THE KREEP-RICH IMBRIUM IMPACT MELT BRECCIA OF THE LUNAR METEORITE SAYH AL UHAYMIR 169

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Introduction: The dominant lithology (87 vol%) of the unique lunar meteorite Sayh al Uhaymir (SaU) 169 from Oman consists of an extremely KREEP-rich polymict, crystalline impact-melt breccia interpreted to be derived from the Imbrium impact melt sheet [1]. This lithology is now assigned together with few mm-sized rock fragments from the Apollo 12 and 14 landing sites to a grouplet called "high-Th impact melt group" [2].

Results and interpretation: The impact melt contains 25 - 40 vol% of shocked plutonic (gabbronoritic to noritic) Procellarum-Terrane clasts characterized by the absence of anorthosites. Many plagioclase clasts show a high albite content reaching An_{57}. The crystalline impact melt between the clasts consists mainly of low-Ca pyroxene, plagioclase intergrown with Ba-bearing K-spar, and smaller amounts of merrillite, zircon, olivine, troilite and kamacite. The SaU 169 impact melt bulk composition shows a strong enrichment in Th (32.7 μg/g), U (8.6 μg/g), K_2O (0.54 wt%), REE (~1330 μg/g), P_2O_5 (1.14 wt%), and Zr (2835 μg/g) [1]. LREE-enriched merrillite is the main REE carrier containing 4-9 wt% REE oxides. Zircon is characterized by HREE-enriched patterns with a negative Eu anomaly. Application of Ti-thermometer for zircon [3] yielded a minimum crystallization temperature of 1168 ± 33°C. SaU 169 impact melt ilmenites are characterized by containing ~0.6 wt% Nb_2O_5. The detailed analysis of all phases crystallized from the impact melt, in combination with its modal abundance and calculated mineral densities allows to estimate the "pure clast-free Imbrium KREEP melt" composed of: ~2.0 wt% P_2O_5, 44.4 SiO_2, 4.9 TiO_2, 10.9 Al_2O_3, 14.0 FeO, 12.2 MgO, 7.4 CaO, 0.8 Na_2O, 0.4 K_2O, ~380 Nb, ~1250 Ba, and ~3400 REEs. This indicates that highly evolved differentiates were present at the Imbrium impact site.

References: [1] Gnos E. et al. 2004. *Science* 305: 657–659. [2] Zeigler R. A. 2006. Abstract #2366. 37th Lunar & Planetary Science Conference. [3] Watson, E.B. and Harrison, T. M. 2005. *Science* 308:841–844.