Northeast Africa 001

Anorthositic regolith breccia

262 g

Figure 1: Northeast Africa 001 illustrating the dark weathered exterior. Image is from Haloda et al. (2006b). Width of sample is ~10 cm.

Introduction

Northeast Africa (NEA) 001 (Fig. 1) was found in Sudan in April 2002, near the Libya-Egypt-Sudan border (Fig. 2). It has no fusion crust, and extensive terrestrial alteration products around the edges and in cracks, include calcite, barite, gypsum, and Fe hydroxides. It is an anorthositic regolith breccia consisting of mineral fragments and lithic clasts in a microcrystalline impact melt matrix (Fig. 3; Russell et al., 2005; Haloda et al., 2006b).

Petrography and mineralogy

The lithic clasts in NEA001 are up to 1 cm in size, and are dominantly anorthositic (Fig. 4a-e and 5). There are some basaltic clasts although these are minor in volume (Snape et al., 2008, 2009). Breccia-in-breccia textures are common, and glass fragments, spherules, and basaltic fragments are also present (Fig. 4f). Plagioclase feldspar compositions are between An_{92} and An_{99} (Russell et al., 2005; Haloda et al., 2006b;

Snape et al., 2008). Some pyroxene mineral fragments contain fine-grained exsolution, and there are also pyroxferrites that have broken down into silica-hedenbergite-fayalite intergrowths (Snape et al., 2008). Pyroxene compositions for the lithic clasts are largely En_{60-70}, augites have Mg# of approximately 0.75 (Fig. 6). Accessory minerals include MgAl spinel, chromite, ilmenite, troilite, FeNi metal, and silica.

The impact melt clasts in NEA 001 exhibit REE patterns, and elemental abundances similar to FAN lunar meteorites and are as incompatible trace element - poor as the Group-4 Apollo 16 feldspathic impact melts (Snape et al., 2009). This indicates that the target bedrock was likely KREEP-poor and feldspathic in nature, and could have been from the FHT on the lunar farside (Snape et al., 2008, 2009).

Figure 2: Region of Northeast Africa in which the sample was found.
Figure 3: Slab of NEA001 showing many feldspathic clasts and terrestrial weathering at the top edge. Divisions on scale are 1 mm (photo from R. Korotev).

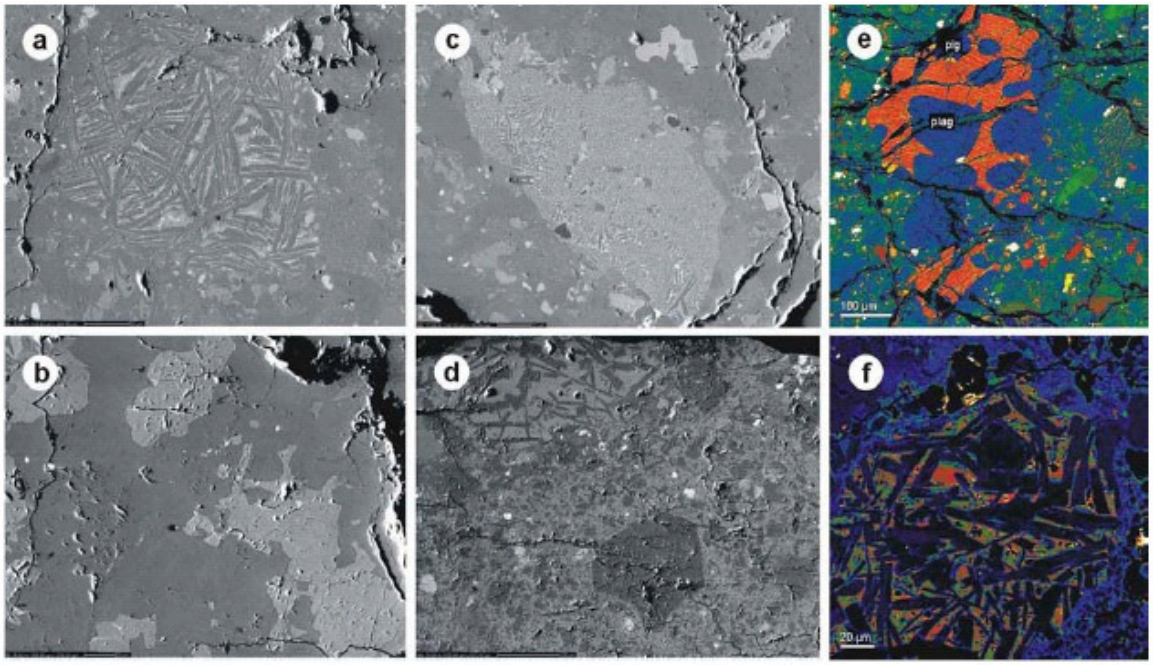


Figure 4: Back scattered electron images of clasts in NEA 001 illustrating the lithologic diversity of the clasts: (a) plagioclase/glass 200 micron wide; (b) anorthositic clast (230 micron); (c) devitrified glass fragment within the regolith breccia; (d) impact melt breccia; (e) false color back scattered electron(BSE) image of a primary gabbroic clasts of the ferroan highlands suite; (f) false color BSE image of a basaltic clast (from Haloda et al., 2006b).

