Deciphering the Mid-Proterozoic shallow marine redox structure and carbon cycle using REE and $\delta^{13}C$

E.J. BELLEFROID[1], N.J. PLANAVSKY[1], G.P. HALVERSON[2], M. KUNZMANN[2]

[1]Dep. of Geology and Geophysics, Yale Univeristy, New Haven, CT, USA
[2]Dep. of Earth and Planetary Science, McGill University, Montreal, QC, Canada

The Mid-Proterozoic remains a relatively uncharted time period in Earth history where our understanding of the carbon cycling and the redox state are poor. We explore the roughly 6km thick carbonate dominated Mid-Proterozoic Muskwa assemblage located in North-eastern British Columbia. Detailed fieldwork reveals a well-exposed mid-ramp to outer basin sequence, preserving a rare deep and shallow marine carbonate system. Combined REE and trace metal study across the basin suggest that oxic to sub-oxic conditions appear to only occur in very shallow waters within inter-tidal to sub-tidal facies. Deep water facies are dominated by ferruginous conditions, and contrary to previous work on this time period, we suggest the observed REE patterns are characterised by an organic signature, suggestive that even under Fe enriched conditions, organic matter outweighed oxides in REE scavenging. Carbon isotopes across the ramp reveals a large isotopic gradient with little indication of alteration.

Most importantly, this work places both REE and carbon isotope within a depth and redox profile exposing how each are interconnected. Our findings suggest that the Mid-Proterozoic biological pump may have been stronger than previously thought. Thus the observed “chatter” in many Mid-Proterozoic carbon isotope records may simply be a by-product of local organic matter production and changes in facies depth.