Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.19685

Confirming the KREEP-rich nature of the parental melt of noritic anorthosite in Apollo 16 breccia 67955 using Pb-Pb systematics

THOMAS HABER[1], ANA ČERNOK[2,3], HARRY BECKER[2] AND ERIK E. SCHERER[1]

[1]Universität Münster
[2]Freie Universität Berlin, Institut für Geologische Wissenschaften
[3]School of Physical Sciences, The Open University
Presenting Author: thomas.haber@uni-muenster.de

The overwhelming majority of impactites at the Apollo landing sites were generated by basin-forming impacts [e.g., 1]. However, even when such rocks can be successfully dated, identifying their corresponding impact basin is challenging [e.g., 2]. Nevertheless, establishing such links is vital for a better understanding of lunar impact chronology and can be demonstrated using the example of breccia 67955. Noritic anorthosite portions of this rock have been previously dated with a ^{147}Sm-^{143}Nd isochron [4200 ±70 Ma; 3] and with U-Pb on low-U zirconolite [4.22 ±0.01 Ga; 4] and zircon [4211 ±4 Ma; 5]. Trace element compositions indicated that this sample crystallized as a cumulate from a KREEP-rich impact melt sheet [3]. Together, these data point to a ~4.2 Ga basin impact within the Procellarum-KREEP Terrane.

Working on a separate split of the same rock, we had previously produced a neutron capture corrected [6, 7] ^{147}Sm-^{143}Nd isochron [4201 ±45 Ma; 8], confirming the sample age. We have acquired new ^{207}Pb/^{206}Pb data, obtained by stepwise digestion [e.g., 9], that also yield a ~4.2 Ga crystallization age, and allow testing for an inherited KREEP component: These Pb-Pb data indicate that that the source(s) of the melt from which 67955 crystallized had a μ-value (^{238}U/^{204}Pb) of ~2000. This is significantly higher than that of 544 obtained by [10] for 67955 itself and is a typical KREEP signature [e.g., 11, 12]. Statistically, ~4.2 Ga impactites at the Apollo 16 landing site were most likely derived from Serenitatis or Nectaris [1], with the confirmed KREEP-rich nature of the parental melt favoring Serenitatis.

[1] Liu et al. (2020) Icarus 339:113609. [2] Černok et al. (2021) Nature Commun. Earth Environ. 2:120 [3] Norman et al. (2016) GCA 172:410-429. [4] Norman & Nemchin (2014) EPSL 388:387-398. [5] Vanderliek et al. (2021) EPSL 576:117216 [6] Sprung et al. (2010) EPSL 295:1-11. [7] Sprung et al. (2013) EPSL 380:77-87. [8] Haber and Scherer (2019) Goldschmidt Abstr.1255 [9] Borg et al. (2011) Nature 447:70-73. [10] Oberli et al. (1979) LPSC X:940-942. [11] Snape et al. (2016) EPSL 451:149–158. [12] Snape et al. (2017) Chem. Geol. 466:608–616.