Northwest Africa 5000

Anorthositic regolith breccia

11528 g

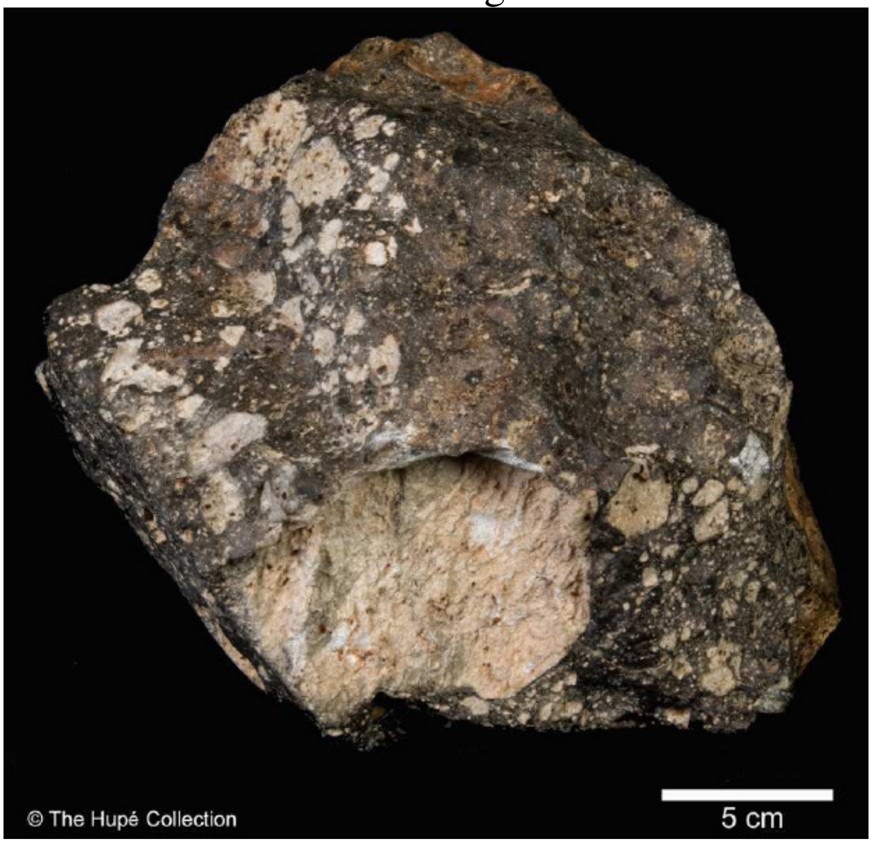

Figure 1: Exterior and interior images of NWA 5000 with scale bars indicated (from Irving et al., 2008).

Introduction

Northwest Africa 5000 (Fig. 1) is breccia containing predominantly light colored gabbroic clasts in a gray partly glassy matrix. This meteorite was discovered in southern Morocco in 2007 (Connolly et al., 2008). The 27 cm x 24 cm x 20 cm sample is the second largest lunar meteorite known, has translucent fusion crust on one side, contraction cracks and regmaglypts that are also associated with desert patina or varnish.

Petrography

The clasts are largely mono-lithologic (Irving et al., 2008) "leuco" gabbro, although there are also gabbroic anorthosite and impact melt clasts and matrix mineral fragments (Fig. 2). The coarse-grained (0.5 to 2.7 mm) calcic plagioclase feldspar (An_{96-98}) is most common phase with pigeonite (Fs_{32-65}) also present, and some of the latter contain fine exsolution lamellae (Irving et al., 2008). Accessory phases include kamacite, merrillite, magnesian ilmenite, titanian chromite, baddeleyite, zirconalite, silica, potassium feldspar, and troilite (Irving et al., 2008).

In addition, high metal content observed in the clasts (Humayun and Irving, 2008) has been attributed to the impactor, and suggested to be processed material from the inner Solar System. The existence of exotic metals within the otherwise igneous-textured gabbroic clasts may signify large-scale impact melting (Humayun and Irving, 2008).

Figure 2: Slice of NWA 5000 showing the "leuco" gabbro clasts as well as grey matrix and a dark impact melt clast near the bottom (from Irving et al., 2008).

Chemistry

The composition of NWA 5000 falls within the field that is typical for feldspathic lunar meteorites (Korotev et al., 2008), despite the scatter portrayed in Figure 3. It has an average of 6.4 wt% FeO, 10 ppm Sc, 900 ppm Cr, 860 ppm Ni, and 0.4 ppm Th (Fig. 3). It also exhibits a moderate and positive Eu anomaly. Splits of the black impact melt clast exhibit relatively higher Na, Sm and Cr compared to the gabbroic clasts (Fig. 3).

