

Neoproterozoic carbonates: An isotopic archive of ocean acidification?

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The Neoproterozoic is a period of exceptional Earth System change marked by extreme fluctuations from icehouse to greenhouse climatic conditions. These severe environmental changes are preserved in the geological record of warm water carbonates sharply overlying glaciogenic strata. In concert with the environmental changes, the carbonate rocks display large and stratigraphically systematic amplitude fluctuations in their stable isotopic composition (Li, B, C, O, Ca). The most intriguing isotopic signal is a characteristic negative C-isotopic excursion. This signal has been used to assess atmospheric $p\text{CO}_2$, organic productivity and carbon cycling during the extreme Earth System changes. Because of the relationship between carbonate $\delta^{13}\text{C}$, $p\text{CO}_2$, ocean acidification and B isotopic composition of marine carbonates, we analysed Neoproterozoic carbonate rocks to obtain their B-isotopic signature and reconstruct ocean pH variation. We collected a C-B-Li-Ca isotopic dataset on postglacial cap carbonates from two discrete glacial intervals in Namibia; these glaciations occurred during the ca. 750-630 Ma time slice. The cap carbonates represent palaeo-geographically and palaeo-environmentally different settings and thus can be used to determine and assess the lateral uniformity and/or variability of these isotopes. Systematic B-isotope excursions (up to 9‰) in the postglacial carbonates appear to be associated with fluctuations in atmospheric $p\text{CO}_2$ and changing weathering rates and can be interpreted as directly reflecting periods of acidification of the surface ocean. Changes in the weathering input are reflected in systematic Li- and Ca-isotope (12‰ and 0.8‰, respectively) excursions. These data provide new insights into the nature of the initiation and termination of Neoproterozoic glaciations and into the isotopic composition of ancient oceans.

A comparative analysis of gas hydrates occurrence and origin in three Indian Ocean regions

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To establish the structural and lithological controls on gas hydrate distribution and to assess the potential energy resource and environmental hazards in the Indian Ocean, cores were recovered from the Krishna-Godavari (KG) and Mahanadi deepwater Basins offshore southeast India, and from an Andaman Sea site. The pore fluids were analyzed for: Cl, SO_4 , carbonate alkalinity, ammonium, Na, K, Ca, Mg, Sr, Ba, Li concentrations, $\delta^{18}\text{O}$, D/H, $\delta^{13}\text{C-DIC}$, $^{87}\text{Sr}/^{86}\text{Sr}$ ratios, and DOC; together with infra-red imaging they provided important constraints on the presence and distribution of gas hydrates, thus on the subsurface hydrology. Evidence for gas hydrates was obtained at each of the sites. The presence and distribution of gas hydrates were inferred from infra-red imaging and pore fluid chloride concentrations and/or salinity, and occasionally mousse-like textures. Chloride concentrations and salinity anomalies, suggest pore volume occupancies from <1% to ~61% at two of the sites in the KG Basin, and from <1% to ~76% at the site in the Andaman Sea. In the KG Basin, the highest methane hydrate concentrations were associated with fracture zones in clay/silt sediments or in some coarser grained horizons, in Andaman Sea higher concentrations were associated with volcanic ash.

A comparative analysis with the Gulf of Mexico and convergent margin gas hydrate occurrences as well as the implications for global change and slope stability will be discussed.