Stratigraphy in Basaltic Achondrites: Kapoeta Revisited

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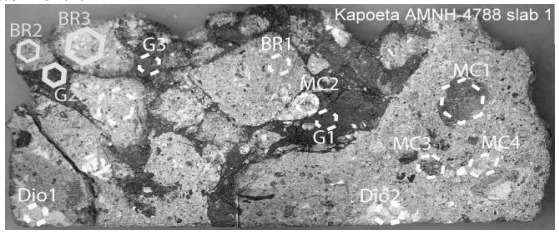
Introduction: The Kapoeta howardite[1-5] is of particular interest as it contains a spectrum of mineral and lithic fragments that cover the known range of the HED planetoid Vesta with Fe/(Fe+Mg) ratios between 0.10 and 0.95 with a mode intermediate to eucrites and diogenites. The lithic clasts have been studied by a variety of techniques, but were generally limited by the inability to characterize very small samples. The characterization of the relationship among the different samples is generally limited to the observation that they are located in the same meteorite. We have begun a campaign to sample petrographically distinct objects from two parallel slabs (Fig. 1) of Kapoeta (AMNH-4788) with the purpose of generating correlated isotopic, compositional, mineralogical and textural data that are strongly constrained by location both within the sample and relative to each other. These objects are currently being prepared for laser ^{40}Ar-^{39}Ar dating of bulk clasts and of mineral separates from them.

Fig. 1. Oblique light image of slab 1 showing areas to be micro-sampled. Solid edges surround areas that have been sampled and irradiated. Dashed areas are represent future samples. Long axis=25mm

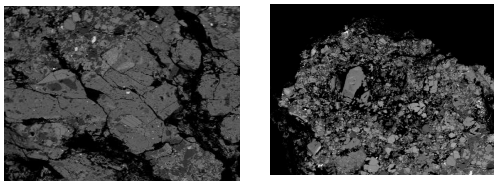


General Petrography: Microanalysis reveals variation of olivine, pyroxene (En80-40)and plagioclase (An95-65) within these clasts indicating that multiple crystallization environments were sampled. Unlike much of Kapoeta, this slab contains abundant impact melt glass (G1,G2,G3)(Fig. 2a). Breccia rich areas (BR1,BR2, BR3)(Fig. 2b), diogenitic lithic clasts (DIO1, DIO2) and numerous mafic clasts (MC1 to 4) (Fig. 3) have either been subsampled and aliquots irradiated (solid, Fig 1) or are in prep.(dashed, Fig 1).

Feldspar samples of 5-15 µg have yielded useful ages in previous studies[6] and comparison of the bulk breccia clasts with separate feldspar grains from them will provide a test of heterogeneity within the breccia.

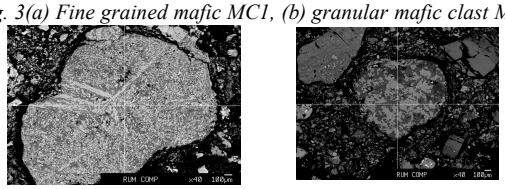
Isotope Measurements: To show that useful data can be obtained from these samples, a test suite of 3 samples was irradiated (with Cd shielding) for 100h at the USGS Triga reactor along with reference minerals FC-2 sanidine (28.02 Ma) and Hb3Gr amphibole (1073.6 Ma). Ar isotopes will be measured at Earth and Planetary Sciences, Rutgers University, using a MAP 215-50 spectrometer operated in pulse-counting mode. Single grains are heated in 6 to 8 steps with a CO_2 laser (maximum T ~1400°C). A typical system blank (10^{-17} mol) is: ^{40}Ar= 20; ^{39}Ar= 0.02; ^{38}Ar= 0.1; ^{37}Ar= 8.0; ^{36}Ar= 0.4. Two breccias and one glass sample from Kapoeta 4788,1 are presently cooling down prior to Ar isotopic measurement: **BR2**: 2 bulk samples of 226µg and 163µg + single grains of 2–10µg; **BR3**: bulk samples ranging from 163-2860µg; **G2**: 7 samples ranging from 3–216 µg. A portionof the mass from each of the three areas has been reserved for noble gas and other measurements. Further processing of the additional characterized samples, especially the feldspar rich mafic clasts will begin after these test results have been assessed.

Fig. 2 (a) Glass matrix breccia G2 (b) Clast BR2



(a) *(b)*

Fig. 3(a) Fine grained mafic MC1, (b) granular mafic clast MC3



(a) *(b)*

Conclusions: The feldspar data may provide chronology of magmatic events. The impact glass samples inthis and other HEDs are critical for distinguishing magmatic from impact chronology once their apparent plateau ages or isochrons are compared across the basaltic achondrite suite as they act as classic marker horizons in the stratigraphy. This study should begin to provide a more systematic chronology of the HED crust by intercolating multiple impact events with magmatic and metamorphic events and provide the markers for Vestan stratigraphy. The impact melt chronology may be a basis for calibrating crater counts from the surface of that body.

References: [1]Dymek et al1976*GCA* **40** [2]Mason & Wiik 1966*Amer Mus Novit.* [3]Mittlefehldt, & Lindstrom 1997 *GCA* **61** [4] Rajan et al. 1979*GCA* **43** [5]Swindle et al. 1990*GCA* **54** [6]Lindsay et al. 2010 MAPS **44**