.206$ (linearized, all per mil), mean value $\delta^{18}\text{O}=3.485\pm0.273$, $\delta^{17}\text{O}=1.602\pm0.118$, $\Delta^{17}\text{O}=-0.238\pm0.032$ (TFL slope=0.528).

Classification: Pallasite, PMG-an. An unusually high amount of the metal is in the form of plessite. Oxygen isotopes indicate an affinity to the pallasite main group.

Specimens: 20.3 g including a probe mount on deposit at UNM, DPitt holds the main mass.

Northwest Africa 10024 (NWA 10024)

(Northwest Africa)

Purchased: 2014

Classification: Ordinary chondrite (LL5)

History: A single stone weighing 119.9 g was found in Morocco in 2014. David Holden acquired the sample from a meteorite prospector in Erfoud 2014.

Physical characteristics: The stone is brown with a rounded, tabular shape. A 10 × 20 cm light-green, rounded, ellipsoidal clast is visible through the weathered fusion crust, which covers approximately 85% of the exterior. The cut face of the interior of the stone is tan and displays small, closely packed chondrules, the clast and flakes of metal surrounded by minor halos of brown oxidation.

Petrography: Description and classification (A. Love, *App*): Sample displays recrystallized chondritic texture composed of distinct chondrules and rounded to irregularly shaped clasts set within a crystalline matrix. Chondrules have an average diameter of 1084 μm, are defined and have turbid mesostasis. A 1.5 cm clast contains many features similar to metal-sulfide depleted, olivine microporphyries described by [Jamsja and Ruzicka \(2010\)](#) as a large, igneous-textured enclave (LITE).

Geochemistry: (A. Love, *App*) Olivine $\text{Fa}_{30.1 \pm 0.2}$, N=12; Low Ca pyroxene $\text{Fs}_{24.0 \pm 0.2}\text{Wo}_{2.3 \pm 0.5}$, N=12

Classification: Ordinary chondrite (LL5, S3, W1)

Specimens: An endcut and one slice weighing 23.34 g, and a polished thin section are currently on deposit at *App*.

Northwest Africa 10031 (NWA 10031)

Morocco

Purchased: 2014

Classification: Enstatite chondrite (EL6)

History: Purchased by Nicola Castellano at the Genova Mineral Fair in May 2014 from a Moroccan dealer.

Physical characteristics: A single piece weighing 115 g totally covered by fusion crust.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*); The thin section displays an equilibrated texture, with very rare relic chondrules set in a matrix consisting of pyroxene, with minor plagioclase. No iron oxides/hydroxides veinlets can be observed. Relic chondrules range from 0.4 to 1.0 mm in diameter and are mainly RP type, with minor GP. Kamacite and troilite are the main opaque phases, partially weathered to iron oxides. Accessory phases are alabandite and daubreelite as blades in troilite. The presence of alabandite, An content of plagioclase and Si content of kamacite point to a classification as EL chondrite.

Geochemistry: Orthopyroxene ($\text{Fs}_{0.4}\text{En}_{98.1}\text{Wo}_{1.5}$), plagioclase ($\text{An}_{16.3}\text{Or}_{5.8}$); Si in kamacite = 0.8 wt.%, Ti in troilite = 6.1 wt.%

Classification: Enstatite chondrite (EL6), S1, W3; probably paired with [NWA 10037](#).

Specimens: A total of 21.3 g specimen and one thin section is on deposit at *MSN-FI*. Castellano holds the main mass.

Northwest Africa 10032 (NWA 10032)

Morocco

Purchased: 2014

Classification: Enstatite chondrite (EL6)

History: Purchased by Nicola Castellano at the Genova Mineral Fair in May 2014 from a Moroccan dealer.

Physical characteristics: A single piece weighing 158 g partially covered by fusion crust.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*); The thin section displays an equilibrated texture, with a matrix consisting of pyroxene and minor plagioclase. Neither iron

oxides/hydroxides veinlets nor chondrules can be observed. Opaque phases are mainly kamacite and troilite, partially weathered to iron oxides. Accessory phases are alabandite and daubreelite as blades in troilite. The presence of alabandite, An content of plagioclase and Si content of kamacite point to a classification as EL chondrite.

Geochemistry: Orthopyroxene ($\text{Fs}_{0.4}\text{En}_{98.1}\text{Wo}_{1.5}$), plagioclase ($\text{An}_{15.9}\text{Or}_{4.5}$); Si in kamacite = 0.6 wt.%, Ti in troilite = 6.2 wt.%

Classification: Enstatite chondrite (EL6)

Specimens: A total of 20.5 g specimen and one thin section is on deposit at MSN-Fi. Castellano holds the main mass.

Northwest Africa 10033 (NWA 10033)

Morocco

Purchased: 2014

Classification: Enstatite chondrite (EL6)

History: Purchased by Nicola Castellano at the Genova Mineral Fair in May 2014 from a Moroccan dealer.

Physical characteristics: A single piece weighing 123 g without fusion crust.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*); The thin section displays an equilibrated texture, with a matrix consisting of pyroxene and minor plagioclase and rare relic chondrules. Iron oxides/hydroxides veinlets can be observed, ranging in width from 150 to 200 μm . Relic chondrules are mainly RP type, with minor GP and range from 0.2 to 0.8 mm in diameter. Opaque phases are mainly kamacite and troilite, partially weathered to iron oxides. Alabandite and daubreelite as blades in troilite are accessory phases. The presence of alabandite, An content of plagioclase and Si content of kamacite point to a classification as EL chondrite.

Geochemistry: Orthopyroxene ($\text{Fs}_{0.5}\text{En}_{98.1}\text{Wo}_{1.4}$), plagioclase ($\text{An}_{15.8}\text{Or}_{4.4}$); Si in kamacite = 0.7 wt.%, Ti in troilite = 5.8 wt.%

Classification: Enstatite chondrite (EL6). Probably paired with [NWA 10034](#) and [NWA 10035](#).

Specimens: A total of 22.4 g specimen and one thin section is on deposit at MSN-Fi. Castellano holds the main mass.

Northwest Africa 10034 (NWA 10034)

Morocco

Purchased: 2014

Classification: Enstatite chondrite (EL6)

History: Purchased by Nicola Castellano at the Genova Mineral Fair in May 2014 from a Moroccan dealer.

Physical characteristics: A single piece weighing 78 g without fusion crust.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*); The thin section displays very rare relict chondrules set in a fine-grained matrix, mainly consisting of pyroxene, with minor plagioclase. Subparallel 200-250 μm -wide veinlets filled with iron oxides/hydroxides can be observed. Relict chondrules range from 0.4 to 1.0 mm in diameter and are mainly RP type, with minor GP. Opaque phases are mainly kamacite and troilite, partially weathered to iron oxides. Accessory phases are alabandite and daubreelite as blades in troilite. The presence of alabandite, An content of plagioclase and Si content of kamacite point to a classification as EL chondrite.

Geochemistry: Orthopyroxene ($\text{Fs}_{0.4}\text{En}_{98.2}\text{Wo}_{1.4}$), plagioclase ($\text{An}_{15.9}\text{Or}_{4.1}$); Si in kamacite = 0.6 wt.%, Ti in troilite = 6.2 wt.%

Classification: Enstatite chondrite (EL6). Probably paired with [NWA 10033](#) and [NWA 10035](#).

Specimens: A total of 15.6 g specimen and one thin section is on deposit at *MSN-FI*. Castellano holds the main mass.

Northwest Africa 10035 (NWA 10035)

Morocco

Purchased: 2014

Classification: Enstatite chondrite (EL6)

History: Purchased by Nicola Castellano at the Genova Mineral Fair in May 2014 from a Moroccan dealer.

Physical characteristics: A single piece weighing 143 g partially covered by fusion crust.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*); The thin section shows an equilibrated texture, with a matrix represented by pyroxene and minor plagioclase and rare relict chondrules. Relict chondrules are mainly RP type, with minor GP, and range from 0.4 to 1.0 mm in diameter. Subparallel veinlets ranging in width from 180-230 μm filled with iron oxides/hydroxides can be observed. Opaque phases are mainly kamacite and troilite, partially weathered to iron oxides. Accessory phases are alabandite and daubreelite as blades in troilite. The presence of alabandite, An content of plagioclase and Si content of kamacite point to a classification as EL chondrite.

Geochemistry: Orthopyroxene ($\text{Fs}_{0.5}\text{En}_{98.1}\text{Wo}_{1.4}$), plagioclase ($\text{An}_{16.4}\text{Or}_{4.0}$); Si in kamacite = 0.9 wt.%, Ti in troilite = 5.7 wt.%

Classification: Enstatite chondrite (EL6). Probably paired with [NWA 10033](#) and [NWA 10034](#).

Specimens: A total of 20.3 g specimen and one thin section is on deposit at *MSN-FI*. Castellano holds the main mass.

Northwest Africa 10036 (NWA 10036)

Morocco

Purchased: 2014

Classification: Enstatite chondrite (EL5)

History: Purchased by Nicola Castellano at the Genova Mineral Fair in May 2014 from a Moroccan dealer.

Physical characteristics: A single piece weighing 145 g totally covered by fusion crust.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*); The thin section shows a partially equilibrated texture, with a matrix, mainly represented by pyroxene and minor plagioclase, and scattered chondrules, easily distinguishable from the matrix. Chondrules are mainly RP type, with minor GP, and range from 0.3 to 0.9 mm in diameter. Opaque phases, mainly consisting of kamacite and troilite, are weathered to iron oxides. Accessory alabandite and daubreelite blades in troilite are visible. The presence of alabandite, An content of plagioclase and Si content of kamacite point to a classification as EL chondrite; chondrules suggest petrologic type 5.

Geochemistry: Orthopyroxene ($\text{Fs}_{0.4}\text{En}_{98.3}\text{Wo}_{1.2}$), plagioclase ($\text{An}_{16.3}\text{Or}_{5.5}$); Si in kamacite = 0.9 wt.%, Ti in troilite = 6.4 wt.%

Classification: Enstatite chondrite (EL5)

Specimens: A total of 21.8 g specimen and one thin section is on deposit at *MSN-FI*. Castellano holds the main mass.

Northwest Africa 10037 (NWA 10037)

Morocco

Purchased: 2014

Classification: Enstatite chondrite (EL6)

History: Purchased by Nicola Castellano at the Genova Mineral Fair in May 2014 from a Moroccan dealer.

Physical characteristics: A single piece weighing 43 g partially covered by fusion crust.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*); The thin section texture consists of a pyroxene-dominant matrix, with minor plagioclase, and very rare relic chondrules (mainly RP type, with minor GP) ranging in size from 0.5 to 1.1 mm. No iron oxides/hydroxides veinlets can be observed. Kamacite and troilite are the main opaque phases, partially weathered to iron oxides. Accessory phases are alabandite and daubreelite as blades in troilite. The presence of alabandite, An content of plagioclase and Si content of kamacite point to a classification as EL chondrite.

Geochemistry: Orthopyroxene ($\text{Fs}_{0.4}\text{En}_{98.2}\text{Wo}_{1.4}$), plagioclase ($\text{An}_{15.4}\text{Or}_{5.4}$); Si in kamacite = 0.6 wt.%, Ti in troilite = 6.3 wt.%

Classification: Enstatite chondrite (EL6)

Specimens: A total of 8.6 g specimen and one thin section is on deposit at *MSN-FI*. Castellano holds the main mass.

Northwest Africa 10038 (NWA 10038)

Morocco

Purchased: 2014

Classification: Ordinary chondrite (L5)

History: Purchased by Nicola Castellano at the Genova Mineral Fair in May 2014 from a Moroccan dealer.

Physical characteristics: Single stone, dark brown crust. The sawn surface shows dark-gray, very fine-grained, shock-melted veins up to 2 mm wide intersecting the coarse grained, light gray chondritic matrix.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*) Two distinct domains have been observed on a thin polished section by means of microprobe examination: the chondritic host shows an equilibrated chondritic texture, with a crystalline matrix surrounding few clearly detectable chondrules (mainly BO, POP and PP types). Main matrix phases are olivine, orthopyroxene, minor plagioclase and diopside, Fe-Ni metal and troilite; the shock-melted domain displays olivine grains set in a microcrystalline to glassy portion, green in plane polars, made of quenched silicates (mainly pigeonite) with scattered rounded metal and troilite blebs, up to 20 μm wide.

Geochemistry: (V. Moggi Cecchi, G. Pratesi, S. Caporali, M. Zoppi, *UniFi*) Chondritic domain: olivine ($\text{Fa}_{25.0\pm0.2}$, $\text{Fe/Mn}=50\pm2$, $n=7$); low-Ca pyroxene ($\text{Fs}_{21.0\pm0.1}\text{En}_{77.7\pm0.3}\text{Wo}_{1.3\pm0.0}$, 0.49 TiO_2 , 0.42 Al_2O_3 , 0.68 Cr_2O_3 , all wt. %; $\text{Fe/Mn}=30\pm2$, $n=7$); diopside ($\text{Fs}_{7.4}\text{En}_{47.7\pm0.3\pm0.1}\text{Wo}_{44.9\pm0.3}$; 0.49 TiO_2 , 0.42 Al_2O_3 , 0.68 Cr_2O_3 , 0.16 MnO , 0.46 Na_2O , all wt. %); shock melted domain: olivine grains ($\text{Fa}_{22.9\pm0.6}$, $\text{Fe/Mn}=53\pm2$, $n=10$); microcrystalline portion ($\text{Fs}_{21.8\pm0.3}\text{En}_{73.7\pm0.4}\text{Wo}_{4.5\pm0.1}$, 3.33 Al_2O_3 , 0.43 MnO , 0.08 TiO_2 , 0.45 Cr_2O_3 , 0.45 Na_2O , 0.23 K_2O , all wt. %, $n=7$).

Classification: Ordinary Chondrite (L5)

Specimens: A total of 22.5 g specimen and one thin section is on deposit at *MSN-FI*. Castellano holds the main mass.

Northwest Africa 10039 (NWA 10039)

Morocco

Find: Sept 2014

Classification: Ordinary chondrite (H5)

Physical characteristics: A single stone without fusion crust.

Petrography: Chondrules absent. Recrystallization is extensive. Major phases are olivine and low-Ca pyroxene. Accessory phases include troilite, albite, and FeNi metal.

Geochemistry: Olivine (Fa_{15.5-18.8}; N = 18), low-Ca pyroxene (Fs_{13.6-16.8}Wo_{2.6-6.8}; N = 9).

Classification: Ordinary chondrite (H5).

Specimens: 20 g at *PMO*.

Northwest Africa 10040 (NWA 10040)

Morocco

Find: 2013 Jan

Classification: Carbonaceous chondrite (CK6)

Physical characteristics: One single stone with a well-preserved fusion crust. Minimal weathering.

Petrography: A few chondrules and FeNi metal are observed in the section. Recrystallization is extensive. The major phase is olivine. Accessory phases include magnetite, and Ni-rich sulfide. Magnetite with well-developed ilmenite exsolution lamellae.

Geochemistry: NiO-rich olivine (average NiO 0.32 wt%, from 0.05 to 0.48 wt%). Ni-rich sulfide (Ni 20-27 wt%). Large compositional variations in plagioclase (An₃₀₋₇₀).

Classification: Carbonaceous chondrite (CK6).

Specimens: 26 g at *PMO*.

Northwest Africa 10041 (NWA 10041)

Morocco

Find: Apr 2012

Classification: Ordinary chondrite (LL5)

Physical characteristics: One single stone with a partial fusion crust.

Petrography: A few chondrules are visible. Recrystallization is extensive. Major phases are olivine and low-Ca pyroxene. Accessory phases include troilite, albite, and FeNi metal.

Geochemistry: Olivine Fa=26.9±0.9 (n=26), Pyroxene Fs_{22.1±0.8}Wo_{1.3±0.6} (n=19), and albite (Ab₈₀₋₈₈).

Classification: Ordinary chondrite (LL5).

Specimens: 20 g at *PMO*.

Northwest Africa 10042 (NWA 10042)

Morocco

Find: Feb 2013

Classification: HED achondrite (Eucrite)

History: Purchased from dealer Said Haddany from Erfoud, Morocco

Physical characteristics: One piece of stone with a fresh fusion crust and broken faces.

Petrography: The brecciated meteorite displays an overall basaltic texture of dominantly lath-shaped calcic plagioclase and exsolved pyroxene. Accessory minerals include chromite, and SiO₂ polymorphs.

Geochemistry: Low-Ca pyroxene $\text{Fs}_{62.0\pm1.0}\text{Wo}_{2.6\pm1.1}$, Fe/Mn=30±1, n=7; augite

$\text{Fs}_{26.5\pm0.5}\text{Wo}_{44.9\pm0.2}$, Fe/Mn=29.8±0.8, n=4; plagioclase $\text{An}_{84.0\pm5.5}\text{Ab}_{14.6\pm4.3}\text{Or}_{1.3\pm1.5}$, n=13.

Classification: Eucrite

Northwest Africa 10043 (NWA 10043)

(Northwest Africa)

Purchased: January 2015

Classification: Primitive achondrite (Lodranite)

History: Purchased in New York City from a Moroccan dealer.

Physical characteristics: One piece. A saw cut shows a mosaic of dark gray grains, some of which are as large as 1 cm. There are a few scattered, fine-grained, opaque minerals present.

Petrography: (C. Agee, *UNM*) This lodranite consists of large poikilitic augite host crystals up to 1000 µm containing smaller olivines (~400 µm) and a few percent low-Ca pyroxene. Accessory phases include metal, oxidized metal, chromite, troilite, and a phosphate; no plagioclase was found.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Augite $\text{Fs}_{7.6\pm0.3}\text{Wo}_{42.5\pm0.7}$, Fe/Mn=16±1, Cr₂O₃=1.16±0.05, n=10; low-Ca pyroxene $\text{Fs}_{16.5\pm0.9}\text{Wo}_{2.4\pm0.0}$, Fe/Mn=20±1, n=2; olivine $\text{Fa}_{14.5\pm0.2}$, Fe/Mn=27±1, n=13.

Classification: Lodranite, not an acapulcoite based on coarse grain size and absence of plagioclase.

Specimens: 20.6 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 10044 (NWA 10044)

(Northwest Africa)

Purchased: January 2015

Classification: HED achondrite (Eucrite, polymict)

History: Purchased in New York City from a Moroccan dealer.

Physical characteristics: One piece. A saw cut shows many dark, fragmental clasts up to 2 mm set in light-gray groundmass.

Petrography: (C. Agee, *UNM*) This eucrite consists of two lithologies, one is an equilibrated basaltic eucrite and the other is an unequilibrated basaltic eucrite. This is a fragmental breccia with some grains up to ~2 mm set in a fine-grained cataclastic groundmass. There are a few shock melt clasts present. Accessory phases include ilmenite, troilite, phosphate, and silica.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Equilibrated low-Ca pyroxene $\text{Fs}_{55.2\pm1.0}\text{Wo}_{5.5\pm1.5}$, Fe/Mn=32±2, n=10; equilibrated augite $\text{Fs}_{32.0\pm3.2}\text{Wo}_{36.0\pm4.6}$, Fe/Mn=31±1, n=4; zoned pigeonite $\text{Fs}_{45.4\pm4.2}\text{Wo}_{9.0\pm2.4}$, Fe/Mn=32±1, n=10; plagioclase $\text{An}_{91.9\pm1.3}\text{Ab}_{7.7\pm1.3}\text{Or}_{0.4\pm0.1}$, n=8.

Classification: Polymict eucrite

Specimens: 12.1 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 10045 (NWA 10045)

(Northwest Africa)

Purchased: January 2015

Classification: HED achondrite (Howardite)

History: Purchased in New York City from a Moroccan dealer.

Physical characteristics: One piece. A sawn surface shows many fragmental clasts, some up to 3 mm, set in a light-gray groundmass. There are many sulfide and metal grains throughout the groundmass.

Petrography: (C. Agee, *UNM*) This howardite consists of three lithologies, one is an equilibrated basaltic eucrite with exsolution pyroxenes (~50%), the second is a unequilibrated basaltic eucrite with zoned pyroxenes (~20%), and the third is an olivine-bearing diogenite (~30%). This is a breccia with single-crystal fragments as well as lithic fragments set in a fine-grained cataclastic groundmass. Accessory phases include kamacite, Fe-metal with trace amounts of nickel, oxidized iron, ilmenite, troilite, chromite, and silica.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Equilibrated eucrite low-Ca pyroxene $\text{Fs}_{56.4 \pm 2.0} \text{Wo}_{6.2 \pm 0.9}$, $\text{Fe/Mn} = 31 \pm 1$, $n=3$; equilibrated eucrite augite/pigeonite $\text{Fs}_{35.9 \pm 10.8} \text{Wo}_{32.3 \pm 11.4}$, $\text{Fe/Mn} = 32 \pm 4$, $n=4$; unequilibrated eucrite low-Ca pyroxene $\text{Fs}_{40.8 \pm 6.1} \text{Wo}_{3.7 \pm 1.9}$, $\text{Fe/Mn} = 29 \pm 2$, $n=3$; diogenite low-Ca pyroxene $\text{Fs}_{26.0 \pm 3.0} \text{Wo}_{2.9 \pm 1.1}$, $\text{Fe/Mn} = 30 \pm 1$, $n=5$; diogenite olivine $\text{Fa}_{36.7 \pm 2.4}$, $\text{Fe/Mn} = 53 \pm 1$, $n=9$; plagioclase $\text{An}_{93.0 \pm 1.6}$, $n=3$.

Classification: Howardite

Specimens: 15.3 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 10046 (NWA 10046)

(Northwest Africa)

Purchased: Jan 2015

Classification: Ordinary chondrite (LL6)

History: Purchased in New York City from a Moroccan dealer.

Physical characteristics: One piece with fusion crust. A saw-cut surface shows a very fine-grained dark gray groundmass with scattered metal/sulfide grains throughout. Shock melt domains are present.

Petrography: (C. Agee, *UNM*) This ordinary chondrite (LL6) has scattered indistinct chondrules. The plagioclase grain size is up to 100 μm . A prominent shock-melted zone with quench crystals was observed. Accessory phases include kamacite, taenite, oxidized iron, troilite, chromite, and calcite.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{29.6 \pm 1.3}$, $\text{Fe/Mn} = 61 \pm 5$, $n=11$; low-Ca pyroxene $\text{Fs}_{24.1 \pm 0.3} \text{Wo}_{1.6 \pm 0.6}$, $\text{Fe/Mn} = 35 \pm 1$, $n=5$; augite $\text{Fs}_{8.9} \text{Wo}_{45.0}$, $\text{Fe/Mn} = 27$, $n=1$.

Classification: Ordinary chondrite (LL6).

Specimens: 15.1 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 10047 (NWA 10047)

(Northwest Africa)

Purchased: January 2015

Classification: Ureilite

History: Purchased in New York City from a Moroccan dealer.

Physical characteristics: One piece with weathered fusion crust. A sawn surface shows a dark brown, poikilitic texture.

Petrography: (C. Agee, *UNM*) This is a diamond-bearing ureilite. The diamonds have elongate habits and aggregates are up to ~2 mm in length. Olivine and pigeonite grains have reduction-rim zoning profiles. There is fine-grained metal and oxidized metal throughout, especially mantling diamond. Accessory troilite is present.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{15.9\pm4.0}$, $\text{Fe/Mn}=31\pm9$, $\text{Cr}_2\text{O}_3=0.53\pm0.11$ (wt%), $n=10$; pigeonite $\text{Fs}_{13.6\pm2.7}\text{Wo}_{7.3\pm2.0}$, $\text{Fe/Mn}=21\pm6$, $\text{Cr}_2\text{O}_3=1.03\pm0.07$ (wt%), $n=10$.

Classification: Ureilite, diamond bearing.

Specimens: 15.1 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 10048 (NWA 10048)

(Northwest Africa)

Purchased: February 2015

Classification: Lunar meteorite

History: Found in December 2014 near the border of Western Sahara and Algeria. Purchased in Mauritania in February 2015.

Physical characteristics: Numerous identical pieces without fusion. Saw cuts show only a few scattered feldspathic clasts and metal grains set in a fairly uniform, dark gray, fine-grained matrix.

Petrography: (C. Agee, *UNM*) This meteorite is a very fine-grained lunar regolith breccia with some shock melt zones present. Most olivine, pyroxene and plagioclase fragments are less than 50 μm in size. Accessory Fe-Ni metal, iron oxide, chromite, and ilmenite were observed. Thin calcite weathering veins are present.

Geochemistry: (C. Agee and N. Muttik, *UNM*) olivine $\text{Fa}_{31.2\pm8.3}$, $\text{Fe/Mn}=95\pm12$, $n=15$; pigeonite $\text{Fs}_{29.3\pm6.9}\text{Wo}_{10.3\pm5.4}$, $\text{Fe/Mn}=56\pm5$, $n=15$; augite $\text{Fs}_{24.1\pm7.2}\text{Wo}_{30.8\pm8.8}$, $\text{Fe/Mn}=48\pm3$, $n=4$; plagioclase $\text{An}_{96.2\pm0.5}\text{Ab}_{3.3\pm0.5}\text{Or}_{0.4\pm0.1}$, $n=3$; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): $\text{SiO}_2=44.6\pm0.9$, $\text{TiO}_2=0.33\pm0.07$, $\text{Al}_2\text{O}_3=22.8\pm2.2$, $\text{Cr}_2\text{O}_3=0.20\pm0.04$, $\text{MgO}=9.1\pm1.8$, $\text{FeO}=8.0\pm1.4$, $\text{MnO}=0.11\pm0.02$, $\text{CaO}=13.9\pm1.0$, $\text{NiO}=0.03\pm0.02$, $\text{Na}_2\text{O}=0.34\pm0.03$, $\text{K}_2\text{O}=0.10\pm0.02$ (all wt%), $\text{Fe/Mn}=71\pm7$, $\text{Mg\#}=67\pm5$, $n=10$.

Classification: Lunar, regolith breccia

Specimens: 20.1 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 10049 (NWA 10049)

(Northwest Africa)

Purchased: 2014

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Eric Twelker from Habib Naji in Morocco, 2014.

Physical characteristics: Single stone. Saw cut shows white feldspathic clasts and a few dark colored clasts set in a dark gray matrix. There a few, very small, metal grains visible.

Petrography: (C. Agee, *UNM*) This meteorite is a fine-grained, lunar feldspathic regolith breccia with numerous agglutinates, shock melt zones and impact melt clasts present. Many of the agglutinates and melt veins are heavily vesiculated. There are also many fragmental feldspar grains and some microgabbros present, a few of these fragments are up to several mm in size. Accessory Fe-Ni metal, Fe-sulfide, chromite, and ilmenite are present. Weathering products iron oxide, barite, and calcite were detected.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{31.5\pm4.9}$, $\text{Fe/Mn}=99\pm9$, $n=29$; forsterite $\text{Fa}_{5.8}$, $\text{Fe/Mn}=87$, $n=1$; pigeonite $\text{Fs}_{26.6\pm5.5}\text{Wo}_{6.0\pm3.8}$, $\text{Fe/Mn}=55\pm4$, $n=10$; augite $\text{Fs}_{22.7\pm8.2}\text{Wo}_{33.1\pm6.9}$, $\text{Fe/Mn}=52\pm8$, $n=14$; anorthite plagioclase $\text{An}_{94.2\pm2.6}\text{Ab}_{5.4\pm2.5}\text{Or}_{0.3\pm0.2}$, $n=10$; labradorite plagioclase $\text{An}_{56.3}\text{Ab}_{37.1}\text{Or}_{6.6}$, $n=1$; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): $\text{SiO}_2=44.5\pm0.8$, $\text{TiO}_2=0.25\pm0.08$, $\text{Al}_2\text{O}_3=31.3\pm1.9$, $\text{Cr}_2\text{O}_3=0.07\pm0.01$,

MgO=3.2±1.8, FeO=3.0±0.4, MnO=0.04±0.02, CaO=17.4±0.4, NiO=0.00±0.00, Na₂O=0.55±0.09, K₂O=0.07±0.01 (all wt%), n=3.

Classification: Lunar feldspathic regolith breccia

Specimens: 12.4 g including a probe mount on deposit at UNM, *Twelker* holds the main mass.

Northwest Africa 10050 (NWA 10050)

Morocco

Purchased: 2014

Classification: Ordinary chondrite (L6, melt breccia)

Petrography: In the light-colored, impact-melted portion contains olivine. Olivine exhibits weak mosaicism, but the plagioclase grains do not contain maskelynite. It is an impact melt with a glassy mesostasis. This portion contains several shock veins. In the dark-colored, chondritic portion contains olivine. Plagioclase grains are coarse and exceed 50 µm in size. Some grains are maskelynite.

Geochemistry: In the light-colored, impact-melted portion: olivine Fa_{24.1±0.2} (n=15), low-Ca pyroxene Fs_{20.8±0.4}Wo_{1.4±0.2} (n=10), and Ca-pyroxene Fs_{7.0±0.3}Wo_{45.8±0.5} (n=11). In the dark-colored, chondritic portion: olivine Fa_{24.3±0.6} (n=12) and low-Ca pyroxene Fs_{20.4±0.2}Wo_{1.6±0.2} (n=14).

Northwest Africa 10052 (NWA 10052)

Morocco

Purchased: 2014

Classification: Carbonaceous chondrite (CR2)

Petrography: Chondrules average ~800 µm in diameter, consistent with CR. There are no large amoeboid olivine inclusions present. There are many large metal grains, consistent with CR. The matrix modal abundance is ~35 vol.%. Low-Ca pyroxene grains typically exhibit polysynthetic twinning. The mean Cr₂O₃ content of ferroan olivine grains (n=16) is 0.54±0.16 wt.%. Kamacite contains 92.8% Fe, 5.7% Ni, 0.29% Co, 0.13% P, 0.19% Cr.

Northwest Africa 10053 (NWA 10053)

Morocco

Purchased: 2014

Classification: Carbonaceous chondrite (CV3)

Petrography: The rock contains abundant fine-grained matrix. There are a few fine-grained CAIs. The chondrules are of PO and POP types and have an average size of ~900 µm. The sample is heavily weathered; about 80% of the metal and sulfide have been altered. Thus there are no large metal grains (as is common in CR chondrites). Metallic Fe-Ni is moderately abundant and the rock exhibits a moderate petrofabric, consistent with it being a reduced CV. Unrimmed amoeboid olivine inclusions are present.

Northwest Africa 10055 (NWA 10055)

Morocco

Purchased: 2014

Classification: Carbonaceous chondrite (CV3)

Petrography: The rock contains abundant fine-grained matrix. There are some fine-grained CAIs and some round, coarser CAIs. The chondrules are of POP and BO types and have a mean

size of ~900 μm . The sample is extremely weathered; about 95% of the opaque phases have been altered and there is minor alteration of the silicates. Unrimmed amoeboid olivine inclusions are present. There are no large metal grains (as is common in CR chondrites). Metallic Fe-Ni is rare; the rock does not exhibit a petrofabric. It is an oxidized CV, probably of the Allende subgroup.

Northwest Africa 10058 (NWA 10058)

Morocco

Purchased: 2014

Classification: Ordinary chondrite (H3)

Petrography: The average kamacite Co content is 0.52 wt.%, consistent with H. Chondrules average about 300 μm in diameter, consistent with H. The Cr_2O_3 content of ferroan olivine grains ($n=18$) is 0.06 ± 0.08 . The rock contains a dark-colored clast, which is poorer in coarse metal and sulfide than the chondritic host. There are curvilinear trails of metal and sulfide dispersed through the clast, indicating shock darkening. Many of the low-Ca pyroxene grains exhibit polysynthetic twinning. Chondrules do not contain clear, isotropic glass.

Geochemistry: Olivine $\text{Fa}_{12.9\pm7.6}$ ($n=20$) and pyroxene $\text{Fs}_{8.3\pm6.3}\text{Wo}_{0.7\pm0.5}$ ($n=18$)

Classification: The sharply defined chondrules, presence of recrystallized silicate matrix material, and absence of Coarse chromite and plagioclase grains indicate that it is petrologic type 3. The olivines are compositionally more heterogeneous than those in H3.8 [Dhajala](#), indicating that the petrologic type is <3.8 . The absence of clear, transparent isotropic glassy mesostasis in the chondrules is characteristic of subtype 3.6-3.9. Most of the low-Ca pyroxene phenocrysts in chondrules exhibit polysynthetic twinning, indicative of subtype ≤ 4 . According to Table 1 of [Huss et al. \(2006\)](#), this is consistent with subtype ≤ 3.4 . Low-Ca pyroxene is also heterogeneous with a PMD of 62.9%, consistent with subtype ≤ 3.6 . The Cr_2O_3 data in ferroan olivine is indicative of subtype ≥ 3.2 . The analytical data suggest subtype 3.4 or so, but from the absence of clear isotropic mesostasis, the higher range is a better classification as H3.6.

Northwest Africa 10059 (NWA 10059)

Morocco

Purchased: 2014

Classification: Ordinary chondrite (H3)

History: Purchased in 2014 in Erfoud Morocco by Brahim Tahiri from a meteorite hunter and sent to his partner Sean Tutorow for classification.

Petrography:

Classification: The olivine has a composition of $\text{Fa}_{17.6\pm1.4}$ ($n=20$) with a PMD of 5%, consistent with subtype 3.9 (according to the [Huss et al. \(2006\)](#) table). The low-Ca pyroxene has a composition of $\text{Fs}_{11.0\pm5.6}$ ($n=19$) with a PMD of 42.0%, consistent with subtype ≤ 3.6 . The rock also contains some recrystallized matrix material, recognizable in spots even through the severe weathering. Recrystallized matrix is generally absent in type 4 chondrites.

Northwest Africa 10060 (NWA 10060)

Morocco

Purchased: 2002

Classification: Ordinary chondrite (L5)

History: Purchased with numerous other unclassified NWA samples from Marvin Kilgore in 2002.

Physical characteristics: The meteorite is partly covered by fusion crust and the rest was weathered in a desert environment.

Petrography: The meteorite has a numerous chondrules of different sizes with an average size of 1.018 mm (n=20). It also has a foreign clast and a dark inclusion that was the result of shock darkening.

Geochemistry: Olivine $\text{Fa}_{22.4\pm1.8}$ (n=16); Pyroxene $\text{Fs}_{19.5\pm0.8}\text{Wo}_{2.2}$ (n=9)

Classification: Ordinary chondrite L5 with a weathering grade of W1, and a shock stage of S2.

Northwest Africa 10061 (NWA 10061)

(Northwest Africa)

Purchased: 2015

Classification: Ordinary chondrite (LL3.00)

History: Purchased by Darryl Pitt from a Moroccan meteorite dealer in Tucson, 2015.

Physical characteristics: One piece with no fusion crust. A sawn surface reveals many densely packed chondrules of variable size.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous unequilibrated chondrules, apparent mean diameter $750\pm600\ \mu\text{m}$ (n=50), many with porphyritic, igneous-zoned olivines and pyroxenes, most with glass or mesostasis. Abundant fine-grained matrix throughout.

Geochemistry: (C. Agee, N. Muttik, *UNM*) All chondrule olivine $\text{Fa}_{13.3\pm8.1}$, range $\text{Fa}_{0.7-32.7}$, n=34; ferroan olivine $\text{Fa}_{14.9\pm7.2}$, $\text{Fe/Mn}=45\pm22$, $\text{Cr}_2\text{O}_3=0.44\pm0.09\ \text{wt\%}$, range $\text{Cr}_2\text{O}_3=0.25-0.62\ \text{wt\%}$, n=30; low-Ca pyroxene $\text{Fs}_{11.3\pm7.4}\text{Wo}_{1.8\pm2.3}$, $\text{Fe/Mn}=20\pm12$, n=21. Aluminous augite present.

Classification: Ordinary chondrite (LL3.00), type 3.00 based on ferroan olivine mean Cr_2O_3 content and sigma from [Grossman and Brearley \(2005\)](#) and by the presence of S-rich matrix. Comparison of Cr_2O_3 in ferroan olivines done using the same microprobe and conditions at *UNM* gave: [NWA 7731](#) (L3.00) $\text{Cr}_2\text{O}_3=0.43\pm0.11\ \text{wt\%}$, n=98; [NWA 8276](#) (L3.00) $\text{Cr}_2\text{O}_3=0.42\pm0.10\ \text{wt\%}$; [Semarkona](#) (LL3.00) $\text{Cr}_2\text{O}_3=0.41\pm0.09\ \text{wt\%}$, n=45.

Specimens: 11.2 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 10062 (NWA 10062)

(Northwest Africa)

Purchased: 2014

Classification: HED achondrite (Eucrite, cumulate)

History: Purchased by Steve Arnold from Youssef Ait El Caid in Morocco, 2014.

Physical characteristics: Several identical appearing pieces with weathered exterior. A saw cut shows white plagioclase (up to ~1 mm) and brown pyroxene (up to ~3 mm) set in a dark groundmass.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows approximately ~60% pyroxene, ~30% plagioclase, ~5% olivine present. Accessory phases observed are troilite, chromite, ilmenite, and silica.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{64.5\pm0.6}$, $\text{Fe/Mn}=46\pm1$, n=5; low Ca pyroxene $\text{Fs}_{51.2\pm3.3}\text{Wo}_{2.4\pm0.4}$, $\text{Fe/Mn}=32\pm1$, n=9; augite $\text{Fs}_{21.7\pm3.1}\text{Wo}_{43.6\pm1.9}$, $\text{Fe/Mn}=29\pm1$, n=5, plagioclase $\text{An}_{90.5\pm3.5}\text{Ab}_{8.5\pm2.2}\text{Or}_{1.0\pm1.4}$, n=7.

Classification: Olivine-bearing cumulate eucrite

Specimens: 20.1 g including a probe mount on deposit at *UNM*, Steve Arnold holds the main mass.

Northwest Africa 10063 (NWA 10063)

(Northwest Africa)

Purchased: 2014

Classification: Ordinary chondrite (L3)

History: Purchased from Morocco, 2014.

Physical characteristics: Three identical appearing pieces with weathered exterior. A saw cut reveals many densely packed chondrules of variable size set in a dark reddish ground mass.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous unequilibrated chondrules, apparent mean diameter 530 ± 320 μm ($n=58$), many with porphyritic, igneously zoned olivines and pyroxenes. Some scattered, opaque, fine-grained matrix is present.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Chondrule olivine $\text{Fa}_{24.6 \pm 7.3}$, range $\text{Fa}_{1.7-31.6}$, $\text{Fe/Mn}=70 \pm 49$, $\text{Cr}_2\text{O}_3=0.05 \pm 0.04$ wt%, $n=44$, chondrule low-Ca pyroxene $\text{Fs}_{11.5 \pm 6.5}\text{Wo}_{0.9 \pm 1.1}$, $\text{Fe/Mn}=28 \pm 16$, $n=21$.

Classification: Ordinary chondrite L3, estimated type 3.4-3.6 based on mean values and 1-sigma of Fa and Cr_2O_3 -content of ferroan olivines.

Specimens: 23.6 g including a probe mount on deposit at *UNM*, Steve Arnold holds the main mass.

Northwest Africa 10064 (NWA 10064)

(Northwest Africa)

Purchased: 2015

Classification: Ordinary chondrite (LL3)

History: Purchased in Morocco, 2015.

Physical characteristics: Six identical appearing pieces with weathered exterior. A saw cut reveals many densely packed chondrules of variable size.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous unequilibrated chondrules, apparent mean diameter 670 ± 300 μm ($n=38$), many with porphyritic, igneously zoned olivines and pyroxenes, containing mesostasis or glass. Opaque, fine-grained matrix is present throughout. A lithologically distinct domain or clast ($\sim 1\text{-cm}$) was dominated by fine-grained matrix with low microprobe totals, consistent with the presence of phyllosilicates; no chondrules were observed in this lithology.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Chondrule olivine $\text{Fa}_{22.4 \pm 10.5}$, $\text{Fe/Mn}=90 \pm 71$, $\text{Cr}_2\text{O}_3=0.08 \pm 0.08$ wt%, $n=12$, chondrule low-Ca pyroxene $\text{Fs}_{12.9 \pm 5.0}\text{Wo}_{1.3 \pm 1.5}$, $\text{Fe/Mn}=27 \pm 6$, $n=8$.

Classification: Ordinary chondrite LL3, estimated type 3.2-3.4 based on mean values and 1-sigma of Fa and Cr_2O_3 -content of ferroan olivines.

Specimens: 20.5 g including a probe mount on deposit at *UNM*, Steve Arnold holds the main mass.

Northwest Africa 10065 (NWA 10065)

(Northwest Africa)

Purchased: 2014 Jun

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Darryl Pitt in June 2014 from a dealer in Mauritania.

Physical characteristics: Single stone (282.8 g) coated by orange-brown weathering products. The fresh interior is dark gray with white clasts and visible fresh metal grains.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of mineral clasts of anorthite, pigeonite (some exsolved), olivine, orthopyroxene, subcalcic augite, augite, ferropigeonite, Ti-Cr-bearing spinel, kamacite, troilite and rare silica polymorph, together with rare devitrified glass spheres (of anorthite+pyroxene bulk composition), in a finer grained matrix containing sparse vesicles.

Geochemistry: Olivine ($\text{Fa}_{26.4-58.6}$, $\text{FeO/MnO} = 94-100$, $N = 3$), orthopyroxene ($\text{Fs}_{11.4-19.2}\text{Wo}_{3.7-3.5}$, $\text{FeO/MnO} = 87-68$, $N = 2$), pigeonite ($\text{Fs}_{32.6}\text{Wo}_{8.2}$, $\text{FeO/MnO} = 65$), ferropigeonite ($\text{Fs}_{45.5-64.8}\text{Wo}_{20.4-22.6}$, $\text{FeO/MnO} = 65-73$, $N = 2$), subcalcic augite ($\text{Fs}_{22.1}\text{Wo}_{35.8}$, $\text{FeO/MnO} = 58$), augite ($\text{Fs}_{13.0-13.9}\text{Wo}_{38.5-41.9}$, $\text{FeO/MnO} = 51-56$, $N = 2$), plagioclase ($\text{An}_{95.4-96.3}\text{Or}_{0.2}$, $N = 2$). Bulk composition (R. Korotev, *WUSL*) INAA of subsamples gave the following mean abundances (in wt.%) FeO 7.9, Na_2O 0.32; (in ppm) Sc 17.4, Ni 490, La 5.1, Sm 2.29, Eu 0.73, Yb 2.0, Lu 0.28, Hf 1.7, Th 1.1.

Classification: Lunar (feldspathic regolithic breccia). Bulk abundances for many elements overlap with those for NWA 8746, suggesting pairing of these two stones.

Specimens: 21.4 g including one polished endcut at *UWB*. The remainder is held by *DPitt*.

Northwest Africa 10066 (NWA 10066)

(Northwest Africa)

Purchased: 2014 Jul

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Darryl Pitt in July 2014 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Relatively large, granular chondrules and sparse, fine grained CAI (up to 2.5 mm, some with finer grained rims) are set in a fine grained, brown matrix containing minor calcite and barite (but no phosphates). Several CAI consist of mainly Al-Ti-diopside and pleonaste spinel, and have rims rich in intermediate olivine.

Geochemistry: Olivine ($\text{Fa}_{0.4-43.0}$, $N = 3$), orthopyroxene ($\text{Fs}_{13.1}\text{Wo}_{2.3}$, $N = 1$), pigeonite ($\text{Fs}_{4.5}\text{Wo}_{14.5}$, $N = 1$), diopside ($\text{Fs}_{2.2}\text{Wo}_{49.5}$; $\text{Fs}_{0.6}\text{Wo}_{51.9}$; $N = 2$).

Classification: Carbonaceous chondrite (CV3).

Specimens: 20.4 g including one polished thin section at *UWB*. The remaining material is held by *DPitt*.

Northwest Africa 10067 (NWA 10067)

(Northwest Africa)

Purchased: 2014 Mar

Classification: Rumuruti chondrite (R3)

History: Purchased by Gary Fujihara in March 2014 from a Moroccan dealer.

Physical characteristics: Several dark brown breccia stones were found together and some exhibit small beige inclusions.

Petrography: (A. Irving and S. Kuehner, *UWS*) Composed mainly of well-formed, small to medium-sized (0.9 ± 0.4 mm) chondrules plus sparse ovoid clasts of the same lithology set within a much finer grained, deep brown matrix (~45 vol.%). Major minerals are olivine, orthopyroxene, subcalcic augite, and augite with accessory troilite, Ti-bearing chromite and Al-rich chromite, plus minor secondary barite. No intact CAI were found in two studied thin sections, but the matrix contains rare grains of Cr-pleonaste, perovskite and Al-Ti diopside.

Geochemistry: Olivine ($\text{Fa}_{0.4-51.3}$, Cr_2O_3 in ferroan examples = 0.07-0.11 wt.%, mean 0.09 ± 0.01 wt.%, $N = 7$), orthopyroxene ($\text{Fs}_{2.1-30.6}\text{Wo}_{0.4-2.0}$, $N = 3$), subcalcic augite ($\text{Fs}_{15.7}\text{Wo}_{34.4}$), augite

(Fs_{10.5}Wo_{44.2}). Oxygen isotopes (K. Ziegler, *UNM*): analyses of three acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ 5.122, 5.244, 4.799; $\delta^{18}\text{O}$ 5.399, 5.655, 4.271; $\Delta^{17}\text{O}$ 2.271, 2.258, 2.544 per mil.

Classification: Rumuruti chondrite (R3, breccia).

Specimens: 20.7 g including two polished thin sections at *UWB*. The remaining material is held by Mr. G. Fujihara.

Northwest Africa 10068 (NWA 10068)

(Northwest Africa)

Purchased: 2008 Jan

Classification: Martian meteorite (Shergottite)

History: Purchased by Dr. David Gregory in January 2008 from a dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Intersertal texture. Composed predominantly of complexly-zoned clinopyroxene and maskelynite with accessory Fe-Ti oxides, pyrrhotite, merrillite, alkali feldspar and alkalic glass. Crystallized melt inclusions rich in ulvöspinel are present within maskelynite.

Geochemistry: Low-Ca pyroxene (Fs_{36.4}Wo_{10.9}; Fs_{44.0-55.9}Wo_{14.3-14.6}; FeO/MnO = 32-38; N = 3), high-Ca pyroxene (Fs_{23.3-33.6}Wo_{34.0-30.5}; Fs_{49.7-54.8}Wo_{21.8-21.2}; FeO/MnO = 31-37; N = 4), plagioclase (An_{53.6-56.0}Or_{0.8-1.2}, N = 3).

Classification: Martian (intersertal shergottite). Paired with [NWA 2975](#) and stones paired with it.

Specimens: A 1.8 g polished slice is at *UWB*; a total of 614.5 g in several pieces is at *ROM*.

Northwest Africa 10069 (NWA 10069)

(Northwest Africa)

Purchased: 2014 Nov

Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Mohammed and Ali Hmani

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of shocked gabbroic eucrite clasts and related debris. Minerals are exsolved pigeonite (pale orange to red-brown in thin section), calcic plagioclase (polycrystalline), silica polymorph, ferrosilite, ferropigeonite, Ti-chromite, ferropseudobrookite, troilite, zircon and secondary barite.

Geochemistry: Orthopyroxene host (Fs_{63.4}Wo_{2.8}, FeO/MnO = 31), clinopyroxene lamella (Fs_{29.8}Wo_{41.6}, FeO/MnO = 33), clinopyroxene host (Fs_{28.5-30.7}Wo_{42.2-40.4}, FeO/MnO = 32-35, N = 2), orthopyroxene lamella (Fs_{62.8}Wo_{3.1}, FeO/MnO = 32), ferropigeonite (Fs_{68.7}Wo_{24.0}, FeO/MnO = 35).

Classification: Eucrite (monomict breccia, gabbroic).

Specimens: 22.3 g including one polished thin section at *UWB*. The remainder is held by *Hmani*.

Northwest Africa 10070 (NWA 10070)

(Northwest Africa)

Purchased: 2014 Jun

Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Darryl Pitt in June 2014 from a dealer in Mauritania.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia composed of relatively coarse (up to 3 mm), angular grains of exsolved pigeonite and plagioclase (plus rare composite lithic clasts preserving primary grain contacts) within a finer matrix of the same minerals, ilmenite, Ti-chromite, troilite and rare baddeleyite.

Geochemistry: Orthopyroxene host ($\text{Fs}_{42.0-43.1}\text{Wo}_{3.0-2.6}$, $\text{FeO/MnO} = 31-32$, $N = 3$), clinopyroxene exsolution lamellae ($\text{Fs}_{17.9-18.5}\text{Wo}_{42.9-42.4}$, $\text{FeO/MnO} = 26-27$, $N = 3$).

Classification: Eucrite (monomict breccia, gabbroic).

Specimens: 16.5 g including one polished thin section at *UWB*. The remainder is held by *DPitt*.

Northwest Africa 10071 (NWA 10071)

(Northwest Africa)

Purchased: 2014 Dec

Classification: Ordinary chondrite (LL3)

History: Purchased by Aras Jonikas in December 2014 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, relatively large (1.5 ± 0.8 mm), round, glass-bearing chondrules are set in a sparse, dark matrix containing stained kamacite. Minerals are olivine, orthopyroxene, pigeonite, augite, plagioclase, cruciform chromite and troilite.

Geochemistry: Olivine ($\text{Fa}_{0.8-52.0}$; Cr_2O_3 in ferroan olivine rims 0.05-0.09 wt.%, mean 0.07 ± 0.01 wt.%, $N = 11$), orthopyroxene ($\text{Fs}_{1.4-9.2}\text{Wo}_{1.0-1.1}$), pigeonite ($\text{Fs}_{19.8}\text{Wo}_{17.0}$), augite ($\text{Fs}_{1.1}\text{Wo}_{47.8}$).

Classification: Ordinary chondrite LL3.

Specimens: 21.1 g including one polished thin section at *UWB*. The remainder is held by Mr. A. Jonikas.

Northwest Africa 10072 (NWA 10072)

(Northwest Africa)

Purchased: 2014 Aug

Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Darryl Pitt in August 2014 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Monomict breccia composed of porphyritic eucrite clasts consisting of bladed exsolved pigeonite phenocrysts (up to 3.5 mm long) set within a very fine-grained (10-20 μm), quench-textured matrix containing pigeonite, calcic plagioclase, silica polymorph, ilmenite, Ti-chromite and troilite.

Geochemistry: Orthopyroxene host ($\text{Fs}_{56.5-57.6}\text{Wo}_{1.6-2.2}$, $\text{FeO/MnO} = 32-33$, $N = 3$), clinopyroxene exsolution lamellae ($\text{Fs}_{23.8-25.1}\text{Wo}_{43.6-42.4}$, $\text{FeO/MnO} = 35-36$, $N = 3$).

Classification: Eucrite (monomict, porphyritic basaltic).

Specimens: 5.3 g including one polished thin section at *UWB*. The remainder is held by *DPitt*.

Northwest Africa 10073 (NWA 10073)

(Northwest Africa)

Purchased: 2015 Jan

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased in Temara, Morocco by Adam Aaronson in January 2015.

Physical characteristics: Single stone (64 g) with a wind-ablated exterior and an interior consisting of whitish clasts (up to 8 mm) in a dark gray matrix.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of mineral clasts of anorthite, olivine, orthopyroxene, subcalcic augite, augite, ferropigeonite, ilmenite, Al-bearing chromite, Ni-poor kamacite and troilite, together with rare glass fragments, in a finer grained matrix. Patches of shock glass are present.

Geochemistry: Olivine ($\text{Fa}_{24.6-40.4}$, $\text{FeO/MnO} = 88-105$, $N = 3$), orthopyroxene ($\text{Fs}_{11.8}\text{Wo}_{3.0}$; $\text{Fs}_{31.1-38.9}\text{Wo}_{2.3-2.2}$; $\text{Fs}_{50.7}\text{Wo}_{2.1}$; $\text{FeO/MnO} = 54-65$, $N = 3$), pigeonite ($\text{Fs}_{19.4}\text{Wo}_{10.6}$, $\text{FeO/MnO} = 63$), ferropigeonite ($\text{Fs}_{54.2}\text{Wo}_{16.6}$, $\text{FeO/MnO} = 62$), titanian ferropigeonite ($\text{Fs}_{74.6}\text{Wo}_{14.8}$, $\text{FeO/MnO} = 65$, $\text{TiO}_2 = 8.4$ wt.%, $\text{Al}_2\text{O}_3 = 1.4$ wt.%, $\text{Na}_2\text{O} = 0.18$ wt.%), subcalcic augite ($\text{Fs}_{38.0}\text{Wo}_{27.0}$, $\text{FeO/MnO} = 58$), augite ($\text{Fs}_{6.5}\text{Wo}_{43.7}$, $\text{FeO/MnO} = 39$), plagioclase ($\text{An}_{95.5-98.5}\text{Or}_{0.2}$, $N = 2$). Bulk composition (R. Korotev, *WUSL*) INAA of subsamples gave the following mean abundances (in wt.%) FeO 3.7, Na_2O 0.40; (in ppm) Sc 7.4, Ni 160, La 3.1, Sm 1.45, Eu 0.80, Yb 1.1, Lu 0.15, Hf 1.1, Th 0.57.

Classification: Lunar (feldspathic fragmental breccia).

Specimens: 12.8 g including one polished endcut at *UWB*. The remainder is held by *Aaronson*.

Northwest Africa 10074 (NWA 10074)

(Northwest Africa)

Purchased: 2014

Classification: Primitive achondrite (Acapulcoite)

History: Purchased by Michael Farmer at the Tucson Gem and Mineral Show, 2014

Physical characteristics: Stone is ~70% covered in brownish fusion crust, with well-developed roll-over lip. Sawn surface is light greenish brown with a smattering of small (<0.5 mm) metal and troilite grains.

Petrography: Recrystallized into polygonal and subhedral grains, typically <0.3 mm, with occasional larger (to 1 mm) grains of orthopyroxene. Silicates have homogenous compositions. Many of the low-Ca pyroxene grains contain a core of small metal/troilite and rare chromite grains. These metal/troilite grains are typically <50 μm long and rounded to euhedral. Troilite covers ~7 areal % and Fe-Ni metal ~3 areal %. Most metal grains have high Ni rim and plessitic core. Kamacite is uncommon. Troilite unshocked and single crystal. Accessory chromite. Shock and weathering low.

Geochemistry: (L. Garvie, *ASU*) Olivine $\text{Fa}_{11.4\pm 0.1}$, $\text{FeO/MnO} = 21.2 \pm 1.0$, $n=10$; low Ca pyroxene $\text{Fs}_{10.8\pm 0.1}\text{Wo}_{1.4\pm 0.3}$, $\text{FeO/MnO} = 13.3 \pm 0.8$, $\text{Cr}_2\text{O}_3 = 0.2 \pm 0.0$ wt%, $n=9$; high Ca pyroxene $\text{Fs}_{4.8\pm 0.1}\text{Wo}_{43.8\pm 0.4}$, $\text{FeO/MnO} = 11.1 \pm 0.7$, $\text{Cr}_2\text{O}_3 = 1.3 \pm 0.0$ wt%, $n=7$; Feldspar $\text{An}_{14.3\pm 0.2}\text{Or}_{4.4\pm 0.2}$, $n=7$. Large metal grains have $\text{Ni} = 13.3 \pm 0.5$ wt% and $\text{Co} = 0.5 \pm 0.1$ wt% ($N = 13$). Small metal grains in silicates have more variable Ni from 5.9 to 9.5 wt%. (K. Ziegler, *UNM*): Analyses of three acid-washed subsamples by laser fluorination dual inlet mass spectrometry gave, respectively, $\delta^{17}\text{O}$ 1.176, 1.021, 0.991; $\delta^{18}\text{O}$ 3.949, 3.724, 3.691; $\Delta^{17}\text{O}$ -0.909, -0.945, -0.958 per mil (reference TFL slope = 0.528, values are linearized)

Classification: Acapulcoite

Northwest Africa 10075 (NWA 10075)

Northwest Africa

Purchased: 2014-Oct

Classification: Ordinary chondrite (L5)

History: Purchased by Fabien Kuntz in October 2014 from a Moroccan dealer at the Munich Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules.

Geochemistry: Olivine (Fa_{24.8-25.0}, N = 2), orthopyroxene (Fs_{20.6-20.7}Wo_{1.3-1.5}, N = 2), clinopyroxene (Fs_{6.8-7.6}Wo_{45.4-45.0}, N = 2).

Classification: Ordinary chondrite (L5).

Specimens: 54.12 g including one polished thin section at *PSF*; main mass with *Kuntz*.

Northwest Africa 10076 (NWA 10076)

Northwest Africa

Purchased: 2014-Jan

Classification: Ordinary chondrite (H6)

History: Purchased by Fabien Kuntz in January 2014 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Largely recrystallized with rare chondrule remnants.

