Oceanic molybdenum isotope fractionation: Diagenesis and hydrothermal ridege-flank alteration

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Abstract

Isotopic analyses of dissolved molybdenum are presented for sediment porewaters from a reducing sedimentary basin and for fluids from a low-temperature ridge flank hydrothermal system. $\partial^{98/95}$Mo in these fluids range from 0.8 - 3.5 ‰ (relative to a laboratory standard), demonstrating that marine sedimentary reactions significantly fractionate Mo isotopes. Within the upper 6 cm of sediment, manganese oxide dissolution produces an isotopically light fluid relative to seawater (mean of 8 analyses = 2.2‰ versus seawater = 2.3 ± 0.1 ‰). Below 6 cm depth, authigenic Mo uptake results in an isotopically heavier fluid (up to 3.5‰) indicating that reducing sediments are likely to be a net sink for isotopically light dissolved Mo. In contrast, fluid circulation within a low-temperature ridge-flank hydrothermal system is a source of isotopically light Mo to the ocean having an end-member fluid of ~0.8 ‰.

Variable rates of ocean circulation from sedimentary ^{231}Pa/^{230}Th during the last ice age termination.

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Uranium-series disequilibria may be used to provide quantitative estimates of the rates of meridional overturning in the North Atlantic Ocean. New ^{231}Pa and ^{230}Th measurements from deep-sea sediment cores indicate dramatic changes in the flux of deep and intermediate waters in association with the millennial climate variability during Termination I. The cores were recovered from complementary locations in the western subtropical Atlantic. OC326-GGC5 (4.5 km) monitors the entire water column and 103GGC (1.0 km) monitors intermediate waters. Measurements of ^{238}U, ^{232}Th, ^{230}Th, and ^{231}Pa in bulk sediment were made by ICP-MS for the interval from the last glacial maximum (LGM) through the Holocene in both cores. A century-scale deglacial climate record based on single-specimen δ^{18}O measurements of the planktonic foraminifera *G. inflata* was also generated in GGC5. The results from this study indicate that while the glacial meridional overturning was diminished relative to the modern, the most pronounced changes in circulation occurred during the deglaciation, and were associated with millennial-scale climate events in the North Atlantic. Intermediate depth circulation strengthened when deep circulation weakened, but was insufficient to maintain the net overturning and meridional heat transport. During the Younger Dryas cooling, the decline in overturning was approximately 50%, and during the H1 iceberg-discharge event, deep circulation essentially ceased. The most extreme cooling of the subtropical Atlantic also occurred during H1. Following the millennial cooling, both meridional overturning and sea-surface temperatures underwent dramatic increases. Changes in the rates of thermohaline circulation thus contributed to the abrupt nature of climate change during the last ice age termination in the North Atlantic.