

Evidence for localized severe euxinia during Lower Jurassic in western Canada sedimentary Basin: a multi-paleo proxies study

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The Early Jurassic, specifically the late Pliensbachian and early Toarcian transition coincides with an episode of global oceanic anoxia, widespread deposition of organic-rich sediments, and a large scale perturbation of the global carbon cycle. The Lower Jurassic Gordondale Member (GM) of the Fernie Formation in the western Canada sedimentary basin is an organic-rich, calcareous shale with high total organic carbon content (TOC) of 6.4 ± 2.4 wt. %.

Molybdenum (Mo) and Rhenium (Re) have been used as paleo-redox proxies for studying early Earth's oxygenation and subsequent oceanic anoxic events. The objective of this study was to combine an array of state-of-the art techniques (e.g. chemical and isotope measurements, μ -scale distribution and Mo speciation analysis) for a high resolution characterization of two continuous cores from the GM to investigate the evolution of redox conditions during Early Jurassic within the western Canada sedimentary basin.

The bulk Mo (150.3 ± 159.9 ppm) and Re (200 ± 200 ppb) concentrations are exceptionally high throughout the studied interval, and display significant variations in sections representing anoxic conditions during GM deposition. The mean Mo and Re enrichment factors in comparison to upper continental crust for all samples are 490.7 ± 252.6 and 2061.3 ± 1434.7 , respectively. The $\delta^{13}\text{C}_{\text{org}}$ values vary between -27.9 and -31.3‰ (V-PDB). Preliminary results for $\delta^{98/95}\text{Mo}$ show a range varying between 0.8 and 1.6‰ (SRM 3134), with higher values associated with highest concentrations of Mo and Re throughout the interval. Interpretation of Mo EXAFS data indicates that the O/S ratio around Mo varies in concert with Mo enrichments, with S atoms being predominant for samples with the highest Mo concentrations.

These new insights support a new model where the western Canada sedimentary basin would have experienced local episodes of severe anoxia during the Lower Jurassic.