Geochemistry: Olivine (Fa_{18.8-19.3}, N = 2), orthopyroxene (Fs_{16.1-16.3}Wo_{1.2-1.5}, N = 2), clinopyroxene (Fs_{7.9-8.7}Wo_{43.3-42.3}, N = 2).

Classification: Ordinary chondrite (H6).

Specimens: 7.15 g including one polished thin section at *PSF*; main mass with *Kuntz*.

Northwest Africa 10077 (NWA 10077)

(Northwest Africa)

Purchased: 2014 Jul

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Fabien Kuntz in July 2014 from a dealer in Fom El Hisn, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of angular mineral fragments in a finer grained matrix containing vesicles. Minerals are anorthite, olivine, orthopyroxene, pigeonite, silica polymorph, bytownite, Cl-bearing apatite, ilmenite, troilite and kamacite.

Geochemistry: Olivine (Fa_{23.9-32.0}, FeO/MnO = 84-94, N = 3), orthopyroxene (Fs_{26.6}Wo_{3.5}, FeO/MnO = 68, N = 1), pigeonite (Fs_{21.3-23.6}Wo_{17.4-10.9}, FeO/MnO = 53-63, N = 3), plagioclase (An_{95.3-96.5}Or_{0.4}; An_{83.2}Or_{0.8}; N = 3). Bulk composition (R. Korotev, *WUSL*) INAA of subsamples gave the following mean abundances (in wt.%) FeO 5.2, Na₂O 0.48; (in ppm) Sc 10.2, La 5.9, Sm 2.7, Eu 1.11, Yb 1.83, Lu 0.25, Th 0.9.

Classification: Lunar (feldspathic regolithic breccia). Paired with [NWA 8641](#) based on texture and bulk composition.

Specimens: 1.08 g piece polished on one side at *PSF*; main mass with *Kuntz*.

Northwest Africa 10078 (NWA 10078)

(Northwest Africa)

Purchased: 2014 Jan

Classification: Ordinary chondrite (L4)

History: Purchased by Fabien Kuntz in January 2014 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (one very large 6 mm).

Geochemistry: Olivine (Fa_{25.2-25.3}, N = 2), orthopyroxene (Fs_{20.1-20.6-20.7}Wo_{1.4-1.3}, N = 2), clinopyroxene (Fs_{7.6-7.7}Wo_{44.2-44.0}, N = 2).

Classification: Ordinary chondrite (L4).

Specimens: 27.81 g including one polished thin section at *PSF*; main mass with *Kuntz*.

Northwest Africa 10080 (NWA 10080)

(Northwest Africa)

Purchased: 2014 Oct

Classification: Ordinary chondrite (L4)

History: Purchased by Fabien Kuntz in October 2014 from a Moroccan dealer at the Munich Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules. Accessory merrillite was observed.

Geochemistry: Olivine ($\text{Fa}_{23.8-23.9}$, $N = 2$), orthopyroxene ($\text{Fs}_{8.3-19.9}\text{Wo}_{0.3-1.1}$, $N = 3$), subcalcic augite ($\text{Fs}_{13.6}\text{Wo}_{32.8}$), augite ($\text{Fs}_{6.8}\text{Wo}_{43.0}$).

Classification: Ordinary chondrite (L4).

Specimens: 23.76 g including one polished thin section at *PSF*; main mass with *Kuntz*.

Northwest Africa 10081 (NWA 10081)

Northwest Africa

Purchased: 2014-Jan

Classification: Ordinary chondrite (LL6)

History: Purchased by Fabien Kuntz in January 2014 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Recrystallized with poikiloblastic texture and distributed small metal grains enclosed within mafic silicates. Some large remnant chondrule features are evident.

Geochemistry: Olivine ($\text{Fa}_{28.0-28.3}$, $N = 2$), orthopyroxene ($\text{Fs}_{22.0-22.5}\text{Wo}_{1.9-2.4}$, $N = 2$), clinopyroxene ($\text{Fs}_{9.7}\text{Wo}_{42.2}$).

Classification: Ordinary chondrite (LL6).

Specimens: 1.0 g including one polished thin section at *PSF*; main mass with *Kuntz*.

Northwest Africa 10082 (NWA 10082)

(Northwest Africa)

Purchased: 2014 Aug

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Alexandre Debiegne in August 2014 from a dealer in Agadir, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Very fine grained annealed breccia with granoblastic texture. Minerals are anorthite, olivine, pigeonite, pentlandite, pleonaste and troilite, with minor fayalite and kamacite.

Geochemistry: Olivine ($\text{Fa}_{29.2-31.4}$, $\text{FeO/MnO} = 103-129$, $N = 3$), pigeonite ($\text{Fs}_{21.7-23.0}\text{Wo}_{17.2-11.8}$, $\text{FeO/MnO} = 55-56$, $N = 3$). Bulk composition (R. Korotev, *WUSL*) INAA of subsamples gave the following mean abundances (in wt.%) FeO 3.5, Na_2O 0.46; (in ppm) Sc 5.1, Ni 490, La 2.8, Sm 0.73, Eu 0.96, Yb 1.1, Lu 0.15, Hf 1.0, Th 0.72.

Classification: Lunar (feldspathic granulitic breccia). Paired with [NWA 8022](#) based on distinctive texture and bulk composition.

Specimens: 1.28 g including a polished piece at *PSF*; main mass with Mr. A. Debiegne.

Northwest Africa 10083 (NWA 10083)

Northwest Africa

Purchased: 2014-Aug

Classification: Ordinary chondrite (L6)

History: Purchased by Alexandre Debienne in August 2014 from a dealer in Agadir, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Largely recrystallized with rare chondrule remnants.

Geochemistry: Olivine ($\text{Fa}_{24.5-24.8}$, $N = 2$), orthopyroxene ($\text{Fs}_{21.1-21.2}\text{Wo}_{1.9-1.8}$, $N = 2$), clinopyroxene ($\text{Fs}_{7.2-9.3}\text{Wo}_{44.8-44.1}$, $N = 2$).

Classification: Ordinary chondrite (L6).

Specimens: 21.4 g including one polished thin section at *PSF*; main mass with Mr. A. Debienne.

Northwest Africa 10084 (NWA 10084)

(Northwest Africa)

Purchased: 2015

Classification: Ordinary chondrite (L, impact melt)

History: Purchased by Luc Labenne from Aziz Habibi in Tucson, 2015.

Physical characteristics: Single stone with smooth black fusion crust. Saw cut reveals a high density of very fine-grained, light-colored crystals set in a dark-gray groundmass, with a few opaque grains scattered throughout.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows a microporphyry with ~50 vol.% olivine grains suspended in ~40 vol.% quench melt. Accessory phases observed are FeNi-metal, Fe-sulfide, chromite, and low-Ca pyroxene. Average olivine grain size is approximately 100 μm . The quench melt consists of μm to sub- μm scale dendritic crystals and glass.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{25.2\pm0.4}$, $\text{Fe/Mn}=49\pm2$, $n=24$; low Ca pyroxene $\text{Fs}_{23.1\pm2.6}\text{Wo}_{1.9\pm1.8}$, $\text{Fe/Mn}=29\pm3$, $n=3$. Quench melt (20 μm defocused electron beam): $\text{SiO}_2=57.8\pm1.4$, $\text{TiO}_2=0.31\pm0.05$, $\text{Al}_2\text{O}_3=6.9\pm0.8$, $\text{Cr}_2\text{O}_3=0.83\pm0.46$, $\text{MgO}=12.9\pm2.0$, $\text{FeO}=8.9\pm2.0$, $\text{MnO}=0.29\pm0.05$, $\text{CaO}=7.0\pm1.6$, $\text{NiO}=0.07\pm0.08$, $\text{Na}_2\text{O}=2.9\pm0.6$, $\text{K}_2\text{O}=1.2\pm0.2$ (all wt%), $\text{Fe/Mn}=31\pm7$ (molar), $\text{Mg\#}=72\pm5$, $\text{K/Na}=0.5\pm0.1$ (wt), $\text{CaO/Al}_2\text{O}_3=1.0\pm0.3$ (wt), $n=41$. Oxygen isotopes (K. Ziegler, *UNM*): acid-washed material analyzed in 3 replicates by laser fluorination gave, respectively $\delta^{18}\text{O}=4.567, 4.452, 4.260$; $\delta^{17}\text{O}=3.501, 3.456, 3.342$; $\Delta^{17}\text{O}=1.090, 1.105, 1.093$ (linearized, all per mil). Magnetic susceptibility (J. Gattacceca, *CEREGE*) $\log \chi=4.18$ (χ in $10^{-9} \text{ m}^3/\text{kg}$).

Classification: L-impact melt. This meteorite has oxygen isotopes that plot on the slope-1 line, above the terrestrial fractionation line, suggesting an affinity to ordinary chondrites. However the quench-melt phase in this meteorite, which is compositionally equivalent to a terrestrial boninite, is enriched in K and depleted in Al with super-chondritic K/Na and Ca/Al.

Specimens: 3.0 g including a probe mount on deposit at *UNM*, Labenne holds the main mass.

Northwest Africa 10085 (NWA 10085)

(Northwest Africa)

Purchased: Feb 2013

Classification: K4

Physical characteristics: A desert-varnished and mostly fusion-crust stone was purchased at the Tucson Gem and Mineral Show in 2013.

Petrography: (J. Utas, *UCLA*) The meteorite is comprised of approximately ~60% matrix, 15-20% chondrules, and ~20% limonite. The average chondrule diameter is ~450 μm . The thin section is dominated by two large chondrules: a 2 mm PP chondrule and a 1.5 mm POP chondrule. Enstatite laths are dispersed throughout the matrix and limonite, with most laths

measuring less than 200 by 30 μm . A few are as large as 400 by 50 μm . Sulfide grains $\sim$ 2-10 μm in diameter are common, but few larger ones are preserved; one 300 μm sulfide grain remains. Three iron phosphide inclusions up to $\sim$ 150 μm were observed; one was associated with euhedral chromite crystals $\sim$ 5 to 50 μm in diameter. Many 5-10 μm grains of unoxidized kamacite and a few grains of taenite are still present in the section.

Geochemistry: Mineral compositions and geochemistry: J. Utas (*UCLA*) Kamacite (N=6, total 99.0%): 93.1% Fe, 6.7% Ni (5.38% to 8.73%), 0.40% Co, 0.19% Mg, 0.13% P, 0.07% Si (0.02% to 0.18%), and 0.05% Mn (just above detection limit). Ti and Cr were not observed above detection limits. Presence of trace Mg in kamacite may indicate contamination from silicate minerals; the above Si value may be slightly higher than the actual value. One taenite grain was observed, with 75.0% Fe, 24.7% Ni, 0.19% Co, 0.09% P. Ti, Cr, Si, and Mg were not detected (total 99.3%). Schreibersite (N=5, total 100.4%): 46.2% Fe, 29.3% Ni, 24.4% P, other elements not observed. Sulfide (N=7, total 98.0%): 50.5% Fe, 49.05% S, 0.31% Cr, 0.05% P (just above detection limit). Plagioclase (N=2, total 100.5%): $\text{An}_{13.3}\text{Ab}_{83.2}\text{Or}_{3.6}$. Oxygen isotopes: (K. Ziegler, *UNM*) $\delta^{17}\text{O} = 1.886\text{‰}$, 2.674‰, 1.411‰ $\delta^{18}\text{O} = 5.629\text{‰}$, 6.873‰, 5.017‰, $\Delta^{17}\text{O} = -1.086\text{‰}$, -0.955‰, -1.238‰. Samples: 1.4, 1.5, and 1.7 mg, respectively, matrix and chondrule.

Classification: (J. Utas and A.E. Rubin, *UCLA*) (K4) Fa, Fs, and Wo averages plot between values obtained for [Kakangari](#), [Lea County 002](#), and [LEW 87232](#). Kamacite and taenite Fe, Ni, and trace elemental abundances are also intermediate. The only differences observed between this stone and other K (type 2-3) meteorites are this stone's petrographic grade and the apparent average grain size of matrix mineral assemblages. These differences are consistent with the stone having experienced a higher degree of thermal metamorphism than other, unequilibrated, K chondrites.

Northwest Africa 10086 (NWA 10086)

(Northwest Africa)

Purchased: Dec 2011

Classification: Ordinary chondrite (LL3)

Physical characteristics: A number of partly fusion-crust fragments were found. The largest single stone recovered weighed approximately 950 g. Most fragments are desert varnished and exhibit abundant chondrules.

Petrography: (A.E. Rubin, *UCLA*) About two-thirds of the olivine grains are in a peak centered at Fa_{30-32} . The average chondrule diameter is 600 μm . There are polysynthetically twinned low-Ca clinopyroxene grains.

Northwest Africa 10087 (NWA 10087)

(Northwest Africa)

Purchased: Feb 2011

Classification: Ordinary chondrite (H3)

Physical characteristics: The stone was completely covered with fusion crust prior to cutting. Small white pits (chondrules) were visible on one side due to weathering.

Petrography: (A.E. Rubin, *UCLA*) The olivine has a peak at Fa_{17-19} , in the H-chondrite range. Chondrules average 300 μm in diameter. There are polysynthetically twinned low-Ca clinopyroxene grains.

Northwest Africa 10088 (NWA 10088)

(Northwest Africa)

Purchased: Feb 2012

Classification: Ordinary chondrite (LL3)

Physical characteristics: The stone exhibited substantial pitting from wind-abrasion; it was entirely desert varnished.

Petrography: (A.E. Rubin, *UCLA*) The average chondrule diameter is 600 μm . There are polysynthetically twinned low-Ca clinopyroxene grains.

Northwest Africa 10090 (NWA 10090)

Morocco

Purchased: Jul 2013

Classification: Ordinary chondrite (H3)

Physical characteristics: The stone was very round and covered with a wind-polished fusion-crust.

Petrography: (A.E. Rubin, *UCLA*) Polysynthetically twinned low-Ca clinopyroxene indicative of type 3 or 4. No chondrule glass (not low type 3), sharply defined chondrules indicative of type 3, and homogeneous olivine and pyroxene suggesting high type 3. Suggested classification is H3.8.

Northwest Africa 10091 (NWA 10091)

Morocco

Purchased: Feb 2013

Classification: Carbonaceous chondrite (CV3)

Physical characteristics: The stone is roughly spherical, with many chondrules visible on its surface. The stone is heavily weathered, with abundant matrix clays.

Petrography: (A.E. Rubin, *UCLA*) One fluffy type-A, fine-grained CAI fragment measuring 70 $\times$ 150 μm in the thin section. Average chondrule diameter $\sim$ 800 μm , many with igneous rims. Matrix abundance is $\sim$ 40%, indicative of CV chondrites. Heterogeneity of olivine indicates type 3. Most chondrules are type I porphyritic or barred olivine, characteristic of CV3. Some metal and sulfide is still preserved within chondrules.

Northwest Africa 10092 (NWA 10092)

(Northwest Africa)

Purchased: Sep 2011

Classification: Carbonaceous chondrite (CO3)

History: Purchased from Ahmad Bouragaa.

Physical characteristics: The stone is very angular, and almost completely fusion-crust. The fusion crust exhibits lipping on one side.

Petrography: (A.E. Rubin, *UCLA*) Heterogeneity of olivine indicates low type 3. Average chondrule diameter is $\sim$ 200 μm consistent with CO3. Matrix abundance $\sim$ 35%, most chondrules are porphyritic type I, consistent with CO3.

Northwest Africa 10093 (NWA 10093)

Algeria

Purchased: Jul 2013

Classification: Ordinary chondrite (LL5)

Physical characteristics: The oblong, round stone is entirely fusion-crust and desert-varnished.

Petrography: (A.E. Rubin, *UCLA*) Chondrules are recrystallized, but readily delineated, consistent with type 5. Plagioclase grains generally 15 μm or smaller, suggesting a petrographic grade lower than 6. No polysynthetically twinned low-Ca clinopyroxene, indicating not type 3-4. Average chondrule diameter is $\sim 600\ \mu\text{m}$, characteristic of LL.

Northwest Africa 10094 (NWA 10094)

(Northwest Africa)

Purchased: 2010 Dec 30

Classification: Ordinary chondrite (LL6)

Physical characteristics: The desert-varnished fragments exhibits $\sim 15\%$ weathered fusion crust.

Petrography: (A.E. Rubin, *UCLA*) Chondrules with average diameter of $\sim 600\ \mu\text{m}$ consistent with LL. Chondrules are highly recrystallized and poorly defined. Plagioclase grains in excess of $50\ \mu\text{m}$ are indicative of type 6.

Northwest Africa 10095 (NWA 10095)

(Northwest Africa)

Purchased: Apr 2012

Classification: Ordinary chondrite (L4)

Physical characteristics: The find consists of two desert-varnished, unoxidized fragments. They are green-gray in color and exhibit many chondrules, some with visible white rims. A small patch of abraded fusion crust is present on one fragment.

Petrography: (A.E. Rubin, *UCLA*) Average chondrule diameter is $\sim 400\ \mu\text{m}$, consistent with an L-chondrite. Polysynthetically twinned low-Ca clinopyroxene is present, but rare, and the lack of glass in chondrules is indicative of a higher degree of metamorphism than observed in type 3 chondrites. Chondrules are well defined, indicative of type 4.

Northwest Africa 10096 (NWA 10096)

(Northwest Africa)

Purchased: Feb 2013

Classification: Ordinary chondrite (L4)

Physical characteristics: The stone is mostly fusion-crust. A desert-varnished broken corner exhibits a chondrule $\sim 1\ \text{cm}$ in diameter.

Petrography: (A.E. Rubin, *UCLA*) Chondrules are unusually large, with an average diameter of $\sim 600\ \mu\text{m}$, similar to LL chondrites. Chondrules are well-defined, but polysynthetically twinned, low-Ca pyroxene is rare, consistent with type 4.

Classification: (A.E. Rubin, *UCLA*) (L4) Olivine and pyroxene are consistent with L.

Northwest Africa 10097 (NWA 10097)

Aousserd, Morocco

Find: 12 Aug 2013

Classification: Ordinary chondrite (L6)

History: Many fragments totalling at least 186 kg were found by a meteorite hunter near Aousserd, Morocco.

Petrography: (A.E. Rubin, *UCLA*) Chondrules are recrystallized and poorly defined. Average chondrule diameter is ~400 µm, consistent with L. The presence of coarse diopside is consistent with type 6. Plagioclase grains consistently exceed 50 µm, consistent with type 6.

Northwest Africa 10098 (NWA 10098)

(Northwest Africa)

Purchased: 2013 July 20

Classification: Carbonaceous chondrite (CO3)

Petrography: (A.E. Rubin, *UCLA*) Stone has approximately 40% matrix, and an average chondrule diameter of ~240 µm. Chondrules exhibit abundant polysynthetically twinned low-Ca pyroxene, indicative of type 3. Most chondrules are type I porphyritic, consistent with a carbonaceous chondrite. Chondrules are sharply defined.

Northwest Africa 10099 (NWA 10099)

(Northwest Africa)

Purchased: 2013 July 20

Classification: Ordinary chondrite (L6)

Petrography: (A.E. Rubin, *UCLA*) Meteorite is highly recrystallized, chondrules are very poorly defined. Many plagioclase grains exceed 50 µm in diameter. Average chondrule diameter is difficult to discern, but olivine and pyroxene are highly equilibrated and well within the L range.

Northwest Africa 10100 (NWA 10100)

(Northwest Africa)

Purchased: 2013 July 10

Classification: Carbonaceous chondrite (CO3)

Petrography: (A.E. Rubin, *UCLA*) Matrix abundance is ~45%, average chondrule diameter is ~200 µm. Most chondrules are type I porphyritic, consistent with a carbonaceous chondrite. Some small amoeboid olivine inclusions are present (~300 µm in diameter). Heterogeneity of olivine and abundant polysynthetically twinned low-Ca pyroxene are indicative of an unequilibrated chondrite. Chondrules are sharply defined.

Geochemistry: Mineral compositions and geochemistry: (A.E. Rubin, *UCLA*) Cr₂O₃ of ferroan olivine: 0.08±0.07 (n=11).

Northwest Africa 10101 (NWA 10101)

(Northwest Africa)

Purchased: 2013 Sep 5

Classification: Carbonaceous chondrite (CV3)

Petrography: (A.E. Rubin, *UCLA*) Meteorite contains ~45% matrix, with an average chondrule diameter of ~800 µm. The largest CAI in the examined section is an elongate, fluffy type-A CAI, interwoven with fine-grained matrix: it measures 1.7 × 0.5 mm. Other, fine-grained, fluffy type-A CAIs in the section measure 900 × 250 µm & 200 × 150 µm. Several ~1 mm AOIs are present in the section, as well as many type I porphyritic chondrules with igneous rims. Many chondrules contain polysynthetically twinned low-Ca pyroxene, indicative of a type 3 chondrite. Chondrules are very sharply defined. The stone contains secondary magnetite. Some metal has been converted into oxides, but the matrix is not thoroughly stained.

Northwest Africa 10102 (NWA 10102)

Morocco

Find: 2010

Classification: Ordinary chondrite (L(LL)3)

History: A 6 kg meteorite was reportedly found near Temara in 2010 and purchased by Ruben Garcia at the 2013 Tucson Gem and Mineral show.

Physical characteristics: Sawn surface is dark greenish black with abundant lighter colored chondrules. Some lighter angular clasts to 4 cm. Slices criss-crossed with thin oxide veins.

Petrography: Abundant chondrules, ~80 area% set in dark black matrix. Large range of chondrules types present (PO, POP, RP, granular, PP, RP with olivine), some in the size range for LL chondrites. Many of the low-Ca pyroxene grains in PP and POP chondrules show polysynthetic twinning. Troilite is abundant, occurring as rims around chondrules, fine-grained in matrix, as a fine web within cracks in silicate grains, and as larger grains. The larger Fe-S grains show significant weathering, however, the fine-grained Fe-S and web-like network is largely unweathered. Three thin sections studied. One section contains three large clasts: 7 × 5 mm clast composed of radial and barred olivine fragments; 6 × 4 mm irregularly shaped clast of radial pyroxene; and, 3 × 2 mm dark achondritic clast. No metal observed.

Geochemistry: (L. Garvie, ASU) Olivine $\text{Fa}_{23.4\pm4.2}$, range $\text{Fa}_{10.3-30.0}$, $\text{FeO/MnO}=52.7\pm10.6$, $\text{Cr}_2\text{O}_3=0.04\pm0.02$ wt%, $n=19$. Low Ca pyroxene $\text{Fs}_{14.4\pm7.6}\text{Wo}_{2.7\pm3.8}$, range $\text{Fs}_{4.4-26.1}\text{Wo}_{0.3-14.4}$, $\text{FeO/MnO}=23.0\pm10.2$, $n=16$; high Ca pyroxene $\text{Fe}_{23.8}\text{Wo}_{35.3}$ and $\text{Fs}_{7.1}\text{Wo}_{43.0}$. (K. Ziegler, UNM): Analyses of three acid-washed subsamples by laser fluorination dual inlet mass spectrometry gave, respectively, $\delta^{17}\text{O}$ 4.212, 4.251, 4.093; $\delta^{18}\text{O}$ 6.486, 6.144, 6.212; $\Delta^{17}\text{O}$ 0.787, 1.007, 0.813 per mil (reference TFL slope = 0.528, values are linearized).

Classification: Ordinary chondrite (L(LL)3, S3, W3). Although the oxygen isotopes plot at the heavy ^{18}O end of the LL field, the mean Fa content is consistent with L, and mean low Ca pyroxene Fs content with H. No Fe-Ni metal found. Despite the weathering, the abundance of areas with thin spider-like veining of unweathered troilite suggests that metal would have been preserved, at least locally, had it been present. Estimation of subtype 3.6 based on Cr_2O_3 content in ferroan olivine and on histograms (Fig. 4) in [Grossman and Brearley \(2005\)](#).

Specimens: 606.8 g at ASU.

Northwest Africa 10103 (NWA 10103)

(Northwest Africa)

Purchased: 2013

Classification: Ordinary chondrite (LL7)

History: A 15.1 g fusion crusted stone was acquired by CMS from the 2013 Tucson Gem and Mineral Show.

Physical characteristics: Stone covered with moderately wind-ablated brown fusion crust. Sawn surface shows a mix of rounded to angular light-gray to white clasts (to 1 cm), in a light olive-green crystalline matrix. Stone is very brittle. Weathering is minor. No chondrules visible.

Petrography: Clasts, which occupy ~70 area% of the stone, are highly recrystallized with hypidiomorphic to granular texture. Olivine grains to 0.6 mm in the clasts. Uneven distribution of grain sizes in the clasts may represent former chondrules. One possible BO chondrules visible. Abundant feldspar >100 μm . Metal and troilite occupy ~2 areal%. Accessory chromite to 400 μm . Interclast region greenish brown in thin section and crystalline.

Geochemistry: (L. Garvie, ASU) Olivine $\text{Fa}_{31.5\pm1.2}$, $\text{FeO/MnO}=61.1\pm4.0$, $N=14$; low-Ca pyroxene $\text{Fs}_{25.6\pm0.4}\text{Wo}_{2.1\pm0.1}$, $\text{FeO/MnO}=37.2\pm1.6$, $n=11$; high-Ca pyroxene $\text{Fs}_{11.0}\text{Wo}_{42.8}$ and $\text{Fs}_{10.9}\text{Wo}_{42.8}$; Feldspar $\text{An}_{10.2}\text{Or}_{2.0}$ and $\text{An}_{11.3}\text{Or}_{2.9}$. (K. Ziegler, UNM): Analyses of three acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ 3.885, 3.834, 4.087; $\delta^{18}\text{O}$ 5.175, 4.943, 5.444; $\Delta^{17}\text{O}$ 1.153, 1.224, 1.213 (all per mil).

Classification: Ordinary chondrite (LL7, S1, W1). Oxygen isotopes plot within the overlapping fields for LL and L, though the olivine and pyroxene compositions are consistent with LL parentage. Absence of chondrules and recrystallized texture are consistent with petrologic grade 7.

Specimens: 15.1 g at ASU

Northwest Africa 10104 (NWA 10104)

(Northwest Africa)

Purchased: 2014

Classification: Carbonaceous chondrite (CK6)

History: A 182.6 g, roughly cuboid meteorite was acquired by Michael Farmer at the 2014 Tucson Gem and Mineral Show.

Physical characteristics: Stone covered with wind ablated fusion crust. Interior is hard, black and featureless.

Petrography: Coarse-grained and recrystallized. Thin section shows few recognizable chondrules, one to 3 mm. Mineralogy dominated by olivine with minor pyroxene and plagioclase. Thin section largely opaque in transmitted light, this opacity is caused by the high abundance of micrometer-sized Fe-S and Cr-rich magnetite grains. No sign of weathering.

Geochemistry: (L. Garvie, ASU) Olivine $\text{Fa}_{33.6\pm0.6}$, $\text{FeO/MnO}=122.1\pm10.3$, $\text{NiO}=0.4\pm0.1$ wt%, $n=10$. High-Ca pyroxene $\text{Fs}_{7.7\pm0.3}\text{Wo}_{47.1\pm1.4}$, $n=3$. Feldspar $\text{An}_{40.5}\text{Or}_{2.3}$ and $\text{An}_{56.4}\text{Or}_{1.1}$.

Classification: Carbonaceous chondrite CK6. Low weathering.

Specimens: 32.2 g at ASU.

Northwest Africa 10106 (NWA 10106)

Morocco

Purchased: 2013

Classification: Ordinary chondrite (H5)

History: Dean Bessey purchased the meteorite in Erfoud, Morocco. It was acquired by Michael Zielinski and brought to CWRU in 2013.

Physical characteristics: The full specimen was completely covered in a dark brown fusion crust. It is bulbous and approximately fist sized. Abundant metal can be seen in the cut section along with rare metal nodules that reach mm size. Chondrules are not well defined in the cut face. The section sample has a total mass of 228.8 g.

Petrography: In plane polarized light the meteorite is seen to consist of approximately 50% chondrules, 16% metal grains, 5% sulfide grains, with the remainder being a dark orange, rusty groundmass. Chondrules range in size from 0.2 mm to about 1.2 mm in diameter, although there is a small population of chondrules around the 0.1 mm size. The chondrules range in type from barred olivine, bladed pyroxene and poikilitic clastic. Metal grains range in size from 0.2 to 6 mm and sulfide grains are small, around 0.2 mm.

Geochemistry: Chondrules are primarily composed of olivine and pyroxene grains with rare areas of feldspathic glass. Olivine grains are $\text{Fa}_{18.2}$ and pyroxene grains are $\text{Fs}_{16.7}$. The metal

nodules are primarily kamacite with a few zones of taenite. Laser ablation ICP-MS shows that the metal nodules are depleted in the siderophile elements, notably Re, Os, Ir, Ru, Pt, and Rh.
Specimens: A type specimen of 22.9 g is kept at *CMNH*. The main mass and a mm thick slab are in the possession of Michael Zielinski.

Northwest Africa 10107 (NWA 10107)

(Northwest Africa)

Purchased: 2014

Classification: Ordinary chondrite (L, melt breccia)

History: Purchased by Tomasz Jakubowski from a local meteorite dealer Morocco.

Petrography: The meteorite is a melt breccia composed of chondritic clasts set into abundant shock melt regions containing abundant FeNi metal and sulphide spherules. Chondritic clasts are L6; plagioclase grain size is about 60 μm .

Northwest Africa 10109 (NWA 10109)

(Northwest Africa)

Purchased: 2014

Classification: Ordinary chondrite (LL3-6)

History: Purchased by Tomasz Jakubowski from a local meteorite dealer Morocco.

Petrography: The meteorite is a chondritic breccia composed of LL3 to LL6 clasts set into a fine-grained clastic matrix. Plagioclase grain size in LL5 clasts is about 30 μm and in LL6 clasts about 80 μm .

Geochemistry: Olivine in type 6: $\text{Fa}_{29.4}$; olivine in type 3: $\text{Fa}_{23.3\pm 6.5}$ ($\text{Fa}_{9.1-33.2}$, $n=53$); pyroxene in type 6: $\text{Fs}_{23.8}\text{Wo}_{1.7}$; pyroxene in type 3: $\text{Fs}_{18.5\pm 6.4}\text{Wo}_{1.1\pm 0.9}$ ($\text{Fs}_{4.9-33}\text{Wo}_{0.3-4.5}$, $n=60$).

Northwest Africa 10116 (NWA 10116)

(Northwest Africa)

Purchased: 2015

Classification: Carbonaceous chondrite (CK6)

History: Purchased by Philippe Schmitt-Kopplin from a local dealer in Morocco who claimed that the piece was found in the region of Smara-Laayoune, Western Sahara.

Petrography: The meteorite displays a grayish interior and is composed of few relict chondrules and rare CAIs set into abundant recrystallized matrix. Fe-rich olivine is by far the most abundant mineral phase, followed by feldspar, Ca-pyroxene, low-Ca pyroxene and Cr-bearing magnetite.

Geochemistry: Cr_2O_3 in magnetite: about 5 wt%.

Specimens: 20.0 g *MNB*; 10.4 g *HZM*

Northwest Africa 10117 (NWA 10117)

(Northwest Africa)

Purchased: 2015

Classification: HED achondrite (Eucrite, brecciated)

History: Purchased by Alan Mazur from a local meteorite dealer in Morocco.

Petrography: The meteorite is a breccia consisting of up to 1 cm-sized eucritic clasts set into a matrix of abundant and recrystallized melt regions. Clasts are dominantly composed of 100-200 μm sized exsolved pyroxene and calcic plagioclase. Minor phases are chromite, troilite, and SiO_2

polymorphs. Fine-grained regions between the clasts appear to be shock melted and partly recrystallized. Pairing with [NWA 8036/8509](#) seems likely.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{61\pm0.5}\text{Wo}_{2.7\pm0.5}$ ($\text{Fs}_{59.4-61.6}\text{Wo}_{2.1-4.5}$, $n=18$, $\text{FeO/MnO}=28-33$); Ca-pyroxene: $\text{Fs}_{26.5\pm0.5}\text{Wo}_{43.7\pm0.5}$ ($\text{Fs}_{25.7-27.7}\text{Wo}_{42.5-44.5}$, $n=20$, $\text{FeO/MnO}=29-35$); calcic plagioclase: $\text{An}_{89.3\pm2}$ ($\text{An}_{80.9-91}$, $n=24$)

Specimens: 24.2 g type specimen, *MNB*; main mass, Alan Mazur, Lanckorona 266, 34-143 Lanckoronan, Małopolska, Poland.

Northwest Africa 10118 (NWA 10118)

(Northwest Africa)

Purchased: 2015 Feb

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Andreas Günemeyer from a local meteorite dealer in Agadir, Morocco.

Petrography: The meteorite displays a dark-grayish interior and is composed of up to 6-mm sized chondrules, whitish CAIs, and olivine amoeboids set into a fine-grained, almost opaque matrix. Several chondrules show reddish staining due to terrestrial weathering; No type II chondrules were encountered.

Northwest Africa 10119 (NWA 10119)

(Northwest Africa)

Purchased: 2015 Feb

Classification: CO3-melt breccia

History: Purchased by Andreas Günemeyer from a local meteorite dealer in Agadir, Morocco.

Petrography: The meteorite is a breccia and consists of up to 6 mm sized angular clasts surrounded by abundant shock melt. The clasts are of CO3 type predominantly composed of small 0.1-0.3 mm sized chondrules, and less abundant CAIs and olivine amoeboids set into a fine-grained almost opaque matrix. Fine-grained material interstitial to the clasts seems to be recrystallized shock melt that contains abundant FeS droplets.

Northwest Africa 10120 (NWA 10120)

Northwest Africa

Purchased: 2009

Classification: Ordinary chondrite (H5)

History: One stone weighing 140.2 g was found in Morocco in 2009. David Holden acquired the sample from a meteorite prospector in Erfoud, 2009.

Physical characteristics: The stone is dark brown and has an oriented tabular shape covered in 33% fusion crust. The cut face of the stone is light brown and shows chondrules and fresh metal flakes.

Petrography: Description and classification (Evan Hamo, *App*): Sample displays recrystallized chondritic texture. Chondrules and fragments are well-defined and have an average diameter of 520 μm .

Geochemistry: (E. Hamo, *App*) Olivine $\text{Fa}_{21.4\pm0.2}$, $N=14$; Low Ca pyroxene $\text{Fs}_{17.0\pm1.0}\text{Wo}_{1.6\pm0.2}$, $N=12$.

Specimens: An endcut and one slice weighing 20.6 g, and a polished thin section are currently on deposit at *App*.

Northwest Africa 10121 (NWA 10121)

(Northwest Africa)

Purchased: 2015 Jan

Classification: HED achondrite (Eucrite, polymict)

History: Purchased in Temara, Morocco by Adam Aaronson in January 2015.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia composed mostly of angular mineral clasts, including ~5 vol.% diagenitic orthopyroxene, plus some basaltic eucrite lithic clasts. Other minerals are exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite, troilite and minor merrillite.

Geochemistry: Diagenitic orthopyroxene (Fs_{29.8}Wo_{4.4}, FeO/MnO = 29), low-Ca pyroxene host (Fs_{52.8-55.8}Wo_{5.1-5.5}, FeO/MnO = 30-34, N = 3), clinopyroxene exsolution lamellae (Fs_{25.4-27.8}Wo_{40.8-39.2}, FeO/MnO = 30-33, N = 3).

Classification: Eucrite (polymict breccia).

Specimens: 20.2 g including one polished thin section at *UWB*. The remainder is held by Mr. F. Stephan.

Northwest Africa 10123 (NWA 10123)

(Northwest Africa)

Purchased: 2015 Jan

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Darryl Pitt in January 2015 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Very fine grained fragmental breccia consisting mostly of mineral clasts of olivine, anorthite, orthopyroxene, pigeonite, augite and Al-chromite set in a matrix of the same minerals plus minor kamacite and barite.

Geochemistry: Olivine (Fa_{22.2-33.9}, FeO/MnO = 82-97, N = 3), low-Ca pyroxene (Fs_{20.4-23.4}, FeO/MnO = 46-54, N = 2), pigeonite (Fs_{33.1}Wo_{8.2}, FeO/MnO = 53), subcalcic augite (Fs_{13.0}Wo_{36.6}, FeO/MnO = 45). Plagioclase >An₉₅ by EDS analysis.

Classification: Lunar (feldspathic breccia).

Specimens: 20.1 g including one polished endcut at *UWB*. The remainder is held by *DPitt*.

Northwest Africa 10124 (NWA 10124)

(Northwest Africa)

Purchased: 2014 Dec

Classification: HED achondrite (Howardite)

History: Purchased by Darryl Pitt in December 2014 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia composed mostly of angular mineral clasts of calcic plagioclase, exsolved pigeonite, silica polymorph, ferroan olivine, ferrosilite, ferropigeonite, augite, chromite, ilmenite and troilite, plus ~20 vol.% diagenitic orthopyroxene, in a finer grained matrix. Sparse basaltic eucrite lithic clasts are also present.

Geochemistry: Olivine (Fa_{73.9-74.4}, FeO/MnO = 40-41, N = 2), diagenitic orthopyroxene (22.1-23.3Wo_{2.7-2.2}, FeO/MnO = 30-34, N = 2), orthopyroxene host (Fs_{56.7}Wo_{1.4}, FeO/MnO = 38), clinopyroxene exsolution lamella (Fs_{24.3}Wo_{43.9}, FeO/MnO = 31), ferrosilite (Fs_{49.9}Wo_{4.9}, FeO/MnO = 30), ferropigeonite (Fs_{59.6}Wo_{15.2}, FeO/MnO = 33), augite (Fs_{22.9}Wo_{42.0}, FeO/MnO = 31).

Classification: Howardite.

Specimens: 20.2 g including one polished thin section at *UWB*. The remainder is held by *DPitt*.

Northwest Africa 10128 (NWA 10128)

(Northwest Africa)

Purchased: 2015 Jan

Classification: HED achondrite (Eucrite, polymict)

History: Purchased by Darryl Pitt in January 2015 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia composed of sparse gabbroic eucrite clasts plus abundant related crystalline debris and a few percent large (up to 3.8 mm) diagenitic orthopyroxene grains set within a fine grained matrix. Other minerals include calcic plagioclase (polycrystalline), orange-stained pyroxenes (pigeonite, subcalcic augite, augite), silica polymorph, olivine (with at least two different compositions), ilmenite, chromite, troilite and minor barite. Diagenitic orthopyroxene exhibits undulose extinction, and is variable in composition.

Geochemistry: Olivine (Fa_{28.3}, FeO/MnO = 55; Fa_{43.8}, FeO/MnO = 48), diagenitic orthopyroxene (Fs_{19.3}Wo_{1.2}, FeO/MnO = 29; Fs_{30.2}Wo_{2.2}, FeO/MnO = 32), pigeonite (Fs_{44.3}Wo_{12.1}, FeO/MnO = 32; Fs_{52.1}Wo_{7.2}, FeO/MnO = 33), subcalcic augite (Fs_{23.3}Wo_{33.2}, FeO/MnO = 25), augite (Fs_{37.2}Wo_{41.4}, FeO/MnO = 33).

Classification: Eucrite (polymict breccia).

Specimens: 20.1 g including one polished thin section at *UWB*. The remainder is held by *DPitt*.

Northwest Africa 10130 (NWA 10130)

(Northwest Africa)

Purchased: 2015 Feb

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Darryl Pitt in February 2015 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed mainly of mineral clasts of anorthite, olivine, pigeonite (some exsolved), subcalcic augite, augite, ilmenite and troilite set within a finer grained, in part vesicular matrix containing sparse Ni-poor kamacite. A fine grained mare basalt clast was observed, as well as some cross-cutting glassy veinlets.

Geochemistry: Olivine (Fa_{23.3-24.1}, FeO/MnO = 94-108, N = 3), pigeonite (Fs_{19.6-20.2}Wo_{6.5-6.7}, FeO/MnO = 49-61, N = 2), subcalcic augite (Fs_{11.9}Wo_{33.5}, FeO/MnO = 39), augite (Fs_{12.2}Wo_{39.1}, FeO/MnO = 63). Plagioclase >An₉₅ by EDS analysis. Bulk composition (R. Korotev, *WUSL*) INAA of subsamples gave the following mean abundances (in wt.%) FeO 6.3, Na₂O 0.63; (in ppm) Sc 9.9, Ni 670, La 16.3, Sm 7.3, Eu 1.33, Yb 5.1, Lu 0.70, Th 2.5.

Classification: Lunar (feldspathic breccia). Paired with [NWA 8455](#) based on textural, mineralogical and bulk compositional similarities.

Specimens: 20.1 g including one polished endcut at *UWB*. The remainder is held by *DPitt*.

Northwest Africa 10132 (NWA 10132)

(Northwest Africa)

Purchased: 2015 Mar

Classification: Ungrouped achondrite

History: Purchased by Darryl Pitt in March 2015 from a dealer in Zagora, Morocco.

Physical characteristics: Single friable stone (940 g) composed of glistening, vitreous yellow-green crystals with minor tiny black grains. Minor brownish weathering occurs on exterior surfaces.

Petrography: (A. Irving and S. Kuehner, *UWS*) Very fresh specimen with an inequigranular to poikilitic texture. Composed predominantly of orthopyroxene (up to 4.8 mm, some as oikocrysts) and olivine (up to 2 mm, some as chadacrysts within orthopyroxene) with interstitial albitic feldspar (~5 vol.%) and accessory Ti-poor chromite and awaruite.

Geochemistry: Olivine ($\text{Fa}_{53.3-53.5}$, $\text{FeO/MnO} = 115-135$, $\text{NiO} = 1.1$ wt.%, $N = 4$), orthopyroxene ($\text{Fs}_{41.6-42.7}\text{Wo}_{3.1-3.4}$, $\text{FeO/MnO} = 78-88$, $\text{Cr}_2\text{O}_3 = 0.3$ wt.%, $N = 3$), plagioclase ($\text{Ab}_{91.0-92.3}\text{An}_{1.8-2.2}\text{Or}_{7.2-5.6}$, $N = 2$). Oxygen isotopes (K. Ziegler, *UNM*): Analyses of four acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ 0.893, 1.373, 1.273, 0.857; $\delta^{18}\text{O}$ 3.832, 4.702, 4.557, 3.789; $\Delta^{17}\text{O}$ -1.130, -1.110, -1.133, -1.144 per mil.

Classification: Achondrite (ungrouped, ultramafic, sodic). This specimen shares many mineralogical similarities with [Northwest Africa 6693](#) and [Northwest Africa 6704](#), but cannot be paired with those specimens based on textural differences and absence of vesicles. The presence of interstitial albite, the elevated Ni in olivine, plus presence of awaruite metal and lack of kamacite are significant differences from lodranites/acapulcoites.

Specimens: 27 g including one polished thin section and one polished thick section at *UWB*. The remaining material is held by *DPitt*.

Northwest Africa 10133 (NWA 10133)

(Northwest Africa)

Purchased: 2014 Apr

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased in April 2014 by Sergey Vasiliev and Marc Jost from a dealer in Tan Tan, Morocco.

Physical characteristics: A group of many small beige to gray stones (total 54.2 g).

Petrography: (A. Irving and S. Kuehner, *UWS*) Following optical examination of all of the small stones constituting the type material, three representative stones were selected for detailed microprobe and bulk chemical analysis. Each specimen consists of small mineral clasts of anorthite, olivine, pigeonite, orthopyroxene, augite, subcalcic augite, forsterite, fayalite, silica polymorph, ilmenite, troilite, zircon (one grain $>100\ \mu\text{m}$) and rare kamacite set within a fine grained vesicular matrix containing minor barite. Rare mare basalt lithic clasts are also present.

Geochemistry: Olivine ($\text{Fa}_{6.0}$, $\text{FeO/MnO} = 71$; $\text{Fa}_{22.7-29.9}$, $\text{FeO/MnO} = 91-106$, $N = 2$; $\text{Fa}_{84.3-89.4}$, $\text{FeO/MnO} = 88-99$, $N = 2$), pigeonite ($\text{Fs}_{24.6-31.9}\text{Wo}_{11.4-6.5}$, $\text{FeO/MnO} = 56-72$, $N = 3$), orthopyroxene ($\text{Fs}_{26.8-45.0}\text{Wo}_{4.4-3.8}$, $\text{FeO/MnO} = 61-73$, $N = 2$), subcalcic augite ($\text{Fs}_{22.0-48.5}\text{Wo}_{25.1-33.0}$, $\text{FeO/MnO} = 62-66$, $N = 3$), augite ($\text{Fs}_{13.1-38.5}\text{Wo}_{44.5-39.6}$, $\text{FeO/MnO} = 49-60$, $N = 2$), plagioclase ($\text{An}_{93.5-96.5}\text{Or}_{0.4-0.1}$, $N = 4$). Bulk composition (R. Korotev, *WUSL*): mean abundances for three separate stones determined by INAA of subsamples are as follows: #A (in wt.%) FeO 5.1, Na_2O 0.49; (in ppm) Sc 10.1, Cr 790, Ni 150, La 5.9, Sm 2.7, Eu 1.07, Yb 1.8, Lu 0.26, Hf 1.9, Th 0.9; #B (in wt.%) FeO 6.1, Na_2O 0.50; (in ppm) Sc 12.0, Cr 930, Ni 290, La 10.0, Sm 4.6, Eu 1.15, Yb 3.2, Lu 0.44, Hf 4.0, Th 1.6; #D (in wt.%) FeO 5.5, Na_2O 0.49; (in ppm) Sc 10.0, Cr 760, Ni 280, La 9.2, Sm 4.3, Eu 1.20, Yb 2.8, Lu 0.39, Hf 3.2, Th 1.4.

Classification: Lunar (feldspathic regolithic breccia). Despite the mineralogical and compositional heterogeneity among these small stones, we conclude that they are paired with [Northwest Africa 8641](#), [Northwest Africa 8682](#) and [Northwest Africa 10077](#).

Specimens: 10.9 g including two polished pieces at *UWB*. The remaining material is held jointly by Mr. S. Vasiliev and Mr. M. Jost.

Northwest Africa 10134 (NWA 10134)

(Northwest Africa)

Purchased: 2015 Jan

Classification: Martian meteorite (Shergottite)

History: Purchased by Dr. David Gregory in January 2015 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Physical characteristics: A small discoidal-shaped stone (25.4 g) covered by black fusion crust.

Petrography: (A. Irving and S. Kuehner, *UWS*) Relatively fine grained (mean grain size 0.4 mm) with an intersertal texture, and composed predominantly of stubby prismatic grains of zoned clinopyroxene (60 vol.%) and maskelynite (37 vol.%) with accessory Cr-bearing ulvöspinel, ilmenite, chlorapatite, merrillite, pyrrhotite, silica+plagioclase intergrowths and interstitial microlite-bearing glass. Sparse patches of vesicular shock glass are present.

Geochemistry: Low-Ca pyroxene ($\text{Fs}_{31.6-56.3}\text{Wo}_{11.0-14.0}$; $\text{FeO/MnO} = 33-39$), high-Ca pyroxene ($\text{Fs}_{21.0-38.6}\text{Wo}_{36.0-27.0}$; $\text{FeO/MnO} = 26-38$), ferroan subcalcic augite rims ($\text{Fs}_{71.7}\text{Wo}_{23.5}$; $\text{FeO/MnO} = 49$), maskelynite ($\text{An}_{44.4-55.3}\text{Or}_{5.0-1.2}$, $N = 2$), plagioclase intergrown with silica ($\text{An}_{36.6}\text{Or}_{3.0}$).

Classification: Martian meteorite (shergottite).

Specimens: 5.2 g including one polished thin section and one polished thick section at *ROM*. The remaining material is held by *Gregory*.

Northwest Africa 10135 (NWA 10135)

(Northwest Africa)

Purchased: 2014

Classification: Ordinary chondrite (L5)

History: A single stone weighing 81.1 g was found in Morocco in 2014. David Holden acquired the sample from a meteorite prospector in 2014.

Physical characteristics: The stone exhibits a tabular shape, displays shallow regmaglypts and is covered in a desert patina. Abundant fresh metal flakes, and chondrules are visible on the fresh cut surface.

Petrography: The sample exhibits a recrystallized chondritic texture composed of poorly defined chondrules with an average diameter of 734.48 μm . Rare Al-rich chondrules are present. Troilite and FeNi are present in the matrix material.

Geochemistry: (A. Burgess, *App*) Olivine $\text{Fa}_{26.3\pm 0.4}$, $N=14$; Low-Ca Pyroxene $\text{Fs}_{21.0\pm 0.5}\text{Wo}_{2.3\pm 0.7}$, $N=12$.

Specimens: An endcut and one slice weighing 17.8 g, and a polished thin section are currently on deposit at *App*.

Northwest Africa 10139 (NWA 10139)

(Northwest Africa)

Purchased: 2014 Mar 15

Classification: Ureilite

History: Purchased by Jan Woreczko from a local meteorite dealer in Erfoud, Morocco.

Petrography: The meteorite shows a cumulate texture of blocky, up to 3 mm sized Cr-rich olivine, augite and rare poikilitically enclosed orthopyroxene crystals. It contains flaky graphite; olivine displays characteristic reduced rims.

Geochemistry: Reduced rims in olivine: $\text{Fa}_{3.7-6.9}$; Cr_2O_3 in olivine: ~ 0.5 wt%

Northwest Africa 10140 (NWA 10140)

(Northwest Africa)

Purchased: 2015 Feb

Classification: Lunar (troctolitic anorthosite)

History: Purchased by Larry Atkins in Morocco in February 2015.

Physical characteristics: Single stone. A saw cut reveals a very fine-grained, light-gray groundmass, crosscut by numerous shock melt veins some up to 3 mm.

Petrography: (C. Agee, *UNM*) This meteorite is a fine-grained anorthositic troctolite ([Prinz and Keil, 1977](#)) with plagioclase (75%), olivine (15%), and low-Ca pyroxene (10%) as dominant silicate phases. There are numerous shock melt domains present, some with quench spinifex textures. Accessory troilite and chromite were observed.

Geochemistry: (C. Agee and N. Muttik, *UNM*) olivine $\text{Fa}_{23.4\pm 2.8}$, $\text{Fe}/\text{Mn}=90\pm 4$, $n=11$; low Ca pyroxene $\text{Fs}_{20.5\pm 1.1}\text{Wo}_{3.7\pm 0.9}$, $\text{Fe}/\text{Mn}=56\pm 6$, $n=9$; plagioclase $\text{An}_{97.1\pm 1.0}\text{Ab}_{2.7\pm 1.0}\text{Or}_{0.2\pm 0.0}$, $n=5$; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): $\text{SiO}_2=42.1\pm 0.3$, $\text{TiO}_2=0.13\pm 0.04$, $\text{Al}_2\text{O}_3=27.3\pm 3.1$, $\text{Cr}_2\text{O}_3=0.11\pm 0.04$, $\text{MgO}=7.8\pm 2.7$, $\text{FeO}=4.4\pm 1.5$, $\text{MnO}=0.05\pm 0.02$, $\text{CaO}=15.4\pm 1.4$, $\text{NiO}=0.00\pm 0.00$, $\text{Na}_2\text{O}=0.27\pm 0.03$, $\text{K}_2\text{O}=0.00\pm 0.00$ (all wt%), $\text{Fe}/\text{Mn}=89\pm 35$, $\text{Mg}\#=75.9\pm 0.8$, $\text{MgO}+\text{FeO}=12.1\pm 4.2$ (wt%), $n=12$.

Classification: Lunar (troctolitic anorthosite) based on [Stoeffler et al. \(1980\)](#).

Specimens: 14 g including a probe mount on deposit at *UNM*, Larry Atkins holds the main mass.

Northwest Africa 10141 (NWA 10141)

(Northwest Africa)

Purchased: 2015 Jan

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Matt Morgan and Lee Morgan in Morocco in January 2015.

Physical characteristics: Single stone. A saw cut reveals a feldspathic breccia with dark-gray shock melt veins.

Petrography: (C. Agee, *UNM*) This meteorite is mixture of a fine-grained cataclastic domains, large fragmental plagioclase crystals, and shock melt veins; some of the veins have ~ 100 μm -size vesicles. Accessory troilite, ilmenite, and chromite were observed.

Geochemistry: (C. Agee and N. Muttik, *UNM*) olivine $\text{Fa}_{38.8\pm 1.4}$, $\text{Fe}/\text{Mn}=102\pm 7$, $n=12$; pigeonite $\text{Fs}_{34.9\pm 3.6}\text{Wo}_{7.2\pm 3.5}$, $\text{Fe}/\text{Mn}=62\pm 4$, $n=5$; augite $\text{Fs}_{25.8\pm 5.3}\text{Wo}_{32.1\pm 0.9}$, $\text{Fe}/\text{Mn}=55\pm 5$, $n=5$; plagioclase $\text{An}_{96.7\pm 0.4}\text{Ab}_{3.1\pm 0.4}\text{Or}_{0.2\pm 0.0}$, $n=6$; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): $\text{SiO}_2=44.1\pm 0.4$, $\text{TiO}_2=0.18\pm 0.04$, $\text{Al}_2\text{O}_3=31.4\pm 1.0$, $\text{Cr}_2\text{O}_3=0.06\pm 0.02$, $\text{MgO}=3.3\pm 0.7$, $\text{FeO}=3.4\pm 0.6$, $\text{MnO}=0.04\pm 0.02$, $\text{CaO}=17.4\pm 0.5$, $\text{NiO}=0.02\pm 0.02$, $\text{Na}_2\text{O}=0.33\pm 0.03$, $\text{K}_2\text{O}=0.05\pm 0.01$ (all wt%), $\text{Fe}/\text{Mn}=76\pm 17$, $\text{Mg}\#=63\pm 2$, $\text{MgO}+\text{FeO}=6.7\pm 1.3$ (wt%), $n=10$.

Classification: Lunar (feldspathic breccia)

Specimens: 8.1 g including a probe mount on deposit at *UNM*, *MtMorgan* and Lee Morgan hold the main mass.

Northwest Africa 10142 (NWA 10142)

(Northwest Africa)

Purchased: 2014

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased in Mauritania by Mohamed Aid, 2014.

Physical characteristics: Single stone. A saw cut reveals a feldspathic breccia with dark-gray shock melt veins.

Petrography: (C. Agee, *UNM*) This meteorite is dominated by feldspathic-rich domains of fine-grained crystals and larger plagioclase fragments. Abundant shock melt veins are present, some with vesicles. Accessory troilite and ilmenite were observed.

Geochemistry: (C. Agee and N. Muttik, *UNM*) olivine $\text{Fa}_{21.3\pm3.6}$, $\text{Fe/Mn}=105\pm5$, $n=2$; pigeonite $\text{Fs}_{25.5\pm7.9}\text{Wo}_{12.0\pm1.6}$, $\text{Fe/Mn}=57\pm6$, $n=2$; augite $\text{Fs}_{17.6\pm4.7}\text{Wo}_{43.2\pm1.5}$, $\text{Fe/Mn}=49\pm15$, low Ca pyroxene $\text{Fs}_{51.3}\text{Wo}_{2.2}$, $\text{Fe/Mn}=63$, $n=1$; plagioclase $\text{An}_{96.5\pm0.4}\text{Ab}_{3.3\pm0.4}\text{Or}_{0.2\pm0.0}$, $n=6$; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): $\text{SiO}_2=43.6\pm0.5$, $\text{TiO}_2=0.18\pm0.07$, $\text{Al}_2\text{O}_3=31.8\pm2.2$, $\text{Cr}_2\text{O}_3=0.06\pm0.04$, $\text{MgO}=3.3\pm1.7$, $\text{FeO}=3.0\pm1.3$, $\text{MnO}=0.04\pm0.02$, $\text{CaO}=17.3\pm0.5$, $\text{NiO}=0.01\pm0.01$, $\text{Na}_2\text{O}=0.33\pm0.03$, $\text{K}_2\text{O}=0.06\pm0.02$ (all wt%), $\text{Fe/Mn}=88\pm62$, $\text{Mg\#}=64\pm7$, $\text{MgO}+\text{FeO}=6.3\pm2.9$ (wt%), $n=23$.

Classification: Lunar (feldspathic breccia)

Specimens: 20.5 g including a probe mount on deposit at *UNM*, Jarkko Kettunen holds the main mass.

Northwest Africa 10143 (NWA 10143)

(Northwest Africa)

Purchased: 2013 Sep

Classification: Carbonaceous chondrite (CV3)

History: Purchased by John Curchin in September 2013 from a Moroccan dealer at the Denver Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly granular and some BO chondrules (average diameter 1.2 mm, up to 2.2 mm in diameter, some with concentric dust rims) plus amoeboid, fine grained CAI (up to 2.7 mm across) are set in a red-brown altered matrix. The proportion of matrix is 30 vol%.

