

# A search for isotopic evidence of thermodiffusion at the core-mantle boundary

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The core-mantle boundary hosts the largest sustained thermal gradient on Earth. Studies have shown that outer core materials could percolate into this thermal boundary layer [1], creating an opportunity for elemental and isotopic fractionation. Leshner et al. measured Fe isotope profiles in Fe±Ni±S alloys subject to a thermal gradient and found that heavy Fe isotopes are concentrated toward colder temperatures [2]. They proposed that mixing of this isotopically heavy material into the mantle through time might explain the heavy Fe isotope composition of silicate Earth relative to chondrites. As Ni behaves similarly to iron in metallic alloys, this model implies that Ni and Fe isotopes would be positively correlated along this thermal gradient, and this positive correlation would be reflected in mantle-derived rocks with varying contributions of core material.

To test this hypothesis, we analyzed Fe and Ni isotopes in the same thermodiffusion experiments, together with MORBs and OIBs. Our data for the thermodiffusion experiments show that Fe and Ni isotopes are indeed positively correlated. However, our preliminary data suggests that this positive correlation is not recorded in natural samples. This leaves us with several possibilities: (1) the process of metal percolation in the thermal boundary layer does not operate on a scale large enough to produce a measurable effect on MORBs and OIBs, or such models require modification to decouple Fe from Ni, (2) isotope fractionation by thermodiffusion is not preserved in the source regions of MORBs and OIBs, or (3) the Fe and/or Ni isotope compositions of MORBs and OIBs do not directly reflect those of their source regions. Additional data on MORBs and OIBs will provide a more robust constraint on the (lack of) correlation between Fe and Ni isotopes. They will shed light on the controls over Fe and Ni isotope fractionations in mantle-derived rocks and whether core-mantle interaction contributed to their isotopic signatures.

[1] Otsuka and Karato (2012) *Nature*, 492(7428), 243-246.