THE ORIGIN OF METAL PARTICLES IN LUNAR METEORITES

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Introduction: The Moon's surface is completely covered by various impact craters, indicative of significant addition of asteroids, especially most abundant chondritic ones. The presence of meteoritic metal in lunar rocks and lunar meteorites could substantially affect the Re-Os isotopic system and the applications of ^{182}Hf-^{182}W system (a half-life of 9 Ma) of metal separated from lunar rocks [1]. In order to assess origin of metal in lunar samples, a combined study of SEM, EPMA and LA-ICP-MS has been planned. Here, we report petrography and EPMA results of metal grains from 4 lunar meteorites. More analyses including HSE by LA-ICP-MS will be presented in the meeting.

Samples and experiments: Polished sections of 4 lunar meteorites were studied, including the KREEP-rich SaU 169 and Dhofar 1442, basaltic NWA 4734, and feldspathic breccia NWA 2995. Metal grains in these meteorites were found with a SEM equipped with EDS. Quantitative analyses of metal were carried with an EPMA (JEOL JXA-8100) operated with 15 kV and 20nA. Overlapping K_α line of Co by K_β line of Fe was corrected.

Results: Metal grains were found in all sections of these lunar meteorites, but with very heterogeneous distribution. There are only 5 small grains (4-10 μm) in Dhofar 1442, 7 grains (5-20 μm) in NWA 4734, 20 grains (up to 30 μm) in NWA 2995, 15 grains (<30 μm) in the regolithic breccia of SaU 169, and 24 grains (4 large grains: 200-300 μm, others: up to 100 μm) in the impact melt breccia of SaU 169. The large metal grains in SaU 169 usually rimmed by merrillite that contains lower REE by a factor of ~2 than those in the fine-grained matrix [2]. Troilite was also found existing with large metal grains.

Only the metal grains in SaU 169 have been measured. All of them are Ni-bearing (5.0-31.0 wt%) with minor Co (0.4-1.2 wt%, except for 0.14-0.22 wt% of a taenite). Despite significant variation among grains, the large grains are relatively homogeneous. Taenite (>8.7 wt% Ni) occurs as small inclusions (≤10 μm) in kamacite, and usually shows increase of Ni towards the rims. The Co-depleted taenite contains minor Cu (0.07-0.15 wt%), different from other Fe-Ni grains.

Discussion and Summary: The Ni-, Co-contents and their correlation of the metal grains in SaU 169 can be explained by a meteoritic origin. Moreover, the wide range of the Co-contents suggests multiple sources, mainly H (0.44-0.51 wt% Co), L (0.7-0.95 wt% Co) and LL (>1.0 wt% Co) chondrites, according to the compositions of kamacite from ordinary chondrites [3]. The merrillite rims of large metal grains could be produced by oxidizing P dissolved in or as schreibersite in metal. The meteoritic origin of most metal grains in the lunar meteorites is consistent with extensive bombardment of the lunar surface by asteroids.

References: [1] Kleine T., et al. 2005. *Science* 310: 1671-1674. [2] Lin Y., et al. 2012. *Geochimica et Cosmochimica Acta* 85: 19-40. [3] Rubin A. E. 1990. *Geochimica et Cosmochimica Acta* 54: 1217-1232.