Geochemistry: Olivine ($\text{Fa}_{0.9-11.2}$, $N = 4$), orthopyroxene ($\text{Fs}_{1.0-1.1}\text{Wo}_{1.2-0.8}$, $N = 2$), clinopyroxene ($\text{Fs}_{0.7-0.9}\text{Wo}_{40.3-46.8}$, $N = 2$).

Classification: Carbonaceous chondrite (CV3).

Specimens: 4.26 g including one polished thin section at *UWB*. The remainder is held by Mr. J. Curchin.

Northwest Africa 10144 (NWA 10144)

(Northwest Africa)

Purchased: 2015 Jan

Classification: HED achondrite (Eucrite, brecciated)

History: Purchased by Darryl Pitt in January 2015 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh breccia consisting of closely packed clasts of mostly very fine-grained basaltic eucrite lithologies with variably plumose to intersertal to ophitic to microgranoblastic textures. Minerals are calcic plagioclase, exsolved pigeonite, silica polymorph, ilmenite, chromite and troilite.

Geochemistry: Host orthopyroxene ($\text{Fs}_{60.2-61.4}\text{Wo}_{3.4-2.5}$, $\text{FeO/MnO} = 34$, $N = 2$), clinopyroxene exsolution lamellae ($\text{Fs}_{26.1-26.2}\text{Wo}_{43.3-43.4}$, $\text{FeO/MnO} = 31-34$, $N = 2$).

Classification: Eucrite (genomict breccia, partly granoblastic).

Specimens: 14.2 g including one polished thin section at *UWB*. The remainder is held by *DPitt*.

Northwest Africa 10145 (NWA 10145)

(Northwest Africa)

Purchased: 2015 Jan

Classification: Primitive achondrite (Lodranite)

History: Purchased by Darryl Pitt in January 2015 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Matrix-poor breccia composed mainly of coarse mineral grains (up to 7 mm) of olivine, orthopyroxene, clinopyroxene, chromite, kamacite (altered to iron hydroxides) and troilite. Olivine contains numerous tiny inclusions composed of chromite+clinopyroxene.

Geochemistry: Olivine ($\text{Fa}_{10.5-10.6}$, $\text{FeO/MnO} = 25$, $N = 3$), orthopyroxene ($\text{Fs}_{8.8-9.0}\text{Wo}_{4.1-1.9}$, $\text{FeO/MnO} = 13-14$, $N = 2$), clinopyroxene ($\text{Fs}_{3.6-3.7}\text{Wo}_{44.7-42.7}$, $\text{FeO/MnO} = 9-11$, $N = 2$).

Classification: Lodranite. Paired with [NWA 10150](#).

Specimens: 23.8 g including one polished thin section at *UWB*. The remainder is held by *DPitt*.

Northwest Africa 10146 (NWA 10146)

(Northwest Africa)

Purchased: 2015 Jan

Classification: HED achondrite (Eucrite, polymict)

History: Purchased by Darryl Pitt in January 2015 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh fragmental breccia composed predominantly of mineral clasts plus some lithic clasts with diabasic to fine intersertal textures. Diagenitic orthopyroxene makes up ~4 vol.%. Other minerals are calcic plagioclase, exsolved pigeonite, silica polymorph, fayalite, ilmenite, rare baddeleyite and Ni-free metal.

Geochemistry: Olivine ($\text{Fa}_{81.8-82.2}$, $\text{FeO/MnO} = 38-39$, $N = 2$), diagenitic orthopyroxene ($\text{Fs}_{27.4-30.5}\text{Wo}_{4.5-4.9}$, $\text{FeO/MnO} = 28-30$, $N = 2$), orthopyroxene host ($\text{Fs}_{57.8}\text{Wo}_{1.4}$, $\text{FeO/MnO} = 31$), clinopyroxene exsolution lamella ($\text{Fs}_{24.3}\text{Wo}_{41.9}$, $\text{FeO/MnO} = 28$).

Classification: Eucrite (polymict breccia).

Specimens: 10.5 g including one polished thin section at *UWB*. The remainder is held by *DPitt*.

Northwest Africa 10147 (NWA 10147)

(Northwest Africa)

Purchased: 2015 Jan

Classification: LL4-melt breccia

History: Purchased by Darryl Pitt in January 2015 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Composed of clasts containing well-formed chondrules set within a much finer grained matrix containing abundant blebby metal and sulfide. Minerals are olivine, orthopyroxene, clinopyroxene, sodic plagioclase, chlorapatite, chromite, kamacite, taenite and troilite.

Geochemistry: Olivine ($\text{Fa}_{27.4-27.7}$, $N = 3$), orthopyroxene ($\text{Fs}_{22.6-22.7}\text{Wo}_{1.3-1.2}$, $N = 3$), clinopyroxene ($\text{Fs}_{7.5-8.8}\text{Wo}_{45.2-45.0}$, $N = 2$).

Classification: Ordinary chondrite (LL4 melt breccia).

Specimens: 25.5 g including one polished slice at *UWB*. The remainder is held by *DPitt*.

Northwest Africa 10148 (NWA 10148)

(Northwest Africa)

Purchased: 2015 Jan

Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Darryl Pitt in January 2015 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Recrystallized breccia consisting of separated fine grained, granoblastic-textured clasts (up to 4 mm) in a finer recrystallized matrix (~40 vol.%). Minerals are calcic plagioclase, orthopyroxene, clinopyroxene, silica polymorph, ilmenite, chromite and troilite.

Geochemistry: Orthopyroxene (Fs_{58.4}Wo_{2.8}, FeO/MnO = 35, N=1), clinopyroxene (Fs_{27.0-27.2}Wo_{41.4-42.2}, FeO/MnO = 34-37, N = 3). Pyroxene compositional homogeneity was checked by BSE and EDS examination.

Classification: Eucrite (monomict breccia, granoblastic).

Specimens: 20.6 g including one polished thin section at *UWB*. The remainder is held by *DPitt*.

Northwest Africa 10149 (NWA 10149)

(Northwest Africa)

Purchased: 2015 Apr

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Darryl Pitt in April 2015 from a dealer in Ouarzazate, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia composed of mineral clasts of anorthite, olivine, pigeonite, subcalcic augite, augite, fayalite, silica polymorph, exsolved pigeonite, Al-Ti-chromite and Ti-rich chromite, along with sparse glass fragments, in a finer-grained matrix.

Geochemistry: Olivine (Fa_{35.1}; Fa_{87.0-89.9}; FeO/MnO = 91-93, N = 3), pigeonite (Fs_{41.0}Wo_{7.3}; Fs_{58.3}Wo_{21.3}; Fs_{21.8}Wo_{24.8}; FeO/MnO = 57-67, N = 3), augite (Fs_{14.5}Wo_{40.2}, FeO/MnO = 45).

Classification: Lunar (feldspathic breccia).

Specimens: 20.1 g included a polished endcut at *UWB*. The remainder is held by *DPitt*.

Northwest Africa 10150 (NWA 10150)

(Northwest Africa)

Purchased: 2014 Sep

Classification: Primitive achondrite (Lodranite)

History: Purchased by Stefan Ralew in September 2014 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Matrix-poor breccia composed mainly of coarse mineral grains (up to 5.5 mm) of olivine, orthopyroxene, clinopyroxene, chromite, kamacite (altered to iron hydroxides) and troilite. Olivine contains numerous tiny inclusions composed of chromite+clinopyroxene.

Geochemistry: Olivine (Fa_{10.4-10.9}, FeO/MnO = 21-23, N = 3), orthopyroxene (Fs_{9.1-9.4}Wo_{1.1-3.2}, FeO/MnO = 14-15, N = 2), clinopyroxene (Fs_{3.5-3.7}Wo_{44.7-45.5}, FeO/MnO = 7-10, N = 2).

Classification: Lodranite. Paired with [NWA 10145](#).

Specimens: 20.8 g including one polished thin section at *UWB*. The remainder is held by *Ralew*.

Northwest Africa 10151 (NWA 10151)

(Northwest Africa)

Purchased: 2014 Jun

Classification: Ordinary chondrite (LL7)

History: Purchased by Stefan Ralew in June 2014 from a Moroccan dealer at the Ensisheim Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Triple grain junction texture with no chondrules. Minerals are olivine, orthopyroxene, clinopyroxene, sodic plagioclase, chlorapatite, chromite, altered kamacite and troilite. Minor secondary veinlets of calcite+ quartz.

Geochemistry: Olivine (Fa_{29.6-30.6}, N = 3), orthopyroxene (Fs_{24.3-24.7}Wo_{2.2-2.1}, N = 3), clinopyroxene (Fs_{9.6-10.1}Wo_{44.6-44.5}, N = 2).

Classification: Ordinary chondrite (LL7).

Specimens: 21.0 g including one polished thin section at *UWB*. The remainder is held by *Ralew*.

Northwest Africa 10152 (NWA 10152)

(Northwest Africa)

Purchased: 2014 Jul

Classification: HED achondrite (Diogenite, polymict)

History: Purchased by Stefan *Ralew* in July 2014 from a dealer in Foug el Hisn, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of angular mineral clasts of mainly diogenitic orthopyroxene with minor calcic plagioclase, olivine, chromite, exsolved pigeonite, troilite and Ni-free metal in a finer grained matrix. The eucritic exsolved pigeonite and calcic plagioclase make up less than 10 vol%.

Geochemistry: Olivine (Fa_{22.8-23.0}, FeO/MnO = 48-57, N = 2), orthopyroxene (Fs_{21.4-21.9}Wo_{2.3-3.6}, FeO/MnO = 26-28, N = 3).

Classification: Diogenite (polymict breccia, olivine-bearing).

Specimens: 20.0 g including one polished thin section at *UWB*. The remainder is held by *Ralew*.

Northwest Africa 10153 (NWA 10153)

Northwest Africa

Purchased: 2014 Dec

Classification: Martian meteorite (Nakhlite)

History: Purchased by Darryl Pitt in December 2014 from a dealer in Erfoud, Morocco.

Physical characteristics: A single (119 g) somewhat friable stone lacking fusion crust. The interior appears granular and overall gray green in color, but with prominent beige to reddish brown interstitial components.

Petrography: (A. Irving and S. Kuehner, *UWS*) Cumulate texture. Large (up to 2.0 mm long) prismatic, compositionally zoned augite grains and subordinate, larger (2.2-3.0 mm), equant grains of olivine (with distinct ferroan rims) are the predominant constituents, along with interstitial birefringent plagioclase laths, chlorapatite, ulvöspinel, exsolved Fe-Ti oxide, plus an optically and compositionally heterogeneous iron silicate phase (red-brown in thin section) resembling chlorophaeite.

Geochemistry: Olivine (cores Fa_{61.3-63.7}, rims Fa_{76.2-81.8}, FeO/MnO = 41-48, N = 4), augite (Fs_{23.1-43.5}Wo_{39.6-41.1}, FeO/MnO = 31-38, N = 8), plagioclase (An_{23.4-25.4}Or_{5.3-3.4}, N = 3), chlorophaeite-like phase (average of 5 analyses in wt.%): SiO₂ 43.3, Al₂O₃ 1.6, Fe₂O₃ 36.0, MgO 2.0, CaO 1.0, Na₂O 0.4, K₂O 0.4. Oxygen isotopes (K. Ziegler, *UNM*): Analyses of three acid-

washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ 2.677, 2.870, 2.591; $\delta^{18}\text{O}$ 4.579, 4.963, 4.446; $\Delta^{17}\text{O}$ 0.259, 0.250, 0.244 per mil.

Classification: Martian meteorite (nakhlite).

Specimens: 22.3 g including one polished thin section and one polished thick section at *UWB*. The remaining material is held by *DPitt*.

Northwest Africa 10155 (NWA 10155)

(Northwest Africa)

Purchased: 2015

Classification: Primitive achondrite (Lodranite)

History: Purchased by Blaine Reed in Tucson from a Moroccan meteorite dealer in 2015.

Physical characteristics: Single stone. Saw cuts and polished surfaces reveal dark-brown colored mosaic of reflective crystals and metal grains.

Petrography: (C. Agee, *UNM*) Examination of a polished mount shows polygonal pyroxene and olivine grains with numerous triple junctions. The average grain size is $700 \pm 300 \mu\text{m}$, $n=25$. Metal and sulfide make up approximately 10% by volume of this meteorite. Accessory chromite and schreibersite were observed.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{4.9 \pm 0.2}$, $\text{Fe/Mn}=10 \pm 0$, $n=6$; low Ca pyroxene $\text{Fs}_{8.5 \pm 0.1}\text{Wo}_{2.5 \pm 0.1}$, $\text{Fe/Mn}=10 \pm 0$, $n=3$; diopside $\text{Fs}_{3.8 \pm 0.2}\text{Wo}_{42.0 \pm 1.5}$, $\text{Fe/Mn}=7 \pm 1$, $n=3$.

Classification: Achondrite (Lodranite).

Specimens: 21.2 g including a probe mount on deposit at *UNM*, *Reed* holds the main mass.

Northwest Africa 10157 (NWA 10157)

(Northwest Africa)

Purchased: 2015

Classification: HED achondrite (Eucrite)

History: Purchased by Luc Labenne in Erfoud in 2015

Physical characteristics: Brownish fragments without fusion crust. Magnetic susceptibility $\log \chi = 4.93$ (χ in $10^{-9} \text{ m}^3/\text{kg}$).

Petrography: Strongly recrystallized igneous rock with triple junctions. Typical grain size $\sim 200 \mu\text{m}$, up to mm. Main minerals: pigeonite with augite exsolution, plagioclase, chromite (euhedral, up to $50 \mu\text{m}$), silica polymorph (to $100 \mu\text{m}$), ilmenite, troilite. Rare metal blebs.

Geochemistry: Pyroxenes: pigeonite $\text{Fs}_{61.2 \pm 0.3}\text{Wo}_{6.3 \pm 0.3}$ ($N=3$), augite $\text{Fs}_{32.3}\text{Wo}_{40.5}$ ($N=1$), $\text{FeO/MnO}=27.6 \pm 1.1$ ($N=4$). Plagioclase $\text{An}_{87.3}\text{Ab}_{12.0}\text{Or}_{0.6}$ ($N=2$), chromite $\text{Cr}\#=0.84$.

Classification: Eucrite (granulitic texture)

Specimens: 12 g at *CEREGE*, main mass with *Labenne*

Northwest Africa 10158 (NWA 10158)

Algeria

Find: 2011

Classification: Mesosiderite

History: Found in Algeria in 2011 and purchased in Agadir, Morocco, in 2012.

Physical characteristics: Coarse-grained brownish stones. Cut surface reveals a dark-gray interior with abundant weathering veins.

Petrography: Assemblage of pyroxene (both zoned and exsolved, to 1 mm), plagioclase (to $500 \mu\text{m}$, with silica inclusions to $20 \mu\text{m}$), chromite (to $50 \mu\text{m}$), silica polymorph (to $200 \mu\text{m}$). Metal

and troilite are preserved as μm -sized grains in the silicates, while larger grains are weathered. Abundant weathering veins.

Geochemistry: Olivine $\text{Fa}_{33.9}\text{FeO/MnO}=42.0$ ($N=1$), orthopyroxene $\text{Fs}_{27.1\pm 2.4}\text{Wo}_{1.6\pm 1.1}$, $\text{FeO/MnO}=28.4$ ($N=3$), plagioclase $\text{An}_{94.8}\text{Ab}_{5.1}\text{Or}_{0.1}$, chromite $\text{Cr}\#=0.81$. Magnetic susceptibility $\log \chi = 4.44$ (χ in $10^{-9} \text{ m}^3/\text{kg}$).

Classification: Mesosiderite. Very strong weathering.

Specimens: 21.7 g at *CEREGE*. Main mass with Jean Redelsperger

Northwest Africa 10159 (NWA 10159)

Morocco

Purchased: 2014 Nov 17

Classification: HED achondrite (Diogenite)

History: The stones were bought in 2014 near Guelmim.

Physical characteristics: Six fragments partially covered by shiny fusion crust. The interior is grayish and coarse grained.

Petrography: Igneous rock with cumulate texture. Typical grain size 1.5 mm. Main minerals are orthopyroxene, olivine (to 3 mm, about 10 vol%). Accessory plagioclase, chromite, silica polymorph (to 200 μm), ilmenite. Rare metal.

Geochemistry: Olivine $\text{Fa}_{25.6\pm 0.4}$, $\text{FeO/MnO}=47.1$ ($N=2$); orthopyroxene $\text{Fs}_{21.7\pm 0.4}\text{Wo}_{2.1\pm 0.1}$, $\text{FeO/MnO}=27.1$ ($N=3$); plagioclase $\text{An}_{83.8}\text{Ab}_{15.5}\text{Or}_{0.6}$; chromite $\text{Cr}\#=0.79$. Magnetic susceptibility $\log \chi = 3.27$ (χ in $10^{-9} \text{ m}^3/\text{kg}$)

Classification: Diogenite

Specimens: 17.3 g at *CEREGE*. Main mass with R. Lenssen

Northwest Africa 10161 (NWA 10161)

(Northwest Africa)

Purchased: 2014 May 17

Classification: HED achondrite (Eucrite)

History: Purchased in Erfoud, May 17, 2014.

Physical characteristics: A single stone entirely covered with fusion crust. Magnetic susceptibility $\log \chi = 2.49$ (χ in $10^{-9} \text{ m}^3/\text{kg}$)

Petrography: Igneous rock with ophitic to subophitic texture. Main minerals are exsolved pyroxene and plagioclase with typical grain size 500 μm . Minor chromite, silica polymorph, troilite, ilmenite. Rare metal.

Geochemistry: Pyroxenes: orthopyroxene $\text{Fs}_{63.2\pm 0.7}\text{Wo}_{2.7\pm 0.5}$ ($N=11$), augite exsolution $\text{Fs}_{28.6\pm 1.0}\text{Wo}_{42.9\pm 1.1}$ ($N=3$), $\text{FeO/MnO}=32.6\pm 2.0$ ($N=14$). Plagioclase $\text{An}_{85.6\pm 3.5}\text{Ab}_{13.6\pm 3.2}\text{Or}_{0.8\pm 0.4}$ ($N=3$). Chromite $\text{Cr}\#=0.79$.

Classification: Eucrite (basaltic)

Specimens: 13 g at *CEREGE*. Main mass with P. Thomas.

Northwest Africa 10162 (NWA 10162)

(Northwest Africa)

Purchased: 2014 May 8

Classification: Carbonaceous chondrite (CV3)

History: Purchased in Erfoud, May 8, 2014.

Physical characteristics: A single dark stone partially covered with fusion crust. Chondrules and CAIs are visible on the cut surface.

Petrography: Chondrules (mostly type I) and CAIs set in a fine-grained Fe-rich foliated matrix. Matrix:chondrule ratio (by point counting, N=298) is 41:59. Average chondrule apparent size $750 \pm 410 \mu\text{m}$ (N=35). Sulfide/magnetite assemblages are abundant in the matrix as μm -sized grains, and around and inside chondrules as blebs up to $100 \mu\text{m}$. No metal was observed.

Geochemistry: Olivine $\text{Fa}_{2.7 \pm 2.3}$ ($\text{Fa}_{0.6-9.0}$, median $\text{Fa}_{2.3}$, N=21), orthopyroxene $\text{Fs}_{1.3 \pm 0.2} \text{Wo}_{1.5 \pm 0.9}$ (N=5). Magnetite contains 1.6 wt% Cr_2O_3 . Magnetic susceptibility $\log \chi = 4.30$ (χ in $10^{-9} \text{ m}^3/\text{kg}$).

Classification: CV3, oxidized subgroup.

Specimens: 7 g at *CEREGE*. Main mass with P. Thomas.

Northwest Africa 10163 (NWA 10163)

(Northwest Africa)

Purchased: 2014 May 6

Classification: HED achondrite (Eucrite, cumulate)

History: Purchased in Rissani, May 6, 2014.

Physical characteristics: Four full stones partially covered with fusion crust.

Petrography: Coarse-grained igneous rock composed mostly of exsolved pyroxene and plagioclase with typical grain size 1 mm. Accessory chromite (to $100 \mu\text{m}$), silica polymorph (to $200 \mu\text{m}$), troilite, ilmenite. Rare metal.

Geochemistry: Pyroxenes: low-ca pyroxene $\text{Fs}_{46.4 \pm 2.1} \text{Wo}_{4.5 \pm 2.9}$ (N=6), augite exsolution $\text{Fs}_{19.2 \pm 0.3} \text{Wo}_{43.3 \pm 0.2}$ (N=2), $\text{FeO/MnO} = 31.5 \pm 3.1$ (N=8). Plagioclase $\text{An}_{91.5 \pm 0.8} \text{Ab}_{8.2 \pm 0.7} \text{Or}_{0.4 \pm 0.1}$ (N=6). Chromite $\text{Cr}\# = 0.79$. Magnetic susceptibility $\log \chi = 2.49$ (χ in $10^{-9} \text{ m}^3/\text{kg}$)

Classification: Eucrite (cumulate). Minor weathering.

Specimens: 15 g at *CEREGE*. Main mass with P. Thomas.

Northwest Africa 10164 (NWA 10164)

(Northwest Africa)

Purchased: 2014 May 5

Classification: HED achondrite (Eucrite)

History: Purchased in Erfoud, May 5, 2014.

Physical characteristics: A single stone partially covered with a shiny fusion crust.

Petrography: Strongly recrystallized igneous rock composed mostly of exsolved pyroxene and plagioclase. Some silicates show triple junctions. Chromite and rare metal.

Geochemistry: Pyroxenes: orthopyroxene $\text{Fs}_{60.1 \pm 0.4} \text{Wo}_{2.3 \pm 0.3}$ (N=7), augite $\text{Fs}_{25.9 \pm 0.3} \text{Wo}_{44.0 \pm 0.3}$ (N=4), $\text{FeO/MnO} = 32.3 \pm 1.4$ (N=11). Plagioclase $\text{An}_{90.4 \pm 0.7} \text{Ab}_{9.3 \pm 0.7} \text{Or}_{0.3 \pm 0.1}$ (N=6), chromite $\text{Cr}\# = 0.85 \pm 0.0$ (N=4). Magnetic susceptibility $\log \chi = 2.92$ (χ in $10^{-9} \text{ m}^3/\text{kg}$)

Classification: Eucrite

Specimens: 18 g and a polished section in *CEREGE*. Main mass with P. Thomas

Northwest Africa 10165 (NWA 10165)

Taouz, Morocco

Purchased: 2014 May 7

Classification: Carbonaceous chondrite (CM2)

History: Purchased in Rissani, May 7, 2014. Found in the Taouz region.

Physical characteristics: A single small dark fragment partially covered with dull fusion crust.

Petrography: Chondrules (many with accretionary dust mantles) and chondrule fragments (in a fine-grained Fe-rich phyllosilicate-rich matrix. Abundances (by point counting, N=286): matrix 77 vol%, chondrules and fragments 23 vol%. Average chondrule apparent size $270 \pm 190 \mu\text{m}$ (N=33). Troilite is found in the matrix as $100 \mu\text{m}$ blebs and as abundant μm -sized grains. Rare metal.

Geochemistry: Olivine $\text{Fa}_{18.9 \pm 19.3}$ ($\text{Fa}_{0.7-64.6}$, PMD 88%, N=20). Magnetic susceptibility $\log \chi = 4.17$ (χ in $10^{-9} \text{ m}^3/\text{kg}$)

Classification: CM2. Minimal weathering.

Specimens: 1.9 g at *CEREGE*. Main mass with P. Thomas

Northwest Africa 10166 (NWA 10166)

(Northwest Africa)

Purchased: 2015

Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Steve Arnold in Morocco, 2015.

Physical characteristics: Single stone. Weathered exterior, a saw cut shows fine-grained, light-gray breccia with a few shock melt veins present.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows approximately ~65% pyroxene, ~30% plagioclase. Accessory phases observed are troilite, chromite, ilmenite, and silica.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Low Ca pyroxene $\text{Fs}_{59.0 \pm 1.1} \text{Wo}_{2.2 \pm 0.7}$, $\text{Fe}/\text{Mn} = 32 \pm 1$, n=7; augite $\text{Fs}_{28.5 \pm 5.2} \text{Wo}_{40.6 \pm 7.0}$, $\text{Fe}/\text{Mn} = 33 \pm 1$, n=6, plagioclase $\text{An}_{88.1 \pm 2.0} \text{Ab}_{11.4 \pm 2.0} \text{Or}_{0.5 \pm 0.1}$, n=5.

Classification: Monomict Eucrite, equilibrated.

Specimens: 20.1 g including a probe mount on deposit at *UNM*, Steve Arnold holds the main mass.

Northwest Africa 10167 (NWA 10167)

(Northwest Africa)

Purchased: 2015

Classification: Ureilite

History: Purchased by Steve Arnold in Morocco, 2015.

Physical characteristics: Single stone. Weathered exterior, saw cuts show a very dark brown interior.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows zoned olivine, unzoned pyroxene, fine-grained metal occupying grain boundaries, some plucking voids that were presumably occupied by graphite. Accessory phases observed are Si-bearing iron metal, chromite, Cr-bearing sulfide, and Fe-oxide.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{16.1 \pm 6.1}$, $\text{Fe}/\text{Mn} = 34 \pm 14$, $\text{Cr}_2\text{O}_3 = 0.63 \pm 0.09 \text{ wt\%}$, n=8; pigeonite $\text{Fs}_{18.0 \pm 0.1} \text{Wo}_{5.9 \pm 0.1}$, $\text{Fe}/\text{Mn} = 29 \pm 1$, $\text{Cr}_2\text{O}_3 = 1.05 \pm 0.02 \text{ wt\%}$, n=8.

Classification: Ureilite

Specimens: 15.2 g including a probe mount on deposit at *UNM*, Steve Arnold holds the main mass.

Northwest Africa 10168 (NWA 10168)

(Northwest Africa)

Purchased: 2015

Classification: Ordinary chondrite (L5)

History: Purchased by Steve Arnold from Morocco, 2015.

Physical characteristics: Three pieces that fit together. Weathered exterior, saw cuts show a very dark green-brown interior, some chondrules visible.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous distinct chondrules, plagioclase grains up to $\sim 10\ \mu\text{m}$.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{24.8\pm 1.0}$, $\text{Fe/Mn}=51\pm 2$, $n=7$; low-Ca pyroxene $\text{Fs}_{22.3\pm 1.2}\text{Wo}_{1.0\pm 0.1}$, $\text{Fe/Mn}=31\pm 3$, $n=6$.

Classification: Ordinary chondrite (L5)

Specimens: 21.3 g including a probe mount on deposit at *UNM*, Steve Arnold holds the main mass.

Northwest Africa 10169 (NWA 10169)

(Northwest Africa)

Purchased: Jan 2015

Classification: Martian meteorite (shergottite)

History: The sample was found in the region of Layoune, and bought at the Tucson show by Luc Labenne from an anonymous Moroccan dealer.

Physical characteristics: An uncrusted fragment with a blotchy appearance.

Petrography: (R. Hewins, S. Pont, B. Zanda, *MNHNP*) The most abundant phase is olivine ($\sim 45\%$) which occurs as subhedral to euhedral crystals $100\ \mu\text{m}$ to $1.5\ \text{mm}$ in size. These contain Cr-rich spinel crystals and melt inclusions with pyroxene and plagioclase. The pyroxenes, pigeonite and augite, are distinguishable (with difficulty) in BSE and show neither zonation nor exsolution. The pigeonite envelopes olivine poikilitically, and is subophitic to plagioclase laths, or interstitial. The "plagioclase" is almost entirely free of fractures and is continuous like glass between the pyroxene grains. It is presumed to be maskelynite because it looks the same as glass identified as maskelynite by Raman spectroscopy in [NWA 10171](#). Augite is interstitial but also occurs as large masses. Ti-rich spinel occurs in association with pyroxene and plagioclase. Minor phases include ilmenite.

Geochemistry: Mineral compositions and Geochemistry: (R. Hewins, *MNHNP*) The olivine composition is $\text{Fo}_{58.7\pm 0.5}\text{Fa}_{41.3\pm 0.5}$, with an FeO/MnO ratio of 49.1 ± 1.6 , $n=121$. The pigeonite composition is $\text{En}_{57.7\pm 1.8}\text{Fs}_{29.8\pm 1.6}\text{Wo}_{12.6\pm 3.1}$, $n=24$, and FeO/MnO of 29.6 ± 1.7 ; and the augite is $\text{En}_{46.5\pm 1.0}\text{Fs}_{19.2\pm 1.1}\text{Wo}_{34.3\pm 1.9}$, $n=32$ with an FeO/MnO ratio of 29.2 ± 1.8 . Spinel ranges from $\text{Sp}_{14}\text{Cr}_{79}\text{Usp}_{3}\text{Mgt}_{4}$ to $\text{Sp}_{6}\text{Cr}_{20}\text{Usp}_{56}\text{Mgt}_{18}$. Plagioclase is stoichiometric $\text{An}_{52.7\pm 1.6}\text{Ab}_{44.9\pm 1.3}\text{Or}_{2.4\pm 0.6}$.

Classification: (R. Hewins and B. Zanda, *MNHNP*) The meteorite has SNC Fe/Mn ratios, maskelynite, and 43% olivine. It is classified as a lherzolitic shergottite.

Northwest Africa 10170 (NWA 10170)

(Northwest Africa)

Purchased: Jan 2015

Classification: Martian meteorite (Shergottite)

History: The sample was discovered near the Moroccan-Algerian frontier and purchased at the Tucson salon from an anonymous Moroccan dealer.

Physical characteristics: Three crusted stones with a general similarity to NWA 2990 when cut. The type specimen includes pieces of all three stones.

Petrography: (R. Hewins, S. Pont, B. Zanda, *MNHNP*) Olivine occurs as euhedral to subhedral microphenocrysts and zoned phenocrysts, 100 μm to 1.5 mm in size. They contain melt and pyroxene inclusions. Olivine is set in a mesostasis of prismatic to subophitic pyroxene and feldspar, with a texture similar to those of [NWA 2990](#) and [NWA 6234](#). Chromite is the main accessory mineral. The "feldspar" is almost entirely free of fractures and is continuous like glass between the pyroxene grains. It is presumed to be maskelynite because it looks the same as glass identified as maskelynite by Raman spectroscopy in [NWA 10171](#).

Geochemistry: Mineral compositions and Geochemistry: (R. Hewins, *MNHNP*) The olivine composition is $\text{Fo}_{67.2 \pm 7.7}$ (Fa_{20-42}), with an FeO/MnO ratio of 52.1. The pigeonite composition is $\text{En}_{69}\text{Fs}_{28}\text{Wo}_4$ to $\text{En}_{52}\text{Fs}_{29}\text{Wo}_{19}$, with average core composition $\text{En}_{65.8 \pm 1.5}$ and the atomic Fe/Mn ratio 31.9. Spinel contains 28-54 wt% Cr_2O_3 . Stoichiometric $\text{An}_{55-48}\text{Ab}_{43-50}\text{Or}_2$ is free of fractures and apparently glass (maskelynite). Mineral compositions resemble those of NWA 6234 ([Gross et al., 2012](#)) but the latter has more calcic plagioclase (An_{65-58}).

Classification: (R. Hewins and B. Zanda, *MNHNP*) The meteorite has SNC Fe/Mn ratios and is classified as an olivine-phyric shergottite.

Northwest Africa 10171 (NWA 10171)

(Northwest Africa)

Purchased: Jan 2015

Classification: Martian meteorite (Shergottite)

History: The sample was discovered in the region of Laayoune Boujdour, and bought by Luc Labenne from an anonymous Moroccan from Zagora.

Physical characteristics: The stone is completely covered with a glossy fusion crust.

Petrography: (R. Hewins, S. Pont and B. Zanda, *MNHNP*) Pyroxene is prominent as large (up to 4 mm) massive or prismatic crystals. Pigeonite is intensely zoned and augite has a thin mantle of pigeonite. Pyroxene margins were subophitic to plagioclase laths. The feldspathic material is smooth, lacks cleavage or fractures. Locally it contains schlieren indicating flow. Raman spectroscopy on regions lacking schlieren indicated the presence of a dominant broad peak at 497 cm^{-1} characteristic of maskelynite and suggesting high (>40 GPa) shock pressure ([Wang et al., 2004](#)). Accessories include ulvospinel and ilmenite.

Geochemistry: Mineral compositions and Geochemistry: (R. Hewins and S. Pont, *MNHNP*) Atomic Fe/Mn in pigeonite is 36 on average ($n=143$) and increases from 30 to 42 following the relationship of Karner et al. (2006, Fig. 6). Pigeonite is $\text{En}_{11}\text{Fs}_{38}\text{Wo}_{11}$ to $\text{En}_6\text{Fs}_{73}\text{Wo}_{21}$. Subcalcic augite is $\text{En}_{47}\text{Fs}_{32}\text{Wo}_{21}$ to $\text{En}_{41}\text{Fs}_{21}\text{Wo}_{38}$. The feldspathic material is stoichiometric $\text{An}_{51-46}\text{Ab}_{46-49}\text{Or}_{3-5}$ and has the Raman spectrum of maskelynite.

Classification: (R. Hewins and B. Zanda, *MNHNP*) The meteorite has SNC Fe/Mn ratios and maskelynite of SNC composition. It is classified as a shergottite.

Northwest Africa 10172 (NWA 10172)

(Northwest Africa)

Purchased: 2015

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Ali and Mohammed Hmani in April 2015, reportedly from Mauritania.

Physical characteristics: Several identically appearing pieces, 320, 328, and 140 g in several smaller pieces. Irregular exterior. A saw cut reveals a breccia with numerous fragmental feldspathic clasts set in a dark-gray groundmass.

Petrography: (C. Agee, *UNM*) This meteorite is mixture of a fine-grained cataclastic domains, large fragmental plagioclase and pyroxene crystals, smaller olivine fragments, symplectites, and shock melt veins. Accessory Fe-metal, silica, ilmenite, and chromite were observed.

Geochemistry: (C. Agee and N. Muttik, *UNM*) olivine $\text{Fa}_{36.8\pm5.3}$, $\text{Fe/Mn}=98\pm5$, $n=7$; pigeonite $\text{Fs}_{39.2\pm12.0}\text{Wo}_{13.9\pm5.1}$, $\text{Fe/Mn}=61\pm5$, $n=10$; augite $\text{Fs}_{35.8\pm16.2}\text{Wo}_{36.0\pm5.1}$, $\text{Fe/Mn}=66\pm9$, $n=4$; plagioclase $\text{An}_{93.3\pm3.7}\text{Ab}_{6.1\pm3.4}\text{Or}_{0.5\pm0.5}$, $n=9$; Shock melt (10 μm defocused electron beam, proxy for bulk meteorite composition): $\text{SiO}_2=45.0\pm1.5$, $\text{TiO}_2=0.34\pm0.14$, $\text{Al}_2\text{O}_3=24.9\pm6.0$, $\text{Cr}_2\text{O}_3=0.17\pm0.12$, $\text{MgO}=7.8\pm3.9$, $\text{FeO}=7.7\pm4.1$, $\text{MnO}=0.11\pm0.06$, $\text{CaO}=14.2\pm2.5$, $\text{NiO}=0.01\pm0.02$, $\text{Na}_2\text{O}=0.43\pm0.14$, $\text{K}_2\text{O}=0.10\pm0.02$ (all wt%), $\text{Fe/Mn}=75\pm17$, $\text{Mg\#}=64\pm5$, $\text{MgO}+\text{FeO}=15.6\pm7.8$ (wt%), $n=23$.

Classification: Lunar (feldspathic breccia)

Specimens: 20.6 g including a probe mount on deposit at *UNM*; Ali and Mohammed *Hmani* hold the main mass.

Northwest Africa 10173 (NWA 10173)

(Northwest Africa)

Purchased: 2015 Feb

Classification: HED achondrite (Eucrite)

History: Purchased by Darryl Pitt in February 2015 from a dealer in Mauritania.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh fragmental breccia composed mainly of angular mineral clasts plus sparse basaltic eucrite lithic clasts (with variable grainsize) set in a finer grained matrix. Minerals are exsolved and unexsolved pigeonite, calcic plagioclase, silica polymorph, Ti-chromite, ilmenite and troilite.

Geochemistry: Host orthopyroxene ($\text{Fs}_{56.5-60.6}\text{Wo}_{2.7-1.8}$, $\text{FeO/MnO} = 31-33$, $N = 3$), clinopyroxene exsolution lamellae ($\text{Fs}_{22.4-25.8}\text{Wo}_{45.6-44.7}$, $\text{FeO/MnO} = 29-35$, $N = 3$).

Classification: Eucrite (breccia).

Specimens: 20.8 g including one polished thin section at *UWB*. The remainder is held by *DPitt*.

Northwest Africa 10174 (NWA 10174)

(Northwest Africa)

Purchased: 2015 Feb

Classification: Ordinary chondrite (L5)

History: Purchased by Darryl Pitt in February 2015 from a dealer in Mauritania.

Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules. Weathering of primary metal grains has caused staining of silicates.

Geochemistry: Olivine ($\text{Fa}_{25.4-25.6}$, $N = 3$), orthopyroxene ($\text{Fs}_{20.9-21.1}\text{Wo}_{1.4-1.7}$, $N = 2$), clinopyroxene ($\text{Fs}_{7.6-12.4}\text{Wo}_{45.6-41.6}$, $N = 2$).

Classification: Ordinary chondrite (L5).

Specimens: 24.2 g including one polished thin section at *UWB*. The remainder is held by *DPitt*.

Northwest Africa 10175 (NWA 10175)

(Northwest Africa)

Purchased: 2015 Feb

Classification: HED achondrite (Howardite)

History: Purchased by Darryl Pitt in February 2015 from a dealer in Mauritania.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh fragmental breccia composed mainly of angular mineral clasts plus a variety of lithic clasts (basaltic eucrite, eucritic breccia) set in a finer grained matrix. Minerals comprise compositionally zoned, diagenitic orthopyroxene (~15 vol.%), exsolved pigeonite, calcic plagioclase, silica polymorph, Ti-poor chromite, ilmenite, zircon, troilite and altered Ni-free metal.

Geochemistry: Orthopyroxene 1 (Fs_{18.1}Wo_{1.1}, FeO/MnO = 31), zoned orthopyroxene 2 (core Fs_{24.8}Wo_{2.2}, rim Fs_{45.8}Wo_{2.0}, FeO/MnO = 31-33), orthopyroxene host 1 (Fs_{55.6}Wo_{2.67}, FeO/MnO = 27), clinopyroxene exsolution lamella 1 (Fs_{25.8}Wo_{41.0}, FeO/MnO = 25), orthopyroxene host 2 (Fs_{49.7}Wo_{2.4}, FeO/MnO = 32), clinopyroxene exsolution lamella 2 (Fs_{21.6}Wo_{43.3}, FeO/MnO = 32).

Classification: Howardite based on the presence of ~15 vol% of diagenitic orthopyroxene.

Specimens: 20.3 g including one polished thin section at *UWB*. The remainder is held by *DPitt*.

Northwest Africa 10177 (NWA 10177)

(Northwest Africa)

Purchased: 2013 Sep

Classification: HED achondrite (Eucrite, polymict)

History: Purchased by John Curchin in September 2013 from a Moroccan dealer at the Denver Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh fragmental breccia composed mainly of clasts of basaltic to partially granoblastic eucrites plus related debris, and minor amounts of diagenitic orthopyroxene. Other minerals are exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite, chromite, troilite and Ni-free metal.

Geochemistry: Host orthopyroxene (Fs_{51.7-52.6}Wo_{3.0-1.5}, FeO/MnO = 30-31, N = 2), clinopyroxene exsolution lamellae (Fs_{24.2-21.1}Wo_{40.2-42.7}, FeO/MnO = 30-32, N = 2), diagenitic orthopyroxene (Fs_{18.1}Wo_{1.2}; Fs_{25.0}Wo_{2.7}; FeO/MnO = 25-35), olivine (Fa_{74.6}, FeO/MnO = 43).

Classification: Eucrite (polymict breccia).

Specimens: 9.7 g including one polished thin section at *UWB*. The remainder is held by Mr. J. Curchin.

Northwest Africa 10178 (NWA 10178)

(Northwest Africa)

Purchased: 2015

Classification: Lunar meteorite

History: Purchased by Darryl Pitt in February, March and May 2015 from Moroccan dealers. .

Physical characteristics: Three similar, very fine grained, brittle stones (556.3 g, 310 g, 413 g) containing larger grains of maskelynite, and with cross-cutting, anastomosing veinlets of green glass.

Petrography: (A. Irving and S. Kuehner, *UWS*) Very fine-grained breccia composed of abundant anorthite (converted to maskelynite), olivine, orthopyroxene and pigeonite with accessory chromite and troilite.

Geochemistry: Olivine (Fa_{22.7-23.0}, FeO/MnO = 87-91, N = 3), orthopyroxene (Fs_{18.7-18.8}Wo_{2.9-3.2}, FeO/MnO = 47-61, N = 2), maskelynite (An_{95.9-97.4}Or₀, N = 2).

Classification: Lunar (troctolitic granulitic breccia). Paired with [NWA 5744](#) and others based on distinctive textural and mineralogical similarities.

Specimens: 40.4 g including one polished endcut at *UWB*. The remainder is held by *DPitt*.

Northwest Africa 10179 (NWA 10179)

(Northwest Africa)

Purchased: 2013 Sep

Classification: HED achondrite (Eucrite, monomict)

History: Purchased by John Curchin in September 2013 from a Moroccan dealer at the Denver Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Basaltic eucrite clasts and related crystalline debris occur in a finer-grained matrix, and all components have been overprinted by metamorphic recrystallization producing partially granoblastic textures. Minerals are exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite, chromite and troilite.

Geochemistry: Host orthopyroxene (Fs_{59.6}Wo_{3.3}, FeO/MnO = 31) with exsolution lamellae of clinopyroxene (Fs_{27.0}Wo_{42.5}, FeO/MnO = 31). Host clinopyroxene (Fs_{26.8}Wo_{42.7}, FeO/MnO = 34) with exsolution lamellae of orthopyroxene (Fs_{59.4}Wo_{4.5}, FeO/MnO = 32).

Classification: Eucrite (recrystallized monomict breccia).

Specimens: 12.4 g including one polished thin section at *UWB*. The remainder is held by Mr. J. Curchin.

Northwest Africa 10180 (NWA 10180)

(Northwest Africa)

Purchased: 2011 Sep

Classification: HED achondrite (Howardite)

History: Purchased by John Curchin in September 2011 from a Moroccan dealer at the Denver Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia containing abundant diagenitic orthopyroxene (~70 vol.% of clast population), basaltic eucrite clasts and related crystalline debris in a finer grained matrix. Other minerals are olivine, exsolved pigeonite, calcic plagioclase, silica polymorph, chromite (with variable Al content), ilmenite and troilite.

Geochemistry: Olivine (Fa_{42.1} and 42.9, FeO/MnO = 47 and 49, N = 2), orthopyroxene (Fs_{20.8-21.4}Wo_{1.8-1.9}, FeO/MnO = 29-34, N = 3), orthopyroxene host 1 (Fs_{56.9}Wo_{4.7}, FeO/MnO = 28), clinopyroxene exsolution lamella 1 (Fs_{27.2}Wo_{41.9}, FeO/MnO = 29), orthopyroxene host 2 (Fs_{49.9}Wo_{2.4}, FeO/MnO = 26), clinopyroxene exsolution lamella 2 (Fs_{22.7}Wo_{42.1}, FeO/MnO = 26).

Classification: Howardite.

Specimens: 6.54 g including one polished thin section at *UWB*. The remainder is held by Mr. J. Curchin.

Northwest Africa 10181 (NWA 10181)

(Northwest Africa)

Purchased: 2015 Feb

Classification: HED achondrite (Diogenite, polymict)

History: Purchased by *GHupé* in January 2015 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia composed of predominantly diagenitic orthopyroxene clasts (~95 vol.% of clast population), autolithic breccia clasts, sparse basaltic eucrite clasts, plus related mineral debris set within a sparse matrix (constituting ~5

vol.% of the specimen). Other minerals are exsolved pigeonite, calcic plagioclase, pigeonite, olivine, silica polymorph, Al-Ti-chromite, stained kamacite, taenite and troilite.

Geochemistry: Olivine ($\text{Fa}_{34.9-36.8}$, $\text{FeO/MnO} = 47-53$, $N = 2$), diogenitic orthopyroxene ($\text{Fs}_{23.0-23.1}\text{Wo}_{1.8-2.6}$, $\text{FeO/MnO} = 30-33$, $N = 3$), orthopyroxene host ($\text{Fs}_{61.7}\text{Wo}_{2.4}$, $\text{FeO/MnO} = 33$), clinopyroxene exsolution lamella ($\text{Fs}_{29.1}\text{Wo}_{42.0}$, $\text{FeO/MnO} = 36$), pigeonite ($\text{Fs}_{46.7}\text{Wo}_{5.2}$, $\text{FeO/MnO} = 22$).

Classification: Diogenite (polymict breccia). Eucrite material makes about 5 vol% of the meteorite.

Specimens: 35 g including one polished thin section at *UWB*. The remainder is held by *GHupé*.

Northwest Africa 10182 (NWA 10182)

(Northwest Africa)

Purchased: 2015 Feb

Classification: HED achondrite (Diogenite)

History: Purchased by G. Hupé in January 2015 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Physical characteristics: A single stone (133.5 g) almost completely coated by black fusion crust. The interior is light brown in color

Petrography: (A. Irving and S. Kuehner, *UWS*) Aggregate of interlocking grains of orthopyroxene. Accessory clinopyroxene, chromite, and altered Ni-free metal.

Geochemistry: Orthopyroxene ($\text{Fs}_{22.5-23.9}\text{Wo}_{1.3-1.2}$, $\text{FeO/MnO} = 30-31$, $N = 3$).

Classification: Diogenite.

Specimens: 20.0 g in the form of one polished endcut at *UWB*. The remainder is held by *GHupé*.

Northwest Africa 10185 (NWA 10185)

(Northwest Africa)

Purchased: 2012

Classification: Carbonaceous chondrite (CO3)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Petrography: The brownish meteorite exhibits chondritic texture of abundant small chondrules, CAIs, and mineral fragments set into a fine-grained matrix. Chondrules are typically 0.1-0.2 mm in diameter; some regions show brownish staining due to terrestrial weathering.

Northwest Africa 10187 (NWA 10187)

(Northwest Africa)

Purchased: 2012

Classification: Ordinary chondrite (L, melt rock)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Petrography: The meteorite displays a fresh dark-grayish interior and consists of abundant shock-melt regions containing characteristic FeNi metal and sulfide spherules. Relict chondrules and chondrule fragments are present. No metal or sulfide veining is observed.

Geochemistry: Analyses of olivine and pyroxene made in relict chondrules.

Northwest Africa 10191 (NWA 10191)

(Northwest Africa)

Purchased: 2014

Classification: Carbonaceous chondrite (C3)

History: Purchased by Darryl Pitt over the period May 2014 to March 2015 from the same dealer in Erfoud, Morocco (and reportedly found at the same site as NWA 8418).

Physical characteristics: A group of nine uncrusted stones (total weight 4262 g) of very similar appearance. All contain visible metal and sporadic, relatively large, round CAI rimmed by chlorapatite.

Petrography: (A. Irving and S. Kuehner, *UWS*) A sample from each stone was analyzed by optical petrographic and electron microprobe techniques applied to thin sections or polished slices. All specimens are relatively fresh and composed of small to large (apparent diameter 0.15-3.9 mm), separated granular chondrules in a finer grained metal-bearing matrix. Chlorapatite occurs patchily throughout the matrix of every specimen. Large (up to 5.5 mm), coarse grained CAI composed of olivine, Al-Ti-diopside, spinel and ilmenite occur sporadically, and are rimmed by chlorapatite; much finer-grained CAI with the same mineral assemblage are also present in some specimens.

Geochemistry: Olivine ($\text{Fa}_{0.4-37.6}$, $\text{FeO/MnO} = 108-135$, $N = 7$), orthopyroxene ($\text{Fs}_{0.9-19.3}\text{Wo}_{0.9-1.5}$, $N = 3$), augite ($\text{Fs}_{6.7-7.8}\text{Wo}_{48.7-47.3}$, $N = 2$).

Classification: Carbonaceous chondrite (C3) with affinities to CV3 chondrites. The abundance of apatite in this specimen is an anomalous feature for carbonaceous chondrites. This and the presence of large rimmed CAI establish that these stones are paired with the [NWA 8418](#) stone found at the same site.

Specimens: 65.4 g including four polished thin sections and six polished slices or endcuts at *UWB*. The remaining material is held by *DPitt*.

Northwest Africa 10192 (NWA 10192)

(Northwest Africa)

Purchased: 2008 Feb

Classification: Ordinary chondrite (L4-6)

History: Purchased by Philip Mani in February 2008 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed mostly of well-formed spherical chondrules (diameter up to 2.0 mm), mineral fragments and sparse recrystallized type 6 clasts (containing rare chondrules) within a finer grained matrix.

Geochemistry: Olivine ($\text{Fa}_{26.7-26.8}$, $N = 3$), orthopyroxene ($\text{Fs}_{15.2-22.4}\text{Wo}_{0.4-0.9}$, $N = 3$), clinopyroxene ($\text{Fs}_{7.6-7.9}\text{Wo}_{38.6-44.7}$, $N = 2$).

Classification: Ordinary chondrite (L4-6 breccia).

Specimens: 9.61 g including one polished thin section at *UWB*; the remainder is held by Mr. P. Mani.

Northwest Africa 10193 (NWA 10193)

(Northwest Africa)

Purchased: 2008 Feb

Classification: Ordinary chondrite (L4)

History: Purchased by Philip Mani in February 2008 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (diameter 0.6-1.8 mm; one 3.6 mm).

Geochemistry: Olivine (Fa_{24.0-24.9}, N = 3), orthopyroxene (Fs_{19.5-22.9}Wo_{0.5-1.0}, N = 3), pigeonite (Fs_{18.3}Wo_{21.7}).

Classification: Ordinary chondrite (L4).

Specimens: 4.48 g including one polished thin section at *UWB*; the remainder is held by Mr. P. Mani.

Northwest Africa 10194 (NWA 10194)

(Northwest Africa)

Purchased: 2008 Feb

Classification: Enstatite chondrite (EL4)

History: Purchased by Philip Mani in February 2008 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed spherical chondrules (diameter up to 2.8 mm) are set within a finer matrix containing abundant altered metal.

Geochemistry: Enstatite (Fs_{0.3-0.5}Wo_{0.4-0.5}, N = 3), kamacite (Ni 5.3-6.0 wt.%, Co 0.5 wt.%, Si 0.3 wt.%, N = 2).

Classification: Enstatite chondrite (EL4).

Specimens: 2.44 g including one polished thin section at *UWB*; the remainder is held by Mr. P. Mani.

Northwest Africa 10195 (NWA 10195)

(Northwest Africa)

Purchased: 2013 Feb

Classification: Ordinary chondrite (L4)

History: Purchased by Philip Mani in February 2013 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed spherical chondrules (diameter 0.25-2.2 mm).

Geochemistry: Olivine (Fa_{24.2-24.6}, N = 3), orthopyroxene (Fs_{20.3-20.5}Wo_{1.2-1.0}, N = 3), subcalcic augite (Fs_{10.7}Wo_{34.5}), augite (Fs_{7.9}Wo_{44.2}).

Classification: Ordinary chondrite (L4).

Specimens: 29.15 g including one polished thin section at *UWB*; the remainder is held by Mr. P. Mani.

Northwest Africa 10196 (NWA 10196)

(Northwest Africa)

Purchased: 2014 Feb

Classification: Ordinary chondrite (L, melt rock)

History: Purchased by Philip Mani in February 2014 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Aggregate of fine grained silicates (olivine, pyroxene, sodic plagioclase), merrillite, chlorapatite, troilite, and fine to coarse grained, blebby metal with very sparse remnant chondrules.

Geochemistry: Olivine (Fa_{24.7-25.2}, N = 3), orthopyroxene (Fs_{20.2-20.9}Wo_{1.5-1.6}, N = 3), clinopyroxene (Fs_{7.5-7.6}Wo_{45.2-45.3}, N = 2).

Classification: Ordinary chondrite (L melt rock).

Specimens: 32.68 g including one polished slice at *UWB*; the remainder is held by Mr. P. Mani.

Northwest Africa 10197 (NWA 10197)

(Northwest Africa)

Purchased: 2009 Feb

Classification: Ordinary chondrite (L4/5)

History: Purchased by Philip Mani in February 2009 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed spherical chondrules (diameter 0.7-2.2 mm).

Geochemistry: Olivine (Fa_{24.3-24.8}, N = 3), orthopyroxene (Fs_{20.3-20.4}Wo_{1.7-1.5}, N = 3), clinopyroxene (Fs_{6.6-7.6}Wo_{45.8-41.5}, N = 2).

Classification: Ordinary chondrite (L4/5).

Specimens: 20.52 g including one polished thin section at *UWB*; the remainder is held by Mr. P. Mani.

Northwest Africa 10198 (NWA 10198)

(Northwest Africa)

Purchased: 2009 Feb

Classification: Ordinary chondrite (L5)

History: Purchased by Philip Mani in February 2009 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed spherical chondrules (0.1-2.8 mm).

Geochemistry: Olivine (Fa_{24.8-26.1}, N = 3), orthopyroxene (Fs_{21.3-21.7}Wo_{1.0-1.3}, N = 3), clinopyroxene (Fs_{8.2-8.3}Wo_{43.6-43.8}, N = 2).

Classification: Ordinary chondrite (L5).

Specimens: 20.53 g including one polished thin section at *UWB*; the remainder is held by Mr. P. Mani.

Northwest Africa 10199 (NWA 10199)

(Northwest Africa)

Purchased: 2015 Feb

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Darryl Pitt in February 2015 from a dealer in Mauritania.

Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly granular and some BO chondrules (up to 2.8 mm, some with concentric dust rims) plus fine grained, irregularly-shaped CAI occur in an almost opaque, fine grained matrix.

Geochemistry: Olivine (Fa_{0.3-49.0}, N = 3), orthopyroxene (Fs_{0.9-1.1}Wo_{0.7-0.8}, N = 3), clinopyroxene (Fs_{0.8-1.2}Wo_{37.8-39.3}, N = 2).

Classification: Carbonaceous chondrite (CV3).

Specimens: 20.4 g including one polished thin section at *UWB*; the remainder is held by *DPitt*.

Northwest Africa 10200 (NWA 10200)

(Northwest Africa)

Purchased: 2014 Sep

Classification: Ordinary chondrite (L3)

History: Purchased by John Curchin in September 2014 from a Moroccan dealer at the Denver Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Highly unequilibrated specimen composed of closely packed, well formed, spherical chondrules (up to 2.4 mm) set within a sparse black matrix. Minerals are olivine, orthopyroxene, chromite, kamacite and troilite. Chondrules contain alkali- and Si-rich glass containing variable amounts of Ca and Fe.

Geochemistry: Olivine ($\text{Fa}_{0.4-73.1}$; Cr_2O_3 in ferroan examples = 0.07-0.79 wt.%, mean 0.25 ± 0.30 wt.%, $N = 15$), orthopyroxene ($\text{Fs}_{1.2-23.5}\text{Wo}_{0.3-1.6}$, $N = 3$).

Classification: Ordinary chondrite L3 (group based on magnetic susceptibility); estimated subtype 3.0-3.2 based on ranges, mean values and standard deviations of Fa and Cr_2O_3 content of ferroan olivines.

Specimens: 10.2 g including one polished thin section at *UWB*; the remainder is held by Mr. J. Curchin.

Northwest Africa 10201 (NWA 10201)

Northwest Africa

Purchased: 2014

Classification: Ordinary chondrite (LL5)

History: 1 stone weighing 53.3 g was found in Morocco in 2014. David Holden acquired the sample from a meteorite prospector in Erfoud 2014.

Physical characteristics: The stone is green and has a flattened triangular shape. Approximately 12% of the stone is covered by a weathered fusion crust. The cut face of the interior of the stone is light grey in color and displays small chondrules, chondrule fragments, orange clasts and fresh flakes of metal.

Petrography: Description and classification (A. Love, *App*): Sample displays recrystallized chondritic texture composed of close-packed, deformed chondrules (avg. diam. 656 μm) and clasts of fine-grained impact melt rock.

Geochemistry: (A. Love, *App*) Olivine $\text{Fa}_{28.9 \pm 0.4}$, $N=8$; Low Ca pyroxene $\text{Fs}_{24.0 \pm 0.8}\text{Wo}_{1.9 \pm 0.4}$, $N=8$

Specimens: An endcut and one slice weighing 10.71 g, and a polished thin section are currently on deposit at *App*.

