

Sulfur isotopic fractionation during planetary differentiation

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Early equilibration of the Earth's mantle with the metallic core accounts for the relative depletion of siderophile (iron-loving) elements in the mantle compared to a chondritic reference. The mantle is highly depleted in sulfur such that, in addition to its volatile character, this element has been suggested to have partitioned into the core.

Furthermore, the sulfur isotopic composition of the Earth's mantle has been recently shown to deviate significantly from chondrites, with a $^{34}\text{S}/^{32}\text{S}$ isotopic shift of $\sim 1.3\%$ [1]. In this study, we experimentally determine whether the sulfur incorporated in the core could have left such an isotopic signature on the mantle.

Preliminary experiments were conducted at 1GPa, at temperatures of 1650 and 1750°C for 2 hours using the Geophysical Laboratory's piston-cylinder apparatus. Starting materials consisted of a Fe-rich peridotite composition, Fe and FeS. A ^{32}S spike was added to the experiment to prove equilibrium has been reached using the three isotope technique. Metallic and silicate fractions were then separated by hand and S chemical extraction was done using standard procedures. Isotope analysis was subsequently performed using the University of Maryland MAT 253 gas source mass spectrometer.

Indistinguishable $\Delta^{33}\text{S}$ values for metal and silicate fractions indicate that at the high temperature conditions of our experiments, and 2 hour durations isotopic equilibrium was systematically reached. There is a resolvable $^{34}\text{S}/^{32}\text{S}$ isotopic fractionation that consistently showed the silicate fraction to be depleted in ^{34}S , consistent with the observed mantle value. We found $1000\ln\alpha_{\text{met-sil}}$ to be between $1.2\pm 0.3\%$ and $2.9\pm 0.4\%$ at 1650°C and $0.7\pm 0.3\%$ and $2.0\pm 0.4\%$ at 1750°C. The lack of isotopic reproducibility is likely the result of the systematic occurrence of metallic micro-contaminants in the silicate fraction, observed using SEM, such that presented isotopic fractionations are minimum values.

The implication of such S isotope fractionation in terms of volatile contents in late-accreted components will be discussed at the conference.

[1] Labidi *et al* (2013) *Nature*. **501**, 208-211.