Northwest Africa 4472 and 4485

Anorthosite-bearing basaltic breccia

64.3, 188 g

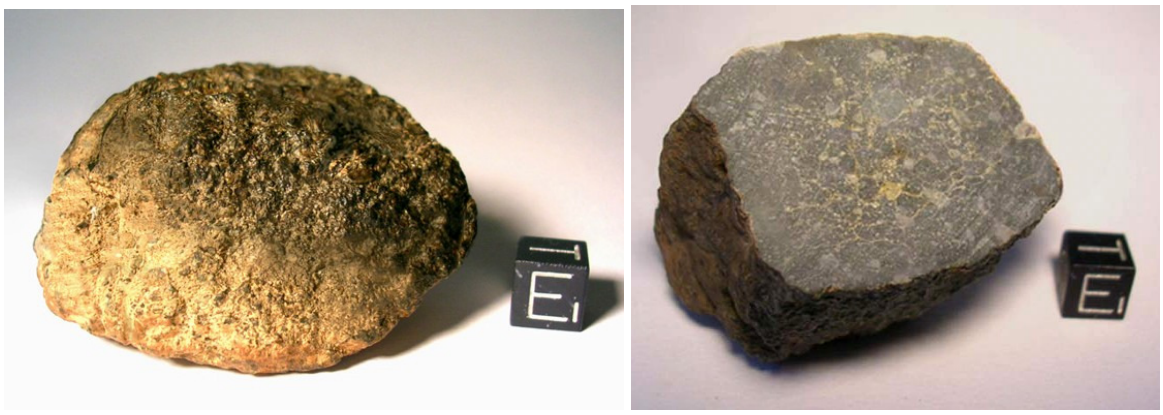


Figure 1: Northwest Africa (NWA) 4485: entire stone (left) and cut mass (right). Cubes are 1 cm. Photos by S. Ralew and M. Altmann.

Introduction

Northwest Africa (NWA) 4472 and 4485 were found in Algeria, and purchased in Morocco in July and September (respectively) of 2006. NWA 4472 is a single 64.3 g stone (without fusion crust) with visible pale gray to whitish clasts in a dark gray matrix. The exterior has fractures and thin coatings of desert varnish on exposed surfaces. NWA 4485 is a single 188 g spheroidal stone with a brown weathered exterior (Fig. 1). The interior consists of pale gray to whitish clasts in a dark gray matrix, and has visible thin veins of terrestrial carbonate (Connolly et al., 2007).

Figure 2: Cut slab of NWA 4472 illustrating dark glassy matrix and light colored feldspathic clast. Cube is 1 cm. (from Kuehner et al., 2007).
Figure 3: Cut slab face of NWA 4472 illustrating dark glassy matrix and light colored feldspathic clast. Cube is 1 cm. (from Kuehner et al., 2007).

Petrography and mineralogy

In both NWA 4472 and 4485, lithic clasts (up to 0.65 cm) are predominantly various types of ophitic to quench-textured basalts (composed of pyroxene(s), plagioclase, olivine, ilmenite, and rare baddeleyite; Figs. 2 and 3). Granophyre clasts (consisting of "ribbon-like"

subparallel intergrowths of silica and K-feldspar with accessory baddeleyite and rare tranquillityite) are present as a minor component, as well as clasts composed mainly of fayalite (with associated glass, silica, K-feldspar, and merrillite) and spherical to ellipsoidal glass objects (up to 60 µm across) (Fig. 4). Mineral clasts include pyroxenes, olivine, plagioclase, silica, zircon, baddeleyite, merrillite, Ti-chromite, fayalite, ilmenite (with baddeleyite inclusions), metal (both kamacite and taenite), troilite, and schreibersite (Connolly et al., 2007; Kuehner et al. 2007; Joy et al., 2007; 2008). Some unusual exsolution features have been noted in both samples, and they involve silica and potassium feldspar intergrowths (Fig. 5).

Mineral compositions are: Olivine ($Fa_{26.3–64.6}$), plagioclase ($An_{86.9–95.5}Or_{0.2–0.6}$), orthopyroxene ($Fs_{18.9–29.3}Wo_{3.8–4.6}$), subcalcic augite ($Fs_{48.9–52.6}Wo_{26.7–39}$), Al-Cr-rich pigeonite ($Fs_{27.0}Wo_{17.1}$; Al = 3.10 wt%, Cr = 1.01 wt%), fayalite ($Fa_{90.3}$), barian K-feldspar intergrown with silica ($Or_{80.9–55.6}Ab_{15.3–30.2}$ $Cn_{0.6–6.3}$) (from Connolly et al., 2007).