Northwest Africa 10202 (NWA 10202)

(Northwest Africa)

Purchased: 2015

Classification: Ordinary chondrite (H5)

History: 1 stone weighing 115.7 g was found in Morocco in 2015. David Holden acquired the sample from a meteorite prospector in Erfoud, 2015.

Physical characteristics: The dark brown stone has a flattened irregular shape. Approximately 30% of the stone is covered by black fusion crust. The cut face of the interior of the stone is mottled light gray and brown in color and displays small chondrules, chondrule fragments, orange clasts and large fresh flakes of metal.

Petrography: Description and classification (A. Love, *App*): Sample displays brecciated texture composed of chondrules with an average diameter of 409 μm and recrystallized clastic debris composed of chondritic rock and porphyritic melt clasts. Sample contains ~16 vol% FeNi metal and a large irregularly shaped, cellular-textured FeNi metal and troilite grain.

Geochemistry: (A. Love, *App*) Olivine $\text{Fa}_{20.9 \pm 0.3}$, $N=8$; Low Ca pyroxene $\text{Fs}_{19.1 \pm 0.4}\text{Wo}_{1.9 \pm 0.6}$, $N=8$

Specimens: An endcut and one slice weighing 20.15 g, and a polished thin section are currently on deposit at *App*.

Northwest Africa 10203 (NWA 10203)

(Northwest Africa)

Purchased: 2015

Classification: Lunar meteorite

History: Purchased by Aziz Habibi in 2015; reportedly found in near the border between Mauritania and Mali.

Physical characteristics: Twenty-seven identically appearing pieces reportedly found together. Irregular exterior, no fusion crust. A saw cut reveals a polymict breccia with numerous fragmental light and dark clasts.

Petrography: (C. Agee, *UNM*) This polymict breccia has at least four distinct lithologies. 1) unbrecciated olivine gabbro with zoned clinopyroxene (~75%), acicular, plumose plagioclase (~15%), olivine (~5%), and minor titanomagnetite; 2) fragmental anorthositic gabbro breccia with ~75% plagioclase; 3) fragmental gabbroic breccia with approximately equal proportions of plagioclase, pyroxene and olivine; 4) shock melt veins and pools, some of which are vesicular. Accessory FeNi-metal, silica, ilmenite, troilite, chromite, and phosphate were observed in the fragmental breccias.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine gabbro: olivine $\text{Fa}_{52.9 \pm 7.1}$, $\text{Fe/Mn} = 100 \pm 12$, $n=6$; clinopyroxene $\text{Fs}_{31.1 \pm 15.8}\text{Wo}_{22.1 \pm 7.6}$, $\text{Fe/Mn} = 41 \pm 10$, $n=7$; plagioclase $\text{An}_{89.9 \pm 3.8}\text{Ab}_{8.9 \pm 3.4}\text{Or}_{1.1 \pm 0.8}$, $n=3$; anorthositic gabbro breccia: olivine $\text{Fa}_{30.6 \pm 3.0}$, $\text{Fe/Mn} = 104 \pm 7$, $n=21$; clinopyroxene $\text{Fs}_{39.4 \pm 15.8}\text{Wo}_{21.7 \pm 10.9}$, $\text{Fe/Mn} = 66 \pm 11$, $n=21$; plagioclase $\text{An}_{96.2 \pm 0.8}\text{Ab}_{3.5 \pm 0.8}\text{Or}_{0.2 \pm 0.1}$, $n=6$; gabbroic breccia: olivine $\text{Fa}_{40.3 \pm 2.9}$, $\text{Fe/Mn} = 98 \pm 5$, $n=6$; clinopyroxene $\text{Fs}_{35.4 \pm 14.3}\text{Wo}_{23.3 \pm 10.0}$, $\text{Fe/Mn} = 63 \pm 10$, $n=9$; plagioclase $\text{An}_{93.0 \pm 1.6}\text{Ab}_{6.6 \pm 1.6}\text{Or}_{0.4 \pm 0.1}$, $n=4$; Shock melt (10 μm defocused electron beam, proxy for bulk meteorite composition): $\text{SiO}_2 = 45.1 \pm 2.0$, $\text{TiO}_2 = 0.54 \pm 0.38$, $\text{Al}_2\text{O}_3 = 24.3 \pm 6.2$, $\text{Cr}_2\text{O}_3 = 0.21 \pm 0.19$, $\text{MgO} = 6.5 \pm 2.9$, $\text{FeO} = 8.2 \pm 3.8$, $\text{MnO} = 0.11 \pm 0.05$, $\text{CaO} = 14.9 \pm 1.9$, $\text{NiO} = 0.03 \pm 0.07$, $\text{Na}_2\text{O} = 0.49 \pm 0.13$, $\text{K}_2\text{O} = 0.10 \pm 0.03$ (all wt%), $n=40$.

Classification: Lunar (polymict breccia)

Specimens: 24 g including a probe mount on deposit at *UNM*; Aziz Habibi holds the main mass.

Northwest Africa 10204 (NWA 10204)

(Northwest Africa)

Purchased: 2015

Classification: HED achondrite (Eucrite, polymict)

History: Purchased by Aziz Habibi in 2015; reportedly found in near the border between Mauritania and Mali.

Physical characteristics: Three identically appearing pieces. Smooth fusion crusted exterior, broken surface reveals a polymict breccia with numerous fragmental white and dark gray clasts, set in a light-gray groundmass.

Petrography: (C. Agee, *UNM*) This polymict breccia has at least two distinct lithologies. 1) equilibrated basaltic eucrite; 2) unequilibrated cumulate eucrite. Accessory low-Ni metal, FeNi-metal, silica, ilmenite, troilite, and chromite were observed.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Basaltic eucrite: low-Ca pyroxene/pigeonite $\text{Fs}_{52.0 \pm 3.2}\text{Wo}_{5.9 \pm 4.3}$, $\text{Fe/Mn} = 33 \pm 1$, $n=8$; augite $\text{Fs}_{33.8 \pm 9.7}\text{Wo}_{30.3 \pm 11.2}$, $\text{Fe/Mn} = 31 \pm 1$, $n=3$; plagioclase

An_{89.4±1.1}, n=2. Cumulate eucrite: pigeonite Fs_{43.5±4.8}Wo_{6.9±4.0}, Fe/Mn=32±2, n=9; plagioclase An_{94.4±0.8}, n=4.

Classification: Achondrite (Eucrite, polymict breccia)

Specimens: 20.2 g including a probe mount on deposit at UNM; Aziz Habibi holds the main mass.

Northwest Africa 10205 (NWA 10205)

(Northwest Africa)

Purchased: 2015

Classification: Primitive achondrite (Lodranite)

History: Purchased by Adam Aaronson in Morocco, 2015.

Physical characteristics: Weathered exterior; saw cut reveals dark brown crystals ~2 mm in diameter.

Petrography: (C. Agee, UNM) Microprobe examination of a polished mount shows numerous pyroxene grains some of which are up to 2000 µm, finer-grained (50-200 µm) olivines are also present. Numerous metal and iron oxide veinlets throughout. Kamacite and troilite detected, plagioclase is absent.

Geochemistry: (C. Agee and N. Muttik, UNM) Olivine Fa_{10.8±0.2}, Fe/Mn=24±0, n=6; low-Ca pyroxene Fs_{9.8±0.3}Wo_{1.6±0.4}, Fe/Mn=14±0, n=3; diopside Fs_{3.9±0.3}Wo_{43.8±0.5}, Fe/Mn=9±1, Cr₂O₃=1.16±0.09 (wt%), n=3.

Classification: Lodranite, not an acapulcoite, based on grain size and absence of plagioclase.

Specimens: 5 g including a probe mount on deposit at UNM; Aaronson holds the main mass.

Northwest Africa 10206 (NWA 10206)

(Northwest Africa)

Purchased: 2015

Classification: Carbonaceous chondrite (CO3.0)

History: Purchased by Adam Aaronson in Morocco, 2015.

Physical characteristics: Smooth abraded fusion crust exterior; saw cut reveals very small chondrules in a very fine-grained, dark brown groundmass.

Petrography: (C. Agee, UNM) Microprobe examination of a polished mount shows numerous chondrules with apparent mean diameter 145±125 µm, n=63. Fine-grained matrix makes up about 30% of this meteorite. FeNi-metal, troilite, iron oxide, diopside, and plagioclase were detected.

Geochemistry: (C. Agee and N. Muttik, UNM) Olivine Fa_{15.4±17.4}, Fe/Mn=54±40, n=29; ferroan chondrule olivine Fa_{27.0±15.7}, Fe/Mn=80±32, Cr₂O₃=0.33±0.12 (wt%), n=16; enstatite Fs_{2.5±2.5}Wo_{2.2±1.5}, Fe/Mn=14±6, n=10.

Classification: Carbonaceous chondrite (CO3.0), 3.0 subtype based on Cr₂O₃ content of ferroan olivine ([Grossman and Brearley, 2005](#)). Values are similar to [Colony](#) (CO3.0) and [Y-81020](#) (CO3.0).

Specimens: 20.0 g including a probe mount on deposit at UNM; Aaronson holds the main mass.

Northwest Africa 10207 (NWA 10207)

(Northwest Africa)

Purchased: 2015

Classification: Primitive achondrite (Lodranite)

History: Purchased by Adam Aaronson in Morocco, 2015.

Physical characteristics: Weathered brown exterior. A saw cut reveals a mosaic of polygonal crystals, most less than ~1 mm, a few up to 2 mm.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows pyroxene and olivine grains with apparent mean diameter $390 \pm 140 \mu\text{m}$ ($n=46$). Numerous grain boundary triple junctions throughout, abundant metal/oxide sulfide veinlets in grain boundaries and crosscutting silicate crystals. Apatite detected, plagioclase is absent.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{15.5 \pm 0.1}$, $\text{Fe/Mn}=30 \pm 1$, $n=6$; low-Ca pyroxene $\text{Fs}_{13.7 \pm 0.2}\text{Wo}_{2.2 \pm 0.3}$, $\text{Fe/Mn}=17 \pm 0$, $n=3$; diopside $\text{Fs}_{6.0 \pm 0.1}\text{Wo}_{43.3 \pm 0.7}$, $\text{Fe/Mn}=12 \pm 1$, $\text{Cr}_2\text{O}_3=1.19 \pm 0.07$ (wt%), $n=3$.

Classification: Lodranite, not acapulcoite, based on absence of plagioclase, however mean grain size of ferromagnesian silicates is slightly smaller than most lodranites.

Specimens: 21.5 g including a probe mount on deposit at *UNM*; Aaronson holds the main mass.

Northwest Africa 10208 (NWA 10208)

(Northwest Africa)

Purchased: 2015

Classification: Carbonaceous chondrite (CO3)

History: Purchased by Adam Aaronson in Morocco, 2015.

Physical characteristics: Weathered exterior. A saw cut reveals very small chondrules in a very fine-grained, dark brown groundmass.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous chondrules with apparent mean diameter $200 \pm 175 \mu\text{m}$, $n=40$. Fine-grained matrix makes up about 40% of this meteorite. Kamacite, taenite, troilite, iron oxide, and phosphate were detected.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{24.6 \pm 15.4}$, $\text{Fe/Mn}=97 \pm 39$, $\text{Cr}_2\text{O}_3=0.15 \pm 0.18$ (wt%), $n=30$; low-Ca pyroxene $\text{Fs}_{2.5 \pm 0.9}\text{Wo}_{2.1 \pm 1.9}$, $\text{Fe/Mn}=27 \pm 13$, $n=13$.

Classification: Carbonaceous chondrite (CO3), subtype estimated between 3.0 and 3.2 based on Cr_2O_3 content of ferroan olivine, however the 1-sigma value of 0.18 is significantly higher than the trend for CO chondrites in figure 15 of [Grossman and Brearley \(2005\)](#).

Specimens: 20.1 g including a probe mount on deposit at *UNM*; Aaronson holds the main mass

Northwest Africa 10209 (NWA 10209)

(Northwest Africa)

Purchased: 2015

Classification: Carbonaceous chondrite (CK6)

History: Purchased by Adam Aaronson in Morocco, 2015.

Physical characteristics: Weathered exterior, some oxidation. A saw cut reveals scattered chondrules, up to 3 mm, in a very fine-grained, dark-gray groundmass. A few small CAIs are visible.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows texturally equilibrated chondrules, plagioclase grains up to $100 \mu\text{m}$. Fe-Ni metal, troilite and magnetite were observed.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fs}_{31.3 \pm 0.2}$, $\text{Fe/Mn}=118 \pm 10$, $\text{NiO}=0.44 \pm 0.08$ (wt%), $n=10$; low-Ca pyroxene $\text{Fs}_{26.7 \pm 0.5}\text{Wo}_{1.0 \pm 0.8}$, $\text{Fe/Mn}=71 \pm 5$, $n=10$.

Classification: Carbonaceous chondrite (CK6)

Specimens: 20.3 g including a probe mount on deposit at *UNM*; Aaronson holds the main mass.

Northwest Africa 10210 (NWA 10210)

(Northwest Africa)

Purchased: 2015

Classification: Primitive achondrite (Acapulcoite)

History: Purchased by Adam Aaronson in Morocco, 2015.

Physical characteristics: Weathered brown exterior. A saw cut reveals a mosaic of very fine-grained polygonal crystals, also scattered metal/sulfide grains.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows pyroxene, olivine, and plagioclase grains with apparent mean diameter $200 \pm 100 \mu\text{m}$ ($n=40$). Numerous grain boundary triple junctions throughout, abundant metal/oxide sulfide veinlets in grain boundaries and crosscutting silicate crystals. Apatite detected.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{10.6 \pm 0.2}$, $\text{Fe/Mn} = 22 \pm 1$, $n=5$; low-Ca pyroxene $\text{Fs}_{11.9 \pm 0.1} \text{Wo}_{2.3 \pm 0.2}$, $\text{Fe/Mn} = 15 \pm 0$, $n=3$; diopside $\text{Fs}_{4.9 \pm 0.2} \text{Wo}_{44.2 \pm 1.0}$, $\text{Fe/Mn} = 11 \pm 0$, $\text{Cr}_2\text{O}_3 = 1.18 \pm 0.13$ (wt%), $n=3$, plagioclase $\text{Ab}_{77.5 \pm 1.5} \text{An}_{20.3 \pm 1.7} \text{Or}_{2.2 \pm 0.2}$, $n=2$.

Classification: Acapulcoite, not lodranite, based on presence of plagioclase, and grain size typical for an acapulcoite.

Specimens: 26.6 g including a probe mount on deposit at *UNM*; Aaronson holds the main mass.

Northwest Africa 10211 (NWA 10211)

(Northwest Africa)

Purchased: 2014

Classification: Ordinary chondrite (L(LL)3)

History: Two fragments totaling 278.7 g were purchased by Sergey Vasiliev in 2014 by internet from a dealer from Morocco.

Petrography: The sample has a well-defined chondritic texture.

Geochemistry: Analyses of olivine and pyroxene clearly show the highly unequilibrated character of the rock (petrologic type 3). Olivine, $\text{Fa}_{15.0 \pm 10.4}$ ($\text{Fa}_{0.4-42.7}$; $n=32$); low-Ca pyroxene, $\text{Fs}_{9.3 \pm 6.6} \text{Wo}_{0.8 \pm 0.9}$ ($\text{Fs}_{1.5-20.2} \text{Wo}_{0.1-4.0}$, $n=25$).

Classification: Based on the chemical data a H, L, or LL classification is impossible. However, based on the chondrule size (generally $> 0.4 \text{ mm}$) the rock must be L3 or LL3. In comparison to the LL3 chondrite [Krymka](#), the chondrules in this new chondrite are slightly smaller. Therefore, an L3 chondrite classification is suggested. The olivines show planar fractures clearly indicating shock stage S3. A shock vein has also been observed. The sample is a heavily weathered (W3-4), only having relict metal.

Northwest Africa 10212 (NWA 10212)

(Northwest Africa)

Purchased: 6 Dec 2014

Classification: Ordinary chondrite (LL3-6)

History: One fragment of 46.6 g was purchased in Hamburg on Dec. 6, 2014, from a dealer from Morocco.

Petrography: A random sampling was obtained indicating minor to moderate degree of unequilibration of olivine and pyroxene. A microscopic study shows that the rock is a chondritic breccia consisting of various types of equilibrated lithologies (types LL4-6 fragments) and minor

amounts of unequilibrated clasts. The sample also contains impact melt clasts. The sample is a relatively fresh (W1). The olivines show planar fractures clearly indicating shock stage S3.

Geochemistry: Olivine $\text{Fa}_{29.0 \pm 1.5}$ (Fa_{23-31} ; $n=20$), orthopyroxene: $\text{Fs}_{23.4 \pm 7.8} \text{Wo}_{2.4 \pm 1.8}$ ($\text{Fs}_{10-51} \text{Wo}_{0.4-8.5}$; $n=20$).

Northwest Africa 10215 (NWA 10215)

Morocco

Purchased: February 2015

Classification: Rumuruti chondrite (R4)

Petrography: The chondrules average 400 μm in diameter, characteristic of R chondrites. There is ~30 vol.% matrix, near the middle of the R-chondrite range. The chondrules are well defined, consistent with type 4.

Geochemistry: The olivine ($\text{Fa}_{38.3 \pm 1.3}$, $n=18$) shows that it is a mostly equilibrated R chondrite. It has little low-Ca pyroxene, $\text{Fs}_{13.7 \pm 0.9} \text{Wo}_{0.30 \pm 0.01}$ ($n=2$). There is also some Ca-pyx, $\text{Fs}_{11.2 \pm 0.9} \text{Wo}_{4.0 \pm 1.0}$ ($n=4$).

Northwest Africa 10217 (NWA 10217)

Morocco

Find: Unknown

Classification: Carbonaceous chondrite (CK5)

Petrography: Opaques include magnetite, pyrite and pyrrhotite.

Geochemistry: Olivine is $\text{Fa}_{30.8 \pm 0.2}$ ($n=20$); low-Ca pyroxene is absent; Ca pyroxene is $\text{Fs}_{10.5 \pm 5.2} \text{Wo}_{42.2 \pm 12.3}$ ($n=8$).

Classification: The homogeneity of the olivine indicates type 4-6. The mean diameter of plagioclase grains (30 μm) indicates type 5. The absence of primary glass indicates type 4-6. The presence of readily discernable chondrules indicates type 5. The coarseness of the groundmass (80 μm) indicates type 5 or 6.

Northwest Africa 10224 (NWA 10224)

Morocco

Purchased: January 2014

Classification: Iron meteorite (IID)

History: Two identical-looking specimens (288.5 and 29.3 g) were purchased in January 2014 by Fabien Kuntz from a Moroccan dealer in Tagounite.

Physical characteristics: Curved, elongated specimen has a reddish-brown exterior with no obvious regmaglypts and little evidence of terrestrial alteration or weathering.

Petrography: Optical investigation reveals a well-developed Widmanstätten pattern consistent with a medium octahedrite (0.95 ± 0.21 mm, $n=55$).

Geochemistry: Bulk composition: ICP-MS data, using sample of [North Chile](#) (Filomena) as standard (C. Herd, S. DuFrane and G. Chen, *UAb*): Ni = 9.7, Co = 6.0 (both wt%); Ir = 14.9, Ga = 70.0, As = 3.5, W = 2.6, Re = 1.45, Cu = 240, Ru = 15.0, Pd = 2.5, Pt = 18.9 (all $\mu\text{g/g}$).

Classification: (C. Herd, *UAb*): IID, medium octahedrite. Concentrations of Ni, Cu, As, Ru, W, Re, Ir and Pt are consistent with the IID group (see [Wasson and Huber, 2006](#)). Ga is a bit low for IID, but too high for other groups (e.g., IIE, III and IV).

Specimens: Type specimen of 24.0 g, including slice removed for ICP-MS, at *UAb*. Main mass with *Kuntz*.

Northwest Africa 10225 (NWA 10225)

(Northwest Africa)

Purchased: 2014 Oct

Classification: Ordinary chondrite (H5)

History: Purchased by Alexandre Debienne in October 2014 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules.

Geochemistry: Olivine (Fa_{18.5-18.7}, N = 3), orthopyroxene (Fs_{15.7-16.4}Wo_{1.1-1.2}, N = 3), augite (Fs_{5.4-7.6}Wo_{45.5-35.0}, N = 2).

Classification: Ordinary chondrite (H5).

Specimens: 37.3 g including one polished thin section at *PSF*; main mass with Mr. A. Debienne.

Northwest Africa 10226 (NWA 10226)

(Northwest Africa)

Purchased: 2014 Aug

Classification: Ordinary chondrite (H4)

History: Purchased by Alexandre Debienne in August 2014 from a dealer in Agadir, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (apparent diameter 0.1-1.6 mm).

Geochemistry: Olivine (Fa_{18.5-18.8}, N = 3), orthopyroxene (Fs_{15.3-16.1}Wo_{2.0-0.7}, N = 3), augite (Fs_{5.0-6.6}Wo_{46.2-45.6}, N = 2).

Classification: Ordinary chondrite (H4).

Specimens: 21.9 g including one polished thin section at *PSF*; main mass with Mr. A. Debienne.

Northwest Africa 10227 (NWA 10227)

(Northwest Africa)

Purchased: 2014 Aug

Classification: Ordinary chondrite (L4)

History: Purchased by Alexandre Debienne in August 2014 from a dealer in Agadir, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (apparent diameter 0.2-2.1 mm).

Geochemistry: Olivine (Fa_{25.6-25.7}, N = 3), orthopyroxene (Fs_{21.2-21.2}Wo_{1.0-0.8}, N = 3), augite (Fs_{6.9-7.1}Wo_{45.1-45.8}, N = 2).

Classification: Ordinary chondrite (L4).

Specimens: 50.0 g including one polished thin section at *PSF*; main mass with Mr. A. Debienne.

Northwest Africa 10228 (NWA 10228)

(Northwest Africa)

Purchased: 2015 May

Classification: Lunar meteorite (feldspathic breccia)

History: Purportedly found near Laagad, east of Assa, Morocco and purchased by John Higgins from a dealer in Ouarzazate in May 2015.

Petrography: (A. Irving and S. Kuehner, *UWS*) Very fine-grained breccia consisting of small mineral clasts of anorthite, olivine, pigeonite, augite, ilmenite, kamacite, troilite, merrillite, plus rare grains of rutile and baddeleyite, within a melt-textured intersertal matrix.

Geochemistry: Olivine (Fa_{25.6-26.2}, FeO/MnO = 91-103, N = 4), pigeonite (Fs_{22.0-24.3}Wo_{6.6-8.0}, FeO/MnO = 50-60, N = 3), augite (Fs₁₄Wo_{37.4}, FeO/MnO = 44).

Classification: Lunar (feldspathic melt-matrix breccia)

Specimens: 4.15 g including one polished slice at *UWB*; main mass with Mr. J. Higgins.

Northwest Africa 10229 (NWA 10229)

(Northwest Africa)

Purchased: 2014 Oct

Classification: Ordinary chondrite (L6)

History: Purchased by Alexandre Debienne in October 2014 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Recrystallized, with rare chondrule remnants.

Geochemistry: Olivine (Fa_{24.9-25.0}, N = 3), orthopyroxene (Fs_{20.7-20.8}Wo_{1.5-1.9}, N = 3), augite (Fs_{8.3-9.2}Wo_{44.1-42.4}, N = 2).

Classification: Ordinary chondrite (L6).

Specimens: 74.8 g including one polished thin section at *PSF*; main mass with Mr. A. Debienne.

Northwest Africa 10230 (NWA 10230)

(Northwest Africa)

Purchased: 2014 Oct

Classification: HED achondrite (Eucrite, brecciated)

History: Purchased by Alexandre Debienne in October 2014 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia composed of mineral clasts and some lithic clasts with intersertal texture. Minerals are exsolved pigeonite, calcic plagioclase, silica polymorph, Ti-bearing chromite, ilmenite and troilite

Geochemistry: Orthopyroxene host (Fs_{59.2-60.3}Wo_{3.3-2.5}, FeO/MnO = 31-33, N = 3), clinopyroxene exsolution lamellae (Fs_{27.0-27.1}Wo_{42.0-42.5}, FeO/MnO = 31-32, N = 3).

Classification: Eucrite (breccia).

Specimens: 5.66 g including one polished piece at *PSF*; main mass with Mr. A. Debienne.

Northwest Africa 10231 (NWA 10231)

(Northwest Africa)

Purchased: 2014 Oct

Classification: Ordinary chondrite (L6)

History: Purchased by Alexandre Debienne in October 2014 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Recrystallized aggregate of olivine, orthopyroxene, augite, sodic plagioclase, chlorapatite, stained kamacite, chromite, taenite and troilite. A finer grained clast has very similar mineralogy but much less metal.

Geochemistry: Olivine (Fa_{25.6-25.9}, N = 3), orthopyroxene (Fs_{20.7-20.9}Wo_{1.4-1.3}, N = 3), augite (Fs_{8.2-10.0}Wo_{43.7-42.7}, N = 2).

Classification: Ordinary chondrite (L6).

Specimens: 5.95 g including one polished thick section at *PSF*; main mass with Mr. A. Debienne.

Northwest Africa 10232 (NWA 10232)

(Northwest Africa)

Purchased: 2014 Aug

Classification: Ordinary chondrite (H6)

History: Purchased by Alexandre Debieenne in August 2014 from a dealer in Agadir, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Recrystallized with rare chondrule remnants.

Geochemistry: Olivine (Fa_{19.8-20.5}, N = 3), orthopyroxene (Fs_{16.4-16.6}Wo_{3.9-4.2}, N = 3), augite (Fs_{9.3-9.4}Wo_{37.3-35.7}, N = 2).

Classification: Ordinary chondrite (H6).

Specimens: 15.3 g including one polished thin section at *PSF*; main mass with Mr. A. Debieenne.

Northwest Africa 10233 (NWA 10233)

(Northwest Africa)

Purchased: 2014 Aug

Classification: HED achondrite (Eucrite, unbrecciated)

History: Purchased by Alexandre Debieenne in August 2014 from a dealer in Agadir, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh, unbrecciated diabasic eucrite with subophitic texture. Larger grains of exsolved pigeonite partially enclose squat laths of calcic plagioclase. Accessory phases are ilmenite, Ti-rich chromite, troilite and Ni-free metal.

Geochemistry: Low-Ca pyroxene (Fs_{58.8-60.1}Wo_{6.6-6.1}, FeO/MnO = 24-27, N = 3), high-Ca pyroxene (Fs_{29.7-30.7}Wo_{41.3-41.1}, FeO/MnO = 25-29, N = 3)..

Classification: Eucrite (unbrecciated, diabasic).

Specimens: 20.25 g including one polished thin section at *PSF*; main mass with Mr. A. Debieenne.

Northwest Africa 10235 (NWA 10235)

(Northwest Africa)

Purchased: 2014 Oct

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Fabien Kuntz in October 2014 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Separated granular chondrules (apparent diameter up to 2.8 mm) and amoeboid, very fine-grained CAI are set in a brown matrix (~ 40 vol.%).

Geochemistry: Olivine (Fa_{0.2-76.5}, N = 3), orthopyroxene (Fs_{1.3-1.8}Wo_{1.1-0.9}, N = 3), clinopyroxene (Fs_{0.8-2.2}Wo_{38.7-35.1}, N = 2), ferroan clinopyroxene in CAI (Fs_{44.6}Wo_{50.8}).

Classification: Carbonaceous chondrite (CV3).

Specimens: 21.95 g including one polished thin section at *PSF*; main mass with *Kuntz*.

Northwest Africa 10236 (NWA 10236)

(Northwest Africa)

Purchased: 2014 Nov

Classification: Ordinary chondrite (L3)

History: Purchased by Fabien *Kuntz* in November 2014 from a dealer in Ouarzazate, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fairly closely packed chondrules (apparent diameter up to 2.3 mm) are set in a finer grained matrix containing stained metal.

Geochemistry: Olivine (Fa_{0.5-32.1}, Cr₂O₃ in ferroan examples 0.04-0.11 wt.%, mean 0.06±0.02 wt.%, N = 7), orthopyroxene (Fs_{4.2-11.5}Wo_{0.3-0.4}, N = 3), augite (Fs_{4.7}Wo_{39.6}), subcalcic augite (Fs_{16.2}Wo_{27.4}).

Classification: Ordinary chondrite (L3).

Specimens: 20.0 g including one polished thin section at *PSF*; main mass with Mr. F. Kuntz.

Northwest Africa 10237 (NWA 10237)

(Northwest Africa)

Purchased: 2014 Nov

Classification: Enstatite chondrite (EH melt rock)

History: Purchased by Fabien Kuntz in November 2014 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Very fine grained heterogenous aggregate of predominantly enstatite and kamacite with accessory oldhamite, niningerite and Cr-bearing troilite, plus regions of tiny enstatite prisms in Na-Al-Si glass.

Geochemistry: Enstatite ($\text{Fs}_{0.6-3.9}\text{Wo}_{0.3-0.4}$, $N = 3$), kamacite (Ni 6.3-6.7 wt.%, Co 0.4 wt.%, Si 2.5 wt.%, $N = 2$).

Classification: Enstatite chondrite (EH melt rock).

Specimens: 21.86 g including one polished thin section at *PSF*; main mass with Kuntz.

Northwest Africa 10238 (NWA 10238)

(Northwest Africa)

Purchased: 2014 Jan

Classification: Ureilite

History: Purchased by Fabien Kuntz in January 2014 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Protogranular aggregate of olivine and low-Ca pyroxene with accessory metal. Olivine grains have more magnesian, reduced rims containing blebs of Fe metal and microdiamond, and consist of polygonal subgrains; both orthopyroxene and pigeonite are present.

Geochemistry: Olivine (cores $\text{Fa}_{23.3-23.4}$, rim $\text{Fa}_{11.9}$), orthopyroxene ($\text{Fs}_{17.4}\text{Wo}_{3.9}$), pigeonite ($\text{Fs}_{17.8}\text{Wo}_{5.8}$; $\text{Fs}_{20.1}\text{Wo}_{11.6}$).

Classification: Ureilite.

Specimens: 24.67 g including one polished thin section at *PSF*; main mass with Kuntz.

Northwest Africa 10239 (NWA 10239)

(Northwest Africa)

Purchased: 2015 Jan

Classification: Ordinary chondrite (H4/5)

History: Purchased by Fabien Kuntz in January 2015 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Some well-formed chondrules (apparent diameter 0.2-1.7 mm) and relatively abundant altered metal.

Geochemistry: Olivine ($\text{Fa}_{18.5-18.6}$, $N = 3$), orthopyroxene ($\text{Fs}_{16.5-16.9}\text{Wo}_{1.3-1.2}$, $N = 3$), augite ($\text{Fs}_{6.0-7.5}\text{Wo}_{47.2-45.8}$, $N = 2$).

Classification: Ordinary chondrite (H4/5).

Specimens: 21.03 g including one polished thin section at *PSF*; main mass with Mr. F. Kuntz.

Northwest Africa 10241 (NWA 10241)

(Northwest Africa)

Purchased: 2015 Jan

Classification: Ordinary chondrite (LL3)

History: Bought by Jean Redelsperger from Lahcen Ait Ha in Erfoud in January 2015.

Physical characteristics: Eight irregular gray fragments without fusion crust. Chondrules are clearly visible at the surface. Cut surface shows closely packed large chondrules, with little weathering.

Petrography: Well-defined closely packed chondrules. Chondrule mesostasis devitrified.

Geochemistry: Olivine range $\text{Fa}_{5.8-39.6}$. Cr_2O_3 in ferroan olivine 0.15 ± 0.12 wt%. Orthopyroxene range $\text{Fs}_{6.1-14.0}$.

Classification: LL3

Specimens: 23.5 g at *CEREGE*. Main mass with Jean Redelsperger. Another 804 g stone exists with the seller, that is not accounted for here.

Northwest Africa 10242 (NWA 10242)

(Northwest Africa)

Purchased: 2015 Jan

Classification: HED achondrite (Diogenite)

History: The two stones were bought in January 2015 by Jean Redelsperger in Agadir

Physical characteristics: Two irregular dark-gray fragments without fusion crust. Cut surface reveals a dark interior with lighter clasts.

Petrography: Coarse brecciated igneous rock with grain size to 2 mm. Main mineral is pyroxene with fine scale augite exsolution. The rock also contains plagioclase, chromite, ilmenite, a silica polymorph, troilite, metal (to 300 μm).

Geochemistry: Orthopyroxene $\text{Fs}_{27.9}\text{Wo}_{2.7}$ (N=1). Augite $\text{Fs}_{35.0 \pm 0.8}\text{Wo}_{34.2 \pm 2.9}$ (N=4).

$\text{FeO/MnO} = 32.1 \pm 2.6$ (N=5). Plagioclase $\text{An}_{92.5}\text{Ab}_{7.2}\text{Or}_{0.3}$ (N=2)

Classification: Diogenite

Northwest Africa 10243 (NWA 10243)

(Northwest Africa)

Purchased: 2015 Jan

Classification: Ordinary chondrite (LL7)

Physical characteristics: A single stone covered with dull fusion crust. Cut surface reveals a fine-grained gray to brownish interior.

Petrography: Strongly recrystallized texture with triple junctions. Main minerals are olivine, orthopyroxene and plagioclase (to 200 μm). One relict chondrule was observed over the $\sim 2 \text{ cm}^2$ polished section.

Classification: LL7 based on texture, Wo content of orthopyroxene, plagioclase size, and near-absence of chondrules.

Specimens: 24 g at *CEREGE*. Main mass with Jean Redelsperger.

Northwest Africa 10244 (NWA 10244)

(Northwest Africa)

Purchased: 2014

Classification: Ordinary chondrite (LL5, melt breccia)

History: 3 fragments of meteorite were purchased from anonymous dealer in Morocco.

Physical characteristics: 3 fragments of the meteorite with combined mass of 2202 g (385, 497 and 1320 g) with brown fusion crust

Petrography: The meteorite is a breccia containing gray (70 vol.%) and black (30 vol. %) lithologies. The gray lithology where mineral analysis were carried out has chondrite structure

and contains rare melt pockets. Olivine has undulatory extinction and planar fractures, rare olivine grains have weak mosaicism and rare planar deformation features. The black lithology contains fine-grained devitrified melt with chondrite fragments.

Specimens: a piece of meteorite, 385 g, a slice of 77 g and many small pieces of 11 g are deposited at *Vernad*.

Northwest Africa 10245 (NWA 10245)

Morocco

Purchased: 2014

Classification: HED achondrite (Eucrite)

Petrography: This sample is composed of fine-grained pyroxene (49%), plagioclase (42%), silica (8%), chromite, ilmenite, metal, troilite, and zircon. Coesite and shock-induced melt veins are present. Coesite was identified based on its chemical composition and Raman shift at 521 cm^{-1} .

Geochemistry: Compositions of low-Ca pyroxene and high-Ca pyroxene are $\text{En}_{37.3\pm0.8}\text{Fs}_{60.5\pm1.1}\text{Wo}_{2.2\pm0.7}$ (n=9) and $\text{En}_{30.4\pm0.6}\text{Fs}_{26.8\pm0.8}\text{Wo}_{42.8\pm1.0}$ (n=8), respectively. Both pyroxenes contain exsolution lamellae. The average Fe/Mn value of pyroxene is 31.3 ± 1.7 . The average composition of plagioclase is $\text{An}_{88.7\pm0.8}\text{Ab}_{10.8\pm0.6}$.

Specimens: 5.71 g at *NU*

Northwest Africa 10246 (NWA 10246)

Algeria

Find: 2014 Nov

Classification: Mesosiderite

History: The specimen was found in eastern Algeria by a nomad in November 2014 and sold to a Moroccan middleman. Following its recovery, the area was extensively searched and no additional material was recovered.

Petrography: The sample contains metal (~60 vol.%) and troilite with interspersed silicate phases. Silicates include low-Ca pyroxene ($\text{Fs}_{24.7}\text{Wo}_{3.1}$) and plagioclase ($\text{Ab}_{9.4\pm0.5}\text{Or}_{0.25\pm0.10}$; n=17). Also present are small grains of silica (~20 μm) in size, chromite (~20 μm) and phosphate (5x10 μm).

Northwest Africa 10247 (NWA 10247)

(Northwest Africa)

Purchased: 2014

Classification: Ordinary chondrite (L6)

History: One stone weighing 257.7 g was found in Morocco in 2014. David Holden acquired the sample from a meteorite prospector in Erfoud, 2014.

Physical characteristics: The stone is angular in shape and displays many small, shallow regmaglypts. A smooth, weathered, dark brown, fusion crust covers approximately 75% of the exterior. The uncrusted edge displays a fine, continuous rollover lip. The cut face showing the interior of the stone is tan with mottle orange regions and displays small chondrules, chondrule fragments and fresh and weathered flakes of metal.

Petrography: Description and classification (A. Love, *App*): Sample displays recrystallized brecciated chondritic texture composed of indistinct chondrules with a diameter of 730 μm , and impact melt clasts set within a crystalline matrix.

Geochemistry: (A.Love, *App*) Olivine $\text{Fa}_{23.4\pm0.2}$, N=8; Low Ca pyroxene $\text{Fs}_{20.6\pm0.2}\text{Wo}_{2.2\pm0.2}$, N=8
Specimens: An endcut and one slice weighing 20.6 g, and a polished thin section are currently on deposit at *App*.

Northwest Africa 10248 (NWA 10248)

(Northwest Africa)

Purchased: 2012

Classification: Ordinary chondrite (L6)

History: 1 stone weighing 23.4 g was found in Morocco in 2012. David Holden acquired the sample from a meteorite prospector in Erfoud, 2012.

Physical characteristics: The stone is dark brown and has an ellipsoidal shape displaying many small, shallow regmaglypts. Weathered brown fusion crust covering approximately 75% of the exterior. The cut face of the interior of the stone is tan and displays a few small chondrules and many chondrule fragments and fresh flakes of metal.

Petrography: Description and classification (A. Love, *App*): Sample displays recrystallized chondritic texture crosscut by glassy shock veins. Few chondrules are defined and have an average diameter of 775 μm .

Geochemistry: (A.Love, *App*) Olivine $\text{Fa}_{23.5\pm0.2}$, N=8; low Ca pyroxene $\text{Fs}_{21.3\pm0.2}\text{Wo}_{1.8\pm0.3}$, N=8; high Ca pyroxene $\text{Fs}_{7.8\pm0.7}\text{Wo}_{48.2\pm0.8}$, N=2

Classification: Ordinary chondrite (L6, S4, W1)

Specimens: An endcut and one slice weighing 4.7 g, and a polished thin section are currently on deposit at *App*.

Northwest Africa 10250 (NWA 10250)

(Northwest Africa)

Find: 2000

Classification: Ordinary chondrite (L3)

History: Found by anonymous dealer in Northwest Africa in 2000

Physical characteristics: Chondrules, metal, and colored minerals are visible. The outline of chondrules varies from sharp to indistinct. Matrix color is brown.

Petrography: Mineral species: olivine, pyroxene, plagioclase, Fe-Ni alloy, FeS, chromite, Cl-apatite, merrillite, native Cu, and SiO_2 .

Geochemistry: Olivine: $\text{Fa}_{24.6\pm11.3}$ (N=52) (matrix), $\text{Fa}_{21.9\pm6.8}$ (N=59) (chondrule); pyroxenes: $\text{Fs}_{17.9\pm5.1}\text{Wo}_{1.5\pm1.0}$ (N=27, low-Ca pyroxene, matrix), $\text{Fs}_{13.2\pm7.4}\text{Wo}_{33.1\pm6.9}$ (N=9, high-Ca pyroxene, matrix), $\text{Fs}_{17.4\pm6.4}\text{Wo}_{1.5\pm1.2}$ (N=45, low-Ca pyroxene, chondrule), $\text{Fs}_{12.3\pm6.1}\text{Wo}_{28.9\pm13.2}$ (N=14, high-Ca pyroxene, chondrule)

Classification: Ordinary chondrite (L3)

Specimens: 31.8 g initial mass (1 fragment, 15.98 g and 3 thin sections) on deposit at NMNS, Mineral Science Laboratory holds the remaining main mass.

Northwest Africa 10251 (NWA 10251)

Northwest Africa

Purchased: 2004 Feb

Classification: Ordinary chondrite (H3-6)

History: A single ~2 kg stone was found in a group of stones labeled [NWA 869](#) at the Tucson Gem show in February 2004, purchased by Edwin Thompson, and cut into slices. Multiple slices totaling 257.7 g were donated to *Cascadia*. A 7.8 g slice was used to make multiple thin sections.

Physical characteristics: Slices are composed dominantly of a host lithology that is medium brown in color and contains abundant metal. Numerous angular black clasts and rounded reddish or light-colored clasts are visible.

Petrography: (M. Hutson and A. Ruzicka, *Cascadia*) Three serial thin sections expose two black and one round reddish-colored clasts set in a host lithology. The host, best described as a type 3 microbreccia, contains small chondrules (50-300 μm across) and chondrule fragments surrounded by a matrix comprised of angular grain fragments and veins of weathering product and sulfide. Glass, zoned olivine, a silica polymorph, sodalite (one ~60 μm across grain), noticeably abundant merrillite and chlor-apatite, and a large (100 μm across) spinel grain were observed. Most olivine grains show irregular or no fractures with slight to moderate undulose extinction, indicative of shock stage S2. Metal and sulfide show evidence of 20-25% replacement indicative of weathering grade W2. The reddish-colored clast is comprised of distinct chondrules and chondrule fragments, some of which contain twinned low-Ca pyroxene. Large (400-500 μm across) metal grains have scalloped edges and envelope chondrule, olivine, and pyroxene fragments. Shock and weathering are similar to the host. The texture suggests this clast is made of high type 3/low type 4 material. The two black clasts are very different from each other. One is composed primarily of melt-rock with abundant parallel veins and droplets of metal and sulfide that stop abruptly at the clast boundary. One edge of the clast has discernable chondrules, which contain ferrous and magnesian zoned olivine grains (in BSE), suggesting this is a partly melted type 3 clast. The other black clast appears to be a high type 6, with barely discernable chondrules blending into coarse-grained interstitial olivine and pyroxene. The clast contains large (up to 450 μm across) phosphate grains, but no large plagioclase feldspar grains. Instead, feldspathic material occurs in small crystallite-filled pockets between olivine and pyroxene grains and in the numerous sulfide/feldspathic veins that cut across all of the olivine, pyroxene, and phosphate grains in the clast. Olivine grains are difficult to see in transmitted and cross-polarized light. The few that were observable showed deformation consistent with shock stage S5 (planar fractures and strong mosaic extinction).

Geochemistry: Compositions of all measured phases in the host meteorite are variable, and include olivine $\text{Fa}_{18.2\pm4.4}$ (N=135), low-Ca pyroxene $\text{Wo}_{1.1\pm1.0}\text{Fs}_{15.4\pm4.8}$ (N=44). In the host lithology, olivine compositions range from $\text{Fa}_{1.1}$ to $\text{Fa}_{36.0}$, with 54 out of 100 grains having compositions (Fa_{16-20}) consistent with an H-group chondrite. Olivine compositions in the reddish clast range from $\text{Fa}_{14.5}$ to $\text{Fa}_{23.3}$, with only 3 out of 19 grains outside of the H-group equilibrated chondrule range. All of the analyzed olivine grains in the high-type black clast are between $\text{Fa}_{16.9}$ and $\text{Fa}_{19.7}$.

Classification: H3-6 fragmental breccia. This rock is clearly not another individual of NWA 869 (L3-6).

Specimens: 249.9 g in six slices, plus three polished thin sections and material in an epoxy stub are on deposit at *Cascadia*. Patrick Thompson holds the main mass.

Northwest Africa 10252 (NWA 10252)

(Northwest Africa)

Purchased: April 2015

Classification: Pallasite (Main group, anomalous)

History: Purchased by Darryl Pitt from Moroccan meteorite dealer in April 2015.

Physical characteristics: Irregular exterior, dark metallic patina, slight oxidation. Polished saw cuts show angular orange-brown-green, translucent olivines set in fresh, unoxidized metal.

Petrography: (C. Agee, *UNM*) Olivine is the only silicate phase present. Approximately 98% of the metal consists of very fine-grained ($<1\ \mu\text{m}$) plessite, with kamacite occurring as a thin mantling around olivine crystals. Accessory schreibersite, chromite, Ni-rich sulfide, and Ca-Mg phosphates were observed.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{13.3\pm0.1}$, $\text{Fe/Mn}=47\pm3$, $n=10$; plessite $\text{Fe}=82.9\pm5.7$, $\text{Ni}=15.9\pm5.8$, $\text{Co}=0.60\pm0.08$ (all wt%), $n=10$; kamacite $\text{Fe}=94.4\pm1.0$, $\text{Ni}=5.9\pm0.9$, $\text{Co}=0.83\pm0.05$ (all wt%), $n=10$; schreibersite $\text{Fe}=59.3\pm2.6$, $\text{Ni}=25.3\pm2.6$, $\text{Co}=0.28\pm0.04$, $\text{P}=14.2\pm0.2$ (all wt%), $n=4$. Oxygen isotopes (K. Ziegler, *UNM*) laser fluorination of acid-washed bulk subsamples gave (mean of 3), respectively, $\delta^{17}\text{O} = 1.351$, $\delta^{18}\text{O} = 3.049$, $\Delta^{17}\text{O} = -0.258$ permil (linearized).

Classification: Pallasite, main group anomalous based on oxygen isotopic composition, likely paired with NWA 10023.

Specimens: 22.6 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 10253 (NWA 10253)

(Northwest Africa)

Purchased: 2015

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Darryl Pitt from a Moroccan meteorite dealer, reportedly found in Mauritania near the Algerian border.

Physical characteristics: Weathered irregular exterior. Saw cuts reveal a fragmental breccia with numerous feldspathic and mafic clasts set in a gray groundmass.

Petrography: (C. Agee, *UNM*) This meteorite is a very heterogeneous polymict breccia consisting of numerous microgabbro clasts, shock melt pools and veins, fragmental plagioclase, pyroxene, and olivine. Accessory Fe-oxide, troilite, Ti-chromite, ilmenite, and silica were observed. Thin calcite weathering veins are present.

Geochemistry: (C. Agee and N. Muttik, *UNM*) olivine $\text{Fa}_{38.3\pm2.7}$, $\text{Fe/Mn}=102\pm5$, $n=14$; pigeonite $\text{Fs}_{39.9\pm14.7}\text{Wo}_{12.7\pm5.5}$, $\text{Fe/Mn}=63\pm9$, $n=14$; augite $\text{Fs}_{42.7\pm14.2}\text{Wo}_{27.0\pm7.9}$, $\text{Fe/Mn}=69\pm11$, $n=10$; anorthite plagioclase $\text{An}_{95.3\pm1.8}\text{Ab}_{4.4\pm1.7}\text{Or}_{0.2\pm0.1}$, $n=6$; labradorite plagioclase $\text{An}_{55.5}\text{Ab}_{43.2}\text{Or}_{1.3}$, $n=1$; Shock melt (10 μm defocused electron beam, proxy for bulk meteorite composition): $\text{SiO}_2=46.1\pm1.6$, $\text{TiO}_2=0.63\pm0.46$, $\text{Al}_2\text{O}_3=23.1\pm4.8$, $\text{Cr}_2\text{O}_3=0.16\pm0.09$, $\text{MgO}=6.8\pm3.5$, $\text{FeO}=7.1\pm3.2$, $\text{MnO}=0.09\pm0.05$, $\text{CaO}=14.0\pm2.0$, $\text{NiO}=0.03\pm0.03$, $\text{Na}_2\text{O}=0.55\pm0.21$, $\text{K}_2\text{O}=0.12\pm0.08$ (all wt%), $\text{Fe/Mn}=81\pm23$, $\text{Mg\#}=61\pm8$, $\text{MgO}+\text{FeO}=13.9\pm6.0$ (wt%), $n=31$.

Classification: Lunar feldspathic breccia

Specimens: 32.5 g including a probe mount on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 10255 (NWA 10255)

(Northwest Africa)

Purchased: 2015 Feb

Classification: Ordinary chondrite (LL3)

History: Purchased by Aerolite Meteorites

Physical characteristics: Single stone, saw cut and polished slices reveal many densely packed chondrules of variable size set in a dark brown groundmass. Largest chondrules up to 10 mm in diameter.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous unequilibrated chondrules, many with porphyritic, igneous-zoned olivines and pyroxenes. Apparent mean chondrule size $850 \pm 450 \mu\text{m}$ (in microprobe section), $n=25$. A few very fine-grained plagioclase grains were observed. Fe-Ni metal, troilite, and chromite are present.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{24.2 \pm 8.3}$, $\text{Fe/Mn}=63 \pm 25$, $\text{Cr}_2\text{O}_3=0.07 \pm 0.09 \text{ wt\%}$, $n=30$, low-Ca pyroxene $\text{Fs}_{11.1 \pm 8.4}\text{Wo}_{0.5 \pm 0.3}$, $\text{Fe/Mn}=20 \pm 12$, $n=12$.

Classification: Ordinary chondrite LL3, estimated type 3.4 based on mean values and 1-sigma of Fa and Fs.

Specimens: 31.47 g including a probe mount on deposit at *UNM*, Aerolite Meteorites holds the main mass.

Northwest Africa 10256 (NWA 10256)

(Northwest Africa)

Purchased: 2015 Feb

Classification: Carbonaceous chondrite (CR2)

History: Purchased by Aerolite Meteorites

Physical characteristics: Six identical appearing pieces with smooth abraded fusion crust. A saw cut reveals many distinct chondrules of variable size set in a dark-gray groundmass. Largest chondrule up to 3 mm in diameter; a few, very small CAIs are visible in the hand specimen.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous unequilibrated chondrules, many porphyritic, some with irregular shapes. Apparent mean chondrule size $625 \pm 325 \mu\text{m}$ (in microprobe section), $n=18$. Fine grained matrix with abundant, finely disseminated metal and sulfide makes up approximately 40% of this meteorite.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{5.4 \pm 3.6}$, $\text{Fe/Mn}=55 \pm 30$, $\text{Cr}_2\text{O}_3=0.10 \pm 0.06 \text{ wt\%}$, $n=21$, low-Ca pyroxene $\text{Fs}_{3.3 \pm 5.0}\text{Wo}_{1.6 \pm 1.4}$, $\text{Fe/Mn}=19 \pm 13$, $n=9$.

Classification: Carbonaceous chondrite CR2.

Specimens: 25.82 g including a probe mount on deposit at *UNM*, Aerolite Meteorites holds the main mass.

Northwest Africa 10257 (NWA 10257)

(Northwest Africa)

Purchased: 2014

Classification: Ordinary chondrite (L4)

History: Purchased by Aerolite Meteorites

Physical characteristics: Single stone. A saw cut reveals numerous chondrules and fine-grained metal throughout, set in a brown groundmass.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows distinct chondrules, many with mesostasis or fine-grained plagioclase. Many iron oxide veinlets observed. Cl-rich apatite present.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{26.4 \pm 0.5}$, $\text{Fe/Mn}=51 \pm 2$, $n=8$; low-Ca pyroxene $\text{Fs}_{22.2 \pm 0.4}\text{Wo}_{0.9 \pm 0.1}$, $\text{Fe/Mn}=30 \pm 1$, $n=6$.

Classification: Ordinary chondrite (L4).

Specimens: 32.96 g including a probe mount on deposit at *UNM*, Aerolite Meteorites holds the main mass.

Northwest Africa 10258 (NWA 10258)

(Northwest Africa)

Purchased: 2015

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Steve Arnold from Morocco, 2015.

Physical characteristics: Single stone, dark irregular surface, no fusion crust. A saw cut reveals numerous light-colored clasts set in a dark groundmass.

Petrography: (C. Agee, *UNM*) This meteorite is mixture of a fine-grained cataclastic domains, fragmental plagioclase and pyroxene crystals, fragmental anorthosite clasts, and shock melt veins; some of the veins have ~200 μm -size vesicles. Accessory troilite, ilmenite, and chromite were observed.

Geochemistry: (C. Agee and N. Muttik, *UNM*) olivine $\text{Fa}_{37.9\pm1.3}$, $\text{Fe/Mn}=98\pm7$, $n=6$; pigeonite $\text{Fs}_{38.9\pm13.7}\text{Wo}_{11.5\pm6.0}$, $\text{Fe/Mn}=62\pm10$, $n=5$; augite $\text{Fs}_{22.7}\text{Wo}_{40.0}$, $\text{Fe/Mn}=57\pm5$, $n=1$; plagioclase $\text{An}_{96.2\pm0.5}$, $n=3$; Shock melt (20 μm defocused electron beam, proxy for bulk meteorite composition): $\text{SiO}_2=46.3\pm1.8$, $\text{TiO}_2=0.44\pm0.18$, $\text{Al}_2\text{O}_3=26.9\pm5.3$, $\text{Cr}_2\text{O}_3=0.014\pm0.10$, $\text{MgO}=5.6\pm2.7$, $\text{FeO}=6.4\pm3.2$, $\text{MnO}=0.08\pm0.05$, $\text{CaO}=14.4\pm2.0$, $\text{NiO}=0.03\pm0.03$, $\text{Na}_2\text{O}=0.54\pm0.24$, $\text{K}_2\text{O}=0.14\pm0.07$ (all wt%), $\text{MgO}+\text{FeO}=12.1\pm5.5$ (wt%), $n=11$.

Classification: Lunar (feldspathic breccia)

Specimens: 11.7 g including a probe mount on deposit at *UNM*, Steve Arnold holds the main mass.

Northwest Africa 10259 (NWA 10259)

(Northwest Africa)

Purchased: 2015

Classification: HED achondrite (Howardite)

History: Purchased by Steve Arnold in Morocco, 2015.

Physical characteristics: Single stone with fusion crust, a broken surface shows many light-colored fragmental clasts, some up to 1-cm, set in a darker-gray groundmass.

Petrography: (C. Agee, *UNM*) This howardite consists of three lithologies, one is an equilibrated basaltic eucrite (~50%), the second is a cumulate eucrite (~20%), and the third is a diogenite (~30%). Accessory phases include Fe-metal with very low nickel content, ilmenite, troilite, and silica.

Geochemistry: (C. Agee and N. Muttik, *UNM*) basaltic eucrite low-Ca pyroxene $\text{Fs}_{60.4\pm2.4}\text{Wo}_{3.0\pm1.6}$, $\text{Fe/Mn}=31\pm2$, $n=4$; basaltic eucrite augite $\text{Fs}_{29.8\pm4.5}\text{Wo}_{41.8\pm2.6}$, $\text{Fe/Mn}=33\pm0$, $n=2$; cumulate eucrite low-Ca pyroxene $\text{Fs}_{41.4\pm5.1}\text{Wo}_{4.3\pm2.5}$, $\text{Fe/Mn}=32\pm2$, $n=3$; diogenite low-Ca pyroxene $\text{Fs}_{27.5\pm1.3}\text{Wo}_{2.7\pm0.5}$, $\text{Fe/Mn}=28\pm1$, $n=3$; plagioclase $\text{An}_{90.0\pm1.2}$, $n=5$.

Classification: Howardite

Specimens: 13.1 g including a probe mount on deposit at *UNM*, Steve Arnold holds

Northwest Africa 10260 (NWA 10260)

(Northwest Africa)

Purchased: 2015

Classification: Ordinary chondrite (LL4)

History: Purchased by Steve Arnold from Morocco, 2015.

Physical characteristics: Single stone with smooth dark fusion crust. Saw cuts show a brecciated interior, some domains with orange brown staining, while other domains are light colored.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows some large distinct chondrules, plagioclase is very fine-grained. Kamacite, taenite, augite, chromite, and Cl-apatite observed.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{30.4\pm2.3}$, $\text{Fe/Mn}=61\pm5$, $n=8$; low-Ca pyroxene $\text{Fs}_{24.6\pm1.0}\text{Wo}_{2.1\pm1.2}$, $\text{Fe/Mn}=36\pm2$, $n=5$.

Classification: Ordinary chondrite (LL4)

Specimens: 23.7 g including a probe mount on deposit at *UNM*, Steve Arnold holds the main mass

Northwest Africa 10262 (NWA 10262)

(Northwest Africa)

Purchased: 2015 Jun 25

Classification: HED achondrite (Howardite)

History: Purchased by Hans Fex from Ruben Garcia who acquired the meteorite from Morocco, 2015.

Physical characteristics: Single stone, no fusion crust. A cut surface shows a dark-gray interior with a few scattered white clasts.

Petrography: (C. Agee, *UNM*) This howardite consist of two main lithologies, an unequilibrated eucrite with zoned pyroxene (~50%), and a diogenite (~50%). Accessory phases include chromite, silica, and olivine.

