VERY HIGH-K KREEP-RICH CLASTS IN THE IMPACT MELT BRECCIA OF THE LUNAR METEORITE SAU 169 – POSSIBLE PRISTINE urKREEP SAMPLE

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Introduction: KREEPy is a chemical feature of a variety of lunar samples, enriched in K, REEs and P. The primordial KREEP melt (referred to as urKREEP) is generally supposed as the last residual melt of the lunar magma occean, and its composition was defined as the Apollo-14 breccias with highest KREEP (KREEP) [1]. The lunar meteorite Sayh al Uhaymir (SaU) 169 was reported as the most KREEP-rich lunar sample [2], and zircon in the impact melt breccia (IMB) of SaU 169 has an U-Pb age of ~3.9 Ga [2,3]. We conducted a comprehensive study of the IMB, and found very high-K KREEP-rich (VHK) clasts that have an average composition closest to the supposed urKREEP.

Results: The VHK clasts consist mainly of low-Ca pyroxene and BaO-rich orthoclase with less ilmenite, phosphates, zircon and plagioclase. Seven VHK clasts were found in the 1.0 cm^2 polished thin section of SaU 169 IMB. The presence of major orthoclase and the coarser grain sizes distinguish the VHK clasts from the fine-grained matrix. However, compositions of low-Ca pyroxene, merrilite, apatite and zircon in both lithologies are nearly identical. All grains of zircon in both lithologies were tranformed to diaplectic glass with smooth surface and comfirmed by Raman spectra, except for that some fractured areas of several large grains remain crystalline. Zircon Pb-Pb dating with CAMECA 1280 shows a bimodal pattern with a major peak of 3909±3 (2σ) Ma and a small peak of 3998±6 (2σ) Ma. The remained crystalline areas of zircon tend to be older. However, no difference was found in zircon Pb-Pb ages between the VHK clasts and the fine-grained matrix.

Discussion and conclusions: The concentrations of REEs and P of the fine-grained matrix calculated from the modal composition and mineral chemistry are 2.8-3.6×KREEP [1]. This is about twice as high as those of the IMB [2], which are diluted by 25-40 vol% shocked rock and mineral clasts [2]. Both fine-grained matrix and IMB are depleted in K (0.5, 0.6×KREEP). In contrast, the VHK clasts are K-rich (4×KREEP), besides enrichments of REE and P (2.7-3.7×KREEP). The composition of the VHK clasts is the closest to the supposed urKREEP. The fine-grained matrix probably has a genetic relationship with the VHK clasts based on their similar mineral chemistry and zircon Pb-Pb age pattern, but it was depleted in K by some processes. The small peak of ~4.0 Ga indicates a minimum crystallization age of the VHK clasts, consistent with ~4.3 Ga U-Pb age of the dense mineral fractions [4].

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