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Multi-system chronometry of lunar impact melt rock 61156

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Most mafic KREEP-rich impact melt rocks from the Apollo 16 landing site likely formed during the ~3.9 Ga Imbrium event [e.g., 1]. While some of the less KREEP-enriched and more feldspathic A16 melt rocks might also have formed during this event [2], they can also record other impacts [3, 4] and therefore offer crucial insights into the lunar bombardment history.

Sample 61156 is a relatively KREEP-poor, poikilitic impact melt rock for which previous dating efforts suggest an Imbrium or post-Imbrium formation age [5, 6]. We attempted to date this sample using multiple isotopic systems (Lu-Hf, Sm-Nd, Rb-Sr) and will also apply Pb-Pb dating. The Hf and Sm isotopic compositions of the sample indicate that it has been strongly affected by neutron capture (μ^{180}Hf = -424, ε^{149}Sm = -75). We have therefore corrected our Lu-Hf and Sm-Nd isotopic data using the model of [7, 8]. Using 7 of 9 mineral fractions yields an Sm-Nd isochron of 3.906 ±0.058 Ga (MSWD = 2.0), whereas no Lu-Hf and Rb-Sr isochrons could be obtained. The disturbance of those two systems might be the result of a post-crystallisation reheating event, which is indicated by the diffusive loss observed in the ^{40}Ar/^{39}Ar systematics of the sample [5].

The Sm-Nd date is consistent with an Imbrium origin of the sample [9, 10]. In this case, the melt from which 61156 crystallised might have formed by secondary cratering caused by Imbrium ejecta bombarding the feldspathic highland materials around the Apollo 16 landing site, or it might have been part of the Imbrium ejecta itself.

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