Geochemistry: (C. Agee and N. Muttik, *UNM*) unequilibrated eucrite low-Ca pyroxene $\text{Fs}_{43.2\pm8.5}\text{Wo}_{6.0\pm5.4}$, $\text{Fe/Mn}=30\pm3$, $n=4$, augite $\text{Fs}_{18.9}\text{Wo}_{42.6}$, $\text{Fe/Mn}=28$, $n=1$; and minor olivine $\text{Fa}_{32.4}$ $n=1$; diogenite low-Ca pyroxene $\text{Fs}_{24.7\pm3.7}\text{Wo}_{2.0\pm0.4}$, $\text{Fe/Mn}=31\pm2$, $n=6$; plagioclase $\text{An}_{86.9\pm1.6}$, $n=4$.

Classification: Howardite, ~50% eucrite, ~50% diogenite.

Specimens: 20.98 g including a probe mount on deposit at *UNM*, Hans Fex holds the main mass.

Northwest Africa 10263 (NWA 10263)

Mauritania

Purchased: 2015 May

Classification: Lunar meteorite (feldspathic breccia)

History: Two identical stones found together in Mauritania were purchased by Darryl Pitt in May 2015 from a dealer in Zagora, Morocco.

Physical characteristics: No fusion crust is evident. The interior of each stone consists of white to light gray clasts set in a dark gray matrix.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia composed of angular mineral clasts of anorthite, pigeonite, olivine, orthopyroxene, subcalcic augite, augite, fayalite, silica polymorph, ilmenite, kamacite, rare zircon and rare taenite in a finer grained matrix.

Geochemistry: Olivine ($\text{Fa}_{32.6-33.8}$, $\text{FeO/MnO} = 87-102$, $N = 3$), orthopyroxene ($\text{Fs}_{26.1}\text{Wo}_{4.0}$, $\text{FeO/MnO} = 53$), pigeonite ($\text{Fs}_{27.5-41.8}\text{Wo}_{11.2-11.4}$, $\text{FeO/MnO} = 55-59$; $\text{Fs}_{61.8}\text{Wo}_{21.0}$, $\text{FeO/MnO} = 68$; $N = 3$), subcalcic augite ($\text{Fs}_{41.5-51.7}\text{Wo}_{30.9-32.6}$, $\text{FeO/MnO} = 64$, $N = 2$), fayalite ($\text{Fa}_{93.6}$, $\text{FeO/MnO} = 84$), plagioclase ($\text{An}_{93.2-94.8}\text{Or}_{0.2-0.5}$, $N = 3$). Bulk composition (R. Korotev, *WUSL*)

INAA of subsamples gave the following mean abundances (in wt.%) FeO 11.6, Na₂O 0.43; (in ppm) Sc 23.4, La 8.7, Sm 4.0, Eu 0.91, Yb 2.7, Lu 0.40, Th 1.3.

Classification: Lunar (feldspathic fragmental breccia).

Specimens: 20.65 g including one polished endcut at *UWB*; main mass with *DPitt*.

Northwest Africa 10265 (NWA 10265)

(Northwest Africa)

Purchased: 2015

Classification: Primitive achondrite (Lodranite)

History: Seven identical stones were purchased by Adam Aaronson in Temara, Morocco over the period May to August 2015.

Physical characteristics: No fusion crust is evident. The interior of each stone consists of large grains of distinctly green pyroxene and yellow-brown olivine with subordinate stained metal.

Petrography: (A. Irving and S. Kuehner, *UWS*) Coarse grained (up to 6.5 mm) protogranular aggregate of predominantly clinopyroxene (finely exsolved) and olivine with accessory chromite (red-brown in thin section), Ni-poor kamacite and troilite.

Geochemistry: Olivine (Fa_{11.0-11.2}, FeO/MnO = 33-36, N = 4), clinopyroxene host (Fs_{4.1-4.6}Wo_{42.7-44.0}, FeO/MnO = 12, Cr₂O₃ = 1.1-1.3 wt.%, N = 4), orthopyroxene exsolution lamellae (Fs_{9.7-10.6}Wo_{0.9-2.3}, FeO/MnO = 18-24, N = 4).

Classification: Lodranite (wehrlitic).

Specimens: 20.1 g including one polished thin section at *UWB*; main masses with *Aaronson*.

Northwest Africa 10266 (NWA 10266)

(Northwest Africa)

Purchased: 2014 Oct

Classification: Ordinary chondrite (H5)

History: Purchased by Adam Aaronson in Rissani, Morocco, in October 2014.

Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules are present.

Geochemistry: Olivine (Fa_{18.7-18.8}, N = 3), orthopyroxene (Fs_{15.9-17.3}Wo_{1.0-1.7}, N = 2), clinopyroxene (Fs_{5.5-5.7}Wo_{45.6-45.3}, N = 2).

Classification: Ordinary chondrite (H5).

Specimens: 20.1 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 10270 (NWA 10270)

(Northwest Africa)

Purchased: 2014 Mar

Classification: Ordinary chondrite (L4/5)

History: Purchased by John Higgins in March 2014 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules (up to 2.2 mm) occur in a recrystallized matrix containing holly-leaf shaped grains of stained metal.

Geochemistry: Olivine (Fa_{25.1-25.2}, N = 3), orthopyroxene (Fs_{20.1-20.2}Wo_{2.4-2.0}, N = 3), clinopyroxene (Fs_{8.1-8.3}Wo_{43.4-43.3}, N = 2).

Classification: Ordinary chondrite (L4/5).

Specimens: 13.28 g including one polished thin section at *UWB*; main masses with Mr. J. Higgins.

Northwest Africa 10271 (NWA 10271)

(Northwest Africa)

Purchased: 2014 Feb

Classification: Enstatite achondrite

History: Purchased by Dr. David Gregory in February 2014 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Aggregate of ~54 vol.% enstatite and ~45 vol.% kamacite with accessory daubreelite, schreibersite and diopside, plus rare heideite and perryite.

Geochemistry: Enstatite ($\text{Fs}_{0.1-0.4}\text{Wo}_{0.4-0.3}$, $N = 3$), kamacite (mean of 3 in wt. %: Ni 5.8, Co 0.4, Si 1.9, P 0.2).

Classification: Enstatite achondrite (metal-rich). This specimen is much too metal-rich to be regarded as an aubrite.

Specimens: The entire specimen including a polished probe mount is at *ROM*.

Northwest Africa 10272 (NWA 10272)

(Northwest Africa)

Purchased: 2015 May

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Pierre-Marie Pelé and Fabien Kuntz in May 2015 from a dealer in Agadir, Morocco.

Physical characteristics: No fusion crust is evident. The interior consists of white to light-gray clasts set in a dark-gray matrix.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia composed of angular mineral clasts of calcic plagioclase, pigeonite, olivine, orthopyroxene, subcalcic augite, augite, fayalite, silica polymorph, Ti-Cr-rich spinel, Al-Ti-chromite, ilmenite, rare baddeleyite and rare troilite in a finer grained matrix.

Geochemistry: Olivine ($\text{Fa}_{18.5-35.8}$, $\text{FeO/MnO} = 90-109$, $N = 3$), orthopyroxene ($\text{Fs}_{44.9}\text{Wo}_{1.8}$, $\text{FeO/MnO} = 70$), pigeonite ($\text{Fs}_{30.3}\text{Wo}_{5.7}$; $\text{Fs}_{25.8}\text{Wo}_{12.1}$; $\text{FeO/MnO} = 55-54$), subcalcic augite ($\text{Fs}_{56.5}\text{Wo}_{25.1}$, $\text{FeO/MnO} = 65$), augite ($\text{Fs}_{18.0}\text{Wo}_{37.1}$, $\text{FeO/MnO} = 56$), fayalite ($\text{Fa}_{95.6}$, $\text{FeO/MnO} = 96$), plagioclase ($\text{An}_{88.0-96.9}\text{Or}_{0.5-0.2}$, $N = 3$).

Classification: Lunar (feldspathic breccia).

Specimens: 15.15 g including one polished endcut at *PSF*; main mass is held jointly by Mr. P. Pelé and Kuntz.

Northwest Africa 10273 (NWA 10273)

(Northwest Africa)

Purchased: 2013 Sep

Classification: Carbonaceous chondrite (CK4)

History: Purchased by Dr. David Gregory in September 2013 from a Moroccan dealer at the Denver Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, separated chondrules (apparent diameter up to 2.9 mm) containing Cr-magnetite plus fine-grained amoeboid CAI are set in a dark matrix.

Geochemistry: Olivine ($\text{Fa}_{30.8-30.9}$, $N = 3$), orthopyroxene ($\text{Fs}_{24.6-25.3}\text{Wo}_{0.5-1.1}$, $N = 3$), subcalcic augite ($\text{Fs}_{13.7}\text{Wo}_{33.0}$), augite ($\text{Fs}_{10.7}\text{Wo}_{47.4}$).

Classification: Carbonaceous chondrite (CK4).

Specimens: 21 g plus a polished thin section at *ROM*; the remainder is held by *Gregory*.

Northwest Africa 10274 (NWA 10274)

(Northwest Africa)

Purchased: 2014 Apr

Classification: Ordinary chondrite (L5)

History: Purchased by John Higgins in April 2014 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules are present. Crosscutting, fine-grained shock zones are composed of comminuted fragments in a dark matrix.

Geochemistry: Olivine ($\text{Fa}_{25.6-25.8}$, $N = 3$), orthopyroxene ($\text{Fa}_{20.4-20.5}\text{Wo}_{1.3-1.0}$, $N = 3$), clinopyroxene ($\text{Fs}_{7.2-7.3}\text{Wo}_{44.9-45.1}$, $N = 2$).

Classification: Ordinary chondrite (L5).

Specimens: 20.1 g including a polished thin section at *UWB*; the remainder is held by Mr. J. Higgins.

Northwest Africa 10275 (NWA 10275)

(Northwest Africa)

Purchased: 2014 Sep

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Dr. David Gregory in September 2014 from a Moroccan dealer at the Denver Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, separated chondrules (apparent diameter up to 3.8 mm), some with multiple concentric dust rims, plus fine-grained CAI (up to 1.2 mm across) are set in a reddish-brown matrix (~40 vol.%).

Geochemistry: Olivine ($\text{Fa}_{2.0-43.3}$, $N = 3$), orthopyroxene ($\text{Fs}_{0.8-23.3}\text{Wo}_{1.0-4.2}$, $N = 3$), clinopyroxene ($\text{Fs}_{0.9-17.7}\text{Wo}_{33.5-37.9}$, $N = 2$). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ -4.594, -8.405, -4.024; $\delta^{18}\text{O}$ -0.493, -4.391, -0.001; $\Delta^{17}\text{O}$ -4.334, -6.087, -4.023 per mil.

Classification: Carbonaceous chondrite (CV3).

Specimens: The entire specimen including a polished thin section is reposited at *ROM*.

Northwest Africa 10276 (NWA 10276)

(Northwest Africa)

Purchased: 2014 Sep

Classification: Carbonaceous chondrite (CK3)

History: Purchased by Dr. David Gregory in September 2014 from a Moroccan dealer at the Denver Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, separated chondrules (apparent diameter up to 2.8 mm) containing Cr-magnetite plus fine-grained elongate CAI (up to 8 mm) are set in a dark matrix.

Geochemistry: Olivine ($\text{Fa}_{0.8-29.8}$, $N = 3$), orthopyroxene ($\text{Fs}_{4.0-24.4}\text{Wo}_{0.8-0.9}$, $N = 3$), subcalcic augite ($\text{Fs}_{1.8}\text{Wo}_{27.9}$), augite ($\text{Fs}_{1.6}\text{Wo}_{41.5}$). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ -6.630, -2.962, -4.711; $\delta^{18}\text{O}$ -3.265, 0.895, -1.277; $\Delta^{17}\text{O}$ -4.906, -3.435, -4.037 per mil.

Classification: Carbonaceous chondrite (CK3).

Specimens: The entire specimen including a polished thin section is reposited at *ROM*.

Northwest Africa 10277 (NWA 10277)

(Northwest Africa)

Purchased: 2014 Sep

Classification: HED achondrite (Diogenite)

History: Purchased by Dr. David Gregory in September 2014 from a Moroccan dealer at the Denver Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Aggregate of interlocking grains of orthopyroxene (exhibiting significant preferred orientation of prismatic habit) with minor olivine, chromite, troilite, and rare clinopyroxene and Ni-free metal.

Geochemistry: Orthopyroxene ($\text{Fs}_{22.4-24.3}\text{Wo}_{1.6-3.1}$, $\text{FeO/MnO} = 27-32$, $N = 3$), olivine ($\text{Fa}_{24.9-27.6}$, $\text{FeO/MnO} = 41-45$, $N = 3$), clinopyroxene ($\text{Fs}_{13.5}\text{Wo}_{39.1}$, $\text{FeO/MnO} = 23$).

Classification: Diogenite.

Specimens: 7 g plus a polished thin section at *ROM*; the remainder is held by *Gregory*.

Northwest Africa 10278 (NWA 10278)

(Northwest Africa)

Purchased: 2014 Sep

Classification: Carbonaceous chondrite (CK3)

History: Purchased by Dr. David Gregory in September 2014 from a Moroccan dealer at the Denver Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, separated chondrules (apparent diameter up to 3.5 mm) containing Cr-magnetite plus fine-grained amoeboid CAI are set in a deep brown, turbid matrix.

Geochemistry: Olivine ($\text{Fa}_{1.4-44.3}$, $N = 3$), orthopyroxene ($\text{Fs}_{0.8}\text{Wo}_{5.0}$; $\text{Fs}_{11.5}\text{Wo}_{1.0}$, $N = 2$), subcalcic augite ($\text{Fs}_{4.3}\text{Wo}_{26.8}$), diopside ($\text{Fs}_{1.9-2.2}\text{Wo}_{50.4-59.0}$, $N = 2$). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}\text{O}$ -5.487, -6.781, -12.996; $\delta^{18}\text{O}$ -1.735, -3.623, -9.745; $\Delta^{17}\text{O}$ -4.571, -4.868, -7.851 per mil.

Classification: Carbonaceous chondrite (CK3).

Specimens: The entire specimen including a polished thin section is reposited at *ROM*.

Northwest Africa 10279 (NWA 10279)

(Northwest Africa)

Purchased: 2014 Feb

Classification: Ordinary chondrite (L5)

History: Purchased by Bob Falls in February 2014 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules are present within a recrystallized matrix containing stained metal.

Geochemistry: Olivine ($\text{Fa}_{25.3-25.9}$, $N = 3$), orthopyroxene ($\text{Fa}_{20.6-21.4}\text{Wo}_{1.5-1.3}$, $N = 3$), clinopyroxene ($\text{Fs}_{7.7-7.8}\text{Wo}_{44.3-44.7}$, $N = 2$).

Classification: Ordinary chondrite (L5).

Specimens: 26.9 g including a polished thin section at *UWB*; the remainder is held by Mr. R. Falls.

Northwest Africa 10280 (NWA 10280)

(Northwest Africa)

Purchased: 2014 Feb

Classification: Ordinary chondrite (LL6)

History: Purchased by Bob Falls in February 2014 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of indistinct recrystallized clasts containing some relict, relatively large chondrules.

Geochemistry: Olivine ($\text{Fa}_{30.1-30.4}$, $N = 3$), orthopyroxene ($\text{Fa}_{23.9-24.6}\text{Wo}_{2.1-2.3}$, $N = 3$), clinopyroxene ($\text{Fs}_{10.3-11.42}\text{Wo}_{436.5-42.0}$, $N = 2$).

Classification: Ordinary chondrite (LL6 breccia).

Specimens: 29.8 g including a polished thin section at *UWB*; the remainder is held by Mr. R. Falls.

Northwest Africa 10281 (NWA 10281)

(Northwest Africa)

Purchased: 2015 Jun

Classification: Martian meteorite (Shergottite)

History: Purchased by Darryl Pitt in June 2015 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Intersertal texture. Composed predominantly of patchily-zoned clinopyroxene and maskelynite with accessory Cr-ulvöspinel, ilmenite, pyrrhotite and rare chlorapatite.

Geochemistry: High-Ca pyroxene ($\text{Fs}_{21.5-39.3}\text{Wo}_{35.3-26.2}$, $\text{FeO/MnO} = 27-36$, $N = 4$), low-Ca pyroxene ($\text{Fs}_{45.6-53.4}\text{Wo}_{9.5-12.2}$, $\text{FeO/MnO} = 33-37$, $N = 4$), maskelynite ($\text{An}_{50.9-56.3}\text{Or}_{1.8-1.0}$, $N = 3$).

Classification: Martian (shergottite, intersertal).

Specimens: 22.5 g including a polished thin section at *UWB*; the remainder is held by *DPitt*.

Northwest Africa 10282 (NWA 10282)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (H4/5)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005 and subsequently donated to the Planetary Studies Foundation.

Petrography: (A. Irving and S. Kuehner, *UWS*) Some well-formed chondrules (apparent diameter up to 1.9 mm) and relatively abundant stained metal.

Geochemistry: Olivine ($\text{Fa}_{18.8-19.8}$, $N = 3$), orthopyroxene ($\text{Fs}_{16.8-17.4}\text{Wo}_{1.4-1.2}$, $N = 3$), augite ($\text{Fs}_{6.4-8.1}\text{Wo}_{46.2-44.0}$, $N = 2$).

Classification: Ordinary chondrite (H4/5).

Specimens: The entire specimen plus one polished thin section made from it are repositied at *PSF*.

Northwest Africa 10283 (NWA 10283)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L3-6)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005 and subsequently donated to *PSF*.

Petrography: (A. Irving and S. Kuehner, *UWS*) Distinct chondrules (apparent diameter up to 1.9 mm) are present, but also related type 5 and type 6 recrystallized clasts.

Geochemistry: Olivine ($\text{Fa}_{4.1-31.0}$, Cr_2O_3 in ferroan examples 0.04-0.06 wt.%, $N = 7$), orthopyroxene ($\text{Fs}_{4.6-20.6}\text{Wo}_{0.5-0.8}$, $N = 3$), augite ($\text{Fs}_{8.1-8.2}\text{Wo}_{45.1-44.3}$, $N = 2$).

Classification: Ordinary chondrite (L3-6 breccia).

Specimens: The entire specimen plus one polished thin section made from it are reposited at *PSF*.

Northwest Africa 10284 (NWA 10284)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L3)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005 and subsequently donated to the Planetary Studies Foundation.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (apparent diameter up to 1.5 mm; one 4 mm).

Geochemistry: Olivine ($\text{Fa}_{14.1-25.3}$, Cr_2O_3 in ferroan examples 0.03-0.08 wt.%, $N = 7$), orthopyroxene ($\text{Fs}_{3.8-6.9}\text{Wo}_{0.4-0.5}$; $\text{Fs}_{21.5}\text{Wo}_{3.3}$, $N = 3$), augite ($\text{Fs}_{8.6}\text{Wo}_{45.2}$), subcalcic augite ($\text{Fs}_{5.1}\text{Wo}_{34.8}$).

Classification: Ordinary chondrite (L3).

Specimens: The entire specimen plus one polished thin section made from it are reposited at *PSF*.

Northwest Africa 10285 (NWA 10285)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L4)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005 and subsequently donated to the Planetary Studies Foundation.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (apparent diameter up to 2.1 mm) are set in a relatively coarse grained matrix.

Geochemistry: Olivine ($\text{Fa}_{24.7-24.9}$, $N = 3$), orthopyroxene ($\text{Fs}_{21.2-21.5}\text{Wo}_{1.6-1.5}$, $N = 3$), augite ($\text{Fs}_{7.4-8.0}\text{Wo}_{46.8-45.4}$, $N = 2$).

Classification: Ordinary chondrite (L4).

Specimens: The entire specimen plus one polished thin section made from it are reposited at *PSF*.

Northwest Africa 10287 (NWA 10287)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (H/L5)

History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005 and subsequently donated to the *PSF*.

Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules (apparent diameter up to 2.1 mm). Most metal is fresh with only minor staining.

Geochemistry: Olivine (Fa_{21.7-21.9}, N = 3), orthopyroxene (Fs_{18.4-19.1}Wo_{1.3-1.4}, N = 3), augite (Fs_{6.2-6.3}Wo_{46.2-46.8}, N = 2).

Classification: Ordinary chondrite (H/L5). The H/L classification is based primarily on the intermediate olivine composition (almost identical to that for Haxtun), but is also consistent with the intermediate magnetic susceptibility value for such a fresh specimen.

Specimens: The entire specimen plus one polished thin section made from it are reposit at *PSF*.

Northwest Africa 10288 (NWA 10288)

(Northwest Africa)

Purchased: 2015 Jun

Classification: Ordinary chondrite (L4, melt breccia)

History: Purchased by Marcin Cimale in June 2015 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Equilibrated clasts containing well-formed chondrules are present within a darker, finer grained matrix containing blebs and shreds of metal and troilite. Clasts have shock stage S2.

Geochemistry: Mineral composition in equilibrated clasts: olivine (Fa_{24.9-25.0}, N = 3), orthopyroxene (Fs_{20.2-20.6}Wo_{1.5-1.4}, N = 3), augite (Fs_{7.9-10.5}Wo_{45.1-41.5}, N = 2).

Classification: Ordinary chondrite (L4 melt breccia).

Specimens: 24.3 g including one polished slice at *PSF*; remainder with Mr. M. Cimale.

Northwest Africa 10289 (NWA 10289)

(Northwest Africa)

Purchased: 2015 May

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Fabien Kuntz in May 2015 from a dealer in Rissani, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (apparent diameter up to 3.1 mm) plus fine-grained amoeboid to ragged CAI are set in a deep brown fine-grained matrix (~40 vol.%).

Geochemistry: Olivine (Fa_{0.3-25.4}, N = 3), orthopyroxene (Fs_{1.4-3.3}Wo_{1.0-0.5}, N = 3), pigeonite (Fs_{29.2}Wo_{8.0}), diopside (Fs_{0.8}Wo_{36.8}; Fs_{0.6}Wo_{49.7}).

Classification: Carbonaceous chondrite (CV3).

Specimens: 21.29 g including one polished thin section at *PSF*; remainder with *Kuntz*.

Northwest Africa 10290 (NWA 10290)

(Northwest Africa)

Purchased: 2015 May

Classification: Ordinary chondrite (L4)

History: Purchased by Fabien Kuntz in May 2015 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Very closely-packed, well-formed chondrules (apparent diameter 0.3-2.5 mm) are set in a very sparse matrix (~5 vol.%).

Geochemistry: Olivine (Fa_{25.2-25.4}, N = 3), orthopyroxene (Fs_{19.1-21.3}Wo_{4.5-4.1}, N = 3), augite (Fs_{8.1-9.1}Wo_{41.8-39.6}, N = 2).

Classification: Ordinary chondrite (L4).

Specimens: 25.99 g including one polished thin section at *PSF*; remainder with *Kuntz*.

Northwest Africa 10291 (NWA 10291)

(Northwest Africa)

Purchased: 2015 May

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Fabien Kuntz in May 2015 from a dealer in Erfoud, Morocco.

Physical characteristics: No fusion crust is present on these three small very similar stones. The interior of each one consists of sparse white to beige clasts in a dark gray matrix containing vesicles.

Petrography: (A. Irving and S. Kuehner, *UWS*) Mineral fragments of plagioclase, olivine, orthopyroxene, pigeonite (some exsolved), augite, fayalite, silica polymorph, ilmenite, Ti-chromite and troilite, plus rare intersertal basalt clasts, are set in a finer grained vesicular matrix.

Geochemistry: Olivine ($\text{Fa}_{30.1-33.7}$, $\text{FeO/MnO} = 87-90$, $N = 3$), orthopyroxene ($\text{Fs}_{29.2}\text{Wo}_{3.6}$, $\text{FeO/MnO} = 59$), pigeonite ($\text{Fs}_{26.4}\text{Wo}_{10.3}$, $\text{FeO/MnO} = 61$), augite ($\text{Fs}_{17.9-52.1}\text{Wo}_{38.0-40.0}$, $\text{FeO/MnO} = 43-75$, $N = 2$), clinopyroxene host ($\text{Fs}_{26.9}\text{Wo}_{35.8}$, $\text{FeO/MnO} = 49$), low-Ca pyroxene exsolution lamellae ($\text{Fs}_{44.0}\text{Wo}_{6.5}$, $\text{FeO/MnO} = 63$), fayalite ($\text{Fa}_{71.0}$, $\text{FeO/MnO} = 100$), plagioclase ($\text{An}_{93.6}\text{Or}_{0.1}$; $\text{An}_{61.5}\text{Or}_{2.0}$).

Classification: Lunar (feldspathic regolithic breccia).

Specimens: 2.52 g including a polished slice at *PSF*; remainder with *Kuntz*.

Northwest Africa 10295 (NWA 10295)

(Northwest Africa)

Purchased: 2015 Jan

Classification: Ordinary chondrite (L3)

History: Purchased by Marcin Cimala in Quarzazate, January 2015.

Physical characteristics: Single stone with weathered fusion crust. A saw cut shows many densely packed chondrules set in dark-brown matrix.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous porphyritic chondrules, most with mesostasis or glass. Apparent mean chondrule diameter $514 \pm 324 \mu\text{m}$, $n=28$.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Chondrule olivine $\text{Fa}_{22.1 \pm 11.1}$, $\text{Cr}_2\text{O}_3 = 0.11 \pm 0.20$ (wt%), $n=12$; chondrule low-Ca pyroxene $\text{Fs}_{16.6 \pm 5.8}\text{Wo}_{1.5 \pm 1.3}$, $n=19$.

Classification: Ordinary chondrite (L3), estimated subtype 3.5 based on mean values of Fa and Fs and 1-sigma standard deviation.

Specimens: 24.9 g including a probe mount on deposit at *UNM*, Marcin Cimala holds the main mass.

Northwest Africa 10296 (NWA 10296)

(Northwest Africa)

Purchased: 2015 Jan

Classification: Ordinary chondrite (L3.15)

History: Purchased by Marcin Cimala in Tantan, January 2015.

Physical characteristics: Single stone with weathered exterior. Saw cut shows many densely packed chondrules set in dark-brown matrix.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous porphyritic chondrules, most with mesostasis or glass. Abundant opaque matrix. Apparent mean chondrule diameter $594 \pm 227 \mu\text{m}$, $n=18$.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Chondrule olivine $\text{Fa}_{19.5\pm 10.1}$, $\text{Cr}_2\text{O}_3=0.19\pm 0.17$ (wt%), $n=30$; chondrule low-Ca pyroxene $\text{Fs}_{12.7\pm 8.0}\text{Wo}_{0.5\pm 0.4}$, $n=12$.

Classification: Ordinary chondrite (L3.15), subtype 3.15 based on mean values of Fa and Fs and 1-sigma standard deviation, and on the ferroan olivine mean value of Cr_2O_3 and 1-sigma standard deviation ([Grossman and Brearley, 2005](#)).

Specimens: 22.4 g including a probe mount on deposit at *UNM*, Marcin Cimala holds the main mass.

Northwest Africa 10297 (NWA 10297)

(Northwest Africa)

Purchased: 2015 Jan

Classification: Ordinary chondrite (L3)

History: Purchased by Marcin Cimala in Zagora, January 2015.

Physical characteristics: Single stone with weathered exterior. A saw cut shows many densely packed chondrules set in orange-brown matrix.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous porphyritic chondrules, most with mesostasis or glass. Scattered opaque matrix. Apparent mean chondrule diameter $714\pm 303\text{ }\mu\text{m}$, $n=20$.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Chondrule olivine $\text{Fa}_{22.1\pm 10.4}$, $\text{Cr}_2\text{O}_3=0.05\pm 0.04$ (wt%), $n=30$; chondrule low-Ca pyroxene $\text{Fs}_{19.2\pm 12.9}\text{Wo}_{1.6\pm 1.6}$, $n=12$.

Classification: Ordinary chondrite (L3), estimated subtype L3.5 based on mean value of Fa and 1-sigma standard deviation, and on the ferroan olivine mean value of Cr_2O_3 and 1-sigma standard deviation, similar to [Chainpur](#) L3.4 and [Tieschitz](#) L3.6 ([Grossman and Brearley, 2005](#)).

Specimens: 20.6 g including a probe mount on deposit at *UNM*, Marcin Cimala holds the main mass.

Northwest Africa 10298 (NWA 10298)

(Northwest Africa)

Purchased: 2015 Jan

Classification: Ordinary chondrite (L3.2)

History: Purchased by Marcin Cimala in Quarzazate, January 2015.

Physical characteristics: Single stone with weathered exterior. Saw cut shows many densely packed chondrules set in reddish-brown matrix.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous porphyritic chondrules, most with mesostasis or glass. Abundant opaque matrix. Apparent mean chondrule diameter $731\pm 394\text{ }\mu\text{m}$, $n=29$.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Ferroan chondrule olivine $\text{Fa}_{26.3\pm 13.6}$, $\text{Fe/Mn}=71\pm 37$, $\text{Cr}_2\text{O}_3=0.13\pm 0.07$ (wt%), $n=30$; chondrule low-Ca pyroxene $\text{Fs}_{10.1\pm 7.3}\text{Wo}_{0.6\pm 0.4}$, $n=12$.

Classification: Ordinary chondrite (L3.2), type 3.2 based on mean value of Cr_2O_3 in ferroan chondrule olivine and the 1-sigma standard deviation, similar to Kyrnka L3.2 ([Grossman and Brearley, 2005](#)).

Specimens: 22.5 g including a probe mount on deposit at *UNM*, Marcin Cimala holds the main mass.

Northwest Africa 10299 (NWA 10299)

Northwest Africa

Purchased: 2015 Feb

Classification: Martian meteorite (Shergottite)

History: One stone was purchased from an anonymous Moroccan dealer in Tucson, February, 2015.

Physical characteristics: The meteorite of 339 g has irregular shape, dark-brown spotted surface, and fusion crust is absent.

Petrography: (C.A. Lorenz, *Vernad*) The rock of coarse-grained subophitic texture, consists of an elongated prismatic grains of clinopyroxene (67 vol%, 0.7-3.0 mm) and interstitial prismatic plagioclase grains (23 vol%, 0.3-1.0 mm). Plagioclase is almost completely transformed to maskelinite, but several grains preserved the crystal structure at the grain edges. Pyroxene strongly fractured, twinned, with mosaic extinction. Plagioclase is almost completely maskelynitized. Fine-grained aggregate of silica and feldspar occur in interstitials between clinopyroxene crystals. Melt pockets of glass with bubbles are presented (5 vol%). Accessory phases are fayalite, sulfide, Ti-magnetite, ilmenite, chromite, apatite, baddeleyite. Weathering products are barite and calcite.

Geochemistry: Mineral compositions and geochemistry: (Borisovsky S.E., *IGEM*, EPMA) Pyroxene is $\text{Fs}_{23-79}\text{En}_{9-65}\text{Wo}_{7.4-35}$. The zoned pyroxene typically ranges from cores $\text{Fs}_{27}\text{En}_{33}\text{Wo}_{40}$ to rims $\text{Fs}_{68}\text{En}_{11}\text{Wo}_{19}$. $\text{FeO/MnO} = 34.2 \pm 5.1$. Pigeonite, $\text{Fs}_{54\pm13}\text{En}_{31\pm14}\text{Wo}_{15\pm3}$ (in average, $n=26$); augite $\text{Fs}_{29\pm10}\text{En}_{40\pm8}\text{Wo}_{31\pm4}$ (in average, $n=23$). Plagioclase $\text{An}_{55\pm4}\text{Ab}_{43\pm4}\text{Or}_{2.4\pm1.8}$ (in average, $n=17$) and varies $\text{An}_{48-61}\text{Ab}_{38-51}\text{Or}_{0.9-6.3}$.

Classification: Martian (shergottite). The meteorite is moderately weathered.

Northwest Africa 10300 (NWA 10300)

(Northwest Africa)

Purchased: 2013 Apr

Classification: HED achondrite (Diogenite)

History: Purchased by Darryl Pitt in April 2013 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Matrix-poor breccia composed predominantly of turbid orthopyroxene (exhibiting undulose extinction) with subordinate olivine, chromite and anorthite. Glass with a composition intermediate between those of orthopyroxene and olivine occurs along grain boundaries.

Geochemistry: Orthopyroxene ($\text{Fs}_{25.9-25.7}\text{Wo}_{2.9-3.1}$, $\text{FeO/MnO} = 28-31$, $N = 3$), olivine ($\text{Fa}_{33.0-33.5}$, $\text{FeO/MnO} = 48-51$, $N = 2$).

Classification: Diogenite (breccia, shock-melted).

Specimens: 15.5 g including one polished thin section at *UWB*; main mass with *DPitt*.

Northwest Africa 10301 (NWA 10301)

(Northwest Africa)

Purchased: 2015 Jan

Classification: Ordinary chondrite (H5)

History: Purchased in Temara, Morocco by Adam Aaronson in January 2015.

Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse chondrules are present with a recrystallized matrix containing relatively abundant altered metal, sodic plagioclase and accessory chlorapatite.

Geochemistry: Olivine (Fa_{18.2-18.7}, N = 3), orthopyroxene (Fs_{15.8-16.4}Wo_{0.9-1.3}, N = 3), augite (Fs_{5.2-5.5}Wo_{46.6-45.7}, N = 2).

Classification: Ordinary chondrite (H5)

Specimens: 20.3 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 10302 (NWA 10302)

(Northwest Africa)

Purchased: 2013 Apr

Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Darryl Pitt in April 2013 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Monomict breccia composed of basaltic eucrite clasts in a matrix of related debris. Minerals are calcic plagioclase, exsolved pigeonite, silica polymorph, ilmenite and troilite.

Geochemistry: Orthopyroxene host (Fs_{60.4-62.4}Wo_{3.7-2.6}, FeO/MnO = 30-31, N = 3), clinopyroxene exsolution lamellae (Fs_{26.4-26.5}Wo_{44.2-44.0}, FeO/MnO = 30, N = 2).

Classification: Eucrite (monomict breccia).

Specimens: 20.1 g including one polished thin section at *UWB*; main mass with *DPitt*.

Northwest Africa 10303 (NWA 10303)

(Northwest Africa)

Purchased: 2014 Mar

Classification: Ordinary chondrite (LL3)

History: Purchased by John Higgins in March 2014 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely-packed, well-formed chondrules (apparent diameter 0.2-3.2 mm) set in a sparse, finer grained matrix.

Geochemistry: Olivine (Fa_{0.6-45.0}, Cr₂O₃ in ferroan examples = 0.08-0.11 wt.%, N = 6), orthopyroxene (Fs_{3.5-32.2}Wo_{0.4-1.0}, N = 3), subcalcic augite (Fs_{35.3-35.7}Wo_{35.6-32.7}, N = 2).

Classification: Ordinary chondrite (LL3).

Specimens: 14.7 g including one polished thin section at *UWB*; main mass with Mr. J. Higgins.

Northwest Africa 10304 (NWA 10304)

(Northwest Africa)

Purchased: 2013 Apr

Classification: HED achondrite (Eucrite, polymict)

History: Purchased by Darryl Pitt in April 2013 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Composed mainly of debris derived from a gabbroic eucrite lithology (present as sparse lithic clasts) plus minor diagenitic orthopyroxene (associated with olivine). Major minerals are calcic plagioclase (polycrystalline), exsolved pigeonite (some exhibiting red-brown altered cores in thin section), silica polymorph, ilmenite and troilite.

Geochemistry: Diagenitic orthopyroxene (Fs_{29.6}Wo_{2.3}, FeO/MnO = 27), olivine (Fa_{28.4-34.9}, FeO/MnO = 50-51, N = 2), orthopyroxene host (Fs_{59.3-59.5}Wo_{1.5-1.4}, FeO/MnO = 29-30, N = 2), clinopyroxene exsolution lamellae (Fs_{28.6-28.7}Wo_{41.3-41.5}, FeO/MnO = 30-32, N = 2).

Classification: Eucrite (polymict breccia).

Specimens: 8.1 g including one polished thin section at *UWB*; main mass with *DPitt*.

Northwest Africa 10305 (NWA 10305)

(Northwest Africa)

Purchased: 2015 May

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Fabien Kuntz in May 2015 from a dealer in Rissani, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Separated chondrules (apparent diameter up to 3.0 mm, some rimmed) plus fine-grained, irregularly shaped CAI are set in a red-brown matrix (~40 vol.%).

Geochemistry: Olivine ($\text{Fa}_{0.2-39.5}$, $N = 3$), orthopyroxene ($\text{Fs}_{0.9-1.7}\text{Wo}_{0.9-2.0}$, $N = 3$), augite ($\text{Fs}_{0.6}\text{Wo}_{36.8}$; $\text{Fs}_{0.8}\text{Wo}_{43.6}$; $N = 2$).

Classification: Carbonaceous chondrite (CV3).

Specimens: 23.3 g including one polished thin section at *PSF*; remainder with *Kuntz*.

Northwest Africa 10306 (NWA 10306)

(Northwest Africa)

Purchased: 2015 May

Classification: Ordinary chondrite (LL3)

History: Purchased by Fabien Kuntz in May 2015 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, well-formed chondrules (apparent diameter 0.4-3.8 mm) occur in a finer-grained matrix (~10 vol.%).

Geochemistry: Olivine ($\text{Fa}_{0.4-45.3}$, Cr_2O_3 in ferroan examples 0.02-0.19 wt.%, $N = 7$), orthopyroxene ($\text{Fs}_{0.8-29.7}\text{Wo}_{0.6-1.2}$, $N = 3$), augite ($\text{Fs}_{5.2}\text{Wo}_{38.8}$, subcalcic augite ($\text{Fs}_{12.0}\text{Wo}_{29.3}$). Magnetic susceptibility $\log \chi = 4.15$ (χ in 10^{-9} m³/kg).

Classification: Ordinary chondrite (LL3).

Specimens: 22.83 g including one polished thin section at *PSF*; remainder with *Kuntz*.

Northwest Africa 10307 (NWA 10307)

(Northwest Africa)

Purchased: 2015 May

Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Fabien Kuntz in May 2015 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh fragmental breccia containing some ophitic eucrite clasts (one large clast measures 1.7 cm $\times$ 1.5 cm), but mostly composed of related mineral fragments (predominantly calcic plagioclase and exsolved pigeonite). Accessory minerals include silica polymorph, Ti-chromite, ilmenite, troilite and zircon.

Geochemistry: Low-Ca pyroxene host ($\text{Fs}_{55.3}\text{Wo}_{6.6}$, $\text{FeO/MnO} = 32$, $N = 1$), augite exsolution lamella ($\text{Fs}_{29.3}\text{Wo}_{39.6}$, $\text{FeO/MnO} = 32$, $N = 1$), augite host ($\text{Fs}_{29.2}\text{Wo}_{40.0}$, $\text{FeO/MnO} = 29$, $N = 1$), low-Ca pyroxene exsolution lamella ($\text{Fs}_{57.3}\text{Wo}_{6.2}$, $\text{FeO/MnO} = 29$, $N = 1$), pigeonite ($\text{Fs}_{55.9}\text{Wo}_{7.4}$, $\text{FeO/MnO} = 31$, $N = 1$), augite ($\text{Fs}_{33.6}\text{Wo}_{37.6}$, $\text{FeO/MnO} = 38$, $N = 1$).

Classification: Eucrite (monomict breccia).

Specimens: 17.17 g including one polished thin section at *PSF*; remainder with *Kuntz*.

Northwest Africa 10308 (NWA 10308)

(Northwest Africa)

Purchased: 2015 May

Classification: Carbonaceous chondrite (CO3)

History: Purchased by Fabien Kuntz in May 2015 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Small chondrules (apparent diameter up to 0.9 mm), angular mineral fragments and small CAI are set in a red-brown matrix (~40 vol.%).

Geochemistry: Olivine ($\text{Fa}_{0.4-52.9}$, Cr_2O_3 in ferroan examples 0.02-0.10 wt.%, $N = 6$), orthopyroxene ($\text{Fs}_{0.7-8.8}\text{Wo}_{3.3-2.2}$, $N = 3$), augite ($\text{Fs}_{0.9}\text{Wo}_{37.1}$; $\text{Fs}_{1.4}\text{Wo}_{49.1}$; $N = 2$).

Classification: Carbonaceous chondrite (CO3).

Specimens: 6.12 g including one polished thin section at *PSF*; remainder with *Kuntz*.

Northwest Africa 10309 (NWA 10309)

(Northwest Africa)

Purchased: 2015 Aug

Classification: Lunar meteorite (feldspathic breccia)

History: A group of similar stones (total weight 16518 g, the largest weighing 6404 g) were found together at an undisclosed location in Mauritania, and were purchased by Darryl Pitt in August 2015 from a dealer in Mauritania.

Physical characteristics: All pieces lack fusion crust but the exteriors exhibit a thin desert patina. Interiors consist of angular white clasts (up to 1.5 cm across, some with minor red-brown staining) set within a fine grained, medium-gray matrix.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of angular mineral clasts of anorthite, pigeonite (some exsolved), orthopyroxene, subcalcic augite, olivine, chromite (both Ti-rich and Ti-poor varieties) in a finer grained, partly vesicular matrix containing kamacite, troilite and Ni-poor taenite.

Geochemistry: Olivine ($\text{Fa}_{8.6-54.3}$, $\text{FeO/MnO} = 82-96$, $N = 4$), orthopyroxene ($\text{Fs}_{18.7}\text{Wo}_{2.8}$, $\text{FeO/MnO} = 56$), subcalcic augite ($\text{Fs}_{18.1}\text{Wo}_{31.8}$, $\text{FeO/MnO} = 60$), low-Ca pyroxene host ($\text{Fs}_{50.4}\text{Wo}_{6.1}$, $\text{FeO/MnO} = 63$), augite exsolution lamellae ($\text{Fs}_{24.2}\text{Wo}_{41.4}$, $\text{FeO/MnO} = 50$), plagioclase ($\text{An}_{95.8-96.1}\text{Or}_{0.2}$, $N = 2$).

Classification: Lunar (feldspathic regolithic breccia).

Specimens: 22.16 g including one polished thin section at *UWB*; main mass with *DPitt*.

Northwest Africa 10310 (NWA 10310)

(Northwest Africa)

Purchased: April 2013

Classification: Ordinary chondrite (L6)

History: Purchased on-line as an NWA meteorite originally from a Moroccan dealer by John Shea in April 2013 and a portion subsequently donated to *Cascadia*.

Physical characteristics: Already cut individual with partial fusion crust. Sawed faces show chondritic texture with rust haloes around the metal.

Petrography: (M. Ream and A. Ruzicka, *Cascadia*) Large chondrules in this sample are somewhat readily recognized in thin section with transmitted light, but boundaries are indistinct and matrix is mostly transparent, and feldspar grain size is up to 100 μm across, consistent with petrographic type 6. The mean diameter of the recognizable chondrules ($N = 20$) is 0.9 ± 0.4 mm. Contains about 4% metal + 6% troilite (+ minor weathering products). Olivine grains are mosaicized and most grains display 2 sets of planar fractures indicative of shock stage S4. Chromite-feldspar pods are also present. One unusual ~3-mm- diameter object is concentrically zoned with a fine-grained (10 – 30 μm) core of silica and metal, a mantle of low- and high-Ca

pyroxene, and a ragged, 50 – 100 μm thick rim of feldspar $\pm$ chromite with 5 – 10 μm grains of troilite dispersed evenly throughout the object.

Geochemistry: Olivine, $\text{Fa}_{25.8\pm0.4}$ ($\text{Fa}_{25.4-26.8}$, $N = 12$); low-Ca pyroxene, $\text{Fs}_{21.6\pm0.4}\text{Wo}_{1.8\pm0.3}$ ($\text{Fs}_{21.1-22.5}$, $N = 9$); high-Ca pyroxene, $\text{Fs}_{8.6\pm2.2}\text{Wo}_{45.2\pm2.5}$ ($\text{Wo}_{43.4-46.9}$, $N = 2$); feldspar, $\text{Ab}_{84.8\pm4.2}\text{Or}_{5.9\pm1.4}$ ($\text{Ab}_{81.8-91.1}$, $N = 4$).

Classification: Data are most consistent with an L6 chondrite.

Specimens: *Cascadia* holds 40.4 g, a polished thin section, and potted butt. John Shea holds the main mass.

Northwest Africa 10311 (NWA 10311)

(Northwest Africa)

Purchased: April 2013

Classification: Ordinary chondrite (H5)

History: Purchased online in 2013 by John A. Shea as an NWA meteorite and a portion subsequently donated to *Cascadia*.

Physical characteristics: Already cut piece shows well-developed fusion crust on external surfaces. Cut faces show chondritic texture with high metal content and significant reddish staining.

Petrography: (M. Ream and A. Ruzicka, *Cascadia*) Chondrules can be readily distinguished from the moderately coarse-grained matrix. Mean chondrule diameter is ($N = 29$) 0.8 ± 0.2 mm. Sample contains $\sim 10\%$ metal and $\sim 8\%$ troilite. The olivine is mosaicized and most grains show 2 planar fracture sets, indicating a shock stage S4. Cl-apatite and merrillite (~ 70 – 150 μm) are present. Feldspar grain sizes are typically ~ 50 μm or less.

Geochemistry: Olivine, $\text{Fa}_{19.5\pm0.4}$ ($\text{Fa}_{1.9-20.6}$, $N = 15$); low-Ca pyroxene, $\text{Fs}_{17.1\pm0.3}\text{Wo}_{1.6\pm0.2}$ ($\text{Fs}_{16.8-17.9}\text{Wo}_{1.2-1.9}$, $N = 12$); feldspar $\text{Ab}_{9.6\pm0.6}\text{Or}_{6.2\pm0.5}$ ($\text{Ab}_{78.9-80.2}\text{Or}_{5.9-6.9}$, $N = 4$)

Classification: High metal content and mineral compositions suggests an H chondrite, and feldspar grain sizes suggest a petrologic type 5.

Specimens: *Cascadia* holds 46.2 g and polished thin section. John Shea holds the main mass.

Northwest Africa 10312 (NWA 10312)

(Northwest Africa)

Purchased: 2011 March

Classification: Ordinary chondrite (H5)

History: 86.6 g comprised of 4 pieces and smaller fragments of NWA meteorites were donated to *Cascadia* in April 2014.

Physical characteristics: The largest piece is irregular and shows extensive development of caliche and weathering patina on broken surfaces.

Petrography: (M. Ream and A. Ruzicka, *Cascadia*) Olivine is weakly mosaicized and most grains show 1 – 2 planar fracture sets, indicating shock stage S3. Sample contains $\sim 2.5\%$ each of metal and troilite, with perhaps slightly more troilite than metal, along with weathering products. Mean chondrule diameter is ($N = 36$) 0.7 ± 0.3 mm. Matrix is dark, weathered, and fine grained.

Geochemistry: Olivine, $\text{Fa}_{19.1\pm0.2}$ ($\text{Fa}_{18.8-19.4}$, $N = 12$); low-Ca pyroxene, $\text{Fs}_{17.0\pm0.3}\text{Wo}_{1.2\pm0.2}$ ($\text{Fs}_{16.7-17.3}\text{Wo}_{1.0-1.6}$, $N = 6$).

Classification: H5 chondrite based on mineral chemistry and chondrule integration.

Specimens: *Cascadia* holds three pieces (57.1 g, 4.4 g, 2.5 g), several small fragments, a polished thin section, and a potted butt. Keith Dickson holds the main mass.

Northwest Africa 10313 (NWA 10313)

(Northwest Africa)

Purchased: February 2015

Classification: Ordinary chondrite (L6)

History: Purchased from *Horst* Burkhard in Tuscon in Feb 2015 as an unclassified NWA meteorite, and a portion subsequently donated to *Cascadia*.

Physical characteristics: Partly fusion crusted individual, broken surfaces mostly have dark patina, one cut face shows chondritic texture with metal that locally forms vein-like segments. There are rust haloes surrounding the metal grains. Fusion crust is very thin and reveals underlying chondritic texture.

Petrography: (M. Ream and A. Ruzicka, *Cascadia*) Chondrules are poorly defined and large (diameter 1.5 ± 0.6 mm, $N = 18$) and are set in mostly transparent, coarse matrix, with secondary feldspar grain sizes exceeding 50 μm . Moderate mosaicism and planar fracturing in olivine indicates shock grade S4. Contains ~4-5% metal and ~3% troilite.

Geochemistry: Olivine, $\text{Fa}_{25.5 \pm 0.3}$ ($\text{Fa}_{24.9-26.2}$, $N = 22$); low-Ca pyroxene, $\text{Fs}_{21.7 \pm 0.7}\text{Wo}_{1.6 \pm 0.3}$ ($\text{Fs}_{20.9-24.0}\text{Wo}_{1.1-2.1}$, $N = 27$).

Classification: L6 chondrite based on mineral composition, metal content, and texture, although chondrule size relatively large.

Specimens: *Cascadia* holds a 39.5 g slab, a 3.6 g slice, a 0.5 g slice, a polished thin section, and a potted butt. Art Johnstone holds the main mass.

Northwest Africa 10315 (NWA 10315)

Morocco

Purchased: Feb 2015

Classification: Carbonaceous chondrite (CO3)

Classification: The sample consists of about 60 vol% well-defined chondrule and chondrule fragments and inclusions (aggregates) and about 30-40 vol% of matrix and opaques. The sample has small chondrules and olivine and pyroxene are unequilibrated. All these observations are consistent with a CO3 classification. The olivines show undulatory extinction indicating shock stage S2. The sample is heavily weathered.

Northwest Africa 10317 (NWA 10317)

Morocco

Purchased: 6 Jul 2015

Classification: Lunar meteorite

History: Histroy: The single individual of 11.0 g was found Morocco and purchased in Dakhla, Morocco, July 6, 2015.

Petrography: (A. Bischoff and S. Ebert, *IfP*) Fine-grained breccia consisting of small mineral and lithic clasts of anorthositic rocks, impact melt rocks and breccias, granulitic lithologies, anorthite, olivine, pyroxenes, and opaques embedded in a fine-grained, well-lithified matrix.

Geochemistry: Mineral compositions and geochemistry: Olivine ($\text{Fa}_{34.1 \pm 2.3}$, range: $\text{Fa}_{28.8-36.9}$; mean $\text{Fe/Mn} = 96$, $n = 10$), low-Ca pyroxene ($\text{Fs}_{28.2-69.2}\text{Wo}_{3.8-19.5}$, mean $\text{Fe/Mn} = 46.2$, $n = 5$), Ca-pyroxene ($\text{Fs}_{16.9-63.2}\text{Wo}_{24.8-39.2}$, $\text{Fe/Mn} = 57.4$), plagioclase ($\text{An}_{96.0 \pm 1.5}$; range: $\text{An}_{92.8-97.3}$; $n = 9$)

Classification: Lunar (feldspathic breccia)

Specimens: 2.2 g including one polished thin section at *IfP*; main mass with S. Decker (Meteorite-Museum, 55430 Oberwesel, Germany)

Northwest Africa 10318 (NWA 10318)

Morocco

Purchased: 22 Apr 2015

Classification: Lunar meteorite

History: An individual of 31.0 g was found in Morocco and purchased from a Moroccan meteorite dealer in Dakhla, Morocco, April 22, 2015.

Petrography: (A. Bischoff and S. Ebert, *IfP*) This meteorite is a severely shocked rock with maskelynite (~65-75%), olivine (~10%), and low-Ca pyroxene (~15-20%) as dominant silicate phases. The mafics occur as rounded phases poikilitically enclosed in maskelynite. The shock veins probably formed after the shock that transformed the plagioclase to maskelynite, because they cut through homogenous maskelynite areas. Accessory phases were observed include troilite and chromite.

Geochemistry: Mineral compositions and geochemistry: Olivine $\text{Fa}_{26.4\pm0.6}$, $\text{Fe/Mn}=97$, $n=11$; low-Ca-pyroxene $\text{Fs}_{21.8\pm0.7}\text{Wo}_{5.0\pm2.0}$, $\text{Fe/Mn}=54$, $n=11$; plagioclase $\text{An}_{97.1\pm0.6}$, range: $\text{An}_{96.0-98.2}$ mol% An; $n=10$;

Classification: Achondrite (lunar, granulitic breccia of olivine-bearing anorthositic norite precursor), low weathering grade, high shock stage (S5).

Specimens: A total of 6.2 g including a thin section on deposit at *IfP*. S. Decker (Meteorite-Museum, 55430 Oberwesel, Germany) holds the main mass.

Northwest Africa 10319 (NWA 10319)

Morocco, (Northwest Africa)

Purchased: 2006

Classification: HED achondrite (Eucrite, cumulate)

History: A single stone of 7 g was found by an anonymous finder in Western Sahara and purchased by Romano Serra at the Bologna Mineral Show in 2006.

Physical characteristics: The main mass has no fusion crust.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): A cumulate eucrite consisting of large orthopyroxene crystals, 150-200 μm in width, with minor clinopyroxene and anorthitic plagioclase. Some orthopyroxene crystals display very fine (1-2 μm width) pigeonite exsolution lamellae. Minor phases include ilmenite and chromite.

Geochemistry: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*) Calcic plagioclase $\text{An}_{90.1\pm1}\text{Or}_{0.5\pm0.1}$, $n=7$, pigeonite ($\text{Fs}_{49.8\pm1.6}\text{En}_{34.4\pm5}\text{Wo}_{15.8\pm0.8}$; $n=8$; $\text{Fe/Mn}=34.99\pm0.14$); low-Ca pyroxene ($\text{Fs}_{59.5\pm1.3}\text{En}_{36.7\pm1.4}\text{Wo}_{3.8\pm0.2}$; $n=7$; $\text{Fe/Mn}=36.98\pm0.15$); pigeonite exsolution lamellae in low-Ca pyroxene ($\text{Fs}_{47.1\pm1.6}\text{En}_{33.8\pm1.3}\text{Wo}_{19.1\pm0.8}$; $n=9$; $\text{Fe/Mn}=35.90\pm0.13$). Oxygen isotopes: (I. Franchi, R. Greenwood, *OU*) $\delta^{17}\text{O}=1.84\text{‰}$, $\delta^{18}\text{O}=3.96\text{‰}$, $\Delta^{17}\text{O}=-0.22\text{‰}$.

Classification: Eucrite-cm with low degree of shock and low degree of weathering.

Specimens: A total of 1.4 g specimen and one thin section is on deposit at *MSN-FI*. The main mass is on deposit at *OAM*.

Northwest Africa 10320 (NWA 10320)

Morocco

Purchased: 2006

Classification: HED achondrite (Eucrite, cumulate)

History: A single stone of 73.2 g was found by an anonymous finder in Western Sahara and purchased by Romano Serra at the Bologna Mineral Show in 2006.

Physical characteristics: The main mass has no fusion crust.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): A thin section displays a cumulate eucritic texture consisting of large orthopyroxene crystals, 200-250 μm in width, minor clinopyroxene and anorthitic plagioclase. Orthopyroxene crystals occasionally display fine, 3-5 μm wide pigeonite exsolution lamellae. Minor phases include ilmenite, troilite, chromite, and FeNi metal.

Geochemistry: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*) Calcic plagioclase $\text{An}_{88.7 \pm 1.1} \text{Or}_{0.5 \pm 0.1}$, $n=6$; low-Ca pyroxene ($\text{Fs}_{54.3 \pm 1.3} \text{En}_{43.3 \pm 1.4} \text{Wo}_{2.4 \pm 0.2}$; $n=7$; $\text{Fe/Mn}=47.03 \pm 0.16$); pigeonite ($\text{Fs}_{51.2 \pm 1.2} \text{En}_{40.0 \pm 1.5} \text{Wo}_{8.8 \pm 0.3}$; $n=8$; $\text{Fe/Mn}=34.63 \pm 0.13$); pigeonite exsolution lamellae in orthopyroxene ($\text{Fs}_{40.6 \pm 1.5} \text{En}_{38.1 \pm 1.4} \text{Wo}_{21.3 \pm 0.9}$; $n=8$; $\text{Fe/Mn}=39.41 \pm 0.12$). Oxygen isotopes: (I. Franchi, R. Greenwood, *OU*) $\delta^{17}\text{O} = 1.81\text{‰}$, $\delta^{18}\text{O} = 3.88\text{‰}$, $\Delta^{17}\text{O} = -0.21\text{‰}$.

Classification: Eucrite-cm with low degree of shock and low degree of weathering.

Specimens: A total of 14.6 g specimen and one thin section is on deposit at *MSN-FI*. The main mass is on deposit at *OAM*.

Northwest Africa 10324 (NWA 10324)

Morocco

Purchased: 2015 Mar 10

Classification: Carbonaceous chondrite (CR2)

History: Purchased in Erfoud, Morocco, on 2015 March 3.

Physical characteristics: One partly oriented stone with desert varnish weighing 141.6 g.