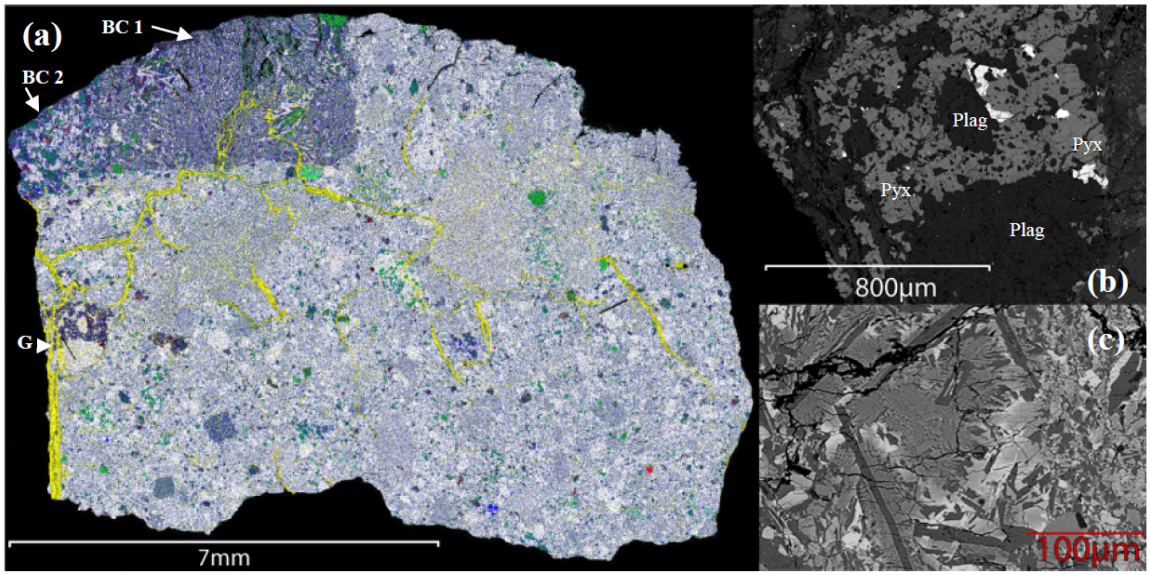


Figure 5: (a) Montaged elemental map of NEA 001 (from Snape et al., 2008): Si = blue, Al = white, Mg = green, Fe = red, Ca = yellow and Ti = pink (same color scheme as depicted in Fig.1 of [6]). (b) BSE image of large gabbroic clast with minor ilmenite phases (clast labeled as 'G' in 1a). (c) Devitrified plumose textures in large shocked basaltic clast (clast labeled as 'BC' in 1a). Labeled phases: 'Plag' = plagioclase; 'Pyx' = pyroxene.

