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The petrogenesis of impact basin melt rocks in lunar meteorite Shişr 161†

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ABSTRACT

This study explores the petrogenesis of Shişr 161, an immature lunar regolith breccia meteorite with low abundances of incompatible elements, a feldspathic affinity, and a significant magnesian component. Our approach was to identify all clasts >0.5 mm in size in a thin section, characterize their mineral and melt components, and reconstruct their bulk major and minor element compositions. Trace element concentrations in representative clasts of different textural and compositional types indicate that the clast inventory of Shişr 161 is dominated by impact melts that include slowly cooled cumulate melt rocks with mafic magnesian mineral assemblages. Minor exotic components are incompatible-element-rich melt spherules and glass fragments, and a gas-associated spheroidal precipitate. Our hypothesis for the petrologic setting of Shişr 161 is that the crystallized melt clasts originate from the upper ~1 km of the melt sheet of a 300 to 500 km diameter lunar impact basin in the Moon's feldspathic highlands. This hypothesis is based on size requirements for cumulate impact melts and the incorporation of magnesian components that we interpret to be mantle-derived. The glassy melts likely formed during the excavation of the melt sheet assemblage, by an impact that produced a >15 km diameter crater. The assembly of Shişr 161 occurred in a proximal ejecta deposit of this excavation event. A later impact into this ejecta deposit then launched Shişr 161 from the Moon. Our geochemical modeling of remote sensing data combined with the petrographic and chemical characterization of Shişr 161 reveals a preferred provenance on the Moon's surface that is close to pre-Nectarian Riemann-Fabry basin.

Keywords: Lunar meteorite, spherule, Feldspathic Highlands Terrane, impact melt, cumulate, Riemann-Fabry basin