Petrography: (C. R. Heckel and J. Zipfel, *Senck*) Two polished sections show a texture of 50-60% chondrules and 30-35% fine-grained matrix. Chondrules range in size from 0.7 to 1.5 mm. They are dominated by type I PO and POP chondrules. Type II chondrules of PO and BO textures are rare. Some chondrules contain clear mesostasis. Up to 10% FeNi is present as rims around or as blebs within type I chondrules. Rare large metal rims also contain chromite inclusions and networks of troilite veins. Sulfide is predominantly present in the fine-grained matrix. Pervasive veins of metal and troilite are almost completely replaced by Fe-oxides.

Geochemistry: Mineral compositions and Geochemistry: EMPA data of Type I chondrules: olivine cores $\text{Fa}_{3.3 \pm 1.3}$, $N=24$, olivine rims $\text{Fa}_{1.7-20.7}$, $N=17$, low Ca-pyroxene $\text{Fs}_{2.9 \pm 0.9} \text{Wo}_{0.7 \pm 0.2}$, $N=23$, high Ca-pyroxene $\text{Fs}_{2.2 \pm 1.0} \text{Wo}_{43.5 \pm 2.6}$, $N=7$, mesostasis $\text{SiO}_2=45-55$, $\text{Al}_2\text{O}_3=16-33$; $\text{CaO}=11-19$ (all in wt.%). Type II chondrules: olivine cores $\text{Fa}_{16.7 \pm 2.5}$, $N=9$, olivine rims $\text{Fa}_{33.7 \pm 3.3}$, $N=6$, mesostasis $\text{SiO}_2=65-67$, $\text{Al}_2\text{O}_3=15-17$; $\text{CaO}=4-5$ (all in wt. %). Oxygen isotopes: (A. Pack, *UGött*) Analyses by laser fluorination gave: $\delta^{17}\text{O} = 1.79$, $\delta^{18}\text{O} = 5.95$, $\Delta^{17}\text{O} = -1.37$ (all per mil) and plot in the CR field.

Classification: Carbonaceous chondrites (CR2), low shock and moderate weathering levels.

Specimens: A total of 21 g is on deposit at *Senck*. The main mass holder is anonymous.

Northwest Africa 10325 (NWA 10325)

(Northwest Africa)

Purchased: 2014

Classification: Ordinary chondrite (L6)

History: Purchased by Aerolite Meteorites

Physical characteristics: Single stone. A saw cut reveals a few faint chondrules set in a dark-brown groundmass.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows a few indistinct chondrules, some coarse-grained plagioclase present. Some iron oxide veinlets observed. Chromite present.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{25.5\pm0.7}$, $\text{Fe/Mn}=49\pm2$, $n=7$; low-Ca pyroxene $\text{Fs}_{21.9\pm0.6}\text{Wo}_{1.1\pm0.3}$, $\text{Fe/Mn}=30\pm2$, $n=6$.

Classification: Ordinary chondrite (L6).

Specimens: 20.2 g including a probe mount on deposit at *UNM*, Aerolite Meteorites holds the main mass.

Northwest Africa 10329 (NWA 10329)

(Northwest Africa)

Purchased: 2015

Classification: HED achondrite (Eucrite, brecciated)

History: The meteorite was purchased by Tomasz Jakubowski from a local meteorite dealer in Zagora, Morocco and donated to *MNB*.

Physical characteristics: One individual completely covered by fusion crust.

Petrography: The meteorite is a breccia composed of basaltic clasts with different mineral grains sizes set into a less abundant clastic matrix. Dominant minerals in clasts and matrix are pyroxene with very fine exsolution lamellae and calcic plagioclase. Minor phases include chromite SiO_2 polymorphs, and troilite.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{51.9\pm7.4}\text{Wo}_{10.6\pm3.4}$ ($\text{Fs}_{36.4-62.1}\text{Wo}_{5-18.9}$, $n=33$, $\text{FeO/MnO}=28-34$); Ca-pyroxene: $\text{Fs}_{33.9\pm6.5}\text{Wo}_{37.8\pm7.4}$ ($\text{Fs}_{29.4-48.8}\text{Wo}_{21-42.9}$, $n=16$, $\text{FeO/MnO}=30-34$); calcic plagioclase: $\text{An}_{83.9\pm1.1}$ ($\text{An}_{80.2-85.8}$, $n=19$)

Northwest Africa 10330 (NWA 10330)

(Northwest Africa)

Purchased: 2015

Classification: Carbonaceous chondrite (CK5)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Three stones partly covered by fusion crust.

Petrography: The meteorite displays a greyish to greenish interior and is composed of several still clearly defined chondrules and rare CAIs set into abundant recrystallized matrix. Ferroan olivine is the most abundant mineral phase; more minor phases include feldspar, Ca-pyroxene and Cr-bearing magnetite.

Northwest Africa 10333 (NWA 10333)

(Northwest Africa)

Purchased: 2015

Classification: HED achondrite (Eucrite)

History: The meteorite was purchased from a local meteorite dealer in Tan Tan, Morocco.

Physical characteristics: Three stones almost completely covered by fusion crust.

Petrography: The meteorite displays a pronounced basaltic texture of dominantly coarse-grained pyroxenes (up to 1.5 mm) and calcic plagioclase (up to 2 mm). Pyroxene is typically exsolved; minor phases include SiO_2 polymorphs, chromite and troilite.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{57.9 \pm 0.8} \text{Wo}_{2.1 \pm 0.7}$ ($\text{Fs}_{59.2-60.1} \text{Wo}_{1.6-4.3}$, $n=19$, $\text{FeO/MnO}=30-33$); Ca-pyroxene: $\text{Fs}_{24.7 \pm 0.5} \text{Wo}_{43.8 \pm 0.5}$ ($\text{Fs}_{23.9-25.6} \text{Wo}_{42.8-44.6}$, $n=19$, $\text{FeO/MnO}=27-33$); calcic plagioclase: $\text{An}_{82.7 \pm 3.9}$ ($\text{An}_{78.2-89.8}$, $n=19$)

Northwest Africa 10334 (NWA 10334)

(Northwest Africa)

Purchased: 2015

Classification: Ureilite

History: The meteorite was purchased from a meteorite dealer at the meteorite fair in Ensisheim, France.

Petrography: The meteorite shows a cumulate texture of blocky, up to 1.5 mm sized Cr-rich olivine and pyroxene crystals. Pyroxene shows a patchy compositional zoning and olivine displays characteristic reduced rims. The meteorite contains abundant flaky graphite.

Geochemistry: reduced rims in olivine: $\text{Fa}_{2.9-12.7}$; Cr_2O_3 in ol: ~ 0.7 wt%

Northwest Africa 10341 (NWA 10341)

(Northwest Africa)

Purchased: 2015

Classification: Rumuruti chondrite (R6)

Petrography: Fresh dark-grayish interior. A breccia composed of heterogeneously distributed type 6 lithic fragments in a fine-grained clastic groundmass. Ferroan olivine is the dominant mineral phase in clasts and groundmass. Minor phases include albitic feldspar, augite, chromite, pentlandite and pyrrhotite. FeNi metal is virtually absent.

Northwest Africa 10344 (NWA 10344)

(Northwest Africa)

Purchased: 2014

Classification: Martian meteorite (Shergottite)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: A small greenish-gray individual lacking any fusion crust was found in the North African desert.

Petrography: The meteorite displays an equigranular igneous texture of dominantly up to 1 mm sized olivine, pigeonite and maskelynite grains; minor phases include phosphates, sulfides, and chromite. The subhedral to euhedral olivine grains are often poikilitically enclosed by pyroxene. Both, pyroxene and olivine, frequently contain chromite inclusions. Olivine is compositionally homogeneous within each grain, but varies from grain to grain, ranging from Fa_{38} to Fa_{40} . Intense fracturing, conversion of plagioclase to maskelynite and strong mosaicism of olivine attest to a high degree of shock metamorphism. The meteorite is weakly weathered.

Geochemistry: olivine: $\text{Fa}_{38.7 \pm 0.5}$ ($37.9-39.6$, $n=20$); $\text{FeO/MnO}=44-53$; pyroxene: $\text{Fs}_{28.5 \pm 1.5} \text{Wo}_{11.6 \pm 2.6}$ ($\text{Fs}_{24.5-30.3} \text{Wo}_{7.3-16.2}$, $n=20$, $\text{FeO/MnO}=24-30$); feldspar: $\text{An}_{48.7 \pm 4.2} \text{Ab}_{48.6 \pm 3.4}$ ($\text{An}_{42.2-53.4} \text{Ab}_{44.6-54}$, $n=20$).

Classification: Martian, Lherzolithic shergottite

Northwest Africa 10363 (NWA 10363)

(Northwest Africa)

Purchased: 2015 May

Classification: Ordinary chondrite (LL3)

History: Purchased by Fabien Kuntz in May 2015 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, well-formed chondrules (apparent diameter 1.5 ± 1.1 mm) in a sparse fine-grained matrix containing altered metal.

Geochemistry: Olivine ($\text{Fa}_{2.7-48.8}$, Cr_2O_3 in ferroan examples 0.01-0.03 wt.%, $N = 6$), orthopyroxene ($\text{Fs}_{2.4-15.1}\text{Wo}_{0.2-4.4}$, $N = 3$), subcalcic augite ($\text{Fs}_{6.3}\text{Wo}_{34.2}$), augite ($\text{Fs}_{6.8}\text{Wo}_{42.1}$). Magnetic susceptibility $\log \chi = 3.59$ (χ in 10^{-9} m³/kg).

Classification: Ordinary chondrite (LL3).

Specimens: 15.73 g including one polished thin section at *PSF*; main mass with *Kuntz*.

Northwest Africa 10365 (NWA 10365)

(Northwest Africa)

Purchased: 2015 May

Classification: Ordinary chondrite (LL6)

History: Purchased by Fabien Kuntz in May 2015 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with rare relict chondrules.

Geochemistry: Olivine ($\text{Fa}_{30.6-30.8}$, $N = 3$), orthopyroxene ($\text{Fs}_{24.2-24.4}\text{Wo}_{1.5-1.2}$, $N = 3$), augite ($\text{Fs}_{9.2-10.0}\text{Wo}_{43.7-44.8}$, $N = 2$).

Classification: Ordinary chondrite (LL6).

Specimens: 23.66 g including one polished thin section at *PSF*; main mass with *Kuntz*.

Northwest Africa 10372 (NWA 10372)

(Northwest Africa)

Purchased: 2015

Classification: Carbonaceous chondrite (CK3)

History: The meteorite was purchased from a meteorite dealer at the mineral fair in Ensisheim, France.

Petrography: The meteorite displays a dark grayish to greenish interior and is composed of well defined chondrules (300-1500 μm in apparent diameter) set into abundant fine-grained matrix. Olivine is the most abundant mineral phase, followed by low-Ca pyroxene and albitic feldspar in the matrix; magnetite contains about 4 wt% Cr_2O_3 ; metal is virtually absent.

Northwest Africa 10374 (NWA 10374)

(Northwest Africa)

Purchased: 2015

Classification: Carbonaceous chondrite (CK6)

History: The meteorite was purchased from a meteorite dealer at the mineral fair in Ensisheim, France.

Petrography: The meteorite displays a fresh grayish to slightly greenish interior and is dominantly composed of recrystallized matrix; relict chondrules are rare. Olivine is by far the most abundant mineral phase, followed by feldspar, Ca-pyroxene and Cr-bearing magnetite. Metal is absent.

Geochemistry: Cr_2O_3 in magnetite: about 5 wt%

Northwest Africa 10375 (NWA 10375)

(Northwest Africa)

Purchased: 2015

Classification: Martian meteorite (Shergottite)

History: The meteorite was purchased from the meteorite dealer Med Lamine Ahmed.

Physical characteristics: Four small greenish individuals lacking any fusion crust were recovered from the northwestern Sahara.

Petrography: The meteorite displays a coarse-grained basaltic texture and is dominantly composed of blocky up to 1.5 mm sized clinopyroxene and plagioclase grains. Pyroxene shows complex patchy zoning, fine exsolution lamella and strong mosaicism. Often chromite inclusions are found enclosed in pyroxene. Plagioclase is intermediate in composition and converted into maskelynite due to strong shock metamorphism. Minor phases include ilmenite, ulvöspinel, and merrillite.

Geochemistry: Pyroxene: $\text{Fs}_{40.1 \pm 14.1} \text{Wo}_{21.7 \pm 8.6}$ ($\text{Fs}_{20.5-62} \text{Wo}_{12.4-34.5}$, $n=36$, $\text{FeO/MnO}=24-38$); feldspar: $\text{An}_{50.1 \pm 3.6} \text{Ab}_{47.2 \pm 1.4}$ ($\text{An}_{40-53.6} \text{Ab}_{44.2-50}$, $n=23$)

Classification: Martian, basaltic shergottite

Northwest Africa 10376 (NWA 10376)

(Northwest Africa)

Purchased: 2015

Classification: Lunar meteorite

History: The meteorite was purchased from the meteorite dealer Med Lamine Ahmed.

Physical characteristics: One small grayish individual lacking any fusion crust was found in the northern Sahara.

Petrography: The meteorite is a polymict breccia composed of lithic and mineral clasts consolidated in a fine-grained clastic, partly molten and recrystallized matrix. Lithic clasts are dominantly basaltic and gabbroic, mineral clasts include up to 200 μm sized olivine, exsolved pyroxene, and feldspar grains. Accessories are Ti-chromite, pyrrhotite, ilmenite, and silica. Some calcite weathering veins are present.

Geochemistry: low-Ca pyroxene: $\text{Fs}_{29.3} \text{Wo}_{4.8}$ $\text{FeO/MnO}=51$; Ca-pyroxene: $\text{Fs}_{16.3 \pm 1.3} \text{Wo}_{36.3 \pm 2.5}$ ($\text{Fs}_{4.1-18.8} \text{Wo}_{31.1-40}$, $n=11$, $\text{FeO/MnO}=41-65$); feldspar: $\text{An}_{86.3 \pm 11.4} \text{Ab}_{13.1 \pm 1.1}$ ($\text{An}_{56-93.6} \text{Ab}_{6.3-42.3}$, $n=16$)

Northwest Africa 10377 (NWA 10377)

(Northwest Africa)

Purchased: 2015 Jan

Classification: Ordinary chondrite (L, melt breccia)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Petrography: The meteorite is composed of regions displaying chondritic textures with recognizable chondrules intermingled with abundant melt regions characterized by recrystallized shock melt and characteristic FeNi metal and sulfide globules. Olivine and pyroxene show strong mosaicism attesting to a high degree of shock metamorphism.

Northwest Africa 10380 (NWA 10380)

(Northwest Africa)

Purchased: 2014 May 5

Classification: HED achondrite (Eucrite)

History: Purchased in Erfoud May 5, 2014.

Physical characteristics: A single crusted full stone. Cut surface reveals a light gray, brecciated interior.

Petrography: Igneous fine-grained brecciated rock. Main minerals are pyroxene and plagioclase with minor silica polymorph, troilite, ilmenite. Rare metal.

Geochemistry: Pyroxene $\text{FeO/MnO}=34.2\pm0.5$ (N=2). Plagioclase $\text{An}_{90.6}\text{Ab}_{8.9}\text{Or}_{0.5}$ (N=3). $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 2.73$.

Classification: Euclite, brecciated.

Specimens: 10.4 g at *CEREGE*. Main mass with P. Thomas

Northwest Africa 10381 (NWA 10381)

Beni-Tajjite, Morocco

Purchased: 2014 May 17

Classification: HED achondrite (Howardite)

History: Purchased in Erfoud May 17, 2014. Found in the Beni-Tajjite region, Morocco.

Physical characteristics: A single stone partially covered with a dull fusion crust. Cut surface reveals a gray, brecciated interior.

Petrography: Igneous brecciated rock. Main minerals are pyroxene and plagioclase. Minor phases: silica polymorph, metal, troilite. The groundmass is diagenetic and consists of mineral fragments in a clastic matrix. Most pyroxenes are exsolved, some zoned. A 5-mm euclite clast makes up 20% of the observed section and has an ophitic to subophitic texture with exsolved pyroxene and typical grain size 600 μm .

Geochemistry: Pyroxene $\text{FeO/MnO}=30.4\pm2.5$ (N=11). Diagenetic lithology pyroxene $\text{Fs}_{31.1\pm4.7}\text{Wo}_{7.1\pm5.6}$ ($\text{Fs}_{22.6-37.8}\text{Wo}_{2.2-17.5}$, N=6). Euclite lithology orthopyroxene $\text{Fs}_{59.0\pm1.5}\text{Wo}_{5.3\pm1.7}$ (N=3), augite. $\text{Fs}_{29.5\pm0.6}\text{Wo}_{41.2\pm0.4}$ (N=2). $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.01$.

Classification: Howardite (based on the 20% euclite material modal abundance in the observed section).

Specimens: 14.1 g at *CEREGE*. Main mass with P. Thomas

Northwest Africa 10383 (NWA 10383)

(Northwest Africa)

Purchased: 2015

Classification: Ordinary chondrite (LL3)

History: Bought by Luc Labenne in Erfoud in 2015

Physical characteristics: A single crusted stone. Cut surface reveals a brown interior with large well delineated chondrules. A lighter cm chondritic clast is visible.

Petrography: Well delineated tightly packed chondrules. Chondrule mesostasis is quenched. Dusty olivine is found in some chondrules.

Geochemistry: Olivine $\text{Fa}_{18.4\pm11.4}$ (range 0.6-31.6, PMD=57%, N=11). Cr_2O_3 in ferroan olivine 0.24 ± 0.14 wt% (N=9). Low-Ca pyroxene $\text{Fs}_{24.4\pm20.8}\text{Wo}_{1.7\pm0.9}$ ($\text{Fs}_{1.8-52.0}$, N=3). $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.48$.

Classification: LL3, brecciated. LL group based on magnetic susceptibility. Estimated sub-type 3.15 from Cr_2O_3 content in ferroan olivine.

Specimens: 24.7 g at *CEREGE*. Main mass with *Labenne*

Northwest Africa 10384 (NWA 10384)

(Northwest Africa)

Purchased: 2015 Jan

Classification: Ureilite

History: Bought by Luc Labenne in Erfoud in 2015

Physical characteristics: A single crusted stone

Petrography: Aggregate of coarse olivine grains with reduced margins and minor pyroxenes, with recrystallized texture. Metal is found as veins in between grains, and as small grains in the olivine margins.

Geochemistry: Olivine core $\text{Fa}_{17.4}$ (N=1), reduced margins $\text{Fa}_{8.5}$ (N=1). Pigeonite $\text{Fs}_{15.1.1}\text{Wo}_{8.4}$ (N=1). $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.32$.

Classification: ureilite. strong weathering

Specimens: 9.6 g at *CEREGE*. Main mass with *Labenne*

Northwest Africa 10385 (NWA 10385)

(Northwest Africa)

Purchased: 2015 Jan

Classification: Carbonaceous chondrite (CO3)

History: Bought by Luc Labenne in Erfoud in 2015

Physical characteristics: Dull brownish stone without fusion crust. Cut surface reveals dark brown interior with small chondrules.

Petrography: Small chondrules (average size about 200 μm), mostly of type I, and CAIs (to 500 μm) set in a fine grained metal-rich matrix. Abundant FeNi blobs in the chondrules and the matrix.

Geochemistry: Olivine $\text{Fa}_{16.1\pm 14.5}$ (PMD=84%, N=13). Cr_2O_3 in ferroan olivines 0.31 ± 0.07 wt%. Low-Ca pyroxene $\text{Fs}_{2.6}\text{Wo}_{0.7}$ (N=1). $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.74$.

Classification: CO3

Specimens: 20.6 g at *CEREGE*. Main mass with *Labenne*

Northwest Africa 10386 (NWA 10386)

(Northwest Africa)

Purchased: 2014

Classification: Ureilite

History: Bought by Luc Labenne in Agadir in 2014

Physical characteristics: A single brown stone

Petrography: Aggregate of coarse olivine grains with reduced margins and minor pyroxenes, with recrystallized texture. Metal is found as veins in between grains, and as small grains in the olivine margins.

Geochemistry: Olivine cores $\text{Fa}_{19.7\pm 1.8}$ (N=3). Orthopyroxene $\text{Fs}_{19.1}\text{Wo}_{4.0}$ (N=1). $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.35$.

Classification: ureilite, moderate weathering

Specimens: 5.3 g at *CEREGE*. Main mass with *Labenne*

Northwest Africa 10387 (NWA 10387)

(Northwest Africa)

Purchased: 2015 May

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Fabien Kuntz in May 2015 from a dealer in Rissani, Morocco, and subsequently acquired by Xavier Gonzalez.

Petrography: (A. Irving and S. Kuehner, *UWS*) Separated chondrules (apparent diameter 1.6 ± 1.2 mm, some rimmed) plus fine-grained CAI are set in a deep reddish-brown matrix (~40 vol.%).

Geochemistry: Olivine ($\text{Fa}_{1.5-46.8}$, $N = 3$), orthopyroxene ($\text{Fs}_{1.3-15.0}\text{Wo}_{3.7-2.7}$, $N = 3$), augite ($\text{Fs}_{0.7-6.5}\text{Wo}_{36.9-35.6}$, $N = 2$).

Classification: Carbonaceous chondrite (CV3). Low/moderate weathering.

Specimens: 14.22 g including one polished thin section at *PSF*; remainder with Mr. X. Gonzalez.

Northwest Africa 10388 (NWA 10388)

(Northwest Africa)

Purchased: 2010 Feb

Classification: HED achondrite (Diogenite)

History: Purchased by Dr. David Gregory in February 2010 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Very fresh specimen composed predominantly of interleaved, bladed grains of orthopyroxene (72.2 vol.%) and calcic plagioclase (25.1 vol.%) exhibiting strong lattice preferred orientation. Some larger (up to 4 mm), equant grains of orthopyroxene are also present. Accessory minerals are olivine, Ti-bearing chromite, Ti-free and Al-bearing chromite, rare silica polymorph and troilite.

Geochemistry: Orthopyroxene (cores $\text{Fs}_{22.3-24.9}\text{Wo}_{1.8-3.0}$; rims $\text{Fs}_{30.9-34.9}\text{Wo}_{4.1-3.2}$; $\text{FeO/MnO} = 29-33$; $N = 4$), olivine ($\text{Fa}_{33.7-37.0}$, $\text{FeO/MnO} = 43-47$, $N = 2$), olivine inclusion in large orthopyroxene grain ($\text{Fa}_{26.7}$, $\text{FeO/MnO} = 39$), plagioclase ($\text{An}_{85.9-88.0}\text{Or}_{0.1-0.3}$, $N = 3$).

Classification: Diogenite (noritic). The plagioclase abundance (25 vol%) is anomalous for a diogenite.

Specimens: 26.71 g including one polished thin section at *ROM*; remainder with *Gregory*.

Northwest Africa 10389 (NWA 10389)

(Northwest Africa)

Purchased: 2014 Feb

Classification: Carbonaceous chondrite (CO3)

History: Purchased by Dr. David Gregory in February 2014 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Small chondrules, angular mineral fragments and small, fine-grained CAI are set in a reddish-brown matrix (~30 vol.%).

Geochemistry: Olivine ($\text{Fa}_{0.8-70.6}$, Cr_2O_3 in ferroan examples 0.03-0.20 wt.%, mean 0.08 ± 0.07 wt.%, $N = 7$), orthopyroxene ($\text{Fs}_{4.9}\text{Wo}_{0.4}$), pigeonite $\text{Fs}_{1.6}\text{Wo}_{5.7}$, augite ($\text{Fs}_{0.6-2.7}\text{Wo}_{37.3-42.7}$).

Classification: Carbonaceous chondrite (CO3). Low/moderate weathering.

Specimens: 18.5 g including one polished thin section at *ROM*; remainder with *Gregory*.

Northwest Africa 10390 (NWA 10390)

(Northwest Africa)

Purchased: 2015 Feb

Classification: HED achondrite (Eucrite, unbrecciated)

History: Purchased by Bob Falls in February 2015 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) The fresh specimen has a microgabbroic texture with minor cataclastic effects on grain boundaries, and consists predominantly of finely exsolved pigeonite and calcic plagioclase with accessory silica polymorph, ilmenite, troilite plus rare baddeleyite and Ni-free metal.

Geochemistry: Orthopyroxene host ($\text{Fs}_{59.8}\text{Wo}_{4.1}$, $\text{FeO/MnO} = 31$), clinopyroxene exsolution lamella ($\text{Fs}_{30.4}\text{Wo}_{39.6}$, $\text{FeO/MnO} = 31$), discrete clinopyroxene ($\text{Fs}_{33.5}\text{Wo}_{35.9}$, $\text{FeO/MnO} = 31$).

Classification: Euclite (unbrecciated, microgabbroic).

Specimens: 21.3 g including one polished thin section at *UWB*; main mass with Mr. R. Falls.

Northwest Africa 10391 (NWA 10391)

(Northwest Africa)

Purchased: 2006 Feb

Classification: LL4-7

History: Purchased by Mike Silver in February 2006 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh breccia consisting of angular chondrite clasts plus some well-formed, discrete chondrules in a finer grained matrix. The most abundant clasts are entirely recrystallized with no relict chondrules (LL7), but also present are LL4 clasts and LL6 clasts containing rare chondrules. All components are compositionally equilibrated.

Geochemistry: Olivine ($\text{Fa}_{31.5-31.6}$, $N = 4$), orthopyroxene ($\text{Fs}_{24.5-24.8}\text{Wo}_{2.5-2.4}$, $N = 3$), clinopyroxene ($\text{Fs}_{10.8-11.8}\text{Wo}_{43.4-40.4}$, $N = 2$).

Classification: Ordinary chondrite (LL4-7 breccia).

Specimens: 22 g including one polished thin section at *ROM*; remainder with Mr. M. Silver.

Northwest Africa 10392 (NWA 10392)

(Northwest Africa)

Purchased: 2015 Jul

Classification: HED achondrite (Euclite, polymict)

History: Purchased in Temara, Morocco by Adam Aaronson in July 2015.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh matrix-rich fragmental breccia composed of euclite clasts with variable grain size and texture (intersertal to diabasic) plus related crystal debris and sparse grains of diagenetic orthopyroxene. Exsolved pigeonite, calcic plagioclase, silica polymorph, olivine, ilmenite, chromite, troilite and rare zircon.

Geochemistry: Clinopyroxene host ($\text{Fs}_{31.1}\text{Wo}_{39.8}$, $\text{FeO/MnO} = 32$), orthopyroxene exsolution lamella ($\text{Fs}_{66.4}\text{Wo}_{1.6}$, $\text{FeO/MnO} = 30$), low-Ca pyroxene host ($\text{Fs}_{55.8}\text{Wo}_{6.6}$, $\text{FeO/MnO} = 33$), clinopyroxene exsolution lamella ($\text{Fs}_{28.5}\text{Wo}_{39.7}$, $\text{FeO/MnO} = 34$), diagenetic orthopyroxene ($\text{Fs}_{26.4}\text{Wo}_{3.4}$, $\text{FeO/MnO} = 29$; $\text{Fs}_{30.7}\text{Wo}_{3.9}$, $\text{FeO/MnO} = 33$), clinopyroxene inclusion in more ferroan orthopyroxene ($\text{Fs}_{13.0}\text{Wo}_{43.1}$, $\text{FeO/MnO} = 23$), olivine ($\text{Fa}_{76.9-77.5}$, $\text{FeO/MnO} = 42-44$, $N = 2$).

Classification: Euclite (polymict breccia).

Specimens: 20.1 g including one polished thin section at *UWB*; main mass with Aaronson.

Northwest Africa 10393 (NWA 10393)

(Northwest Africa)

Purchased: 2015 Jun

Classification: Carbonaceous chondrite (CO3)

History: Purchased by Fabien Kuntz in June 2015 at the Ste. Marie-aux-Mines Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Small chondrules, angular mineral fragments and small, fine-grained CAI are set in a reddish-brown matrix (~40 vol.%).

Geochemistry: Olivine ($\text{Fa}_{0.4-45.9}$, Cr_2O_3 in ferroan examples 0.02-0.06 wt.%, $N = 7$), orthopyroxene ($\text{Fs}_{1.1-2.8}\text{Wo}_{0.9-3.8}$, $N = 3$), clinopyroxene ($\text{Fs}_{0.7-4.7}\text{Wo}_{44.7-41.0}$).

Classification: Carbonaceous chondrite (CO3)

Specimens: 23.04 g including one polished thin section at *PSF*; main mass with *Kuntz*.

Northwest Africa 10394 (NWA 10394)

Northwest Africa

Purchased: 2012 Feb

Classification: Ordinary chondrite (H4)

History: Purchased by Dr. David Gregory in February 2012 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, relatively small chondrules and relatively abundant stained metal.

Geochemistry: Olivine ($\text{Fa}_{17.7-17.8}$, $N = 3$), orthopyroxene ($\text{Fs}_{15.1-15.7}\text{Wo}_{1.0-1.1}$, $N = 3$), clinopyroxene ($\text{Fs}_{4.9-5.3}\text{Wo}_{46.5-45.9}$, $N = 2$).

Classification: Ordinary chondrite (H4).

Specimens: 22.08 g including one polished thin section at *ROM*; remainder with *Gregory*.

Northwest Africa 10395 (NWA 10395)

(Northwest Africa)

Purchased: 2012 Feb

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Dr. David Gregory in February 2012 from a Moroccan dealer at the Tucson Gem and Mineral Show.

Petrography: (A. Irving and S. Kuehner, *UWS*) Separated granular chondrules (apparent diameter 2.3 ± 1.8 mm) and CAI (up to 5 mm) are set in an orange-brown matrix (~40 vol.%). Some CAI are very fine grained whereas others are relatively coarse grained. Minerals in CAI include gehlenite, kirschsteinite, nepheline, anorthite, awaruite and PGE-dominated metal alloys (containing Ru, Mo, Fe and Ni).

Geochemistry: Olivine ($\text{Fa}_{0.8-46.8}$, $N = 3$), orthopyroxene ($\text{Fs}_{3.5}\text{Wo}_{0.8}$), pigeonite ($\text{Fs}_{1.1}\text{Wo}_{6.0}$), subcalcic clinopyroxene ($\text{Fs}_{0.6-3.6}\text{Wo}_{36.7-33.1}$).

Classification: Carbonaceous chondrite (CV3). Low/moderate weathering.

Specimens: 20.1 g including one polished thin section at *ROM*; remainder with *Gregory*.

Northwest Africa 10396 (NWA 10396)

North West Africa

Purchased: 2014 Mar

Classification: Carbonaceous chondrite (CK4)

Classification: The sample consists of about 50% well-defined chondrule and chondrule fragments and 50% of matrix and opaques. Among the opaques abundant magnetite is observed. The mean composition of olivine is $\text{Fa}_{1.7}$, which also contains NiO (0-3-0.6 wt%). All these

observations support the CK classification. The olivines show undulatory extinction indicating a S2 shock degree classification. The sample is heavily weathered and most sulfides have been destroyed.

Northwest Africa 10397 (NWA 10397)

Northwest Africa

Purchased: 2015

Classification: Ordinary chondrite (L5)

History: One stone weighing 298.7.g was found in Morocco in 2015. David Holden acquired the sample from a meteorite prospector in Erfoud, 2015.

Physical characteristics: The stone is brown and rounded to angular in shape. A smooth, weathered, brown fusion crust with numerous shallow regmaglypts covers approximately 85% of the exterior of the stone. The cut face of the interior of the stone is tan with mottle orange regions and displays small chondrules, chondrule fragments and fresh and weathered flakes of metal.

Petrography: Description and classification (A. Love, *App*): Sample displays recrystallized chondritic texture crosscut by a few glassy shock veins. Most chondrules are indistinct, while droplet chondrules, have an average diameter of 745 μm (n=34), retain their circular profiles.

Geochemistry: (A.Love, *App*): Olivine $\text{Fa}_{23.8\pm0.7}$, N=8; Low Ca pyroxene $\text{Fs}_{20.6\pm0.6}\text{Wo}_{2.4\pm0.8}$, N=8.

Classification: Based on chemistry, texture and abundance of orthorhombic low-Ca pyroxene, this is an ordinary chondrite (L5 S3 W1).

Specimens: An endcut, one slice and many small pieces weighing 20.36 g, and a polished thin section are currently on deposit at *App*.

Northwest Africa 10399 (NWA 10399)

Northwest Africa

Purchased: 2014

Classification: Ordinary chondrite (L4)

History: One stone weighing 58.4.g was found in Morocco in 2014. David Holden acquired the sample from a meteorite prospector in Erfoud 2014.

Physical characteristics: The oriented stone is green and has a triangular shape. The stone is 99% covered by a weathered fusion crust that displays shallow regmaglypts. Clumps of sand grains appear to be fused to the portions of the crust. The cut face of the interior of the stone is dark orange in color and displays small chondrules, chondrule fragments, dark clasts and fresh and weathered flakes of metal.

Petrography: Description and classification (A. Love, *App*): Sample displays recrystallized chondritic texture composed of indistinct chondrules and fragments set within a transparent crystalline matrix of olivine, pyroxene (abundance of clinoenstatite $\sim$ to orthoenstatite), apatite, troilite and FeNi grains. Few chondrules are defined but have an average diameter of 753 μm .

Geochemistry: (A.Love, *App*): Olivine $\text{Fa}_{22.7\pm0.2}$, N=8; Low Ca pyroxene $\text{Fs}_{21.1\pm2.6}\text{Wo}_{2.7\pm0.4}$, N=8

Classification: Based on chemistry and abundance of low Ca pyroxene, this is an ordinary chondrite (L4, S2, W3).

Specimens: 11.9 g type specimen and 1 polished thin section are on deposit at *App*

Northwest Africa 10401 (NWA 10401)

(Northwest Africa)

Purchased: 2015

Classification: Lunar meteorite

History: Purchased by Steve Arnold from a dealer in Ouarzazete, Morocco in 2015.

Physical characteristics: Two stones totaling 354 g (218 and 136 g). A sawed piece from one of the stones reveals a very fine-grained, light-gray groundmass that is cross-cut by several shock melt veins. Larger white clasts within the groundmass are present.

Petrography: A. Hilton (*CoW*), J. Gross (*Rut*). This meteorite is an anorthositic troctolite with a granulitic texture. It contains plagioclase (59-65%), olivine (23-26%), orthopyroxene, and clinopyroxene (pyx total: 12-15%) as the main silicate phases. Accessory grains of spinel were observed. Microprobe examination shows two particularly large clasts (diameters 3.1-4.7 mm) surrounded by a light-gray, fine-grained matrix and many smaller clasts (0.1-0.8 mm). The sample is crosscut by an abundant number of thin shock melt veins. The veins show compositional variation as well as partial assimilation of surrounding grains in some areas and are homogeneous in others. Plagioclase grains (0.2-0.8 mm) are angular and sub-euhedral in shape, while mafic clasts rich in olivine and pyroxene (0.1-0.3 mm) are composed of small (<10-35 μm) anhedral olivine and pyroxene grains. Single anhedral grains of olivine and pyroxene are also present in the sample, including some that exhibit pyroxene exsolution lamellae. The matrix is composed of small, granular, anhedral grains of olivine and pyroxene that appear to outline grain boundaries of plagioclase fragments.

Geochemistry: J. Gross (*Rut*) and A. Hilton (*CoW*). Olivine $\text{Fa}_{18.6\pm2}$ (N=180), $\text{Fe/Mn}=88.1\pm8.3$; Orthopyroxene: $\text{Fs}_{15.5\pm2}\text{Wo}_{3.1\pm0.6}\text{En}_{81.4\pm4.7}$, $\text{Fe/Mn}=49.3\pm6$ (N=48); Clinopyroxene: $\text{Fs}_{9.0\pm1.4}\text{Wo}_{41.3\pm7.9}\text{En}_{49.7\pm6.8}$, $\text{Fe/Mn}=37.2\pm4$ (N = 20); Plagioclase $\text{An}_{96.6\pm0.3}\text{Ab}_{2.9\pm0.6}\text{Or}_{0.1\pm0.05}$ (N=254). The shock melt vein (defocused electron beam as proxy for bulk composition) has an average composition of: $\text{Na}_2\text{O} = 0.27\pm0.1$, $\text{MgO} = 9.7\pm0.3$, $\text{SiO}_2 = 45\pm0.8$, $\text{Al}_2\text{O}_3 = 26\pm0.6$, $\text{P}_2\text{O}_5 = 0.02\pm0.04$, $\text{K}_2\text{O} = 0.01\pm0.01$, $\text{CaO} = 15\pm6$, $\text{TiO}_2 = 0.12\pm0.03$, $\text{MnO} = 0.06\pm0.04$, $\text{FeO} = 4.1\pm0.3$, $\text{BaO} = 0.01\pm0.03$, $\text{Cr}_2\text{O}_3 = 0.13\pm0.03$, $\text{NiO} = 0.02\pm0.02$, N=74. Bulk composition (R. Korotev, *WUSL*): INAA on a 99 mg fragment gave FeO 6.1 wt%, Na_2O 0.24 wt%; Sc 8.7, Cr 1300, Ni 124, La 0.65, Sm 0.38, Eu 0.55, Yb 0.37, Th 0.07, all in ppm.

Classification: Lunar (anorthositic troctolitic breccia with granulitic texture)

Specimens: 20 g at *TCU*, thick section probe mount at *RU*; Peter Scherff holds the main mass.

Northwest Africa 10402 (NWA 10402)

(Northwest Africa)

Purchased: 2015 Jun

Classification: HED achondrite (Eucrite, brecciated)

History: Purchased by Aras Jonikas in June 2015 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia composed mostly of crystal debris plus some intact eucrite clasts (with intersertal and fine-grained, quench textures). Exsolved pigeonite in all components has the same optical properties; other minerals are calcic plagioclase, fayalite, silica polymorph, ilmenite and troilite, plus rare ferroan orthopyroxene, ferropigeonite and Ni-free metal.

Geochemistry: Olivine ($\text{Fa}_{77.2}$; $\text{Fa}_{89.0}$; $\text{FeO/MnO} = 43-44$, N = 2), low-Ca pyroxene host ($\text{Fs}_{57.8}\text{Wo}_{6.7}$, $\text{FeO/MnO} = 30$), clinopyroxene exsolution lamella ($\text{Fs}_{30.5}\text{Wo}_{39.5}$, $\text{FeO/MnO} = 31$), discrete orthopyroxene ($\text{Fs}_{39.0}\text{Wo}_{3.1}$, $\text{FeO/MnO} = 31$), ferropigeonite ($\text{Fs}_{77.1}\text{Wo}_{15.8}$, $\text{FeO/MnO} = 30$).

Classification: Eucrite (genomict breccia).

Specimens: 9.9 g including one polished thin section at *PSF*; main mass with Mr. A. Jonikas.

Northwest Africa 10403 (NWA 10403)

(Northwest Africa)

Purchased: 2015 Jun

Classification: HED achondrite (Diogenite, polymict)

History: Purchased by Aras Jonikas in June 2015 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia composed mostly of diagenitic clasts and debris, plus <10 vol.% eucritic debris and lithic clasts (with intersertal to recrystallized textures). Minerals are orthopyroxene (with several different compositions), calcic plagioclase, exsolved pigeonite, silica polymorph, chromite and troilite.

Geochemistry: Diagenitic orthopyroxene (Fs_{22.4}Wo_{2.1}; Fs_{34.2}Wo_{2.2}; FeO/MnO = 34, N = 2), orthopyroxene host (Fs_{58.3}Wo_{3.8}, FeO/MnO = 29), clinopyroxene exsolution lamella (Fs_{29.2}Wo_{41.5}, FeO/MnO = 30), orthopyroxene host (Fs_{48.5}Wo_{2.2}, FeO/MnO = 20), clinopyroxene exsolution lamella (Fs_{21.8}Wo_{39.6}, FeO/MnO = 19).

Classification: Diogenite (polymict breccia)

Specimens: 20.85 g including one polished thin section at *PSF*; main mass with Mr. A. Jonikas.

Northwest Africa 10404 (NWA 10404)

(Northwest Africa)

Purchased: 2015 May

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased by Darryl Pitt in May 2015 from a dealer in Ouarzazate, Morocco.

Physical characteristics: A single stone (229 g) lacking fusion crust. Interior slices exhibit angular mineral clasts plus rounded colorless, brownish and greenish glassy objects in gray, partly vesicular matrix

Petrography: (A. Irving and S. Kuehner, *UWS*) Vitric fragmental breccia composed of angular to rounded lithic clasts plus mineral clasts of anorthite, olivine, pigeonite, orthopyroxene, subcalcic augite, augite and rare Ti-chromite, troilite and taenite in a partly vitreous matrix. Some lithic clasts are fine grained, plagioclase-phyric crystalline lithologies, but many consist of partly-devitrified glass with bulk compositions intermediate between those of anorthite, olivine and low-Ca pyroxene. The latter consist of isotropic cores (colorless to pale brown in thin section) mantled by aggregates rich in polycrystalline, spherulitic birefringent crystallites within zones parallel to clast margins and constituting ~50% of clast volumes.

Geochemistry: Olivine (Fa_{26.4}; Fa_{47.2}, FeO/MnO = 77-84, N = 2), orthopyroxene (Fs_{37.6}Wo_{3.2}, FeO/MnO = 64), pigeonite (Fs_{21.1-25.9}Wo_{15.5-11.3}, FeO/MnO = 59-60, N = 2), subcalcic augite (Fs_{21.9}Wo_{32.2}, FeO/MnO = 51), augite (Fs_{20.0}Wo_{37.9}, FeO/MnO = 46), plagioclase (An_{96.1-97.0}Or_{0.0}, N = 3). Bulk composition (R. Korotev, *WUSL*) INAA of subsamples gave the following mean abundances (in wt.%) FeO 3.8, Na₂O 0.36; (in ppm) Sc 6.8, La 4.2, Sm 2.0, Eu 0.83, Yb 1.5, Lu 0.21, Th 0.74.

Classification: Lunar (feldspathic vitric regolithic breccia).

Specimens: 20.61 g including one polished thin section at *UWB*; main mass with *DPitt*.

Northwest Africa 10405 (NWA 10405)

(Northwest Africa)

Purchased: 2015 Jul

Classification: Carbonaceous chondrite (CK3)

History: Purportedly found in Mauritania and purchased by Darryl Pitt in July 2015 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Separated, well-formed chondrules (apparent diameter 2.0 ± 1.0 mm) containing stained Cr-magnetite are set in an orange-brown matrix containing intermediate plagioclase, calcite and minor barite.

Geochemistry: Olivine ($\text{Fa}_{3.2-33.1}$, $\text{FeO/MnO} = 91-110$, $N = 3$), orthopyroxene ($\text{Fs}_{19.7-23.5}\text{Wo}_{1.3-0.4}$, $N = 3$), clinopyroxene ($\text{Fs}_{1.4}\text{Wo}_{43.3}$; $\text{Fs}_{11.8}\text{Wo}_{50.2}$).

Classification: Carbonaceous chondrite (CK3).

Specimens: 33.6 g including one polished thin section at *UWB*; main mass with *DPitt*.

Northwest Africa 10406 (NWA 10406)

(Northwest Africa)

Purchased: 2015 Jul

Classification: HED achondrite (Eucrite, monomict)

History: Purportedly found in Mauritania and purchased by Darryl Pitt in July 2015 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia composed of eucrite clasts plus fine grained, related debris in an orange stained matrix. Minerals are exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite, Ti-bearing chromite and troilite.

Geochemistry: Orthopyroxene host ($\text{Fs}_{49.4}\text{Wo}_{2.5}$, $\text{FeO/MnO} = 25$), clinopyroxene exsolution lamella ($\text{Fs}_{21.5}\text{Wo}_{41.1}$, $\text{FeO/MnO} = 22$), low-Ca pyroxene ($\text{Fs}_{46.4}\text{Wo}_{5.0}$, $\text{FeO/MnO} = 26$), clinopyroxene ($\text{Fs}_{24.7}\text{Wo}_{39.5}$, $\text{FeO/MnO} = 28$).

Classification: Eucrite (monomict breccia).

Specimens: 32 g including one polished thin section at *UWB*; main mass with *DPitt*.

Northwest Africa 10407 (NWA 10407)

(Northwest Africa)

Purchased: 2015 Jul

Classification: Carbonaceous chondrite (CO3)

History: Purportedly found in Mauritania and purchased by Darryl Pitt in July 2015 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Small chondrules, mineral fragments and irregularly-shaped CAI are set in a deep brown matrix (~40 vol.%).

Geochemistry: Olivine ($\text{Fa}_{0.8-65.0}$; Cr_2O_3 in ferroan olivine 0.10-0.48 wt.%, mean 0.28 wt.%, sd 0.16 wt.%, $N = 9$), orthopyroxene ($\text{Fs}_{1.2-2.2}\text{Wo}_{1.2-1.0}$, $N = 3$), diopside ($\text{Fs}_{1.4}\text{Wo}_{48.3}$), augite ($\text{Fs}_{43.2}\text{Wo}_{41.0}$).

Classification: Carbonaceous chondrite (CO3).

Specimens: 21.3 g including one polished thin section at *UWB*; main mass with *DPitt*.

Northwest Africa 10408 (NWA 10408)

(Northwest Africa)

Purchased: 2015 Jul

Classification: HED achondrite (Eucrite, unbrecciated)

History: Purportedly found in Mauritania and purchased by Darryl Pitt in July 2015 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh unbrecciated eucrite with intersertal texture composed of exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite, Ti-Al-bearing chromite and troilite.

Geochemistry: Orthopyroxene host ($\text{Fs}_{59.8-61.1}\text{Wo}_{1.7-1.8}$, $\text{FeO/MnO} = 34-35$, $N = 3$), clinopyroxene exsolution lamellae ($\text{Fs}_{23.8-24.7}\text{Wo}_{44.9-44.5}$, $\text{FeO/MnO} = 33-34$, $N = 3$).

Classification: Eucrite (unbrecciated).

Specimens: 21.3 g including one polished thin section at *UWB*; main mass with *DPitt*.

Northwest Africa 10409 (NWA 10409)

(Northwest Africa)

Purchased: 2011 Aug

Classification: Ordinary chondrite (L4)

History: Purchased in Temara, Morocco by Adam Aaronson in August 2011.

Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, slightly ellipsoidal chondrules (1.2 ± 0.8 mm) occur in a very sparse matrix.

Geochemistry: Olivine ($\text{Fa}_{23.1-24.5}$, $N = 4$), orthopyroxene ($\text{Fs}_{19.6-20.1}\text{Wo}_{0.8-1.6}$, $N = 3$), augite ($\text{Fs}_{9.2-11.6}\text{Wo}_{42.5-42.0}$, $N = 2$).

Classification: Ordinary chondrite (L4)

Specimens: 20.5 g including one polished thin section at *UWB*; main mass with *Aaronson*.

Northwest Africa 10410 (NWA 10410)

(Northwest Africa)

Purchased: 2015 Jun

Classification: HED achondrite (Diogenite)

History: Purchased by Aras Jonikas in June 2015 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh fragmental breccia composed predominantly of angular grains of orthopyroxene with minor olivine, chromite and troilite in a sparse matrix.

Geochemistry: Olivine ($\text{Fa}_{24.9-25.5}$, $\text{FeO/MnO} = 48-51$, $N = 2$), orthopyroxene ($\text{Fs}_{20.8}\text{Wo}_{1.3}$; $\text{Fs}_{29.6}\text{Wo}_{3.2}$; $\text{FeO/MnO} = 29-31$, $N = 2$).

Classification: Diogenite (breccia).

Specimens: 15.54 g including one polished thin section at *PSF*; main mass with Mr. A. Jonikas.

Northwest Africa 10411 (NWA 10411)

(Northwest Africa)

Purchased: 2015

Classification: HED achondrite (Howardite)

History: Purchased by John Higgins in August and September 2015 from Moroccan dealers.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia composed mostly of diogenite debris plus ~12 vol.% of eucrite clasts (with intersertal textures) and related debris. Minerals are orthopyroxene, chromite, exsolved pigeonite, calcic plagioclase, olivine, silica polymorph, chromite, ilmenite and troilite, plus rare zircon and Ni-free metal.

Geochemistry: Olivine ($\text{Fa}_{43.1-44.1}$, $\text{FeO/MnO} = 53-54$, $N = 2$), diogenitic orthopyroxene ($\text{Fs}_{22.1-24.4}\text{Wo}_{2.1-2.4}$, $\text{FeO/MnO} = 31$, $N = 3$), orthopyroxene host ($\text{Fs}_{52.4}\text{Wo}_{3.5}$, $\text{FeO/MnO} = 30$), clinopyroxene exsolution lamella ($\text{Fs}_{24.2}\text{Wo}_{39.0}$, $\text{FeO/MnO} = 26$), orthopyroxene host ($\text{Fs}_{40.6}\text{Wo}_{3.1}$, $\text{FeO/MnO} = 28$), clinopyroxene exsolution lamella ($\text{Fs}_{19.6}\text{Wo}_{42.1}$, $\text{FeO/MnO} = 27$).

Classification: Howardite.

Specimens: 26.9 g including one polished thin section at *UWB*; remainder with Mr. J. Higgins.

Northwest Africa 10412 (NWA 10412)

(Northwest Africa)

Purchased: 2009

Classification: Ordinary chondrite (H4-6)

History: One stone weighing 22.6 g was found in Morocco in 2009. David Holden acquired the sample from a meteorite prospector in Erfoud 2009.

Physical characteristics: The stone is dark brown and has a rounded-irregular shape. The stone is covered by a weathered patina. The stone is friable and the cut face of the interior of the stone is dark in color and displays small chondrules, chondrule fragments, dark clasts and weathered flakes of metal.

Petrography: Description and classification (A. Love, *App*): Sample is a breccia and composed of distinct chondrules and fragments, recrystallized chondritic clasts devoid of visible chondrules and shock-darkened fragments. Many chondrules are defined and have an average diameter of 0.46 ± 0.20 mm (N=66).

Geochemistry: (A. Love, *App*): Olivine $\text{Fa}_{19.5 \pm 1.3}$, N=12; Low Ca pyroxene $\text{Fs}_{17.8 \pm 1.9} \text{Wo}_{1.6 \pm 0.2}$, N=8.

Classification: Based on poorly equilibrated compositions of olivine and pyroxene and textures this is an ordinary chondrite breccia (H4-6, S2, W1).

Specimens: An endcut and one slice weighing 7.34 g, and a polished thin section are currently on deposit at *App*.

Northwest Africa 10413 (NWA 10413)

(Northwest Africa)

Purchased: 2014

Classification: Ordinary chondrite (L5)

History: One stone weighing 69.3 g was found in Morocco in 2014. David Holden acquired the sample from a meteorite prospector in Erfoud 2014.

Physical characteristics: The stone is brown and has a rounded-irregular shape. The stone is covered by a weathered patina. The interior of the stone is mottled with patches of secondary brown FeO cement with lighter patches and displays weathered flakes of metal and FeS.

Petrography: Description and classification (A. Love, *App*): Sample is a breccia composed of indistinct chondrules and fragments and clasts of recrystallized chondritic rock. Chondrules are poorly defined and have an average diameter of $943 \mu\text{m}$.

Geochemistry: (A. Love, *App*): Olivine $\text{Fa}_{24.9 \pm 0.3}$, N=8; Low Ca pyroxene $\text{Fs}_{20.7 \pm 0.2} \text{Wo}_{2.2 \pm 0.3}$, N=8.

Classification: Based on olivine and pyroxene compositions and texture, this is an ordinary chondrite breccia (L5, S2, W3).

Specimens: Three slices and small chips weighing 13.86 g, and a polished thin section are currently on deposit at *App*.

Northwest Africa 10414 (NWA 10414)

(Northwest Africa)

Purchased: 2015 Sept 1

Classification: Martian meteorite (Shergottite)

Physical characteristics: Small complete stone with the shape of a shield. The crust is granular-looking.

Petrography: (R. Hewins, S. Pont, B. Zanda, *MNHNP*) This meteorite consists of 77% weakly zoned pigeonite prisms, up to 4×1 mm in size, resembling a crystal mush. There is neither olivine nor augite present. The pigeonite is euhedral, highly fractured, with small feldspathic inclusions as well as ~ 200 nm exsolution lamellae. It is locally subophitic to plagioclase/maskelynite laths (~ 500 μ m) on its margins. The interstices (22%) contain Si-rich mesostasis glass as well as plagioclase/maskelynite. The latter has euhedral Ca-rich cores visible in enhanced BSE, and zonation, though in normal contrast it appears to be unfractured maskelynite. Raman spectra of this transparent material are dominated by peaks of adjacent pyroxene and phosphate, but weak broad peaks near 500 and 600 cm^{-1} characteristic of maskelynite can be seen. Spinel ($<1\%$) occurs mainly as inclusions in pigeonite. Accessory phases include ilmenite, merrillite, silica, baddeleyite and pyrrhotite, occurring on pigeonite margins or in interstitial feldspathic patches. There are small (~ 200 μ m) patches of heterogeneous shock melt at some pigeonite-maskelynite contacts, with interfingering or veining of this melt and maskelynite. Adjacent "pigeonite" is lamellar to fibrous.

Geochemistry: (R. Hewins, *MNHNP*) Pigeonite composition (mean, s.d.) is $\text{En}_{54.3 \pm 6.7} \text{Fs}_{36.2 \pm 5.5} \text{Wo}_{9.5 \pm 2.2}$, with Fe/Mn (atomic) 35.0 ± 7.1 . Data fall on and below the Fe-Mn trend line for SNC, with some excluded high Mn points apparently related to alteration. Plagioclase/maskelynite is $\text{An}_{46.4 \pm 4.1} \text{Ab}_{51.1 \pm 3.6} \text{Or}_{2.5 \pm 0.7}$, with a range of An_{54-36} . The Cr-Ti spinel has up to 55 mol% chromite, up to 48% ulvöspinel and up to 35% magnetite.

Classification: (R. Hewins, B. Zanda and S. Pont *MNHNP*) The meteorite is classified as Martian (shergottite). It is a basaltic shergottite, but is unusual in being a pigeonite cumulate with no olivine or augite.

Specimens: 8 g at *MNHNP*. The main mass is held by *Labenne*.

Northwest Africa 10415 (NWA 10415)

(Northwest Africa)

Purchased: 2015

Classification: Lunar meteorite (feldspathic breccia)

History: Aras Jonikas purchased three stones from a Moroccan dealer in Guelmim, in August 2015.

Physical characteristics: Three identical appearing stones, 144, 15, and 5 g, with eathered exteriors. A saw cut reveals prominent light-colored feldspathic clasts, also numerous dark-gray clasts, and some shock melt veins and vesicles.

Petrography: (C. Agee, *UNM*) This is a fragmental, cataclastic, shock-melted lunar meteorite. Numerous feldspar grains and scattered olivines and pyroxenes are present throughout. There are shock melt domains present with vesicles. Accessory troilite, chromite, and Fe-oxides were observed.

Geochemistry: (C. Agee and N. Muttik, *UNM*) olivine $\text{Fa}_{39.1 \pm 0.3}$, Fe/Mn= 104 ± 8 , n=2; pigeonite $\text{Fs}_{43.0 \pm 1.8} \text{Wo}_{8.9 \pm 0.8}$, Fe/Mn= 60 ± 5 , n=2; augite $\text{Fs}_{33.3 \pm 12.7} \text{Wo}_{35.0 \pm 6.5}$, Fe/Mn= 64 ± 5 , n=2 plagioclase $\text{An}_{96.8 \pm 0.3}$, n=2; Shock melt (20 μ m defocused electron beam, proxy for bulk meteorite composition): $\text{SiO}_2=46.2 \pm 1.2$, $\text{TiO}_2=0.17 \pm 0.13$, $\text{Al}_2\text{O}_3=31.6 \pm 4.4$, $\text{Cr}_2\text{O}_3=0.06 \pm 0.05$, $\text{MgO}=3.2 \pm 2.4$, $\text{FeO}=3.2 \pm 2.3$, $\text{MnO}=0.05 \pm 0.04$, $\text{CaO}=17.6 \pm 1.8$, $\text{NiO}=0.02 \pm 0.02$, $\text{Na}_2\text{O}=0.34 \pm 0.03$, $\text{K}_2\text{O}=0.10 \pm 0.04$ (all wt%), $\text{MgO}+\text{FeO}=6.5 \pm 4.7$ (wt%), n=5.

Classification: Lunar (feldspathic breccia), high alumina.

Specimens: 20.2 g including a probe mount on deposit at *UNM*, Aras Jonikas holds the main mass.

Northwest Africa 10416 (NWA 10416)

Mali

Purchased: April 2015

Classification: Martian meteorite

History: Reportedly found in Mali, purchased by Darryl Pitt.

Physical characteristics: Irregular, desert-varnished exterior without fusion crust. A saw cuts reveal green-orange olivine phenocrysts set in a groundmass of white plagioclase and light green pyroxene. Fine, dark, shock-melt veins are present.

