Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37877

Biogenic carbonates - a paleothermometer?

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The marine biogenic carbonate record is an exceptional but underutilised archive of geochemical paleoproxies. Differences in sea water temperature, depth, shelf geometry and nutrient availability control the distribution of biogenic carbonate factories into two, globally prominent end-members (warm and cool water). Despite comprehensive understanding of the distribution of warm and cool water carbonates, geochemical characterisation is almost non-existent. Consequently, the behaviour of many trace elements between these settings and their response to past climate change is unknown. Australia's continental shelf is latitudinally divided between warm and cool water carbonate factories, which have been active throughout the Cenozoic (66.0 Ma – present), potentially recording global average cooling throughout this period in their geochemistry. This study compared whole-rock (ICP-MS) and in-situ (SEM, LA ICP-MS) analysis techniques to characterise warm water biogenic carbonate sediments from the North West Shelf (NWS) (ODP Expedition 123, Site 765; IODP Expedition 356, Site 1461) with the Great Australian Bight (GAB) (ODP Expedition 182, Sites 1127, 1128, 1132). Deep water/pelagic sites (>2000 m water depth) effectively characterise end-members as their similar peri-platform ooze composition minimises intra-sample variation, preventing spurious geochemical results. Higher Mg, Mg/Ca, U, U/Ca, Be, Mo, and REE+Y, and lower Ba are found in deep water biogenic carbonates from the NWS (Site 765) compared to the GAB (Site 1128). Ratios of Mg/Ca and U/Ca in these carbonates may indicate global cooling from the Neogene (23.03 – 2.58 Ma) to the Quaternary (2.58 Ma – present). The study, for the first time, demonstrates utility of biogenic carbonate trace element chemistry as a paleoclimate proxy.

