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Field validation of molybdenum accumulation in sediments as an indicator of hypoxic water conditions

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Accumulation of authigenic molybdenum (Mo) in marine sediments has often been used as qualitative indicator of periods of hypoxic bottom water, but rarely, if ever, used quantitatively. Laboratory experiments have shown that the accumulation rate of Mo may serve as a quantitative surrogate for direct measurement of hypoxic conditions in overlying waters, with Mo accumulation in the top 1 cm of sediment linearly related to the period of exposure to dissolved oxygen (DO) concentrations below ~3 mg/L. To determine if these laboratory results can be applied to field settings, accumulation rates of Mo in sediments from Narragansett Bay (RI, USA) were related to the frequency of hypoxia in bottom waters. Sediment cores were collected from 6 sites encompassing a range of hypoxic exposures. The frequency of bottom-water hypoxia was determined from RI Dept. of Environmental Management monitoring data for the years 2003-2007. ^{210}Pb dating of selected core sections at each site established sedimentation rates. Total Mo concentrations were determined in surficial sediments by HF digestion and ICP-MS analysis. Lithogenic contributions were estimated by multiplying measured Al concentrations by a mean crustal Mo:Al ratio, and the lithogenic portion subtracted from total Mo to estimate concentrations of authigenic Mo. Authigenic Mo concentrations and sedimentation rates were combined to yield authigenic Mo accumulation rates. The calculated accumulation rates determined from field samples did not correlate well with the frequency of hypoxia. The highest calculated rate corresponded with the highest frequency of hypoxia, but there was significant scatter among sites with less frequent hypoxia. There was strong correlation, however, between concentrations of Mo in the sediments and the mean frequency of hypoxia in overlying bottom waters, such that concentration of Mo in sediments may be a better indicator of the frequency of hypoxia than accumulation rate.

KEYWORDS: molybdenum; accumulation; sediments; hypoxia; dissolved oxygen