Petrography: (C. Agee, *UNM*) This is an olivine basalt with ~10% olivine phenocrysts (~1 mm in diameter), and intergranular clinopyroxene (~50%) and labradorite plagioclase (~30%). The olivines and clinopyroxenes show igneous zoning. The clinopyroxenes have Mg-rich pigeonite cores and Fe, Ca-rich rims, some of the rims are augitic. Approximately ~10% of the plagioclase has been transformed to maskelynite. Maskelynite occurs primarily in contact with, or near shock melt veins. There is a significant amount of secondary alteration present in the olivines and plagioclase. The olivine alteration occurs primarily in the cores of grains, giving low microprobe totals, and is orange in color (olivine rims are unaltered, give normal totals, are transparent and green in color). The plagioclase alteration occurs in at least 50% of the grains observed, shows low microprobe totals, and depletion of Na and K relative to unaltered labradorite domains. Accessory ilmenite, Ti-Cr-Al-Fe spinel, chromite, and Fe-sulfide were observed throughout the sample.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{50.7 \pm 7.5}$, $\text{Fe/Mn} = 57 \pm 2$, $n=19$; clinopyroxene $\text{Fs}_{27.6 \pm 7.0} \text{Wo}_{9.7 \pm 8.0}$, $\text{Fe/Mn} = 32 \pm 2$, $n=128$; plagioclase $\text{An}_{63.5 \pm 4.3} \text{Ab}_{36.0 \pm 4.2} \text{Or}_{0.5 \pm 0.1}$, $n=9$. Shock melt vein (20 μm electron microprobe beam size) SiO_2 47.3 ± 2.3 , TiO_2 0.53 ± 0.25 , Cr_2O_3 0.42 ± 0.17 , Al_2O_3 15.9 ± 2.6 , MgO 10.2 ± 2.0 , FeO 14.1 ± 3.2 , MnO 0.33 ± 0.06 , NiO 0.01 ± 0.01 , CaO 8.8 ± 1.3 , Na_2O 1.56 ± 0.60 , K_2O 0.07 ± 0.3 , $n=26$. Bulk composition by quad ICPMS (L. Borg, LLNL) Mg 98729 ± 6562 , Al 31142 ± 1894 , Ca 46482 ± 3540 , Ti 3540 ± 180 , Mn 3687 ± 212 , Fe 132424 ± 8398 , La 0.22 ± 0.01 , Ce 0.59 ± 0.04 , Pr 0.11 ± 0.01 , Nd 0.79 ± 0.02 , Sm 0.61 ± 0.03 , Eu 0.35 ± 0.01 , Gd 1.16 ± 0.06 , Tb 0.30 ± 0.01 , Dy 2.15 ± 0.05 , Ho 0.46 ± 0.02 , Er 1.36 ± 0.04 , Tm 0.19 ± 0.01 , Yb 1.25 ± 0.06 , Lu 0.19 ± 0.01 (all ppm, 2-sd). Oxygen isotopes (K. Ziegler, *UNM*) were performed on two types of material: 1) relatively unaltered material and 2) altered material with many orange olivine fragments. All samples were acid-washed and analyzed by laser fluorination. 1) "Unaltered" material: $\delta^{18}\text{O} = 4.539, 4.445, 4.392, 4.740, 4.627, 4.310, 4.500$; $\delta^{17}\text{O} = 2.668, 2.674, 2.573, 2.760, 2.716, 2.500, 2.630$; $\Delta^{17}\text{O} = 0.271, 0.327, 0.254, 0.257, 0.273, 0.224, 0.254$; 2) "altered olivine" material: $\delta^{18}\text{O} = 4.592, 7.323, 6.592, 8.214, 7.012, 6.091$; $\delta^{17}\text{O} = 2.609, 4.041, 3.635, 4.471, 3.850, 3.353$; $\Delta^{17}\text{O} = 0.184, 0.174, 0.154, 0.134, 0.148, 0.137$ (linearized, all per mil).

Classification: Martian. This is a martian meteorite based on oxygen isotopes, Fe/Mn of clinopyroxene and olivine, and An-content of plagioclase. This martian meteorite is unlike shergottite basalts in that only about 10% of the plagioclase has been converted to maskelynite. Shock pressures appear to have been lower than for shergottites and in this regard it most resembles [NWA 8159](#). Like NWA 8159, this meteorite also shows a significant LREE-depletion. The altered olivine cores in this meteorite are inconsistent with terrestrial weathering which

would normally show chemical attack on the outer surfaces or along internal fractures. The unaltered and altered domains in this sample have different oxygen isotope values, unaltered material gives values that fall within the range of SNC meteorites, whereas altered olivine material shows a much wider range of $\delta^{18}\text{O}$ values (up to 8.214 permil).

Specimens: 31.0 g including several probe mounts and polished thin sections on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 10417 (NWA 10417)

Morocco

Purchased: 2015 May

Classification: Iron meteorite (IAB-MG)

History: A single specimen was purchased in May 2015 by Fabien Kuntz from a Moroccan dealer in Erfoud.

Petrography: (C. Herd and Y. Orui, *UAb*): Optical investigation and bandwidth measurement of a 3×3.5 cm polished and etched end slice reveals a well-developed Widmanstätten pattern consistent with a coarse octahedrite (average bandwidth = 1.7 ± 0.3 mm, $n = 43$). Plessite is common. One 4×9 mm troilite inclusion was observed.

Geochemistry: Bulk composition (C. Herd and G. Chen, *UAb*): Ni = 8.1 wt%, Co = 4.8 mg/g; Ir = 2.6, Pt = 5.6, Os = 2.0, Ru = 4.5, Rh = 1.1, Pd = 3.7, Au = 1.5, Ga = 89, As = 16.9, W = 0.8, Re = 0.2, Cu = 171 (all $\mu\text{g/g}$), obtained by solution ICP-MS using [North Chile](#) (Filomena) as an internal standard.

Classification: (C. Herd, *UAb*): IAB-MG, coarse octahedrite. Composition is consistent with IAB Complex, Main Group (MG), although Ni and As are slightly above the typical Main Group concentrations relative to those reported by [Wasson and Kallemeyn \(2002\)](#).

Specimens: Type specimen of 24.1 g, including a single, 18 g etched end slice, and several smaller pieces (one of which was used for ICP-MS analysis), at *UAb*. Main mass *Kuntz*.

Northwest Africa 10419 (NWA 10419)

(Northwest Africa)

Purchased: 2015

Classification: Primitive achondrite (Lodranite)

History: Purchased by Adam Aaronson in Morocco, 2015.

Physical characteristics: Weathered exterior. A saw cut reveals dark brown and orange crystals ~ 1 mm in diameter.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows 70% pyroxene grains and 20% olivine grains. Numerous metal and iron oxide veinlets throughout. Kamacite, taenite, chromite, troilite, and Cl-rich apatite detected, plagioclase is absent.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fe}_{7.5 \pm 0.9}$, $\text{Fe/Mn} = 15 \pm 1$, $n = 7$; low-Ca pyroxene $\text{Fs}_{11.0 \pm 0.1}$ $\text{Wo}_{3.1 \pm 0.2}$, $\text{Fe/Mn} = 13 \pm 1$, $n = 4$; diopside $\text{Fs}_{5.5 \pm 0.4}$ $\text{Wo}_{41.2 \pm 1.1}$, $\text{Fe/Mn} = 9 \pm 0$, $\text{Cr}_2\text{O}_3 = 1.54 \pm 0.02$ (wt%), $n = 2$.

Classification: Lodranite, not an acapulcoite, based on relatively coarse grain size and absence of plagioclase.

Specimens: 26 g including a probe mount on deposit at *UNM*, *Aaronson* holds the main mass.

Northwest Africa 10420 (NWA 10420)

(Northwest Africa)

Purchased: 2015

Classification: Ordinary chondrite (H5)

History: Purchased by Adam Aaronson in Morocco, 2015.

Physical characteristics: Weathered exterior. A saw cut reveals many small, closely packed chondrules set in a dark brown matrix.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows small chondrules typical of H-chondrites. Abundant metal and oxidized metal throughout.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{18.2\pm0.2}$, $\text{Fe/Mn}=37\pm1$, $n=24$; low-Ca pyroxene $\text{Fs}_{16.4\pm0.4}\text{Wo}_{1.5\pm0.5}$, $\text{Fe/Mn}=22\pm1$, $n=12$.

Classification: Ordinary chondrite (H5).

Specimens: 20.1 g including a probe mount on deposit at *UNM*, main mass *Aaronson*

Northwest Africa 10421 (NWA 10421)

(Northwest Africa)

Purchased: 2015

Classification: Rumuruti chondrite (R6)

History: Purchased by Adam Aaronson in Morocco, 2015.

Physical characteristics: Fusion crusted exterior. Broken surface reveals dark-gray interior with some small reflective opaque grains.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows and unbrecciated texture with rare relict chondrules. Fe-Ni sulfide, troilite, Ti-rich Cr-spinel, and phosphates observed. There is an overabundance of high-Ca pyroxene to low-Ca pyroxene. Scattered plagioclase with some grains up to 150 μm present.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{39.6\pm0.2}$, $\text{Fe/Mn}=84\pm3$, $\text{NiO}=0.20\pm0.08$ (wt%), $n=12$; low-Ca pyroxene $\text{Fs}_{28.5\pm2.5}\text{Wo}_{1.3\pm0.3}$, $\text{Fe/Mn}=55\pm3$, $n=4$; high-Ca pyroxene $\text{Fs}_{11.9\pm0.5}\text{Wo}_{45.1\pm0.4}$, $\text{Fe/Mn}=46\pm6$, $n=8$.

Classification: Rumuruti chondrite (R6) based on Fa, Fe/Mn, and Ni content of olivine, presence of nickel bearing sulfide and Ti-rich spinel. The abundance of high-Ca pyroxene over low-Ca pyroxene is consistent with a metamorphosed (equilibrated) R-chondrite.

Specimens: 20.5 g including a probe mount on deposit at *UNM*, *Aaronson* holds the main mass.

Northwest Africa 10422 (NWA 10422)

(Northwest Africa)

Purchased: 2015

Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Adam Aaronson in Morocco, 2015.

Physical characteristics: Fusion crusted exterior. Broken surface reveals a typical HED breccia with light and dark-gray clasts.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows a mildly brecciated texture with approximately 60% pyroxene and 35% plagioclase. Many pyroxenes show distinct exsolution lamellae. Low-Ni iron metal, troilite, Ti-chromite, ilmenite and silica were observed. Some fine shock melt veins are present.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Low-Ca pyroxene $\text{Fs}_{65.5\pm0.5}\text{Wo}_{2.1\pm0.3}$, $\text{Fe/Mn}=32\pm1$, $n=6$; high-Ca pyroxene $\text{Fs}_{29.6\pm0.7}\text{Wo}_{42.7\pm0.4}$, $\text{Fe/Mn}=33\pm1$, $n=6$; plagioclase $\text{An}_{88.1\pm0.5}$, $n=3$.

Classification: Eucrite monomict. Equilibrated, with clear compositional separation of low-Ca and high-Ca pyroxene.

Specimens: 9 g including a probe mount on deposit at *UNM*, *Aaronson* holds the main mass.

Northwest Africa 10423 (NWA 10423)

Morocco, (Northwest Africa)

Purchased: Feb 2015

Classification: HED achondrite (Eucrite, cumulate)

History: A single stone of 21 g was found by nomads in Western Sahara and purchased by Giorgio Tomelleri at the Erfoud market in 2015.

Physical characteristics: The main mass has no fusion crust.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): A cumulate eucrite mainly consisting of large (120-190 μm in width) orthopyroxene crystals and minor clinopyroxene and anorthitic plagioclase 100-200 μm wide crystals. Orthopyroxene crystals occasionally display very fine to fine augite exsolution lamellae ranging from 2 to 8 μm in width. Minor phases include ilmenite and chromite.

Geochemistry: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*) Calcic plagioclase $\text{An}_{84.3\pm1}\text{Or}_{0.8\pm0.1}$, $n=8$, low-Ca pyroxene ($\text{Fs}_{61.9\pm1.4}\text{En}_{35.6\pm1.2}\text{Wo}_{2.6\pm0.1}$; $n=6$; $\text{Fe/Mn}=36.76\pm0.13$); pigeonite ($\text{Fs}_{52.1\pm1.4}\text{En}_{34.8\pm1.2}\text{Wo}_{13.1\pm0.8}$; $n=7$; $\text{Fe/Mn}=34.02\pm0.12$); augite exsolution lamellae in low-Ca pyroxene ($\text{Fs}_{27.5\pm1.2}\text{En}_{30.3\pm1.3}\text{Wo}_{42.2\pm1.8}$; $n=7$; $\text{Fe/Mn}=32.21\pm0.11$). Oxygen isotopes: (I. Franchi, R. Greenwood, *OU*) $\delta^{17}\text{O}=2.23\text{‰}$, $\delta^{18}\text{O}=4.69\text{‰}$, $\Delta^{17}\text{O}=-0.204\text{‰}$.

Classification: Eucrite-cm with low degree of shock and low degree of weathering.

Specimens: A total of 4.7 g specimen and one thin section is on deposit at MSN-Fi. Main mass with Giorgio Tomelleri

Northwest Africa 10424 (NWA 10424)

Morocco

Purchased: Feb 2015

Classification: HED achondrite (Eucrite, cumulate)

History: A single stone of 58 g was found by nomads in Western Sahara and purchased by Giorgio Tomelleri at the Erfoud market in 2015.

Physical characteristics: The main mass has no fusion crust.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): A cumulate eucrite mainly consisting of orthopyroxene crystals, 90-210 μm in width and mostly displaying augite exsolution lamellae, with clinopyroxene and anorthitic plagioclase. Exsolution lamellae range from 2 to 10 μm in width. Minor phases include ilmenite and chromite.

Geochemistry: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*) Calcic plagioclase $\text{An}_{83.7\pm1.2}\text{Or}_{1.3\pm0.1}$, $n=7$, low-Ca pyroxene ($\text{Fs}_{63.7\pm1.3}\text{En}_{34.4\pm1.2}\text{Wo}_{1.9\pm0.1}$; $n=7$; $\text{Fe/Mn}=33.79\pm0.11$); pigeonite ($\text{Fs}_{59.0\pm1.2}\text{En}_{34.1\pm1.1}\text{Wo}_{6.9\pm0.6}$; $n=8$; $\text{Fe/Mn}=39.37\pm0.11$); augite exsolution lamellae in low-Ca pyroxene ($\text{Fs}_{34.4\pm1.1}\text{En}_{30.4\pm0.9}\text{Wo}_{35.2\pm1.8}$; $n=8$; $\text{Fe/Mn}=37.49\pm0.12$). Oxygen isotopes: (I. Franchi, R. Greenwood, *OU*) $\delta^{17}\text{O}=1.95\text{‰}$, $\delta^{18}\text{O}=4.18\text{‰}$, $\Delta^{17}\text{O}=-0.229\text{‰}$.

Classification: Eucrite-cm with low degree of shock and low degree of weathering.

Specimens: A total of 11.8 g specimen and one thin section is on deposit at MSN-Fi. Main mass with Giorgio Tomelleri.

Northwest Africa 10435 (NWA 10435)

(Northwest Africa)

Purchased: 2014

Classification: Ordinary chondrite (L5)

History: 1 stone weighing 98.0 g was found in Morocco in 2014. David Holden acquired the sample from a meteorite prospector in Erfoud, 2014.

Physical characteristics: The stone is dark brown and has a rounded-irregular shape. The stone is covered by a weathered patina. The cut face of the interior of the stone is dark in color and displays small chondrules, chondrule fragments, dark clasts and weathered flakes of metal.

Petrography: Description and classification (A. Love, *App*): Sample displays recrystallized chondritic texture crosscut by glassy, shock veins. Few chondrules are defined and have an average diameter of 806.26 μm . Ellipsoidal chondrules define a preferred orientation.

Geochemistry: (A. Love, *App*): Olivine $\text{Fa}_{24.9\pm0.3}$, $N=8$; Low Ca pyroxene $\text{Fs}_{20.9\pm0.7}\text{Wo}_{1.9\pm0.3}$, $N=7$

Classification: Based on equilibrated compositions of olivine and pyroxene and textures this is an ordinary chondrite (L5, S4, W5).

Specimens: An endcut and two slices weighing 21.1 g, and a polished thin section are currently on deposit at *App*.

Northwest Africa 10437 (NWA 10437)

(Northwest Africa)

Purchased: April 2015

Classification: Ordinary chondrite (H5)

History: Purchased by team eegooblago (Brahim Tahiri, Dustin Dickens and Sean Tutorow) while on expedition in Northwest Africa and Western Sahara in April and May 2015.

Physical characteristics: Single stone, weathered exterior, saw cuts reveal many small chondrules and metal/sulfide grains set in reddish brown groundmass.

Petrography: (C. Agee, *UNM*) This meteorite has distinct chondrules and fine-grained plagioclase ($<50\text{ }\mu\text{m}$) throughout. Kamacite, taenite, and a phosphate phase observed.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{19.6\pm0.2}$, $\text{Fe/Mn}=39\pm2$, $n=7$; low-Ca pyroxene $\text{Fs}_{17.4\pm0.1}\text{Wo}_{1.5\pm0.2}$, $\text{Fe/Mn}=23\pm1$, $n=5$.

Classification: Ordinary chondrite (H5)

Specimens: 21.06 g including a probe mount on deposit at *UNM*, Sean Tutorow holds the main mass.

Northwest Africa 10438 (NWA 10438)

(Northwest Africa)

Purchased: May 2015

Classification: HED achondrite (Eucrite, unbrecciated)

History: Purchased by team eegooblago (Brahim Tahiri, Dustin Dickens and Sean Tutorow) while on expedition in Northwest Africa and Western Sahara in April and May 2015.

Physical characteristics: Single stone (consisting of 4 broken pieces that fit together), weathered exterior. A saw cuts reveal a light-colored mix of millimeter-sized plagioclase and pyroxene crystals, some weathering veins present.

Petrography: (C. Agee, *UNM*) This meteorite consists of ~60% pyroxene and ~35% plagioclase. Many pyroxene grains show fine exsolution lamellae. Troilite, Ti-chromite, ilmenite and silica observed.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Pigeonite $\text{Fs}_{61.1\pm0.3}\text{Wo}_{6.6\pm0.2}$, $\text{Fe/Mn}=29\pm1$, $n=4$; augite $\text{Fs}_{32.1\pm0.6}\text{Wo}_{40.4\pm0.4}$, $\text{Fe/Mn}=29\pm0$, $n=3$.

Classification: Unbrecciated eucrite. Equilibrated, clear compositional separation of pigeonite and augite.

Specimens: 28.95 g including a probe mount on deposit at *UNM*, Sean Tutorow holds the main mass.

Northwest Africa 10439 (NWA 10439)

(Northwest Africa)

Purchased: April 2015

Classification: HED achondrite (Howardite)

History: Purchased by team eegooblago (Brahim Tahiri, Dustin Dickens and Sean Tutorow) while on expedition in Northwest Africa and Western Sahara in April and May 2015.

Physical characteristics: Single stone, weathered exterior. A saw cuts reveal plagioclase and pyroxene clasts up to 3 mm set in a light gray groundmass.

Petrography: (C. Agee, *UNM*) This is a fragmental, polymict breccia consisting of approximately 40% diogenite and 60% eucrite lithologies, based on pyroxene compositions. Troilite, chromite, ilmenite and silica observed.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Diogenite low-Ca pyroxene $\text{Fs}_{31.1\pm3.8}\text{Wo}_{3.7\pm1.5}$, $\text{Fe/Mn}=30\pm1$, $n=6$; cumulate eucrite low-Ca pyroxene $\text{Fs}_{40.2\pm1.1}\text{Wo}_{4.7\pm4.9}$, $\text{Fe/Mn}=29\pm4$, $n=2$; basaltic eucrite low-Ca pyroxene $\text{Fs}_{56.8\pm2.0}\text{Wo}_{4.7\pm2.1}$, $\text{Fe/Mn}=31\pm1$, $n=6$; basaltic eucrite high-Ca pyroxene $\text{Fs}_{25.2\pm2.9}\text{Wo}_{42.5\pm0.7}$, $\text{Fe/Mn}=30\pm2$, $n=2$; plagioclase $\text{An}_{88.8\pm2.0}$, $n=3$.

Classification: Howardite

Specimens: 20.16 g including a probe mount on deposit at *UNM*, Sean Tutorow holds the main mass.

Northwest Africa 10440 (NWA 10440)

(Northwest Africa)

Purchased: April 2015

Classification: HED achondrite (Howardite)

History: Purchased by team eegooblago (Brahim Tahiri, Dustin Dickens and Sean Tutorow) while on expedition in Northwest Africa and Western Sahara in April and May 2015.

Physical characteristics: Single stone, fusion crust. A saw cuts reveal dark gray and green clasts up to 3 mm set in a light gray groundmass.

Petrography: (C. Agee, *UNM*) This is a fragmental, polymict breccia consisting of approximately 60% diogenite and 40% eucrite lithologies, based on pyroxene compositions. Troilite, chromite, Fe-metal, and silica observed.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Diogenite low-Ca pyroxene $\text{Fs}_{27.4\pm4.2}\text{Wo}_{3.7\pm2.9}$, $\text{Fe/Mn}=29\pm3$, $n=7$; eucrite pigeonite $\text{Fs}_{54.4\pm3.7}\text{Wo}_{10.8\pm7.2}$, $\text{Fe/Mn}=33\pm1$, $n=4$; plagioclase $\text{An}_{75.6\pm14.0}$, $n=3$; olivine $\text{Fa}_{37.1}$, $\text{Fe/Mn}=51$, $n=1$.

Classification: Howardite

Specimens: 20.8 g including a probe mount on deposit at *UNM*, Sean Tutorow holds the main mass.

Northwest Africa 10441 (NWA 10441)

(Northwest Africa)

Purchased: April 2015

Classification: Martian meteorite (Shergottite)

History: Purchased by team eegooblago (Brahim Tahiri, Dustin Dickens and Sean Tutorow) while on expedition in Northwest Africa and Western Sahara in April and May 2015.

Physical characteristics: Six indential appearing stones with no fusion crust. Saw-cut surfaces show an intergranular mix of light-green pyroxene and maskelynite. Dark colored melt veins and pockets are prominent, with most showing significant vesiculation.

Petrography: (C. Agee, *UNM*) This meteorite consists of ~50% pyroxene, ~30% maskelynite, and ~15% shock melt. Pyroxenes show igneous zoning, and some are partially melted from shock. Shock melt domains are up to 1 cm wide and many contain vesicles 1-3 mm in diameter. All plagioclase has been transformed to maskelynite. Fe-sulfide, Ti-magnetite, ilmenite, and silica observed.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Pigeonite $\text{Fs}_{49.5\pm 9.2}\text{Wo}_{15.7\pm 3.3}$, $\text{Fe/Mn}=36\pm 3$, $n=31$; augite $\text{Fs}_{28.4\pm 6.7}\text{Wo}_{33.3\pm 2.0}$, $\text{Fe/Mn}=32\pm 3$, $n=33$; maskelynite $\text{An}_{53.8\pm 1.7}\text{Ab}_{44.2\pm 2.0}\text{Or}_{2.1\pm 0.7}$.

Classification: Martian (shergottite).

Specimens: 20.5 g including a probe mount on deposit at *UNM*, Sean Tutorow holds the main mass.

Northwest Africa 10442 (NWA 10442)

(Northwest Africa)

Purchased: April 2015

Classification: Ordinary chondrite (H3)

History: Purchased by team eegooblago (Brahim Tahiri, Dustin Dickens and Sean Tutorow) while on expedition in Northwest Africa and Western Sahara in April and May 2015.

Physical characteristics: Single stone, weathered exterior. Saw cuts reveal many densely packed chondrules set in a dark brown groundmass.

Petrography: (C. Agee, *UNM*) Numerous porphyritic chondrules are present in a primarily opaque matrix. FeNi-metal, iron oxide, and troilite observed.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{18.6\pm 2.1}$, $\text{Fe/Mn}=37\pm 4$, $n=12$; low-Ca pyroxene $\text{Fs}_{17.3\pm 3.0}\text{Wo}_{1.7\pm 0.9}$, $\text{Fe/Mn}=23\pm 5$, $n=3$; aluminous pyroxene $\text{Fs}_{13.6\pm 2.4}\text{Wo}_{9.3\pm 7.8}$, $\text{Fe/Mn}=32\pm 8$, $n=3$.

Classification: Ordinary chondrite (H3), estimated 3.9 subtype from mean Fa-content and 1-sd.

Specimens: 20.35 g including a probe mount on deposit at *UNM*, Sean Tutorow holds the main mass.

Northwest Africa 10443 (NWA 10443)

(Northwest Africa)

Purchased: 2015 Jul

Classification: Carbonaceous chondrite (CK3)

History: Purportedly found in Mauritania and purchased by Darryl Pitt in July 2015 from a Moroccan dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Separated, well-formed chondrules (apparent diameter 1.9 ± 1.0 mm; one 10 mm $\times$ 7 mm) with grains of stained Cr-magnetite are set in an orange-brown matrix containing intermediate plagioclase, calcite and minor barite.

Geochemistry: Olivine ($\text{Fa}_{7.7-41.6}$, $\text{FeO/MnO} = 89-126$, $N = 3$), orthopyroxene ($\text{Fs}_{25.2-28.9}\text{Wo}_{0.7-3.0}$, $N = 3$), augite ($\text{Fs}_{12.3}\text{Wo}_{45.7}$; $\text{Fs}_{22.2}\text{Wo}_{50.5}$, $N = 2$).

Classification: Carbonaceous chondrite (CK3). Possibly paired with NWA 10405 based on distinctive textures, similar silicate compositions and presence of secondary calcite.

Specimens: 22 g including one polished thin section at *UWB*; main mass with *DPitt*.

Northwest Africa 10444 (NWA 10444)

(Northwest Africa)

Purchased: 2015 May

Classification: HED achondrite (Howardite)

History: Purchased by Fabien Kuntz in May 2015 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh fragmental breccia containing some basaltic eucrite clasts but mostly composed of related mineral fragments plus some diagenetic orthopyroxene (~12 vol.%). Minerals include calcic plagioclase, exsolved pigeonite, fayalite, Ti-Al-chromite, troilite and ilmenite (some in intergrowths with Ni-free metal, troilite and silica polymorph).

Geochemistry: Orthopyroxene host ($\text{Fs}_{61.0}\text{Wo}_{3.3}$, $\text{FeO/MnO} = 30$), augite exsolution lamella ($\text{Fs}_{28.3}\text{Wo}_{42.4}$, $\text{FeO/MnO} = 29$), augite host ($\text{Fs}_{30.5}\text{Wo}_{39.8}$, $\text{FeO/MnO} = 30$), low-Ca pyroxene exsolution lamella ($\text{Fs}_{56.4}\text{Wo}_{7.7}$, $\text{FeO/MnO} = 29$), diagenetic orthopyroxene ($\text{Fs}_{27.9}\text{Wo}_{3.6}$; $\text{Fs}_{42.4}\text{Wo}_{1.9}$; $\text{FeO/MnO} = 30\text{--}31$, $N = 2$), fayalitic olivine ($\text{Fa}_{70.8\text{--}72.7}$, $\text{FeO/MnO} = 44\text{--}45$, $N = 2$).

Classification: Howardite.

Specimens: 21.72 g including one polished thin section at *PSF*; remainder with *Kuntz*.

Northwest Africa 10446 (NWA 10446)

(Northwest Africa)

Purchased: 2014 Apr

Classification: HED achondrite (Diogenite)

History: Purchased by Bob Falls in April 2014 from a dealer in Zagora, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Composed predominantly of orthopyroxene (exhibiting undulose extinction) with accessory silica polymorph, chromite, stained Ni-free metal and troilite.

Geochemistry: Orthopyroxene ($\text{Fs}_{25.9\text{--}26.2}\text{Wo}_{2.5\text{--}2.0}$, $\text{FeO/MnO} = 28\text{--}29$, $N = 3$).

Classification: Diogenite.

Specimens: 20.2 g including one polished thin section at *UWB*; remainder with Mr. R. Falls.

Northwest Africa 10447 (NWA 10447)

(Northwest Africa)

Purchased: 2015 May

Classification: Lunar meteorite (feldspathic breccia)

History: Purportedly found with other similar stones near Al Mahbas, southern Morocco, and purchased by Fabien Kuntz in May 2015 from a dealer in Agadir, Morocco.

Physical characteristics: A single small stone (21.73 g) lacking fusion crust. The interior exhibits white, pale orange and light gray clasts set in a gray matrix (~25 vol.%).

Petrography: (A. Irving and S. Kuehner, *UWS*) Fragmental breccia composed of mineral clasts of anorthite, olivine, pigeonite, augite, subcalcic augite, ferropigeonite, fayalite, silica polymorph, Ti-Al-chromite, ilmenite, troilite and rare baddeleyite in a finer grained matrix.

Geochemistry: Olivine ($\text{Fa}_{37.0\text{--}39.9}$, $\text{FeO/MnO} = 97$, $N = 2$), pigeonite ($\text{Fs}_{29.1}\text{Wo}_{11.7}$, $\text{FeO/MnO} = 55$), ferropigeonite ($\text{Fs}_{65.9}\text{Wo}_{7.3}$, $\text{FeO/MnO} = 70$), subcalcic augite ($\text{Fs}_{20.5}\text{Wo}_{25.4}$; $\text{Fs}_{64.7}\text{Wo}_{25.2}$;

FeO/MnO = 55-70), augite ($\text{Fs}_{31.6}\text{Wo}_{37.5}$, FeO/MnO = 74), fayalite ($\text{Fa}_{73.9}$, FeO/MnO = 106), plagioclase ($\text{An}_{91.1-91.4}\text{Or}_{0.1-0.4}$, N = 2). Bulk composition (R. Korotev, *WUSL*): INAA of subsamples gave the following mean abundances (in wt.%) FeO 15.3, Na_2O 0.30; (in ppm) Sc 30.2, Ni 140, La 5.0, Sm 2.47, Eu 0.67, Yb 1.9, Lu 0.28, Hf 1.8, Th 0.8.

Classification: Lunar (feldspathic breccia).

Specimens: 4.44 g including a polished endcut at *PSF*; remainder with *Kuntz*.

Northwest Africa 10448 (NWA 10448)

(Northwest Africa)

Purchased: 2015 May

Classification: Carbonaceous chondrite (CV3)

History: Purchased by Fabien Kuntz in May 2015 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Separated chondrules (apparent diameter 1.5 ± 1.2 mm, some rimmed) plus fine-grained CAI (up to 6 mm across) are set in a red-brown matrix (~40 vol.%).

Geochemistry: Olivine ($\text{Fa}_{0.7-74.0}$, N = 3), orthopyroxene ($\text{Fs}_{0.7-0.8}\text{Wo}_{0.8-0.9}$, N = 3), augite ($\text{Fs}_{0.9}\text{Wo}_{37.6}$; $\text{Fs}_{1.4}\text{Wo}_{49.1}$; N = 2).

Classification: Carbonaceous chondrite (CV3).

Specimens: 23.12 g including one polished thin section at *PSF*; remainder with *Kuntz*.

Northwest Africa 10449 (NWA 10449)

(Northwest Africa)

Purchased: 2015 May

Classification: Carbonaceous chondrite (CK6)

History: Purchased by Fabien Kuntz in May 2015 from a dealer in Erfoud, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Mostly recrystallized with some indistinct chondrules containing Cr-magnetite (partly altered to red-brown oxyhydroxides).

Geochemistry: Olivine ($\text{Fa}_{33.5-34.5}$, FeO/MnO = 102-124, N = 3), clinopyroxene ($\text{Fs}_{6.0-7.1}\text{Wo}_{50.0-49.8}$, N = 2).

Classification: Carbonaceous chondrite (CK6).

Specimens: 2.51 g including one polished thin section at *PSF*; main mass with *Kuntz*.

Northwest Africa 10450 (NWA 10450)

Algeria

Purchased: 2015 May

Classification: Martian meteorite (Shergottite)

History: Purchased by Pierre-Marie Pelé in May 2015 from a dealer in Rissani, Morocco.

Purportedly found in the same Algerian strewnfield as [NWA 2975](#), located in the Tanezrouft region near the Mali border.

Physical characteristics: A batch of several small, fusion crusted stones.

Petrography: (A. Irving and S. Kuehner, *UWS*) Intersertal texture. Composed predominantly of zoned clinopyroxene and maskelynite with accessory ilmenite, ulvöspinel and pyrrhotite.

Pyroxenes contain sparse melt inclusions consisting of K-rich glass + ulvöspinel + merrillite.

Geochemistry: Pigeonite ($\text{Fs}_{33.1-60.2}\text{Wo}_{13.7-14.8}$, FeO/MnO = 31-37, N = 3), high-Ca pyroxene ($\text{Fs}_{24.4-47.2}\text{Wo}_{32.0-25.2}$, FeO/MnO = 29-36, N = 3), plagioclase ($\text{An}_{41.1-44.5}\text{Or}_{2.8-2.4}$, N = 2).

Classification: Martian (shergottite). Paired with NWA 2975 and many others.

Specimens: 5.29 g stone with one polished face at *PSF*; remaining material held by Mr. P. Pelé.

Northwest Africa 10451 (NWA 10451)

Morocco

Purchased: 2014 May 26

Classification: HED achondrite (Diogenite)

History: The history of the sample is unknown. It was purchased from Abdeliah Alfiniss.

Physical characteristics: The small sample is covered with fusion crust.

Petrography: The meteorite is a diogenite monomict breccia composed of more than 95% orthopyroxene, with minor olivine, clinopyroxene, plagioclase, and chromite. Crystals range from 1-5 mm and are surrounded by crushed and fractured grains. Mineral grains are homogenous and show no exsolution features.

Classification: Diogenite

Specimens: 5.5 g at *SI*

Northwest Africa 10452 (NWA 10452)

Morocco

Purchased: 2014 May 26

Classification: HED achondrite (Eucrite)

History: The history of the meteorite is unknown, except that it was purchased by L. A. Taylor from Abdellah Alfiniss.

Physical characteristics: The small stone is dark and covered by fusion crust.

Petrography: The meteorite consists of 37% low-Ca pyroxene, 15% high-Ca pyroxene, 44% plagioclase, 3% silica, and less than 1% minor minerals (troilite, ilmenite, chromite, and apatite). The rock has a subophitic, non-brecciated texture, but is highly fractured. Grain sizes extend up to 2 mm.

Geochemistry: Pigeonite $\text{Fs}_{59\pm2}\text{Wo}_{3\pm1}$ ($n=20$), Augite $\text{Fs}_{11\pm1}\text{Wo}_{30\pm2}$ ($n=13$). Plagioclase is $\text{An}_{82\pm3}$ ($n=18$).

Classification: The meteorite is an unusual basaltic eucrite, with higher high-Ca pyroxene than in other meteorites of this class.

Specimens: 4.0 g at *SI*

Northwest Africa 10453 (NWA 10453)

(Northwest Africa)

Purchased: Feb 2002

Classification: Ordinary chondrite (H6)

History: Donated to *Cascadia* on May 24, 2002 by Edwin *Thompson*, who obtained the meteorite in February 2002 at the Tucson Gem and Mineral Show from a Moroccan trader.

Physical characteristics: Fusion crust with hairline fractures or partly removed by abrasion covers the hand specimen.

Petrography: Granoblastic textured specimen with ~10% metal showing poorly defined chondrules.

Geochemistry: (K. Farley and A. Ruzicka, *Cascadia*) Olivine ($\text{Fa}_{19.1\pm0.4}$, $N=14$), low-Ca pyroxene ($\text{Fs}_{17.0\pm0.4}\text{Wo}_{2.2\pm0.4}\text{En}_{80.8\pm0.7}$, $N=13$), plagioclase ($\text{Ab}_{82.6\pm0.7}\text{Or}_{3.6\pm0.6}\text{An}_{13.7\pm0.6}$, $N=6$).

Classification: H6 chondrite based on mineral chemistry, texture and metal content.

Specimens: *Cascadia* holds 14.0 g in three pieces, in addition to one polished thin section.

Northwest Africa 10454 (NWA 10454)

(Northwest Africa)

Purchased: Feb 2004

Classification: Ordinary chondrite (L5/6)

History: Purchased by Dick Pugh from a Moroccan trader during the February 2004 Gem and Mineral Show in Tucson, Arizona. Pieces were donated to *Cascadia* in 2004 and the remaining mass in 2014.

Physical characteristics: Fragmented hand specimen partly covered with a thin fusion crust and partly covered by caliche. Cut and polished face reveals lighter-colored granoblastic clasts cut by veins, set in a larger portion of darker host that includes chondrules and fragments and small patches of apparent dark-gray shock melt.

Petrography: Host consists of numerous, readily delineated chondrules (0.71 ± 0.35 mm diameter) set against a translucent to transparent matrix. Somewhat coarse feldspar (length 51 ± 23 μ m, range 23-123 μ m, N=43) within and around chondrules. Rust stains occur around metal (~6% overall in rock), but metal is largely unaffected by weathering.

Geochemistry: (K. Farley and A. Ruzicka, *Cascadia*) Olivine ($\text{Fa}_{25.9 \pm 0.8}$, Fe/Mn = 49.0 ± 4.5 at., N = 27), low-Ca pyroxene ($\text{Fs}_{21.7 \pm 0.3} \text{Wo}_{1.9 \pm 0.1} \text{En}_{76.5 \pm 0.3}$, Fe/Mn = 29.0 ± 2.3 at., N = 23), feldspar ($\text{Ab}_{83.8 \pm 1.0} \text{An}_{11.5 \pm 1.1} \text{Or}_{4.7 \pm 1.1}$, N = 6).

Classification: L5/6 based on mineral chemistry, metal content, chondrule size, and textures. Feldspar grain size consistent with type 5/6 transition.

Specimens: *Cascadia* holds the entire sample which includes two specimens of mass 214.9 g and 22.5 g, as well as one polished thin section and one potted butt.

Northwest Africa 10455 (NWA 10455)

(Northwest Africa)

Purchased: Feb 2004

Classification: Ordinary chondrite (L6)

History: Obtained by Edwin Thompson from a Moroccan Trader in Tucson, Arizona, at the February 2004 Tucson Gem and Mineral Show. Samples acquired by *Cascadia* in February 2004 and October 2015.

Physical characteristics: Exterior is partly black and shiny, and partly reddish. The cut face displays an obvious breccia texture with light brown stained clasts (up to 1 cm across) separated by dark veins of various thickness.

Petrography: Clasts with granoblastic texture and highly indistinct chondrule boundaries are enclosed in numerous dark melt veins up to 1 mm thick, which occupy up to ~30% of the rock. Maskelynite occurs close to veins. Feldspathic phases often >50 μ m across. Metal grains are heavily weathered, but troilite is mostly unweathered. About 4% metal overall (remaining).

Geochemistry: (K. Farley and A. Ruzicka, *Cascadia*) Olivine ($\text{Fa}_{26.0 \pm 0.4}$, Fe/Mn = 48.9 ± 4.5 at., N = 20), low-Ca pyroxene ($\text{Fs}_{21.7 \pm 0.4} \text{Wo}_{1.6 \pm 0.2} \text{En}_{76.7 \pm 0.4}$, Fe/Mn = 28.3 ± 2.0 at., N = 13), feldspar ($\text{Ab}_{74.2 \pm 6.7} \text{An}_{16.0 \pm 3.4} \text{Or}_{9.9 \pm 3.5}$, N = 7).

Classification: Veined L6 chondrite based on textures, mineral chemistry, and metal volume.

Specimens: *Cascadia* holds the entire sample, including 103.4 g in two pieces as well as two polished thin sections and two potted butts.

Northwest Africa 10456 (NWA 10456)

(Northwest Africa)

Purchased: Feb 2002

Classification: Ordinary chondrite (L4)

History: Purchased from a Moroccan trader at the Tucson show in February 2002; 22.2 g slice donated to *Cascadia* on July 2, 2012.

Physical characteristics: Fusion crust covers ~90% of the surface; all exterior surfaces show brown-red weathering patina; cut faces show chondritic texture.

Petrography: Composed of well-defined chondrules (diameter 0.73 ± 0.41 mm, N=77), some with fine-grained rims, and ~20% intervening opaque to translucent fine-grained matrix. Contains ~2-3% metal + troilite each, with ~40-50% metal and ~40% troilite weathered. Shock stage S4 (N=25 olivine grains). One $\sim 2 \times 1$ mm inclusion, an apparent clast, contains chondrule and silicate fragments and a spinel-rich micro-CAI (~ 60 μ m across) embedded in troilite.

Geochemistry: (M. Ream and A. Ruzicka, *Cascadia*) Olivine ($\text{Fa}_{24.2 \pm 0.4}$, N=30), low-Ca pyroxene ($\text{Fs}_{15.2 \pm 5.7} \text{Wo}_{1.4 \pm 1.8} \text{En}_{83.4 \pm 6.0}$, N=19).

Classification: L4 chondrite based on texture and mineral chemistry.

Specimens: *Cascadia* holds a 19.6 g slice, a polished thin section, and a mounted butt. Bob Falls holds the main mass.

Northwest Africa 10457 (NWA 10457)

(Northwest Africa)

Purchased: 2013

Classification: Ordinary chondrite (L6)

History: Purchased in 2013 by John Shea. Samples were donated to *Cascadia* in October, 2014.

Physical characteristics: Reddish weathering patina and patchy fusion crust occur on rough exterior surfaces, and faint chondritic texture is visible in cut faces.

Petrography: Granoblastic textured specimen showing poorly-defined chondrules and feldspar often >50 μ m across in a reddish stained section. Chondrule diameter 0.73 ± 0.21 mm (N=8). Contains ~2-3% metal, with $<40\%$ of metal and troilite replaced by weathering products. Shock stage S4 (N=25 olivine grains).

Geochemistry: (M. Ream and A. Ruzicka, *Cascadia*) Olivine ($\text{Fa}_{25.9 \pm 0.4}$, N=13), low-Ca pyroxene ($\text{Fs}_{21.8 \pm 0.3} \text{Wo}_{1.4 \pm 0.2} \text{En}_{76.7 \pm 0.4}$, N=10).

Classification: L6 chondrite based on mineral chemistry and texture.

Specimens: *Cascadia* holds 43.7 g in multiple pieces, in addition to one polished thin section and a mounted butt. John H. Shea holds the main mass.

Northwest Africa 10458 (NWA 10458)

(Northwest Africa)

Purchased: Aug 2014

Classification: Ordinary chondrite (L5)

History: Purchased in August 2014 by John Shea from Gary Fujihara who obtained the meteorite from a trader of specimens collected from near the border of Morocco and Algeria. Samples were donated to *Cascadia* in October, 2014

Physical characteristics: Shiny fusion crust covers most of hand specimen. Rust halos surround metal in cut faces.

Petrography: Granoblastic textured specimen showing somewhat indistinct chondrules and feldspar <50 μ m across. Chondrule diameter 0.72 ± 0.37 mm (N=24). Contains ~4% metal, with

most metal and troilite grains showing minimal or no replacement by weathering products. Shock stage S3 (N=25 olivine grains).

Geochemistry: (M. Ream and A. Ruzicka, *Cascadia*) Olivine ($\text{Fa}_{25.1\pm0.4}$, N=12), low-Ca pyroxene ($\text{Fs}_{21.2\pm0.2}\text{Wo}_{1.7\pm0.2}\text{En}_{77.1\pm0.3}$, N=12).

Classification: L5 chondrite based on mineral chemistry and texture.

Specimens: *Cascadia* holds 42.3 g in three pieces, in addition to one polished thin section and a mounted butt. John H. Shea holds the main mass.

Northwest Africa 10460 (NWA 10460)

Northwest Africa

Purchased: 2012

Classification: Ordinary chondrite (H4)

History: A 1582 g meteorite was purchased by Gary Spraggins from a Moroccan meteorite dealer at the 2012 Tucson and Gem and Mineral Show.

Physical characteristics: Sawn slice shows abundant chondrules and chondrule fragments in a dark matrix. Largest chondrule 3.7 mm diameter, though majority <0.7 mm diameter. No metal visible.

Petrography: (L. Garvie, ASU) Range of chondrule types including CC, PO, POP, BO and one radial olivine. The slice contains one large (1.3 mm) BO with pentagonal arrangement of olivine bars. Olivine shows sharp extinction indicative of S1. Secondary feldspar grains not evident. All metal oxidized, though some troilite remaining.

Geochemistry: (L. Garvie, ASU) Olivine $\text{Fa}_{18.6\pm0.3}$, Fe/Mn=37.5±0.2 wt%, n=7. Low Ca pyroxene $\text{Fs}_{16.6\pm0.3}\text{Wo}_{1.5\pm0.3}$, Fe/Mn=22.1±1.1 wt%, n=6.

Classification: H4, S1, W4

Specimens: 35.6 g slice and one polished thin section at ASU.

Oglat Sidi Ali 33°31'45"N, 02°37'01" W

Eastern, Morocco

Find: 2013 Apr

Classification: Iron meteorite (ungrouped)

History: At least 30 pieces, ranging from 3 to 10s of grams, with a total mass of 240 g, were recovered by Hassane Nachit, *IZU*, in Apr 2013.

Physical characteristics: External surface is moderately oxidized. The cut surface displays no trace of staining.

Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, Uni-Fi) A cut and polished section displays 3 prominent lamellae directions, intersecting at 60° angles. The meteorite is a very fine octahedrite, with an average bandwidth of 0.2±0.1 mm. On a much finer scale, the lamellae are composed of multiple tiny kamacite spindles roughly parallel to each other and ranging in width from 30 to 80 µm, separated by thin, Ni-rich taenitic spindles both forming a plessitic octahedrite arrangement.

Geochemistry: (C. Herd and G. Chen, *UAb*) Ni=140.7, Co=11.7 (both mg/g); Cu=249, Ga=79.1, As=9.99, W=5.79, Ir=2.5, Pt=43.9, Pd=8.79, Ru=53.22, Re=0.28 (all µg/g). Data were obtained by ICP-MS using [North Chile](#) as a calibration standard.

Classification: Ungrouped, plessitic octahedrite. The texture shows characteristics similar to those of other plessitic octahedrites, but the high Ni, Ga, Ru, Pd and Pt, as well as the relatively low Ir contents are outside the limits for the IIC group.

Specimens: Several pieces, with total mass 195 g, are on deposit at *IZU*; 3 pieces, 30 g in total, are on deposit at *MSN-FI*; 11 g and a polished sample weighing 3.5 g are on deposit at *MSP*.

Old Camp Wash 33°30'N, 112°56'W

Arizona, USA

Find: 2015 Feb

Classification: Ordinary chondrite (L6)

History: A large broken stone weighing 13.1 kg and displaying distinct fusion crust and some regmaglypts was found on the surface by a rancher while he was riding on his ATV near the town of Tonopah, Arizona. A thorough search of the area by meteorite hunters produced two more large fragments and a several small ones totaling an additional 4982.2 grams.

Physical characteristics: Saw cut reveals many scattered faint chondrules in an orange-brown groundmass.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows texturally equilibrated chondrules, and plagioclase grains up to 100 μm .

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{26.4\pm0.5}$, $\text{Fe/Mn}=51\pm2$, $n=8$; low-Ca pyroxene $\text{Fs}_{22.2\pm0.4}\text{Wo}_{0.9\pm0.1}$, $\text{Fe/Mn}=30\pm1$, $n=6$.

Classification: Ordinary chondrite (L6)

Specimens: 24.98 g including a probe mount on deposit at *UNM*, Aerolite Meteorites holds the main mass.

O'Malley 021 30°42'47.30"S, 131°27'35.90"E

South Australia, Australia

Purchased: 2012 May 18

Classification: Ordinary chondrite (H4)

History: Larger piece + two fragments found by A. Langendam on a claypan.

Physical characteristics: The larger sample has a series of large crack and 65% fusion crust, the smaller samples also have some fusion crust.

Petrography: (L. Bowlt, *Monash*) Poorly defined chondrules, ranging in size up to 2 mm occur in an oxidized recrystallised matrix. Mineralogy includes olivine, pyroxene, plagioclase, Fe-Ni metal and troilite. Chondrule mesostases are moderately fine grained and plagioclase has not formed distinct individual grains. Chondrule types include PO, RP, CC and BO. Troilite grains are small (30 microns) and diffuse, whereas there are relatively large (200 micron) metal grains. Most olivine grains show sharp extinction, although some show undulose extinction and there is no evidence of shock lamellae. Widespread oxide veins branch throughout the sample. Metal and troilite grains show similar levels of weathering, 60-70% in total.

Geochemistry: (L. Bowlt, *Monash*) Microprobe analyses show that olivine and pyroxene compositions are uniform: olivine $\text{Fa}_{17.1-18.4}$, mean $\text{Fa}_{17.8\pm0.65}$, $n=5$; Low-Ca pyroxene $\text{Fs}_{15.2-15.9}$, mean $\text{Fs}_{15.5\pm0.4}$, $n=3$.

Classification: Ordinary chondrite (H4, S3, W3)

Specimens: All specimens and one thin-section held by A. Tomkins.

Ooldea 003 30°33'50.88"S, 131°48'14.16"E

South Australia, Australia

Purchased: 2013 Apr 06

Classification: Ordinary chondrite (H4)

History: Single broken specimen found by E Mare

Physical characteristics: Angular 3 cm block with 95% brown-orange fusion crust

Petrography: (A. Tait, *Monash*) Chondrules have clear edges. Mesostasis shows evidence of initial recrystallization inside POP chondrules. Chondrules range in size from 1 - 2 mm, they include: POP, BO, RP, AP, CC, GOP and RP with clinoenstatite. Olivine shows a weak undulous extinction. Oxidation is almost complete (>95%), with extensive weathering veins and corrosion cavities.

Geochemistry: (A. Tait, *Monash*) FEG-SEM analyses show that olivine and pyroxene is uniform in their composition: olivine $\text{Fa}_{18.4-19.1}$, mean $\text{Fa}_{18.8 \pm 0.2}$, $n=8$; Low-Ca pyroxene $\text{Fs}_{16.0-16.9}$, mean $\text{Fs}_{17.0 \pm 0.3}$, $n=9$.

Classification: Ordinary Chondrite (H4, S2, W3)

Specimens: Specimen and one thin-section held by A. Tomkins.

Ooldea 005 30°34'13.40"S, 131°46'26.60"E

South Australia, Australia

Purchased: 2013 Apr 09

Classification: Ordinary chondrite (H5)

History: Seven fragments over ~10 m² found by A Langendam

Physical characteristics: Several flatish blocky fragments up to 5 cm, several with partial fusion crust, weathered to brown-red.

Petrography: (A. Tait, *Monash*) Poorly defined chondrules inside a recrystallized matrix. Plagioclase crystals are small (<50 μm). Chondrule populations include: POP, RP, PO, BO, GOP. Olivine grains contain shock lamellae and shock darkening. Weathering of FeNi and troilite is ~80% complete. Large corrosion cavities exist inside weathered metal grains. These are often connected by extensive iddingsite veins.

Geochemistry: (A. Tait, *Monash*) FEG-SEM analyses show that olivine and pyroxene are uniform in their composition: olivine $\text{Fa}_{19.0-19.5}$, mean $\text{Fa}_{19.3 \pm 0.2}$, $n=5$; Low-Ca pyroxene $\text{Fs}_{16.7-17.2}$, mean $\text{Fs}_{16.9 \pm 0.3}$, $n=6$.

Classification: Ordinary Chondrite (H5, S3, W3)

Specimens: All specimens and one thin-section held by A. Tomkins.

Ooldea 006 30°36'40.40"S, 131°53'14.40"E

South Australia, Australia

Purchased: 2013 Apr 13

Classification: Ordinary chondrite (H3)

History: Single broken specimen found by A Tait

Physical characteristics: An equant broken specimen with 65% fusion crust, weathered red-brown.

Petrography: (A. Tait, *Monash*) Chondrules have distinct edges, ranging in size up to 2 mm residing in an oxidized matrix. Mineralogy includes olivine, pyroxene, plagioclase, FeNi metal, troilite and apatite. Chondrule types include: POP, PO, RP, C and BO. Olivine shows weak undulose extinction and there are no indicators of higher shock grade. Oxidation is widespread throughout the sample (~70%). Iddingsite veins crosscut the sample.

Geochemistry: (A. Tait, *Monash*) FEG-SEM analyses show that olivine and pyroxene are uniform in their composition: olivine $\text{Fa}_{18.9-19.6}$, mean $\text{Fa}_{19.4 \pm 0.2}$, $n=10$; Low-Ca pyroxene $\text{Fs}_{16.0-16.9}$, mean $\text{Fs}_{16.7 \pm 0.3}$, $n=8$.

Classification: Ordinary Chondrite (H3, S2, W3)

Specimens: Specimen and one thin-section held by A. Tomkins.

Ooldea 007 30°37'46.40"S, 131°53'10.50"E

South Australia, Australia

Purchased: 2013 Apr 18

Classification: Ordinary chondrite (H3)

History: Single stone found by A. Tait, taken for biological experiments.

Physical characteristics: Single equant stone, well fractured chondrite.

Petrography: (A. Tait, *Monash*) Chondrule edges are well defined. Chondrules range between 1-2 mm. Mesostasis is dark and fine grained. Chondrule types that exist: POP, GOP, PP, RP, BO. Olivine grains show extensive shock lamellae and undulous extinction. Oxidation is extensive <5% troilite remains, no FeNi. Oxidation veins crosscut the sample.

Geochemistry: (A. Tait, *Monash*) FEG-SEM analyses show that olivine and pyroxene are uniform in their composition: olivine $Fa_{19.1-19.7}$, mean $Fa_{19.4\pm0.2}$, $n=8$; Low-Ca pyroxene $Fs_{17.0-17.5}$, mean $Fs_{17.2\pm0.2}$, $n=8$.

Classification: Ordinary chondrite (H3, S3, W4)

Specimens: Specimen and one thin section held by A. Tomkins.

Ooldea 008 30°35'44.6"S, 131°50'53.2"E

South Australia, Australia

Purchased: 2013 Apr 20

Classification: Ordinary chondrite (LL6)

History: Five fragments found by E. Mare

Physical characteristics: 5 fragments found scattered within a small area.

Petrography: (S. Nutku, *Monash*) Poorly defined chondrules with indistinct edges, ranging from 0.5mm to 1.5mm reside in strongly recrystallized matrix. Matrix mineralogy composed of olivine, pyroxene and plagioclase, crystal size range 40-200 microns. Chondrule types include, RP, POP, PP, PO and cryptocrystalline. Mineralogy includes olivine, pyroxene, plagioclase and minor Fe-Ni metal, troilite minerals. Undulatory extinction is observed in 40% of olivines. Planar fractures pervasive with larger olivine crystals showing conjugate fractures. Minor shock melting is observed. Sample is extensively weathered with only 5% Fe-Ni metal and <10% troilite remaining.

Geochemistry: (S. Nutku, *Monash*) Microprobe analyses show that olivine have moderately variable compositions and pyroxene have uniform compositions: olivine $Fa_{25.0-26.9}$, mean $Fa_{25.9\pm0.8}$, $n=5$; Low-Ca pyroxene $Fs_{21.8-22.9}$, mean $Fs_{22.3\pm0.5}$, $n=5$.

Classification: Ordinary chondrite (LL6, S4, W4)

Specimens: All specimens and one thin section held by A. Tomkins.

Ooldea 009 30°36'33.80"S, 131°56'53.50"E

South Australia, Australia

Purchased: 2013 Apr 22

Classification: Ordinary chondrite (H6)

History: Two jigsaw-fitting fragments 30 cm apart found by A. Tait

Physical characteristics: Two fragments jigsaw fit together to make whole fusion crust. Larger fragment has lichen.

Petrography: (S. Nutku, *Monash*) Chondrules very difficult to discern, indistinct from matrix, sit in an olivine dominated, strongly recrystallized matrix <200 µm. Mineralogy includes olivine, pyroxene, plagioclase, Fe-Ni metal, troilite. Chondrule types include RP (<1.5 mm), POP (1 mm), BO (1 mm) and GOP. Undulose extinction is observed in 20% of olivine crystals.

Weathered troilite has Fe oxide rims. Oxidation approx. 65%.

Geochemistry: (S. Nutku, *Monash*) Microprobe analyses show olivine and pyroxene compositions are uniform: olivine $Fa_{19.3-20.2}$ mean $Fa_{19.8\pm0.4}$, $n=6$; Low-Ca pyroxene $Fs_{16.8-18.0}$, mean $Fs_{17.6\pm0.4}$, $n=6$.

Classification: Ordinary chondrite (H6, S2, W3)

Specimens: All specimens and one thin section held by A. Tomkins.