Radiogenic age dating

Initial ^{40}Ar-^{39}Ar age spectra for three bulk subsamples of a gabbroic clast from NWA 5000 are highly discordant, suggesting a partial re-setting of the K/Ar system based on the initial ~70% of the ^{39}Ar released (Fernandes et al., 2009). This may be due

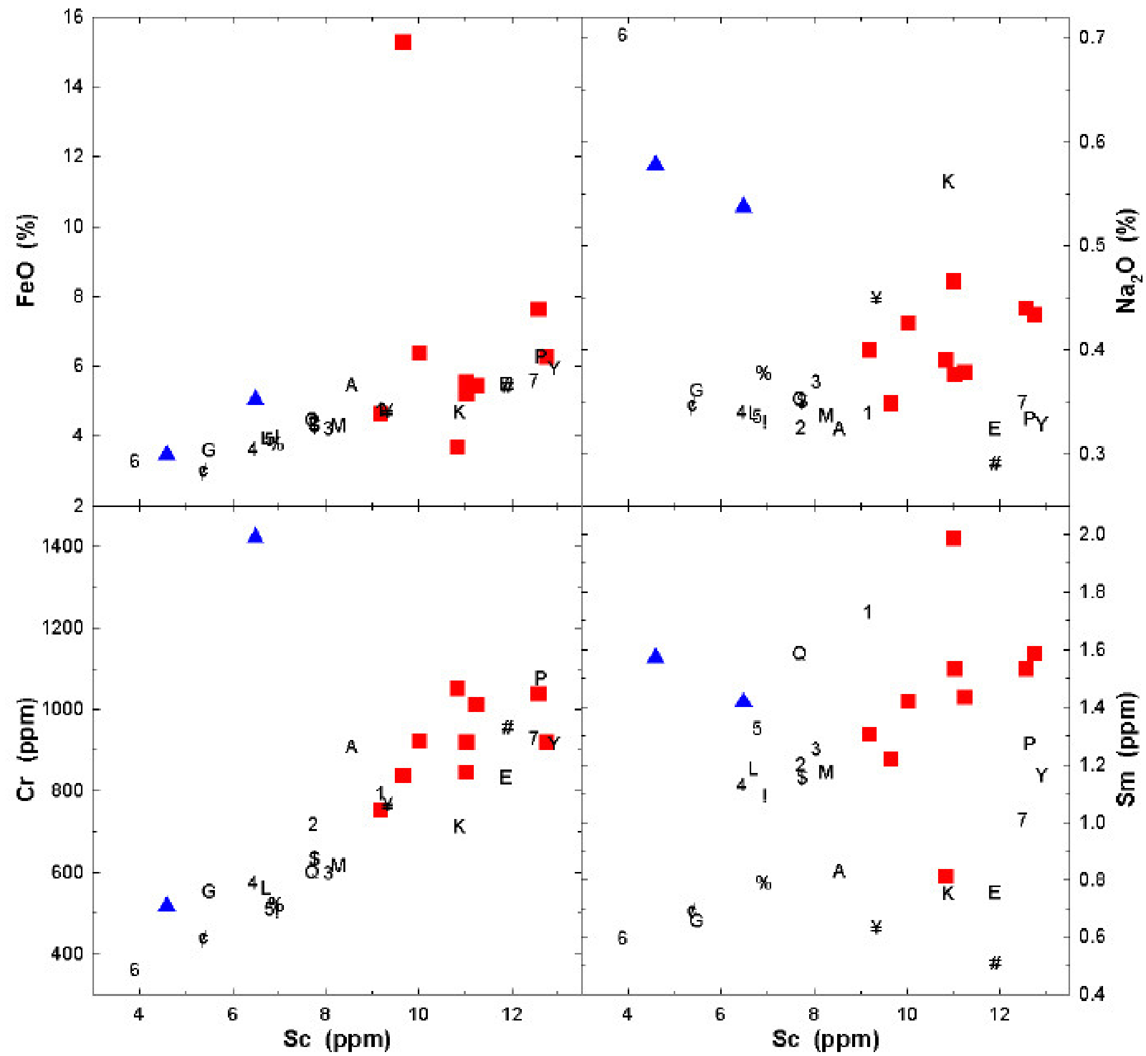

Figure 3: Splits of NWA 5000 analyzed and reported by Korotev et al. (2008). Red squares are gabbroic and matrix splits, whereas the blue triangles are splits of the impact melt clasts.

to a thermal event (impact?) at ~500 Ma. The last ~30% of ^{39}Ar release shows more consistent apparent ages (but nonetheless not meeting standard plateau criteria), suggestive of an age of 3.2±0.1 Ga. This could possibly be the age of the larger impact that created a substantial melt sheet which then differentiated (Fernandes et al., 2009).

Cosmogenic isotopes and exposure ages

^{10}Be, ^{14}C, ^{36}Cl and cosmogenic ^{21}Ne measurements suggest the following exposure history of NWA 5000. After a ~600 Myr residence in the lunar regolith, the meteorite was ejected from a depth of 335 ± 20 g/cm2 on the Moon. The minimum transition time from the Moon to Earth was 1.3 kyr with only a short terrestrial age < 1 kyr, consistent with the presence of fresh, translucent fusion crust on part of the meteorite. A longer terrestrial age - up to ~10.4 kyr – cannot be ruled out.