

Molybdenum molecular geochemistry in distinct solid phases reveal strong heterogeneity in black shales

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Molybdenum (Mo) has become a reliable geochemical proxy of euxinia and is often enriched in black shales where organic matter is preserved. Isotopic signature and total concentration of Mo have been used to interpret spreading and intensity of euxinia in the ancient oceans in concert with Earth's dynamic oxygenation. However, uncertainties exist on the controls governing Mo burial, partitioning, and distribution in shales. X-ray Absorption Fine Structure (XAFS) methods have opened up a new avenue for geochemists to interpret the depositional histories of rocks. By measuring X-ray Adsorption Near-Edge Structure (XANES), information on the oxidation state and coordination chemistry of Mo can be determined. Our research uses an innovative micro X-ray Absorption Fine Structure (μ -XAFS) technique to obtain Mo XANES measurements by targeting organic matter in pore spaces and individual pyrite framboid grains in shales using a 5 μ m diameter x-ray beam. We aimed to determine Mo molecular geochemistry in the early Triassic Montney formation from western Canada. The Montney is an economically important oil and gas reservoir with enriched total Mo concentrations as well as evidence of thermal alteration. The stratigraphy coupled with Mo geochemistry has led some to interpret the depositional setting as distal offshore within an anoxic or euxinic water column. However, petrographic organic matter characterization casts doubt on this interpretation, finding postdepositional organic matter migration into the formation [1]. To further advance this interpretation, we used μ -XAFS targeting both organic matter and pyrite grains to measure Mo molecular geochemistry. Our results indicate that Mo is distributed in a heterogenous pattern within shale beds. When compared to previous preliminary bulk XAFS measurements, we find Mo is in two different pools. These new insights challenge interpretations of Mo using current geochemical approaches studying only bulk geochemistry.

[1] Sanei et al.,(2015). *IJCG*, 150, 296-305