Oued Awlitis 002 (OA 002) 25.966°N, 12.539°W

Morocco/Western Sahara

Find: 2014 May

Classification: Carbonaceous chondrite (CV3)

History: (H. Chennaoui-Aoudjehane, *FSAC*) A group of four identical stones (432 g, 199 g, 1230 g, 628 g) were found by Mr. Addi Smara in May 2014. The 432 g stone was purchased by John Higgins in May 2014 from a dealer in Laayoune, and detailed study of it forms the basis of this classification.

Physical characteristics: The stones are all dark brown with lighter inclusions visible through the desert patina. The cut interior of the 432 g stone exhibits beige to brown chondrules and sparse CAI (some pinkish in color with pale rims).

Petrography: (A. Irving and S. Kuehner, *UWS*) Composed of separated, predominantly granular chondrules (1.5 ± 0.9 mm, some rimmed) within a brown stained matrix. Minerals are olivine, orthopyroxene and clinopyroxene with accessory troilite, taenite and chlorapatite. One irregularly shaped, very fine-grained CAI is present within the prepared thin section. A very unusual "basaltic" clast was also observed, and is composed of laths of intermediate K-bearing plagioclase, aluminous clinopyroxene, olivine and chromian pleonaste spinel.

Geochemistry: Olivine ($Fa_{1.1-36.7}$, $N = 4$), orthopyroxene ($Fs_{3.1-4.8}Wo_{1.0-0.2}$, $N = 3$), clinopyroxene ($Fs_{1.8}Wo_{47.2}$; $Fs_{5.8}Wo_{39.1}$).

Classification: Carbonaceous chondrite (CV3).

Specimens: 20.1 g including one polished thin section at *UWB*. 284 g at AMNH; remaining material of the 432 g stone with Mr. J. Higgins; the holders of the other stones are anonymous.

Oued Awlitis 003 (OA 003) 25°51'N, 12°21'W

Rio de Oro, Western Sahara

Find: 2011

Classification: Ordinary chondrite (LL6)

History: The stone was found near the village of Lemluia in 2011 and bought in Agadir in 2011.

Physical characteristics: A single stone without fusion crust. Surface shows a brecciated rock with abundant melt veins and melt pockets.

Classification: LL6, brecciated

Oued Bourdim 001 32°0'21.1"N, 3°14'15.6" W

Eastern, Morocco

Find: 2007

Classification: Pallasite (Eagle Station group)

History: (H. Chennaoui Aoudjehane, *FSAC*): In November, 2007, Brahim Oubadi from Bouanane, Morocco, was searching for meteorites on the Oued Bourdim wadi. He found many small pieces of a heavy rock (for its size) that looked different from the surrounding materials. Over the next few years, Mr. Oubadi found approximately 400 g. He sold the stones to a meteorite dealer in Boudnib, and they were subsequently sold at the Tucson Gem and Mineral show where they were nicknamed "Boudnib".

Physical characteristics: Many small stones totaling 393 g. The largest are 48.9 g and 68.9 g, whereas the majority are <10 g. Exterior of the stones is dark colored and the olivines are sand blasted with a waxy luster. Fusion crust largely absent, though there are a few remaining patches on the metal. Medium to low weathering.

Petrography: (L. Garvie, *ASU*). A 3 × 2 cm sawn surface of the 48.9 g stone shows 30 areal% metal. Olivine grains highly fractured, rounded and <1 cm across. Swathing kamacite to 1 mm thick and discontinuous. There are a few areas of swathing schreibersite to 0.5 mm thick. Ropey schreibersite also present within the swathing kamacite. Troilite rare, occurring as spheres to 1 mm in the olivine. The bulk of the metal has a martensite decomposition structure ([Novotny et al., 1982](#)), composed of Widmanstätten alpha platelets (typically <100 µm long) in fine plessite matrix; schreibersite 10 to 50 µm is common. The platelets are surrounded by taenite rims. Two chromite grains present. Excluding the 48.9 g stone, six additional stones were sectioned, polished, and etched - all showed metal with the martensite decomposition structure. Terrestrial Fe oxides locally replacing swathing kamacite and troilite.

Geochemistry: (J. Wasson, *UCLA*): Metal composition by INAA (mean of two analyses) Ni 170.3 mg/g; Co 9.1 mg/g, Ga 8.1 µg/g, As 12.8 µg/g, Ir 5.98 µg/g, W 0.36 µg/g, Pt 17 µg/g, and Au 1.34 µg/g. (L. Garvie, *ASU*): EMPA of eight separate olivine grains give $\text{FeO/MnO}=99.9\pm9.0$. (K. Ziegler, *UNM*): Analyses of 5 acid-washed olivine subsamples by laser fluorination dual inlet mass spectrometry gave, respectively, $\delta^{17}\text{O}$ -6.02, -5.98, -5.82, -6.04, -6.48; $\delta^{18}\text{O}$ -2.17, -2.19, -1.85, -2.15, -2.98; $\Delta^{17}\text{O}$ -4.88, -4.83, -4.85, -4.91, -4.91 per mil (reference TFL slope = 0.528, values are linearized).

Classification: Pallasite of the Eagle Station chemical group.

Specimens: *ASU* 116.7 g, Ruben Garcia 158.8 g, and Bob Cuchiara 68.9 g.

Pontes e Lacerda 15°19'45"S, 59°16'10"W

Mato Grosso, Brazil

Find: 2013 Sept

Classification: Iron meteorite (IIIAB)

History: The meteorite was found by a prospector, Mr. M. Braga, while he was searching for gold with a metal detector. The finder sent samples to Andre Moutinho who performed preliminary tests that confirmed the samples have a meteoritic origin. Samples were then provided to Dr. Zucolotto for a complete analysis and classification.

Physical characteristics: A regular weathered round mass weighing 224 g and measuring about 49 × 33 × 31 mm

Petrography: (Maria Elizabeth Zucolotto, *MN/UFRJ*) The examined slice is a 9 cm² endpiece with no fusion crust and heat affected zone. It shows exfoliation along corroded Widmanstätten planes, typical of long terrestrial exposure. Etched sections display a normal, medium Widmanstätten structure with 1.05±0.15 mm bandwidth kamacite. Some subboundaries are decorated with tiny rhabdites. In a heavy etching the kamacite shows abundant cross-hatched

pattern. Taenite and plessite are common and found in about 60% of the slice area, mainly as comb and net plessite. Martensite and black etching duplex fields are also common at the edges. Neumann bands are weakly developed. Schreibersite (to 500 μm) was found in the interiors and borders of kamacite bands. Rhabdites are very common as 1-5 μm thick prisms. No troilite was observed in the examined section, although there were two holes possibly as lost inclusions.

Geochemistry: (J. T. Wasson *UCLA*) INAA, 8.1 wt% Ni; 0.49 wt% Co; 103 ppm Cr; 181 ppm Cu; 20.8 ppm Ga; 5.43 ppm As; 4.84 ppm Ir; 0.738 ppm Au. Composition of major phases (A. Tosi, *IGEO-UFRJ*) kamacite (Ni $7.2\pm0.2\%$, Co $0.65\pm0.15\%$, P 0.02%).

Classification: (J. T. Wasson, *UCLA*) This meteorite can be compared to other IIIAB iron having Au in the range 0.686 to 0.770 ppm. No similar IIIAB has been found in South America. The only one that has a similar composition is [Hot Springs](#), but even it is resolvable in terms of As and probably also Au.

Specimens: Main mass with Andre Moutinho, 22 g *MNRJ*

Porangaba 23°09'36"S, 48°10'52"W

Sao Paulo, Brazil

Confirmed fall: 2015 Jan 9

Classification: Ordinary chondrite (L4)

History: At about 17:35 pm (UTC) on January 9, 2015, a daylight fireball was witnessed in a large area of São Paulo, Brazil. On the same day, the submitter received an e-mail from P. Gama with a picture of a 450 g stone recovered by his employee Julio C. Silva and his son at the rural area of Porangaba. Another mass of 520 g was recovered the next day by Mr. José Maria and his nephew. In both recoveries, a loud thunder was heard which persisted for some time as rumbling noise, that also drew the attention of neighbors. Although some inhabitants heard falling objects near them and many efforts were done in order to recover other stones, only A. Moutinho has recovered additional pieces (2.9 and 3.5 g) to date.

Physical characteristics: The two largest masses are semi-prismatic and almost fully covered by fusion crust with only small pitted corners. Of the two smallest masses, one is fully crusted, the other has only one side crusted.

Petrography: (M. E. Zucolotto, *MNRJ*) The meteorite is friable and a broken surface shows protuberant well defined chondrules of distinct sizes. In thin section, the chondrules display a variety of types (RP, POP, PP, BO, PO and C). Fe-Ni grains occupy ~6 % of the area. Troilite is also present and sometimes associated with kamacite and plessite. Olivine grains show sharp extinction.

Geochemistry: (A. Tosi, *IGEO-UFRJ*) Microprobe analyses show an equilibrated olivine and pyroxene composition of Olivine ($\text{Fa}_{23.7\pm0.5}$; n=18), low-Ca pyroxene ($\text{Fs}_{20.5\pm0.5}\text{Wo}_{1.0\pm0.2}$; n=16) and kamacite ($6.4\pm0.5\%$ Ni and $0.94\pm0.1\%$ Co; n=15)

Classification: The mean olivine, low-Ca pyroxene and kamacite compositions indicate that Porangaba is an L-group chondrite. The chondrules are very well defined and with homogeneous composition, although they exhibit a clear recrystallized matrix. The absence of visible plagioclase grains indicates the petrologic type 4. The rock has been weakly shocked and most of the olivine grains shows weak undulatory extinction, equivalent to shock stage S2. Metallic Fe-Ni grains show no signs of alteration, consistent with weathering grade W0. (L4, S2, W0).

Specimens: Type specimen, 20 g at *MNRJ*. The 450 g mass is held intact by P. Gama, and the 2.9 and 3.5 g specimens with Andre Moutinho. From the 520 g main mass kept by José Maria, a

slice was removed from which the type specimen was obtained and some samples were distributed among many private collectors.

Quebrada Chimborazo 001 (QC 001) 24°7'37.28"S, 69°15'48.51"W

Antofagasta, Chile

Find: 2004 May 8

Classification: Carbonaceous chondrite (CBa)

History: The meteorite was found near the Minera Escondida copper mine at the foot of Pasua hill in the canyon, Quebrada Chimborazo.

Physical characteristics: A single, complete, irregularly shaped stone.

Petrography: The meteorite consists of magnesian nonporphyritic cm-sized chondrules and their fragments, Fe,Ni-metal, sulfide nodules and their fragments, and impact melt material. The chondrules have skeletal olivine textures and consist of magnesian olivine laths; anorthitic mesostasis. The impact melt often shows flow texture and consists of Fe,Ni-metal and sulfides, and abundant ferroan silicate droplets.

Geochemistry: Magnesian olivine laths Fa_{2-5} , $n=5$; low-Ca pyroxene $\text{Fs}_{2-5}\text{Wo}_{0.5-1}$, $\text{TiO}_2=0.1-0.2$, $\text{Al}_2\text{O}_3=0.6-1.1$, $\text{Cr}_2\text{O}_3=0.5-0.6$ (all wt%), $n=8$; high-Ca pyroxene $\text{Fs}_{2-4}\text{Wo}_{40-50}$, $\text{TiO}_2=0.3-1.7$, $\text{Al}_2\text{O}_3=7.6-18.9$, $\text{Cr}_2\text{O}_3=0.3-2.0$ (all wt%), $n=5$; ferroan silicate droplets: $\text{SiO}_2=42.5\pm 1.0$, $\text{TiO}_2=0.26\pm 0.48$, $\text{Al}_2\text{O}_3=3.6\pm 0.3$, $\text{Cr}_2\text{O}_3=0.90\pm 0.15$, $\text{FeO}=17.1\pm 3.3$, $\text{MnO}=0.09\pm 0.03$, $\text{MgO}=33.1\pm 3.6$, $\text{CaO}=2.8\pm 0.59$, $\text{Na}_2\text{O}=0.24\pm 0.07$ (all wt%), $n=24$.

Classification: The meteorite is mineralogically very similar to the subgroup A (CBa) Bencubbin-like carbonaceous chondrites [Gujba](#), [Bencubbin](#), [Weatherford](#), [MIL 05082](#) and [MIL 07411](#).

Specimens: A 20.9 g type specimen and 1 polished thin section are on deposit at the *NHMD*; *Labenne* holds the main mass.

Rabt Sbayta 001 24°6.833'N, 14°56.257'W

Western Sahara

Find: 10 Jan 2015

Classification: Ordinary chondrite (L3)

Classification: The sample consists of abundant well-defined chondrule and chondrule fragments and a low abundance of matrix. Some of the chondrules still have mesostasis glass, indicating type 3. Based on the low matrix abundance, the chondrule size, and the olivine compositional distribution with a peak in the around Fa_{24} , the rock is classified as an L3 ordinary chondrite. The olivines show undulatory extinction, but no planar fractures indicating an S2 shock degree classification. The sample is heavily weathered.

Rainy River 48.72°N, 94.57°W

Ontario, Canada

Find: 2000

Classification: Iron, IAB complex

History: The meteorite was found in 2000 by Robert Milton Weaver on his farm located near the town of Rainy River, Ontario, Canada, and subsequently given to Clive Trevor Williams, who gave it to his grandson, Howard Williams (the present owner). The location of the farm is unknown by the present owner of the meteorite. Consequently, the coordinates of the town are given as the nominal location of the find.

Physical characteristics: The meteorite is a single mass, of roughly ellipsoidal shape with maximum dimensions 17.4 cm × 13.2 cm × 9.5 cm with a mass of 3.26 kg. The exterior is completely covered with an iron oxide crust.

Petrography: Stephen A. Kissin (*LHU*) The meteorite is an octahedrite, although owing to the coarseness and irregular width of the kamacite lamellae, the structure is difficult to discern. The lamellae are somewhat curved and stubby with L:W = 3:1 to 4:1 and widths (uncorrected) from ~2 mm to >3 mm. The kamacite lamellae contain abundant Neumann lines and are polygonalized as a result of shock. Residual taenite lamellae are very thin (<1 mm) and frequently have been heavily oxidized. A single small area of net plessite was observed. Schreibersite in the form of rhabdite is abundant, as well as a few small wormy, globular grains. Troilite is sparsely present as thin wormy grain between kamacite lamellae.

Geochemistry: Mineral compositions and geochemistry: INAA analysis Ni= 7.23 wt%, Co=0.463 wt%, Sb= 410 ppb, Cr=19, Cu=114, Ga=91, Ge=170, As 13.9, W=<10, Re=0.64, Ir=3.87, Pt=7.8, Au=1.47 (all in ppm).

Classification: Iron (IAB complex). The meteorite is moderately shocked as evidenced by the presence of Neumann lines and polygonalization of kamacite. Some of the kamacite lamellae are deformed by minor bending. Hardness of kamacite (VHN=254±13) and taenite (VHN= 492±28) is also evidence of work hardening due to shock.

Specimens: type specimen 47.3 g polished slab, ROM. Main mass 3.20 kg retained by the owner, Howard Williams.

Ramlat as Sahmah 430 (RaS 430) 20.175°N, 56.451°E

Al Wusta, Oman

Find: 2011 Feb

Classification: Ordinary chondrite (H3)

History: Found by an anonymous prospector in February 2011.

Petrography: (A. Irving and S. Kuehner, *UWS*) Unequilibrated chondrite composed of well-formed, small to medium-sized chondrules (mostly 0.3-0.9 mm) in a dark brown, highly altered matrix.

Geochemistry: Olivine (Fa_{0.7-19.1}), orthopyroxene (Fs_{2.2-9.9}Wo_{0.8-0.7}), augite (Fs_{6.0-6.1}Wo_{45.3-44.7}). Oxygen isotopes (K. Ziegler, *UNM*) Analysis of an acid-washed subsample by laser fluorination gave δ¹⁷O 3.170; δ¹⁸O 5.123; Δ¹⁷O 0.465 per mil.

Classification: Ordinary chondrite H3. Oxygen isotopes plot at the edge of the field for H chondrites, but an H affinity is favored by the relatively small chondrule size, abundance of (altered) metal and the low maximum Fa content in olivine.

Specimens: Type specimen plus one polished thin section at *PSF*; main mass with anonymous collector.

Ramlat as Sahmah 510 (RaS 510) 20°32.763'N, 55°30.106'E

Al Wusta, Oman

Find: 2013 Feb 2

Classification: Ordinary chondrite (H3)

History: Found by Edwin Gnos, Beda Hofmann, Urs Eggenberger, Thomas Burri and Pete Stephenson during a search for meteorites on February 2, 2013.

Physical characteristics: Single, dark brown individual.

Petrography: (B. Hofmann, *NMBE* and E. Gnos, *MHNGE*) Mean chondrule size 0.32 ± 0.19 mm (n=67). Homogeneous glass present in some chondrules, more commonly in state of beginning crystallization.

Geochemistry: (N. Greber, *Bern*) Mineral compositions: olivines, $\text{Fa}_{15.7 \pm 4.7}$ ($\text{Fa}_{3.2-20.2}$, n=18). Pyroxene, $\text{Fs}_{13.6 \pm 4.0} \text{Wo}_{1.1 \pm 0.8}$ ($\text{Fs}_{3.7-16.9} \text{Wo}_{0.3-2.7}$, n=14).

Classification: Based on silicate compositions and mean chondrule size this is a H3 chondrite, shock grade S3, weathering W3.

Specimens: All at *NMBE*

Ramlat as Sahmah 511 (RaS 511) 20°30.025'N, 55°31.458'E

Al Wusta, Oman

Find: 3 Feb 2013

Classification: HED achondrite (Eucrite)

History: Found by Edwin Gnos, Beda Hofmann, Urs Eggenberger, Thomas Burri and Pete Stephenson during a search for meteorites on February 3, 2013.

Physical characteristics: Strongly wind-ablated greenish-grey fragment with deep erosion holes, no fusion crust, 10.44 g.

Petrography: (B. Hofmann, *NMBE* and E. Gnos, *MHNGE*) Brecciated texture, consisting of partially maskelynitized plagioclase, pyroxene displaying several sets of PDFs, ilmenite, chromite and sparse troilite. Clast size up to 4 mm, predominantly coarse grained with 0.2-0.6 mm sized mineral grains.

Geochemistry: (N. Greber, *Bern*) Orthopyroxene compositions are $\text{Fs}_{58.2 \pm 1.9} \text{Wo}_{3.8 \pm 1.4}$ ($\text{Fs}_{54.0-60.8} \text{Wo}_{2.0-6.5}$), Fe/Mn = 31.3 (n=10), clinopyroxene compositions are $\text{Fs}_{26.6 \pm 1.0} \text{Wo}_{40.2 \pm 5.7}$ ($\text{Fs}_{25.5-28.0} \text{Wo}_{30.4-43.0}$), Fe/Mn = 31.8 (n=5), plagioclase compositions are $\text{An}_{88.6 \pm 2.4} \text{Or}_{1.3 \pm 2.6}$ ($\text{An}_{81.9-90.4} \text{Or}_{0.3-8.7}$, n=10). Bulk analysis of cut surface by XRF (wt%): Fe 13.1, Mn 0.38 (Fe/Mn 34.2). Oxygen isotopes: (R. Greenwood, *OU*): $\delta^{18}\text{O}=4.08$, $\delta^{17}\text{O}=1.92$, $\Delta^{17}\text{O}=-0.21$.

Classification: Based on petrography and geochemistry, this meteorite is a strongly shocked eucrite breccia.

Specimens: All at *NMBE*

Ramlat Fasad 025 18°34.903'N, 53°06.749'E

Zufar, Oman

Find: 9 Feb 2014

Classification: Ordinary chondrite (H3-6)

History: Found by Edwin Gnos, Beda Hofmann, Thomas Burri, and Marianna Mészáros during a search for meteorites on February 9, 2014.

Physical characteristics: Dark brown individual with attached sand, with remnants of fusion crust.

Petrography: (B. Hofmann, *NMBE* and E. Gnos, *MHNGE*) Mean chondrule size 0.70 ± 0.30 mm (n=38).

Geochemistry: (N. Greber and Å. Rosén, *Bern*) Olivine: mean $\text{Fa}_{16.4 \pm 3.9}$ ($\text{Fa}_{1.0-21.6}$, n=30); pyroxene (n=12): mean $\text{Fs}_{15.8 \pm 2.2} \text{Wo}_{1.1 \pm 0.5}$ ($\text{Fs}_{9.7-19.2} \text{Wo}_{0.2-1.7}$). Clast of petrologic type 6 has $\text{Fa}_{19.5 \pm 1.9}$ (n=15), $\text{Fs}_{16.8 \pm 1.4} \text{Wo}_{1.3 \pm 0.3}$ (n=17).

Classification: Based on mineral compositions (mainly of clast of petrologic type 6) this is a brecciated H chondrite with clasts ranging in petrographic grade from 3 to 6. Shock grade S2, weathering W4.

Specimens: All at *NMBE*

Ramlat Fasad 026 18°35.007'N, 53°06.742'E

Zufar, Oman

Find: 2014 Feb 9

Classification: Ordinary chondrite (H3)

History: Found by Edwin Gnos, Beda Hofmann, Thomas Burri, and Marianna Mészáros during a search for meteorites on February 9, 2014.

Physical characteristics: Dark brown individual without fusion crust.

Petrography: (B. Hofmann, *NMBE* and E. Gnos, *MHNGE*) Mean chondrule size 0.73 ± 0.30 mm (n=53).

Geochemistry: (Å. Rosén, *Bern*) Olivine: mean $Fa_{19.1 \pm 2.4}$ ($Fa_{13.0-26.2}$, n=44); pyroxene (n=27): $Fs_{16.4 \pm 3.0} Wo_{1.7 \pm 1.0}$ ($Fs_{12.8-29.4} Wo_{0.4-5.1}$).

Classification: Based on mineral compositions this is an H chondrite of petrologic type 3, shock grade S3, weathering W3.

Specimens: All at *NMBE*

Ramlat Fasad 027 18°46.804'N, 53°09.346'E

Zufar, Oman

Find: 10 Feb 2014

Classification: Carbonaceous chondrite (CO3)

History: Found by Edwin Gnos, Beda Hofmann, Thomas Burri, and Marianna Mészáros during a search for meteorites on February 10, 2014.

Physical characteristics: Two dark brown wind ablated fragments (7.04 and 3.81 g), found close to each other, no fusion crust preserved. Total mass is 10.85 g.

Petrography: (B. Hofmann, *NMBE* and E. Gnos, *MHNGE*) Homogeneous chondritic texture. Glass-bearing chondrules. CAIs are common. Mean apparent chondrule size is 0.30 ± 0.11 mm (n=93). Matrix abundance ~30%. Contains iron metal and troilite, both are partly altered to (hydr)oxides.

Geochemistry: (N. Greber, *Bern*) Olivine compositions are $Fa_{29.7 \pm 10.9}$ ($Fa_{0.6-36.9}$, n=26). Orthopyroxene compositions are $Fs_{5.7 \pm 1.5} Wo_{2.2 \pm 1.3}$ ($Fs_{4.3-8.8} Wo_{0.4-4.2}$, n=11). Oxygen isotopes: (R. Greenwood, *OU*): $\delta^{18}O = 2.28$, $\delta^{17}O = -2.32$, $\Delta^{17}O = -3.51$.

Classification: Based on petrography (including matrix abundance and chondrule size), geochemistry and oxygen isotopes this meteorite is a CO3 carbonaceous chondrite, unshocked (S1), medium weathering.

Specimens: All at *NMBE*

Red Hill 35°40'40.44"N, 112°4'20.71"W

Arizona, United States

Find: 2000 Oct

Classification: Ordinary chondrite (H4)

History: The specimen was found as a single stone on the range of Deran and Shawn Cameron in northern Arizona on flat rangeland covered with some pinon and juniper trees; there are few rock outcrops on the land.

Physical characteristics: The stone is irregularly shaped and about 20×25 cm in size.

Petrography: The sample has well-defined chondrules and a few low-Ca pyroxene grains have polysynthetic twins. Troilite is polycrystalline; some small metal grains contain small irregular grains of troilite within them as well as a few grains of metallic Cu.

Sahara 00293

(Sahara)

Found: 2000

Classification: Ordinary chondrite (L6)

History: Reportedly collected in the same location as [Sahara 98222](#).

Physical characteristics: Chondrules largely integrated into matrix, difficult to discern in cut section. Abundant shock-induced melt veins and pockets.

Petrography: Fine-grained recrystallized plagioclase throughout matrix, some grains up to 200 μm . Abundant metal sulfides and troilite with trace native Cu. Evidence of minor planar deformation features in olivine. Ubiquitous opaque shock melt veins and associated dark blue ringwoodite and green wadsleyite.

Geochemistry: (C. Fudge, ASU) EPMA: $\text{Fa}_{24.8 \pm 0.1}$ FeO/MnO: 48.8 ± 1.6 n=11; low-Ca pyroxene $\text{Fs}_{20.9 \pm 0.3} \text{Wo}_{1.6 \pm 0.2}$ FeO/MnO: 28.6 ± 1.1 n=12; high-Ca pyroxene $\text{Fs}_{8.4 \pm 0.2} \text{Wo}_{44.4 \pm 0.1}$ FeO/MnO: 20.8 ± 1.2 n=2

Classification: Ordinary chondrite L6, S6, W2

Specimens: 27.05 g and one thin section at ASU

Sahara 00350

(Sahara)

Find: 2000

Classification: Ordinary chondrite (L6)

History: This 14.2 gram piece from Scott Brey is the only material of Sahara 00350 that of which Brey or *Labenne* are aware. The estimated size of the main mass of the ordinary chondrite could be 200 g based on this slice, but the main mass is unknown and may have been much smaller.

Physical characteristics: Description based on 14.2 g complete slice. Sawn surface shows network of dark shock veins. Few chondrules visible, metal grains up to 2 mm.

Petrography: (L. Garvie, C. Fudge and T. Sharp, ASU) Matrix largely recrystallized, with a few recognizable porphyritic and barred olivine chondrules. Plagioclase abundant up to 200 μm . Sparse distribution of metal and troilite. Olivines show mosaicism and planar deformation features consistent with shock stage S5. Shock melt vein approaches 3.0 mm, and contains abundant blue ringwoodite and green wadsleyite confirmed with Raman spectroscopy indicative of S6 shock.

Geochemistry: (C. Fudge, ASU) EPMA: $\text{Fa}_{24.8 \pm 0.1}$ FeO/MnO: 46.7 ± 1.9 n=10; low-Ca pyroxene $\text{Fs}_{20.9 \pm 0.1} \text{Wo}_{1.6 \pm 0.2}$ FeO/MnO: 29.3 ± 1.6 n=10; high-Ca pyroxene $\text{Fs}_{8.4 \pm 0.2} \text{Wo}_{44.3 \pm 0.6}$ FeO/MnO: 20.5 ± 1.2 n=3

Classification: Ordinary chondrite L6, S6, W2

Specimens: 14.2 g and one thin section at ASU. Reportedly collected in the same location as [Sahara 98222](#) and [Sahara 00293](#).

San Juan de Ocotán 20°42'42.1"N, 103°27'22.3"W
Jalisco, Mexico

Confirmed fall: 2007 Sept 22

Classification: Ordinary chondrite (L5)

History: On the night of 22 September 2007, Mr. Saldaña was woken around 3 am by a crashing sound at the side of his house. He went out to investigate and found a black rock at the foot of a brick wall in the courtyard of his house: the stone was reportedly warm to the touch. The rock had passed through a blue tarpaulin and thick plastic sheeting. For four years, Mr. Saldaña used the stone to prop open a door. However, after watching a television show on meteorites in early 2011, he realized the stone might be a meteorite and contacted Michael Farmer, who traveled to Guadalajara to purchase the stone and visit the fall site.

Physical characteristics: Complete 1365 g fusion-crust stone, smooth, with a few scattered regmaglypts. Slightly flattened stone, with the largest face of 12×10 cm. Exterior shows a few minor rust spots and one corner is chipped and shows adhering blue material, presumably from the blue tarpaulin. Sawn surface dominantly mottled white and light grey exhibiting distinct chondrules separated by thin dark matrix. Chondrules up to 3 mm. Metal and troilite typically <1 mm, though one slice has a troilite/metal vein 3 cm long and up to 3 mm wide.

Petrography: (L. Garvie, ASU) Thin section dominated by sharply defined chondrules and chondrules fragments. Chondrule types include BO, RP, PO, and POP. Also a large compound PP chondrule containing two BO chondrules. Many of the chondrules have troilite/metal rims. Chromite grains scattered and <100 μm . Most metal has a holly-leaf-shaped outline. Metal is typically polycrystalline with a few grains showing dark plessitic etch, or tetrataenite rims with cores of vermiform plessite. Troilite polycrystalline and lacking shock lamellae. The troilite/metal vein consists of polycrystalline troilite (grain size 20 to 200 μm) surround by polycrystalline kamacite. Copper rare, occurring as <50 μm grains in troilite and at the troilite/metal boundaries. A few scattered Ca-Cl-rich and Na-Mg-Ca-rich phosphates to 200 μm found. Feldspar fine grained and difficult to recognize in the thin section. Olivine shows mosaicism and PDFs. Rare melt pockets found associated with the large troilite/metal vein.

Geochemistry: (L. Garvie, ASU) Olivine, $\text{Fa}_{24.2 \pm 0.5}$, $\text{Fe/Mn} = 46.4 \pm 3.3$, $n=18$; low Ca pyroxene, $\text{Fs}_{20.7 \pm 0.9}\text{Wo}_{1.2 \pm 0.5}$, $n=12$. Only one high Ca pyroxene grain found, $\text{Fs}_{13.0}\text{Wo}_{30.4}$, $\text{Fe/Mn} 18.7$.

Classification: L5, S4, W0

Specimens: 51.2 g and two thin sections at ASU.

Sawtooth Mountain $38^{\circ}20'46''\text{N}$, $106^{\circ}57'41''\text{W}$

Colorado, United States

Found: 2006

Classification: Ureilite

History: This meteorite was found by Eldon Surbeck in the summer of 2006. He was hunting for fossils on a shale exposure/talus slope when he noticed a stone that looked out of place sitting on the outcrop. He picked it up and took it home thinking that it might be a meteorite.

Physical characteristics: Single stone, oriented. Dark weathered fusion crust covered exterior with rind ~ 3 mm thick. A saw cut reveals dark polycrystalline texture with many thin, macroscopic, graphite grains, some up to 4 mm long.

Petrography: (C. Agee, UNM) Examination of a polished mount shows polygonal olivine and pigeonite grains (300-1000 μm) with triple junctions. Most olivines have fine Fe-metal blebs on grain boundaries and along fractures. Ubiquitous graphite, often as elongate mm-size domains. Fe-metal and oxidized metal occupying most silicate grain boundaries. Chromite is present.

Geochemistry: (C. Agee and N. Muttik, *UNM*) Olivine $\text{Fa}_{24.9\pm3.0}$, $\text{Fe/Mn}=55\pm9$, $\text{Cr}_2\text{O}_3=0.46\pm0.01$, $n=15$; pigeonite $\text{Fs}_{20.8\pm0.1}\text{Wo}_{11.8\pm0.1}$, $\text{Fe/Mn}=33\pm2$, $\text{Cr}_2\text{O}_3=1.07\pm0.01$ wt%, $n=10$.

Classification: Achondrite (ureilite)

Specimens: 21.8 g including a probe mount on deposit at *UNM*, *Reed* holds the main mass.

Sayh al Uhaymir 564 (SaU 564) 20.528°N, 56.681°E

Al Wusta, Oman

Find: 2011 Feb

Classification: Ordinary chondrite (L3)

History: Found by an anonymous prospector in February 2011.

Petrography: (A. Irving and S. Kuehner, *UWS*) Unequilibrated chondrite composed of well-formed, mostly medium-sized chondrules (0.4-1.1 mm; some up to 1.5 mm) in a brown stained matrix

Geochemistry: Olivine ($\text{Fa}_{2.9-62.5}$; Cr_2O_3 in ferroan examples = 0.03-0.08 wt.%, mean 0.05 ± 0.02 wt.%, $N = 5$), orthopyroxene ($\text{Fs}_{0.3-3.7}\text{Wo}_{0.4-0.1}$), pigeonite ($\text{Fs}_{20.2}\text{Wo}_{8.7}$), subcalcic augite ($\text{Fs}_{9.1}\text{Wo}_{31.8}$). Oxygen isotopes (K. Ziegler, *UNM*) Analyses of acid-washed subsamples by laser fluorination gave, respectively $\delta^{17}\text{O}$ 3.562, 3.697; $\delta^{18}\text{O}$ 4.751, 4.902; $\Delta^{17}\text{O}$ 1.053, 1.109 per mil.

Classification: Ordinary chondrite (L3). Oxygen isotopes could be consistent with either an L or LL affinity, but chondrule size and magnetic susceptibility favor an L3 designation.

Specimens: Type specimen plus one polished thin section at *PSF*; main mass with anonymous collector.

Sayh al Uhaymir 587 (SaU 587) 21°00.764'N, 57°19.238'E

Al Wusta, Oman

Found: 2014 Mar 2

Classification: Martian meteorite (Shergottite)

History: A small greenish-gray individual with some fusion crust was found during a field trip in the Oman desert close to the [Sayh al Uhaymir 005/008](#) strewn field.

Petrography: The meteorite displays a porphyritic texture with mm-sized olivine phenocrysts set into in a fine-grained basaltic groundmass of dominantly pigeonite and maskelynite; minor phases include phosphates, sulfides, Ti-rich chromite and chromite. Intense fracturing, conversion of plagioclase to maskelynite, strong mosaicism of olivine and abundant melt veins and melt pockets attest to a high degree of shock metamorphism. The meteorite is moderately weathered with only a few of the larger cracks partially filled with calcite.

Geochemistry: Olivine, $\text{Fa}_{34\pm0.5}$ ($\text{Fa}_{33-35.2}$, $n=15$, $\text{FeO/MnO}=50-61$; pigeonite, $\text{Fs}_{25.2\pm2}\text{Wo}_{9.2\pm1.6}$ ($\text{Fs}_{22.4-28.9}\text{Wo}_{7-14.4}$, $n=24$, $\text{FeO/MnO}=29-35$); maskelynite, $\text{An}_{63.4\pm1.8}\text{Or}_{0.5\pm0.1}$ ($\text{An}_{60.4-65.9}\text{Or}_{0.4-0.6}$, $n=15$); chromite contains up to 17 wt% TiO_2

Classification: Martian (olivine-phyric shergottite)

Specimens: Likely paired with SaU 005/008.

Superior Valley 032 (SuV 032) 35°14'13.4"N, 117°6'0.4"W

California, USA

Find: 2014 Dec 19

Classification: Ordinary chondrite (H5)

Physical characteristics: The sample consists of two pieces which fit together. The bigger piece is 1.9×1.4 cm and weighs 6.89 g. The second piece is 0.7×1.5 cm and weighs 2.24 g. When the two pieces are assembled, it is clear that an additional piece is missing. Both pieces have dark-brown fusion crust with rusty patches.

Petrography: The meteorite has a granular texture consisting mainly of recrystallized chondrules integrated with the matrix. Only a few relict chondrules are visible ranging from 0.4-1 mm. Low-Ca pyroxene grains do not exhibit polysynthetic twinning. Plagioclase grain sizes are ~ 10 -20 μm . Metal grains have a ragged texture; some small shock veins are visible. Some metal grains contain small (5-10 μm) irregular grains of troilite; a few ~ 5 -10 μm copper grains occur with the irregular troilite grains.

Trâpeăng Rônăş 11°20'7"N, 104°41'20"E

Kampong Speu, Cambodia

Confirmed fall: 2010 Jul 4

Classification: Ordinary chondrite (H4)

History: At 11:03 a.m. local time on July 4, 2010, Nary Suon and about a dozen of her neighbors and family members were on a lunch break from preparing rice fields for cultivation in Kampong Speu province of Cambodia. They heard a loud boom, and saw dirt and dust fly up into the air. Upon investigation, a large stone (~ 11.3 kg) was found by Ms. Suon's nephew Choum Pech in a raised berm between fields, where it had gouged a small hole, at 11°20'7"N and 104°41'20"E, which is about 0.3 km from the town Trâpeăng Rônăş. A second stone (~ 1.2 kg), found at 11°21'13"N and 104°42'8"E, and a third stone (~ 0.5 kg, coordinates unknown), were collected later that day. The two larger stones were stored in a wooden cabinet in a house owned by Ms. Suon in Cambodia. Both stones were used for spiritual rituals by villagers, which involved drinking water that had been repeatedly poured over the stones. Ms. Suon brought the 1.2 kg and 11.3 kg specimens to the U.S. in 2013 and 2015, respectively.

Physical characteristics: The 1.2 kg (1188 g) stone was examined by *Cascadia*. This stone is a faceted individual, entirely covered with dark fusion crust, except for a small corner where the crust has broken off. There are regmaglypts on two faces, and flow lines curving over a third face. Much of the fusion crust is still glossy, but has patches of weathering visible. Shrinkage cracks form orange-colored tracteries against the dark crust.

Petrography: (M. Hutson and A. Ruzicka, *Cascadia*) In thin section, the sample contains relatively few (5-10%) complete chondrules. Instead, most of the sample shows chondrule fragments, fragments containing parts of more than one chondrule, and individual grains, surrounded by a fairly dark fine-grained matrix. Devitrified glass is fairly common in chondrules and chondrule fragments.

Geochemistry: Olivine (Fa=18.9 $\pm$ 0.3, n=33), low-Ca pyroxene (Fs=16.9 $\pm$ 0.3, Wo=1.5 $\pm$ 0.2, n=32) and plagioclase feldspar (Ab=80.3 $\pm$ 1.2, An=13.4 $\pm$ 1.0, Or=6.3 $\pm$ 1.4, n=23) are all equilibrated.

Classification: Ordinary chondrite (H4). Class and type based on mineral compositions and texture. 27 out of 37 olivine grains examined have uniform extinction, indicating an S1 shock stage. Despite being a fresh fall, there are rims of weathering products on metal grains, comprising $\sim 5\%$ replacement, indicative of a W1 weathering grade. Elevated weathering can be attributed to the sample being kept in a warm, humid climate for three years, and having had water repeatedly poured over it during that time.

Specimens: 54.7 g of the 1.2 kg stone was donated to *Cascadia* April 22, 2014, where 51.6 g plus a polished thin section and a mount in epoxy are on deposit. The remaining mass of the 1.2 kg specimen and all of the 11.3 kg specimen are currently held by Ms. Suon. The disposition of the smallest stone is unknown.

Uruq al Hadd 008 (UaH 008) 18°11.895'N, 52°47.882'E

Zufar, Oman

Find: 7 Feb 2014

Classification: Carbonaceous chondrite (CV3)

History: Found by Edwin Gnos, Beda Hofmann, Thomas Burri, and Marianna Mészáros during a search for meteorites on February 7, 2014.

Physical characteristics: Single stone of 663.5 g, the fusion crust is partially preserved.

Petrography: (B. Hofmann, *NMBE* and E. Gnos, *MHNGE*) Homogeneous chondritic texture with common CAIs. Mean apparent chondrule size is 1.05 ± 0.61 mm (max. 6 mm) (n=69).

Matrix abundance is 32%, CAIs ~15%. Troilite and mostly weathered iron metal are more abundant than magnetite. Silicates show strong undulous extinction.

Geochemistry: (N. Greber, *Bern*) Olivine compositions are $\text{Fa}_{29.8 \pm 21.0}$ ($\text{Fa}_{0.4-54.9}$, n=16). Low-Ca pyroxene is $\text{Fs}_{3.0 \pm 1.5}$ $\text{Wo}_{2.5 \pm 1.1}$ ($\text{Fs}_{1.0-4.6}$ $\text{Wo}_{0.9-3.6}$, n=6). Oxygen isotopes (R. Greenwood, *OU*): $\delta^{18}\text{O} = 0.45\%$, $\delta^{17}\text{O} = -4.21$ $\Delta^{17}\text{O} = -4.44$.

Classification: Based on mineral compositions, oxygen isotopes and matrix/chondrule ratio this is a CV3 carbonaceous chondrite (CV3-red subgroup). Shock grade S2. The degree of weathering is low.

Specimens: All at *NMBE*

Watson 014 30°33'3.80"S, 131°43'3.30"E

South Australia, Australia

Purchased: 2013 Apr 06

Classification: Ordinary chondrite (H3)

History: Three jigsaw-fitting fragments found by A Tomkins

Physical characteristics: The fusion crust suggests that these three jig-saw fitting fragments represent 70% of the sample.

Petrography: (A. Tait, *Monash*) Chondrule edges are well defined in an opaque microcrystalline matrix. Chondrule sizes ranges from 0.5 -2.0 mm. Chondrule types include: POP, RP, GOP, BO, PP, PBO. Some olivine grains show weak undulose extinction, but no evidence of higher shock indicators. Minor oxidation has occurred (<5%), as thin rims around some metal grains.

Geochemistry: (A. Tait, *Monash*) FEG-SEM analyses show that olivine and pyroxene are uniform in their composition: olivine $\text{Fa}_{18.1-18.8}$, mean $\text{Fa}_{18.5 \pm 0.2}$, n=12; Low-Ca pyroxene $\text{Fs}_{15.6-16.3}$, mean $\text{Fs}_{16.0 \pm 0.3}$, n=13.

Classification: Ordinary chondrite (H3, S2, W1)

Specimens: All specimens and one thin section held by A. Tomkins.

Watson 015 30°34'22.10"S, 131°44'48.10"E

South Australia, Australia

Purchased: 2013 Apr 09

Classification: Ordinary chondrite (H4)

History: Large fragments found by A Langendam

Physical characteristics: A large 9 cm block with partial fusion crust, and a second small fragments with 65% fusion crust, both weathered brown.

Petrography: (J. Savage) Porphyritic chondrules range in size from 0.5 mm to an anomalous 4 mm, with an average size of 1.5 mm. Porphyritic chondrules smaller than 0.5 mm are indistinguishable from the matrix where as those in the size range mentioned above are easily identified. Non-porphyritic chondrules are all of similar size (~1.5 mm) and their boundaries are easily differentiated from the matrix. Some chondrule boundaries show intergrowths of matrix/chondrule composition. Metal and metal-oxides are pervasive and constitute 30% of the matrix. Recrystallized glass makes up 10% of the matrix and the remaining 60% is made up from re-equilibrated chondrites of olivine-pyroxene composition. The mineralogy of the meteorite includes olivine, pyroxene, Fe-Ni metal and troilite. The chondrule types present are PP, POP, BO, C, GOP and PO. Most olivine and pyroxene grains have sharp extinction, with some finer grains beginning to develop undulose extinction. 98% of Fe-Ni metal has been oxidized with sulphides showing 60% weathering. Where troilite grains are still visible, weathering is localized on the grain rims.

Geochemistry: (J. Savage, *Monash*) Microprobe analyses show that olivine and pyroxene compositions are uniform: olivine $Fa_{18.7-19.6}$, mean $Fa_{19.2 \pm 0.3}$, $n=5$; Low-Ca pyroxene $Fs_{17.1-17.5}$, mean $Fs_{17.2 \pm 0.2}$, $n=5$.

Classification: Ordinary chondrite (H4, S2, W4)

Specimens: All specimens and one thin section held by A. Tomkins.

Watson 016 30°29'18.50"S, 131°44'12.90"E

South Australia, Australia

Purchased: 2013 Apr 25

Classification: Ordinary chondrite (L5)

History: One stone found by A. Tomkins.

Physical characteristics: One stone found with 90% complete fusion crust.

Petrography: (A. Tait, *Monash*) Sample shows extensive recrystallization of the matrix, and mesostasis. Relict chondrules include: POP, RP, C, BO, PO. Olivine grains exhibit undulose extinction and shock lamellae. Large plagioclase crystals (~50 μ m) show undulose extinction. Minor oxidation rims on some FeNi/troilite grains, with minor Fe oxide veins.

Geochemistry: (A. Tait, *Monash*) FEG-SEM analyses show that olivine and pyroxene are uniform in their composition: olivine $Fa_{25.1-28.0}$, mean $Fa_{25.8 \pm 0.8}$, $n=11$; Low-Ca pyroxene $Fs_{20.9-21.7}$, mean $Fs_{21.3 \pm 0.2}$, $n=9$.

Classification: Ordinary chondrite (L5, S3, W1)

Specimens: Specimen and one thin section held by A. Tomkins.

Xiaodonggou 47°56.39'N, 88°8.13'E

Xinjiang, China

Find: 2009 Jul

Classification: Iron meteorite (IAB-MG)

History: The specimen was purchased from an anonymous finder. The iron was found half buried in the ground in the Xiaodonggou forest park (Aletai, Xinjiang province) in July 2009, where the finder often went to walk.

Physical characteristics: An irregular piece of iron, with concave surface.

Petrography: (T. Zhang, S. Hu and Y. Lin, *IGGCAS*) The meteorite consists of kamacite and minor taenite and schreibersite, with trace graphite. Different from [Xinjiang \(a\)](#) by the absence of rhomb-like micrometer-sized schreibersite grains.

Geochemistry: Mineral compositions and geochemistry: (G. Wang, *GIGCAS*, T. Zhang, S. Hu and Y. Lin, *IGGCAS*) Kamacite: 5.57-6.47 wt.% Ni, 0.04-0.18 wt% Co; Taenite: 9.73-41.5 wt.% Ni. Bulk compositions: Ni: 6.04 wt.%, Ga: 89.7 ppm, Ge: 318 ppm, Ir: 5.01 ppm.

Classification: (G. Wang, *GIGCAS*, T. Zhan, S. Hu and Y. Lin, *IGGCAS*) IAB, main group

Specimens: The main mass is held by Zhigan Li.

Xinglongquan 40°9'45"N, 117°41'13"E

Hebei, China

Confirmed fall: 2008 Apr 12

Classification: Ordinary chondrite (L3)

History: On 2008 April 12, about 4 pm, people were chatting in Xinglongquan village, Dong Ling township, Zun Hua city, when they heard a loud explosion from Wang Shulan's house. Inside the house, they smelled something like gunpowder. Two main stones and some other pieces were scattered on the floor and there was a hole on the roof. After 2 days, Lei Kesi went to the villager's house, a bought the meteorite. A [Chinese website](#) reported the incident.

Physical characteristics: Total mass: more than 2000 g (two main pieces about 900 and 700 g and several small pieces) gray-white inside with fresh black fusion crust.

Petrography: Recognizable chondrules constitute up to 51.2 vol%. The fragments of chondrules and minerals comprise 19.1 vol%. Fe-Ni metal grains constitute ~4.4 vol%, sulfide 1.9 vol%, and matrix 23.4 vol%. Chondrule boundaries are very clear, and discrete plagioclase crystals are not visible in devitrified mesostasis of barred olivine chondrules. The chondrules' long axes are 0.2 to 2.1 mm, average 0.68 mm. The short axis is 0.1 to 1.6 mm, average 0.49 mm. On the polished thin section, there are two clasts 4.1 × 2.6 mm and 4.5 × 2.3 mm in size; the matrices range from opaque to subtransparent. Fe-Ni metal grains constitute to about 4.4 vol%, the sulfide 1.9 vol%.

Geochemistry: The mineral compositions are very heterogeneous, olivine $Fa_{19.2 \pm 7.85}$, N=32, pyroxene $Fs_{15.2 \pm 8.3}$, N=47. Co content of kamacite is 18.1 mg/g.

Classification: Ordinary chondrite L3; S1; W2.

Specimens: More than 20 g sample and two thin section are deposited at *GUT*.

Xinjiang (a) 47°52'N, 88°7'E

Xinjiang, China

Find: 2003 Aug

Classification: Iron meteorite (IAB-MG)

History: The meteorite was purchased from an anonymous finder in Aletai, Xinjiang province.

Physical characteristics: An irregular piece of iron, with concave surface feature.

Petrography: (T. Zhang, S. Hu and Y. Lin, *IGGCAS*) The iron contains a low abundance of taenite, and show plessitic intergrowths of kamacite and taenite. Schreibersite has two types of occurrence, as coarse and elongated grains between kamacite boundaries, and as abundant rhomb-like micrometer-sized grains in kamacite. Minor dauberrite, troilite, sphalerite and graphite were found.

Geochemistry: Mineral compositions and geochemistry: (G. Wang, *GIGCAS*, T. Zhang, S. Hu and Y. Lin, *IGGCAS*) Kamacite: 5.01-6.80 wt.% Ni, 0.08-0.18 wt% Co; Taenite: 9.77-49.2 wt.% Ni. Bulk compositions: Ni: 6.22 wt.%, Ga: 94.9 ppm, Ge: 321 ppm, Ir: 4.43 ppm.

Classification: (G. Wang, GIGCAS, T. Zhan, S. Hu and Y. Lin, IGGCAS) IAB, main group
Specimens: The main mass is held by Zhigan Li.

Yucca 031 34°45'28.67"N, 114°15'29.38"W

Arizona, United States

Find: 2013 Dec 14

Classification: Ordinary chondrite (H6)

History: A 34.3 g meteorite was found by Twink Monrad while she was hunting for Franconia meteorites with a metal detector. It was found at the top of a hill buried 18 cm deep in soft dirt. The stone appears to be oriented, as it is cone shaped with a slight rollover lip on the back side.

Physical characteristics: Exterior of the stone is covered with brownish weathered fusion crust. The interior is brown with light-colored patches. It has an even distribution of fine metal and troilite grains, estimated 45 areal %. A few chondrules to 1 mm are visible.

Petrography: The stone is largely recrystallized with sparse chondrules. A probe section shows several BO chondrules. Plagioclase grains up to 100 μm are abundant. Chromite is irregularly shaped, to 500 μm . Metal is dominated by irregularly shaped single-crystal kamacite grains to 0.7 mm, which lack shock features. Tetrataenite and plessite are rare. Troilite grains are single crystals and lack shock features. Kamacite/taenite grain boundaries are smooth. One 20 μm native Cu nugget was found. Weathering is minor.

Geochemistry: (L. Garvie, ASU) Olivine $\text{Fa}_{19.7\pm0.5}$, $\text{FeO/MnO}=38.7\pm2.0$, $n=9$; low Ca pyroxene $\text{Fs}_{17.3\pm0.2}\text{Wo}_{1.2\pm0.2}$, $\text{FeO/MnO}=23.5\pm0.8$, $\text{Cr}_2\text{O}_3 = 0.11\pm0.05$ wt%, $n=12$; high Ca pyroxene $\text{Fs}_{6.2\pm0.5}\text{Wo}_{45.5\pm1.6}$, $\text{FeO/MnO}=18.5\pm1.0$, $\text{Cr}_2\text{O}_3 = 0.7\pm0.1$ wt%, $n=5$; kamacite $\text{Ni}=6.1\pm0.4$ wt% and $\text{Co}=0.5\pm0.0$ wt%, $n=6$.

Classification: Ordinary chondrite, H6, S1, W1

Specimens: 12.1 g at ASU.

Yucca 034 34°44.1'N, 114°13.1'W

Arizona, United States

Find: 6 May 2004

Classification: Ordinary chondrite (H6)

History: Jerry A. Baird found the stone on May 6, 2004. He donated it to *Cascadia* on March 9, 2013.

Physical characteristics: Oriented stone covered with weathered fusion crust.

Petrography: In thin section, the sample appears well integrated, but with readily discernable chondrules, consistent with a low type 6 grade. BSE imaging shows that olivine and pyroxene is equilibrated throughout the section. Numerous feldspar grains >50 μm across were observed. Weathering is uneven, but ~15-20% of metal and sulfide grains have been replaced, consistent with a W1 weathering grade. Most olivine grains show undulose extinction and one to two sets of planar fractures, but no melt was observed, indicative of shock stage S3.

Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Olivine ($\text{Fa}_{18.8\pm0.3}$, $N=16$), low-Ca pyroxene ($\text{Fs}_{16.5\pm0.2}\text{Wo}_{1.5\pm0.1}\text{En}_{81.9\pm0.2}$, $N=12$).

Classification: H6 based on mineral chemistry and texture.

Specimens: *Cascadia* holds 84.8 g in a single piece, in addition to two polished thin sections and a mounted butt.

Yucca 040 34°44.063'N, 114°13.370'W

Arizona, United States

Find: 30 Apr 2005

Classification: Ordinary chondrite (H6)

History: Found by Dennis Asher. A 37.7 g sample was donated to *Cascadia* on March 9, 2013.

Physical characteristics: Brownish weathering patina, with patches of weathered fusion crust present on exterior surfaces.

Petrography: Chondrules and matrix are well integrated but chondrules are clearly discernable. BSE imaging shows that silicates are equilibrated throughout. Most plagioclase grains are >50 μm across, but enough larger grains (>100 μm) are present to warrant a type 6 classification (borderline type 5). Thin section is notable for containing a large number of chromite-plagioclase objects. Numerous subparallel hydroxide veins cut across the section, with approximately 50-60% of metal and sulfide replaced by weathering product, indicative of weathering grade W2 (borderline W3). Most olivine grains show mild to moderate undulose extinction with irregular fractures suggesting a shock stage of S2.

Geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Olivine ($\text{Fa}_{18.6\pm0.3}$, N=14), low-Ca pyroxene ($\text{Fs}_{16.5\pm0.3}\text{Wo}_{1.5\pm0.3}\text{En}_{82.1\pm0.4}$, N= 11).

Classification: H6 based on mineral chemistry and texture.

Specimens: *Cascadia* holds 29.0 g in multiple pieces, in addition to two polished thin sections and a mounted butt. Mr. Dennis Asher holds the main mass.

Žďár nad Sázavou 49°31.3' N, 16°2.0' E

Vysocina, Czech Republic

Confirmed fall: 9 Dec 2014

Classification: Ordinary chondrite (L3)

History: A -15 absolute magnitude bolide was observed by thousands of eyewitnesses over large part of central Europe and recorded photographically by 10 automated all-sky fireball observatories at 7 Czech stations of the European Fireball Network on Dec 9, 2014, at 16:16:45-54 UT. Very precise data on atmospheric trajectory, heliocentric orbit and fragmentation history were quickly determined. Based on this analysis it was evident that this event terminated with a multiple meteorite fall. The impact area for possible range of meteorite masses was thus modeled. Two small fresh meteorites which according to the prediction originated in the brightest flare at 36.4 km altitude (5.6 and 39.3 g) were found shortly after the bolide observations (20 Dec 2014 and 12 Jan 2015) during dedicated search. Both were recovered exactly in the predicted location for given mass (both less than 100 m apart the highest probability location).

Physical characteristics: As the meteorites fell in winter, the search was possible only in two short periods when snow was melted. Due to the low inclined trajectory (25 °) and high altitude fragmentation, the predicted impact area for 1 g to 1 kg meteorites is about 30 km long. The recovered meteorites with bulk density of 3.05 g/cm³ and high porosity of about 15% have black crust and are roundish in shape; the smaller one is partly broken, but the larger one is completely crusted.

Petrography: (J. Haloda, *CzGS*; P. Halodova, *CzGS*), The meteorite shows clearly visible and sharply defined chondrules and fine-grained matrix. Chondrule sizes vary from around 0.4 mm to 7 mm. Thin section shows recrystallization of a major part of the fine-grained matrix. Undulose extinction of olivine and orthopyroxene and the presence of irregular fractures indicate a very weak shock stage.

Geochemistry: Mineral compositions and geochemistry: (J. Haloda, CzGS; P. Halodova, CzGS), Chondrules consist mostly of olivine (Fa_{20-27}) mean $\text{Fa}_{23.8}$, PMD-FeO 7.6%, $n=52$; low-Ca pyroxene ($\text{Fs}_{15-23}\text{Wo}_{0.7-1.6}$) mean $\text{Fs}_{19.5}$ $\text{Wo}_{1.33}$, Fs PMD 8.4%, Wo PMD 15.5%, $n=53$. Alkali-bearing glass exhibits a wide range of chemical compositions. Most secondary feldspar grains are $<1\ \mu\text{m}$ but some are larger; chromite, chlorapatite, troilite, kamacite and taenite are also present. The average Co amount in kamacite is 1.3 wt%, Co mean deviation 1.8%.

Classification: (J. Haloda, CzGS; P. Halodova, CzGS), Ordinary chondrite, L3, estimated subtype 3.9, Shock stage S2, weathering grade W0

Specimens: 5.92 g and 39.25 g at CzAS

2. New Dense Collection Areas (DCA):

Algeria: Abadla, Bechar, Gourara.

Chile: Aguada de Varas, Quebrada Chimborazo

Morocco: Istifane (modification), Rabt Sbayta

Tunisia: En Naffatiyah

United States of America: Misfits Flat

3. Listing of institutes and collections

An up-to-date index of collections and approved repositories (next to a green tick mark) cited in the Meteorite Bulletin can be found here:

<https://www.lpi.usra.edu/meteor/MetBullAddresses.php?grp=country>

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Acknowledgments

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