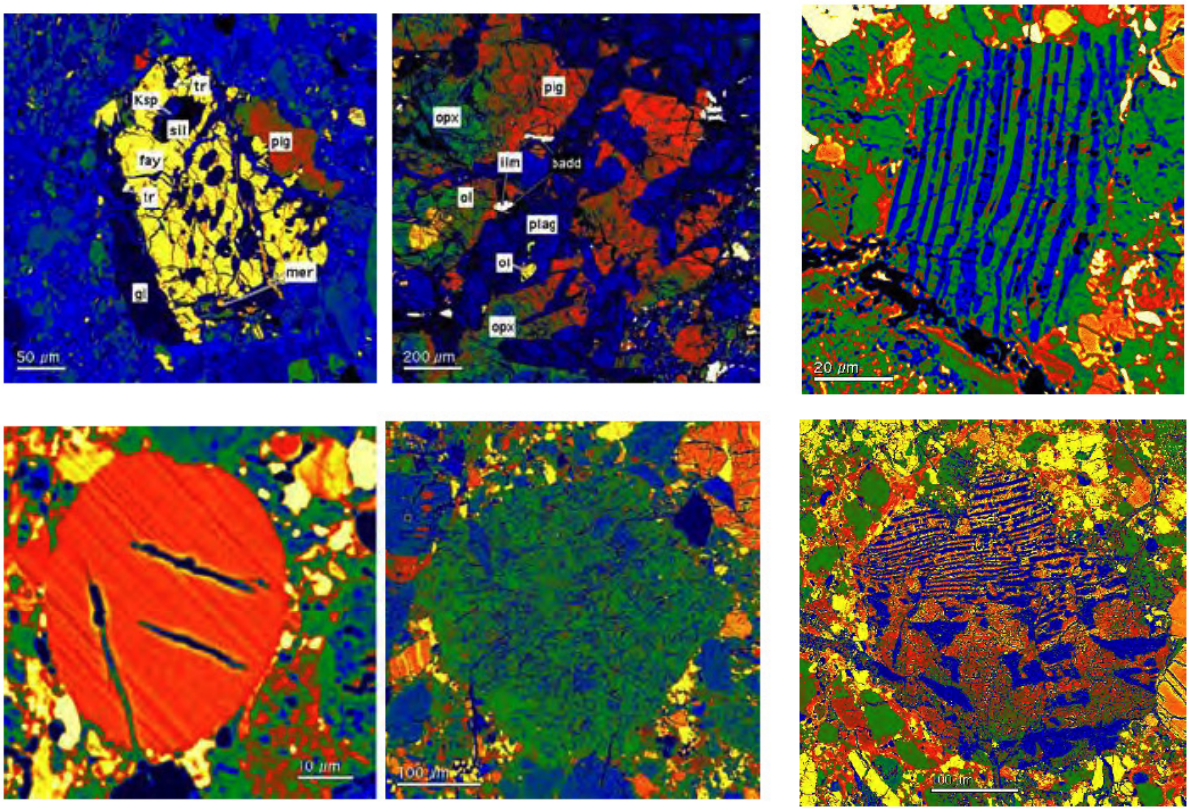
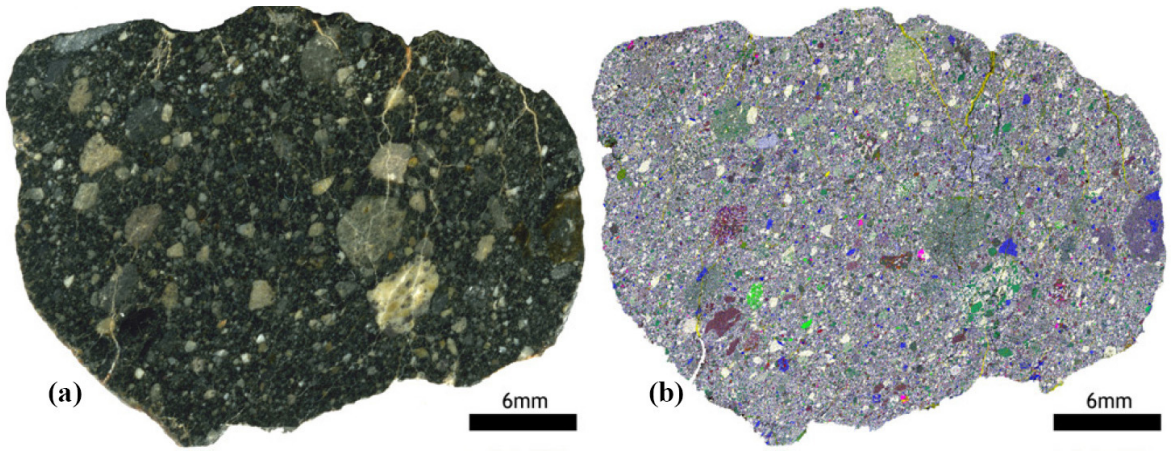
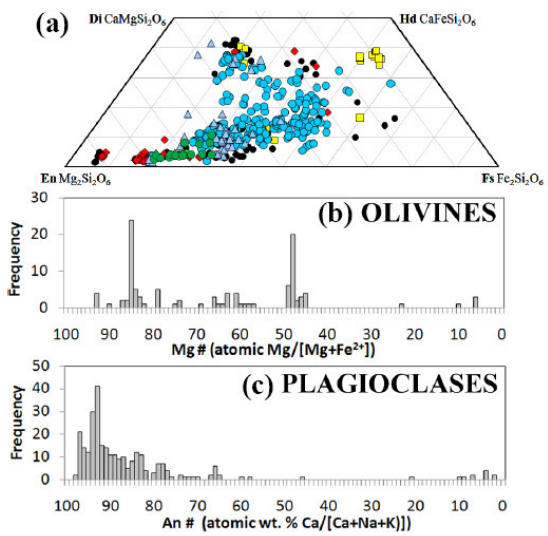


