Molybdenum as a paleoredox proxy: An update

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Concentrations and isotope trends of molybdenum in organic-rich shales are among the favored tracers for euxinia in the ancient ocean on local and global scales. With the successes, however, has also come increasing awareness of the complexity.

The purpose of this talk is to synthesize the broad range of refining and defining proxy developments and applications over the past several years, as a progress report and roadmap for future applications. Among the key topics are (1) our new and refined models for Mo uptake and burial under euxinic conditions, including a rigorous mechanistic understanding of the apparent coupling between Mo and organic matter sinks; (2) our comprehensive view of how Mo is taken up, fractionated isotopically, and buried [or recycled] beneath oxic bottom waters, particularly as coupled to Mn and Fe cycles; (3) our improved perspective on how and when Mo isotopes can be fractionated under permanent or transient euxinia, leading to a more effective use of the global redox proxy and to novel estimates of dissolved sulfide concentrations and their variability within ancient euxinic settings; and (4) our new, all-inclusive understanding of the cycling and mass balance of Mo in the ocean. We are encouraged by emerging consistency with the very latest models for the redox structure of the Proterozoic ocean; inferrences about Mo-limited early eukaryotic and prokaryotic life; and our ability to use Mo isotopes, with caution, to estimate global redox conditions.