Absence of Ga isotopic fractionation during core formation

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Gallium is a siderophile element, however, its abundance in the mantle follows the volatile depletion trend, suggesting an over-abundance compared to what is expected from core-mantle differentiation [1]. The Ga isotopic composition of the bulk silicate Earth is different from most chondrites which could be partly due to metal/silicate differentiation [2]. To better understand the distribution of Ga isotopes metal-silicate partitioning, iron meteorites and metal-silicate high-pressure, high-temperature (HP-HT) experiments were analyzed for their Ga isotopic compositions.

Ga isotopic compositions were analysed in 16 iron meteorites from various groups (IAB, IIAB, IIC, IID, IIE, IIF IIIAB, IVA). HP-HT experiments were composed of 60 wt% MORB and 40 wt% FeS, doped with 1 wt% Ga_2O_3. Experiments were conducted in the piston-cylinder apparatus at 1400°C, for 0.5 and 2.0 hrs. Ga isotopic composition were analyzed at IPGP following [3]. The δ^{71}Ga (^{71}Ga/^{69}Ga permil deviation from IPGP Ga standard) was analyzed with a precision of ~0.1 ‰ (2SD).

Ga isotopes were not fractionated between metal and silicates in the experiments at temperatures as low as 1400°C, which implies that core formation should have a neglible effect on the composition of the Earth's and Moon's mantle. This further suggests the lunar mantle rocks are representatives for the composition of the whole Moon and the Moon is enriched in the heavier isotopes of Ga compared to the Earth [4]. The Ga isotopic composition of the iron meteorites was variable (-0.41 to 0.33‰). The variations within the IAB group were correlated with Cu isotopic composition, which suggests evaporation. Since Ga isotopes are not fractionated during metal/silicate fractionation a possible explanation for these variations are fractionation during crystalisation of the core as observed for Ru isotopes [5].

[1] Drake & Righter (2002) *Nature* **416**, 39-44 [2] Kato & Moynier (2017) *Earth Planet. Sci. Lett.* **479**, 330-339 [3] Chen *et al.* (2013) *Meteorit. Planet. Sci.* **48**, 2441-2450 [4] Kato *et al.* (2017) *Chem. Geol.* **448**, 164-172 [5] Bermingham & Walker (2017) *Earth Planet. Sci. Lett.* **474**, 466-473