

Molybdenum isotope fractionation during soil formation: A new proxy?

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Over the last decade molybdenum has become one of the most investigated tracers for redox conditions in the oceans. However, little is known about the processes controlling the isotope composition of the riverine inputs to the oceans. Several recent studies [1, 2] have shown that many river waters have a heavy Mo isotopic composition. However, crustal rocks are in general close to zero and therefore fractionation of Mo isotopes must occur during weathering or transport. This study has investigated the behavior of Mo isotopes under different weathering conditions. Results from a soil climate gradient from Hawaii show that redox conditions during soil formation can control Mo isotope compositions in soils. Reducing soil profiles have light isotope compositions whereas oxidizing profiles are heavy. This general isotope behavior is confirmed by results from soil profiles from Iceland. Here reducing layers within the profiles show marked negative isotope excursions. In general oxic profiles show positive isotope compositions increasing with depth and organic C content. In addition these profiles show that fractionation relative to the source rock is dependent on the degree of weathering, i.e. relatively un-weathered profiles do not show isotope fractionation. Sequential extractions confirm that organic matter plays a crucial role in fractionating molybdenum isotopes in soils. These observations together with the generally heavy isotope composition of rivers indicate that the current mass balance of molybdenum in Earth surface processes might not be in steady-state. In addition, our data open interesting possibilities for the use of molybdenum isotopes as a paleo-proxy for soil processes. Finally, our data show that interpretations of the marine sedimentary record are difficult as long as we do not understand changes in the molybdenum input over time.

[1] Archer & Vance (2008) *Nature Geosciences* **1**, 599.

[2] Pearce *et al.* (2010) *EPSL* **295**, 104–114.

Diamond anvil cell applied to the geochemistry of Earth's core formation

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The abundances of siderophile elements in the Earth's mantle bear the imprint of the core formation in the early Earth. Thermodynamic expressions used to constrain the metal-silicate partitioning behavior of siderophile elements are mainly established from large volume press experiments that do not cover the full range of potential P-T conditions for core-mantle equilibrium. The diamond anvil cell is the only static technique capable of achieving required P-T conditions but until now its capabilities to perform quantitative metal-silicate partitioning experiments at extreme conditions has been untapped. We use protocols that effectively link high P-T diamond anvil cell with analytical techniques such as focused ion beam device (FIB); NanoSIMS; electron microprobe; transmission electron microscopes; and *in situ* synchrotron X-ray diffraction measurements allow us to obtain quantitative data on element partitioning at superliquidus conditions above 30 GPa and 3000 K. Here we present our advances in both experimental and analytical methods. We look at the partitioning of 6 siderophile elements (Ni, Co, Cr, V, Mn, and Nb) that have been extensively studied at lower P-T conditions and constrain the solubility of light elements (Si and O) at these extreme conditions. Experiments were conducted between 35-75 GPa and 3100-4400 K. We then update expressions that describe the partitioning behavior of these elements to address the validity of proposed core formation models (i.e. single-stage core formation model and continuous core formation model).