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The dynamical tropical ocean chemistry in 1.4 billion years ago

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The Mesoproterozoic Era was a time of wide variability in ocean chemistry as well as emerging eukaryote ecosystems. Is this variability in ocean chemistry temporal or spatial, and should it be considered normal for the Mesoproterozoic Era? What drives such variability, and more broadly, how might such variability be related to atmospheric oxygen concentrations? The Xiamaling Formation of Northern China offers a rare opportunity to explore transitions in ocean chemistry and biogeochemical environment over an approximately 40 million year timescale. The current study takes a multi-proxy approach to explore the dynamics of ocean chemistry through nearly the whole of Xiamaling Formation's depositional history.

Through the analysis of major and trace element, organic and sulfidic isotope, iron speciation, biomarkers[1], we conclude that the Xiamaling Formation displays many types of sedimentological and water chemical dynamics over an estimated 40 million years of deposition. Unit 4 reflects oxygenated depositional conditions under a ferruginous water column, with periodic turbidite deposition, giving the distinct red/green colour banding of the unit. Unit 3 represents continued oxic deposition, but under an OMZ with variable rates of primary production that appear to be climate controlled[2]. The transition from unit 3 to 2 seems to reflect a return to deposition conditions similar to the top of unit 4. Unit 2 was deposited under anoxic conditions that were predominantly ferruginous in the lower part and predominantly euxinic in the upper part. In unit 1, mixed euxinic and ferruginous depositional conditions dominate the lower part of the unit, and at about 40 m, anoxic conditions alternate with oxygenated bottom waters. At about 15 m, occasional wave influence on deposition becomes evident, indicating shallowing to storm wave depth.

Reference:

[1] Wang XM, et al. (2017) AJS, submitted.

[2] Zhang SC, et al. (2016) PANS, 113(7): 1731–1736.