Figure 4 (left, and clockwise from upper left): A. NWA 4472 fayalite-rich clast. B. NWA 4485 basalt clast. C. NWA 4472 glass sphere. D. NWA 4485 quenched clast composed of glass (green) and plagioclase microlites (blue). (from Kuehner et al., 2007).

Figure 5: Exsolution features in clasts from NWA 4472 (above) and NWA 4485 (below) – silica (blue), K-feldspar (green to red) (from Kuehner et al., 2007).

In depth studies of clasts in NWA 4472 have revealed clasts of basalt, FeO-rich glass, Mg suite lithologies, granophyric silica + K-spar intergrowths, impact melt and granulitic breccia (Joy et al., 2008; Figs. 6, 7 and 8).





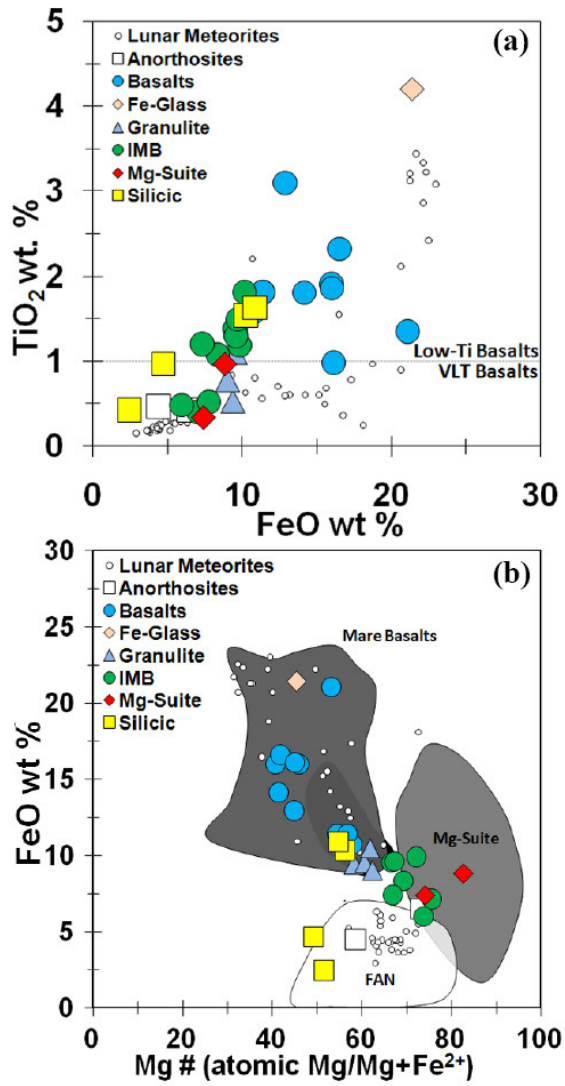


Figure 6: scanned image of NWA 4472 slab (top left) along with x-ray montage of same slab where blue clasts are silicic KREEP-like, green clasts are Mg-suite, and red clasts are FeO-rich mare basalt.

