Highly siderophile element abundances and $^{187}Os/^{188}Os$ in lunar impact melt breccias

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Ancient lunar impact melt rocks are key samples for constraining the highly siderophile element composition (HSE: Re, Os, Ir, Ru, Pt, Rh, Pd, Au) of impacting bodies during the Hadean history of the Earth-Moon system (Morgan *et al.* 1977; Norman *et al.* 2002; Puchtel *et al.* 2008). Such data may provide new insights on the origin of the HSE excess and relative abundances of HSE in the Earth's mantle. We have analysed $^{187}Os/^{188}Os$ and HSE abundances in seven subsamples of the lunar meteorite Dar al Gani (DaG) 400, a lunar impact melt breccia recovered from the Libyan desert. Abundances of Ir in the subsamples range from 2.5 to 4.0 ng/g, in agreement with previous INAA data (Zipfel *et al.* 1998). The refractory HSE Os, Ir, Ru, Pt and Rh are well correlated within DaG 400 ($r > 0.90$), while Pd shows somewhat more scatter. Abundances of Re and Au are decoupled from other HSE and show no correlation with Ir or other refractory HSE, probably due to terrestrial weathering, or less likely, during redistribution on the lunar surface. Rhenium and Au are correlated with each other ($r = 0.80$), and hence, they both seem to be affected by redistribution to a similar extent. Plots of Os, Ru, Pt and Pd against Ir define mixing/dilution lines that intersect the origin within analytical uncertainties or near the origin (Ru vs. Ir). Slope derived HSE/Ir ratios are dominated by the meteoritic component and yield slightly suprachondritic values for Ru/Ir (1.84 ± 0.10, 1σ), while Os/Ir (1.19 ± 0.22, 1σ), Pt/Ir (2.07 ± 0.31) and Pd/Ir (1.39 ± 0.43) are within the range of ordinary and enstatite chondrites. In contrast, Rh/Ir (0.28 ± 0.04) is similar to values in carbonaceous chondrites. The average $^{187}Os/^{188}Os$ of the DaG 400 subsamples (0.1290 ± 7, $2\sigma_m$) is similar to values of ordinary and enstatite chondrites. The HSE composition of the meteoritic component in DaG 400 is most similar, although not identical, to the composition of the meteoritic component inferred for lunar meteorite NWA482 (Puchtel *et al.* 2008), another impact melt breccia. However, in particular elevated Ru/Ir also hint at similarities to a component present in Apollo 17 poikilitic melt rocks (Norman *et al.* 2002; Puchtel *et al.* 2008). Additional data on lunar impact melt rocks from Apollo landing sites will be acquired.

Metal-silicate silicon isotope fractionation in enstatite chondrites

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Mass-dependent silicon isotope fractionation during metal-silicate equilibrium was originally predicted from theoretical calculations of the corresponding fractionation factors [1] and perhaps confirmed by preliminary Si isotope data on experimental metal-silicate equilibrium under high P and high T conditions [2].

Highly reduced enstatite chondrites have the particularity to contain substantial levels of Si in their metal . We have analyzed the Si isotope composition of metal and enstatite fractions in a suite of EH chondrites and several EL6 chondrites using the high-resolution MC-ICPMS Nu 1700 at ETH Zurich. The $\delta^{30}Si$ values reveal permil level fractionations between metal and enstatite, with the metal being enriched in light Si isotopes. As the metal-silicate partition coefficient decreases with temperature, the Si should diffuse out of the metal upon cooling. Thus, our data cannot be explained by kinetic isotope fractionation and is dominated by equilibrium fractionation. The slow diffusion of Si in enstatite will be modelled to estimate closure temperatures as a function of cooling rate and grain size.

We will discuss the silicon isotope data in the context of the thermal history of enstatite chondrites as recorded by thermometers [3].

[1] Schauble (2004) *Rev. Mineral. Geochem.* **55**, 65. [2] Shahar *et al.* (2008) *Geochim. Cosmochim. Acta Suppl.* **72**, A848. [3] Zhang & Sears (1996) *Met. & Planet. Sci.* **31**, 647.