Application of the I/[Ca+Mg] Proxy to Interpreting Early Neoproterozoic $\delta^{13}C$ Anomalies

SARAH WÖRNDLE[1], ZUNLI LU[2], GALEN P. HALVERSON[1], AND MARCUS KUNZMANN[1]

[1]Department of Earth and Planetary Sciences, McGill University, 3450 University St., Montreal QC H3A 0E8, Canada

[2]Department of Earth Sciences, Syracuse University, 310 Heroy Geology Laboratory, Syracuse NY, 13244, USA

The ca. 810 Ma Bitter Springs carbon isotope anomaly is an abrupt and long-lived (5–10 m.y.) departure from the high $\delta^{13}C$ values that otherwise characterize early–middle Neoproterozoic seawtaer. This isotope anomaly, which reflects a -8‰ shift in mean seawater DIC carbon isotope composition, is well represented in relatively pristine carbonates of the lower Akademikerbreen Group, Svalbard. Given increasing evidence that Neoproterozoic oxygenation and eukaryotic diversification began well before the Ediacaran Period, the Bitter Springs anomaly is a logical interval to explore for geochechemical evidence of early Neoproterozoic redox change. To this end we have applied the I/Ca ratio (modified to I/[Ca+Mg] to account for dolomitic samples)—a novel proxy for seawater redox potential that is highly sensitive to changes in oxygen content—to carbonate rocks spanning the anomaly.

Iodine in seawater exists almost exclusively as iodide (I-) and iodate (IO_3^-), with the balance shifted towards iodate under more oxidizing conditions. Because IO_3^- can be incorporated in carbonate during precipitation, variations in I/[Ca+Mg] in carbonate may reflect fluctuations in seawater redox, as has been demonstrated for Cretaceous ocean anoxic events (OAEs). Our preliminary data from Svalbard reveal two prominent features: 1) the Bitter Springs anomaly is associated with low I/[Ca+Mg] ratios compared to carbonates above and below, and 2) two spikes in I/[Ca+Mg] are associated with $\delta^{13}C$ recoveries (positive shifts)—one at the end of the Bitter Springs anomaly and a second that coincides with a smaller magnitude and short-lived anomaly prior to the Bitter Springs event. We tentatively interpret these results to indicate that the Bitter Springs anomaly and the smaller anomaly proceding it coincided with periods of expanded basinal anoxia. The spikes in I/[Ca+Mg] at the end of the negative $\delta^{13}C$ anomolies may be a record of oxidation of iodide/organic-iodine that accumulated in shallow water during the Bitter Springs stage.