Figure 7: Pyroxene, olivine and plagioclase compositions from Joy et al. (2008).

Figure 8: Major element compositions of various clasts in NWA 4472 studied by Joy et al. (2008).

Chemistry

INAA analyses of nine ~30 mg subsamples gave a mean composition of: Na = 0.448, Fe = 7.14 (both wt%), Sc = 20.9, La = 44.7, Sm = 19.51, Eu = 1.50, Yb = 13.4, Zr = 438, Hf = 11.1, Ba = 601, Th = 7.49 (all ppm). and is very similar in bulk composition and petrologic

characteristics to Northwest Africa 4485. INAA on eight ~30 mg subsamples of NWA 4485 gave a mean composition of: Na = 0.441, Fe = 7.27 (both wt%), Sc = 21.7, La = 31.6, Sm = 14.12, Eu = 1.46, Yb = 11.0, Zr = 443, Hf = 11.4, Ba = 375, Th = 6.37 (all ppm). The bulk composition of NWA 4485 is essentially identical to that of Northwest Africa 4472 (Fig. 9). The presence a minor mare basalt component cannot be ruled out in either sample, but these specimens are dominated by materials with KREEP-like composition. Furthermore the REE contents of these samples is higher than most other lunar materials, and similar to SaU 169 in this respect (Fig. 9,10). This compositional characteristic suggests an origin in the Procellarum KREEP terrane on the nearside of the Moon (Joy et al., 2008).

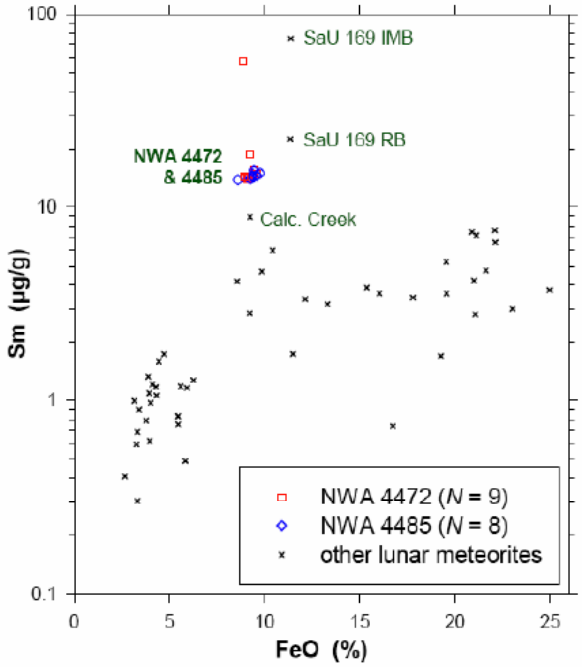


Figure 9: Sm vs. FeO for NWA 4472 and 4485 compared to other lunar meteorites, illustrating their unusually high concentrations of SM (and other REE), in a similar range to those measured for SaU 169.

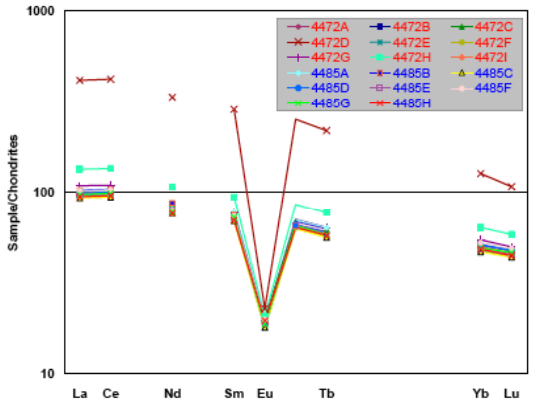


Figure 10: Chondrite-normalized REE abundances of NWA 4472 and NWA 4485 subsamples (very enriched subsample probably contains abundant phosphate).

Radiometric age dating

There are no known studies.

Cosmogenic exposure ages

There are no known studies.