

4.2.P10

Molybdenum isotope abundance variations measured in molybdenites by double-spiking thermal ionization mass spectrometry

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Isotope abundance measurements of molybdenum have the potential to be an insightful tool for the investigation of ore genesis. This redox sensitive element plays an important role in significant biogeochemical cycles and isotope abundance data may provide insight into the sources of hydrothermal fluids and the extent of mass dependent fractionation processes. Double-spiking thermal ionization mass spectrometry has proven capable of measuring subtle, but resolvable isotope abundance ratio variations (up to 0.05 % per mass unit) in selected molybdenite (MoS₂) samples from different geographic regions [1].

Here, we report the results of a double-spiking negative thermal ionization mass spectrometric analytical approach to measure sub-permil isotope abundance variations in a well-described suite of 20 molybdenite samples. The samples were measured using either multiple Faraday cup detectors or, for extreme sensitivity, a multiple ion counting array on a Finnigan Triton. The molybdenites represent thirteen deposits that formed on several continents under a range of geologic conditions. The ages of the molybdenites were determined by Re-Os dating at AIRIE, Colorado State University. Four broad temperature ranges are represented: low (<400 °C), moderate (400 to 500 °C), high (600 to 700 °C) and very high (700 to 900 °C). The relationship between the measured isotope abundance ratio variations and the histories of the ore deposits will be explored.

References

- [1] Wieser and DeLaeter (2003) *Int. J. Mass Spec.* **225**, 177-183.

4.2.P11

Molybdenum isotopes as a potential proxy for net sulfate reduction in marine sediments

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Molybdenum concentrations within the geologic record have been utilized as a proxy for reducing conditions at the time of sedimentary emplacement. However, it is clear that the Mo concentration alone is an inadequate or at least an imperfect proxy. We are exploring the utility of Mo isotopes, in combination with other sedimentary parameters, as a proxy for marine sedimentary conditions. The Mo elemental (and isotopic) balance is dominated by a primary source term (rivers) and two sinks (oxic and anoxic sediments). These two sink terms have significantly different (from an analytical perspective) isotope signatures; thus, from an isotopic point of view, changes in the oxic to anoxic sink ratio should mirror relative changes in the distribution of oceanic oxic to anoxic conditions. Our pursuit of Mo isotopes in marine sediments is focusing on the diagenetic processes that span the range from fully oxic sediments to anoxic sediments with the intent of quantifying relationships among sedimentary redox conditions, trace element concentrations and isotopic distributions. Toward this end we are focusing our efforts on sediments from the Peru/Chile, the Mexican, and California continental margins. Preliminary data suggest a correlation between the net sulfate reduction rate within the sedimentary column and the isotopic composition of the solid phases. What is more surprising is that the range of isotope values measured to date is greater than expected in that we anticipated that marine sediments would have isotope values that lie between the oxic end-member value and ocean water. If our preliminary relationship between net sulfate reduction and Mo isotope values holds, Mo isotopes in combination with sulfur isotopes may produce a powerful proxy for past oceanic redox conditions and the sulfur cycle.