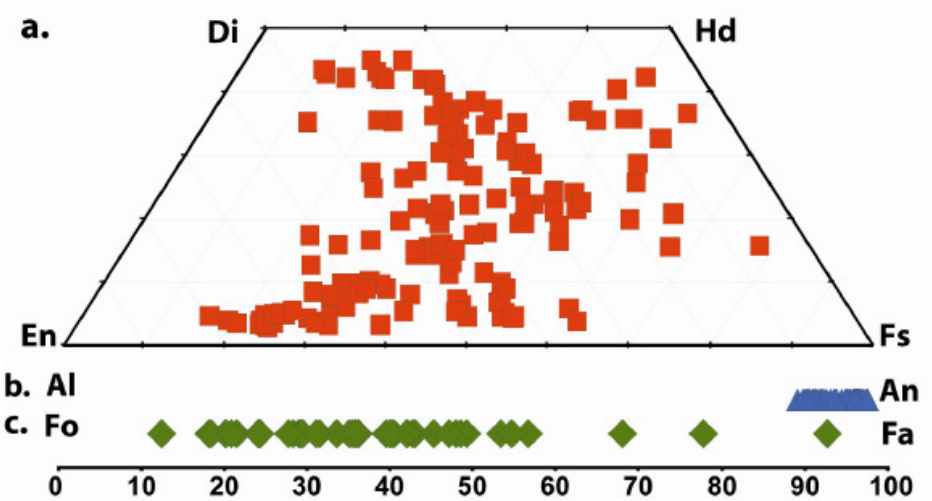
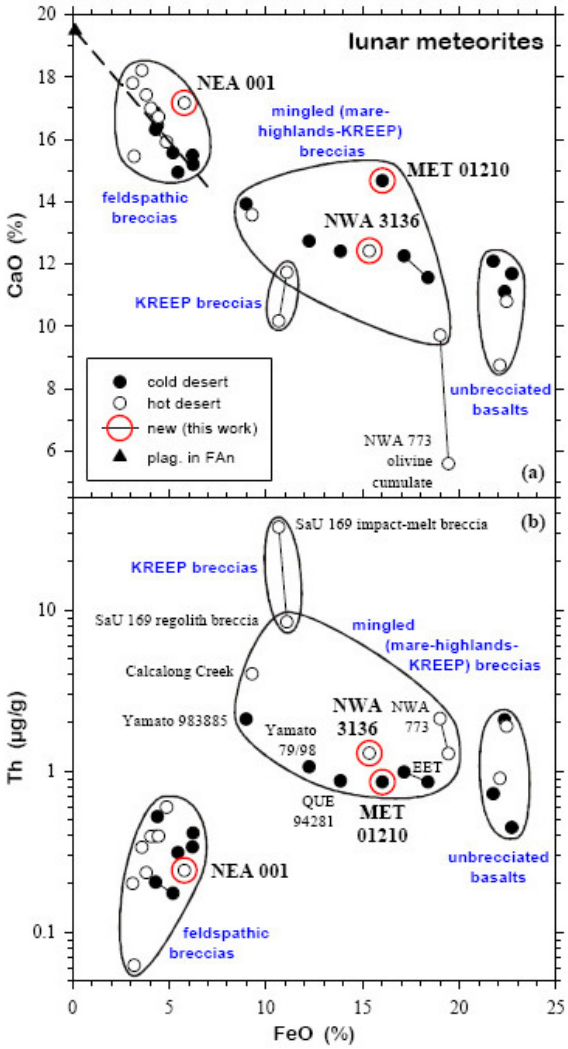


Figure 6: Olivine and pyroxene compositions from mineral fragments and lithic clasts from NEA 001 (from Snape et al., 2008).

Chemistry

NEA 001 has a composition similar to other feldspathic breccias, but is at the high FeO, Sc and Cr end of the group (Fig. 7). The high Sc and low Cr/Sc, together with the FeO, Th and CaO contents demonstrate that NEA001 is FAN-rich with only a minor mare basalt component and little to no KREEP component. Individually analyzed impact melt clasts exhibit overlap with the bulk composition of FANs (Fig. 8; Snape et al., 2009).



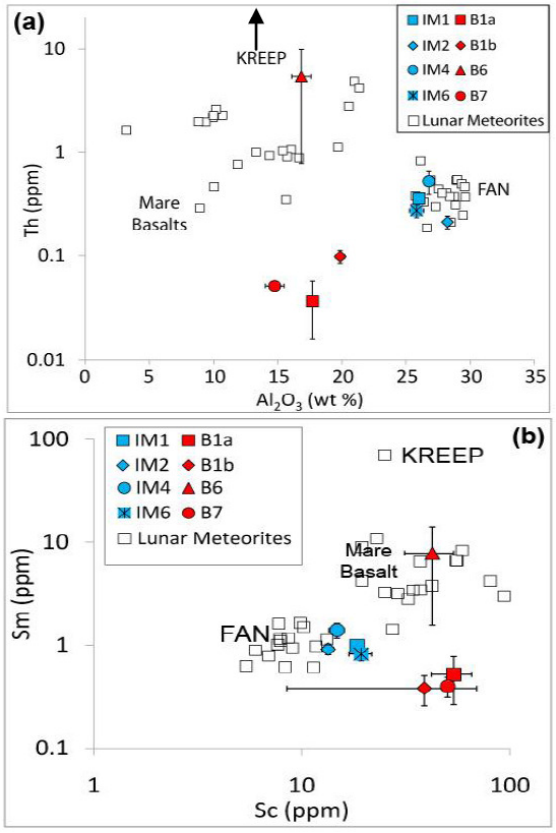


Figure 7 (left): CaO, FeO and Th contents of NEA 001 compared to other feldspathic breccias, mingled, and basaltic lunar meteorites (from Korotev and Irving, 2005).

Figure 8 (right): Sm, Sc, Al_2O_3, and Th contents of impact melt clasts and basaltic clasts studied by Snape et al. (2009).

Radiogenic age dating

None yet reported.

Cosmogenic isotopes and exposure ages

None yet reported.

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