

Paleoceanographic signals imprinted in the Middle-Late Devonian black shales of GEM Mackenzie Project area (N.W.T.) change perception of the Middle Paleozoic Ocean and sea level fluctuations

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Summary

The latest Eifelian - Frasnian strata of the central-northern mainland N.W.T. provide an excellent archive of paleoceanographic signals imprinted in oxic and anoxic facies deposited in close proximity (Kabanov and Jiang, in press). Fondofomitic black-shale strata preserve trace-metal and $\delta^{13}\text{C}_{\text{org}}$ fingerprints of four global anoxic events (Kačák-otomari, Frasnies, Middlesex-punctata, and Rhinestreet). The discovery of aryl isoprenoids (biomarkers of green sulfur reducing bacteria) contributes to the growing evidence of photic-zone euxinia as a common state of oceanographically open and semi-restricted shelfal basins of the Middle Devonian – Early Mississippian, a condition impossible under present-day vigorous thermohaline circulation, but consistent with models of greenhouse ocean depicting drastic slowdown in watermass turnover, reversals of deep circulation, greatly expanded oxygen minimum zones, and profoundly changed nutrient flows. The “top-down eutrophication” model is an alternative hypothesis of the Middle Paleozoic spread of black shales depicting anoxia as a response to the boosting eutrophication from the increase in riverine nutrient loads. The latter was caused by the erosion of soils which during the second half of the Devonian experienced dramatic expansion in thickness and coverage area in response to land afforestation.

The studied rocks were deposited in an oceanographically open basin with fluctuating chemocline as attested by trace-metal proxies, unstable presence of gammacerane in GCMS spectra, and presence of pyritized hyalosponge spicules indicating intermittent episodes of weak bottom oxygenation. Shallow-water carbonate banks in the same basin show signatures of reduced hydrodynamic activity and do not imprint sea level changes in excess of first few meters, which lines up with the shortage of evidence for high-amplitude (exceeding ~20 m) base-level fluctuations in coeval strata worldwide. This supports discarding changes in sea level as the principal control over Devonian anoxic events and instead suggests pulsatory expansions of thick, semi-continuous oxygen minimum zones of the greenhouse ocean. Sea level fluctuations could still be involved as non-glacial (thermal and aquifer?) eustatic transgressions of very modest amplitude.

This presentation is a credit to the GNES Program and a legacy contribution to the GEM Program.

References

Kabanov, P. and Jiang, C. 2020. Photic-zone euxinia and anoxic events in a Middle-Late Devonian shelfal sea of Panthalassan continental margin, NW Canada: changing paradigm of Devonian ocean and sea level fluctuations; *Global and Planetary Change*, v. 188. <https://doi.org/10.1016/j.gloplacha.2020.103153>