Multi-system chronometry of lunar breccia 67955

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Reconstructing the early lunar impact chronology relies on the absolute dating of lunar impactites [e.g., 1], especially those connected to large, pre-Imbrium events. A prime example is the noritic anorthosite portion of breccia 67955, which likely crystallised from the melt sheet of a ~4.2 Ga basin-forming impact in the Procellarum-KREEP Terrane [2, 3]. Partial resetting of the U-Pb system in some accessory minerals is apparently related to the ~3.9 Ga Imbrium impact, which relocated the sample 67955 to the Apollo 16 site [2, 3].

We are conducting a multi-chronometer study (^{176}Lu-^{176}Hf, ^{147}Sm-^{143}Nd, ^{87}Rb-^{87}Sr, and Pb-Pb) on a 2 g aliquout of 67955 to determine the relative behaviors of these isotope systems when such igneous clasts are formed by brecciation and incorporated into the ejecta of a later impact. To allow mineral separation of this fine-grained sample (working grain size 20-40 μm), we used an enclosed system for magnetic separation in ethanol based on [4]. Chemical separation schemes and analytical protocols are extended versions of those described by [5]. So far, we have analysed the ^{147}Sm-^{143}Nd systematics of the sample. The isotopic compositons of the mineral fractions are slightly affected by neutron capture (NC, ε^{149}Sm = -0.9 ±0.2) and we corrected for this using the model of [6, 7]. The resulting ^{147}Sm-^{143}Nd isochron date (4201 ±45 Ma, 5 of 5 isochron points, MSWD = 0.99) confirms the ^{147}Sm-^{143}Nd date of 4200 ±70 Ma reported by [3] and agrees with the low-U zirconolite U-Pb date of 4.22 ± 0.01 Ga [2], suggesting that the Sm-Nd system has not been disturbed by the event(s) that brecciated the sample.

[1] Neukum & Ivanov (1994) *Hazards Due to Comets and Asteroids*, 359-416. [2] Norman & Nemchin (2014) *EPSL* **388**, 387-398. [3] Norman *et al.* (2016) *GCA* **172**, 410-429. [4] Lumpkin & Zaikowski (1980) *Am Min* **65**, 390–392, 1980. [5] Bast *et al.* (2015) *JAAS* **30**, 2323-2333. [6] Sprung *et al.* (2010) *EPSL* **295**, 1-11. [7] Sprung *et al.* (2013) *EPSL* **380**, 77-87.