TRACE ELEMENT COMPOSITION OF IMPACT MELTS IN LUNAR METEORITE SHIŞR 161.

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Introduction: Lunar meteorite Shişr 161 is an immature regolith breccia with a very low abundance of incompatible elements and a magnesian-feldspathic affinity [1]. Following detailed petrographic descriptions and reconstructions of impact melt clast compositions by modal recombination, we analyzed their trace element abundances. This aims to resolve precursor lithologies and test implications for Shişr 161 as a product of an impact into a large lunar impact melt sheet [2].

Methods: Trace element concentrations from a thin section of Shişr 161 were determined by LA-ICP-MS at the University of Houston with 50 and 90 µm Ø laser beams for whole-rock and mineral analyses. We analyzed the bulk compositions of 10 crystallized melt clasts, 10 vitrophyres and glasses, and 4 spherules. These clasts represent types with differing textural and compositional (magnesian and ferroan) characteristics. Single mineral phases were analyzed in 6 clasts and the compositions of 3 moderately coarse crystallized cumulate clasts were modally recombined from the compositions of major mineral components.

Results: Chondrite (CI)-normalized REE patterns for glassy and crystallized melt clasts are mostly flat with 2–12× enrichments relative CI, have positive Eu-anomalies, and fall in the typical range of abundances for lunar granulites [3]. Exceptions are two poikiloblastic clasts with negative Eu-anomalies and bow-shaped REE patterns indicating relative enrichment up to 20× CI. Spherules show strong relative enrichments 100-300× CI that resemble patterns of KREEP-basalts and quartz-monzodiorites [4]. Concentrations of 320 ppm Ni in one spherule and Co <20 ppm in three other spherules are outside the range of Apollo volcanic glasses [4].

A plagioclase fragment shows the typical evolved REE pattern of alkali-anorthosite [4]. Plagioclase in cumulate impact melt clasts has REE abundances 1-5× CI for the LREE and 0.2-1× CI for the HREE, which falls between ferroan-anorthosite and Mg-rich-norite plagioclase [4]. Cumulate olivine contains 200–260 ppm Cr, 70–90 ppm Ni and ~60 ppm Co and displays evolved, sub-chondritic REE patterns. Orthopyroxenes in cumulate clasts show chondritic abundances of LREE and 6-20× CI for the HREE. Augites are most enriched in the MREE, up to 40× CI and, thus contain the largest reservoir of incompatible elements among the main mineral components of cumulate melt clasts in Shişr 161. Concentrations of Th are <0.6 ppm for all melt clasts analyzed but reach 17 ppm in spherules.

Summary: Most impact melt clasts in Shişr 161 show only subtle variation among compositional and textural types, suggesting they are the result of the impact processing of upper lunar crust. Impact spherules record admixed, exotic components with KREEP and/or alkali-element enrichment.

References: [1] Korotev, R.L. 2012. *Meteoritics & Planetary Science* 47:1365-1402. [2] Wittmann A. et al. 2013. Abstract #2061. 44th Lunar & Planetary Science Conference. [3] Treiman A.H. et al. *Meteoritics & Planetary Science* 45:163-180. [4] Papike J.J. 1998. *Reviews in Mineralogy* 36: Chapter 5, 234 p.