COMPARISON OF ISOTOPIC PATTERNS IN THE PACIFIC AND ATLANTIC: S, Δ_{47}, AND B

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PROJECT OBJECTIVES

- Compare changes in S ($\delta^{34}S$), B ($\delta^{11}B$), and clumped isotopes (Δ_{47} and Δ_{48}) in diagenetically altered material from the Atlantic (Bahamas) and the Pacific (Enewetak).

PROJECT RATIONALE

While sulfur ($\delta^{34}S$) and boron ($\delta^{11}B$) isotopes have been used to interpret changes in the oceanic conditions during the Neogene, they have also been used in much older materials extending back into the Proterozoic. For example the $\delta^{34}S$ values of carbonate associated sulfate ($\delta^{34}S_{CAS}$) has been used to interpret changes in the burial of organic material (Lyons et al., 2005) and weathering from continental sources, while $\delta^{11}B$ values have been used as a paleo pH proxy (Kasemann et al., 2010) during snowball earth and other climate events such as those which occurred at the Permo-Triassic boundary (Clarkson et al., 2015). This study investigates the influence of diagenesis on both of these proxies through the examination of their behavior in sediments which have experienced well constrained diagenetic conditions from the Atlantic (Bahamas) and the Pacific (Enewetak). We have already shown that signals comparable to those measured across the Permo-Triassic boundary (Clarkson et al., 2015) and associated with major snowball earth events (Kasemann et al., 2010) can be found within a diagenetically altered shallow marine carbonate (Stewart et al., 2015) (Fig. 1). In addition, we find covarying changes in the $\delta^{34}S_{CAS}$ values within the same sections associated with bacterial sulfate reduction (BSR) coincident with the development of the freshwater lens.

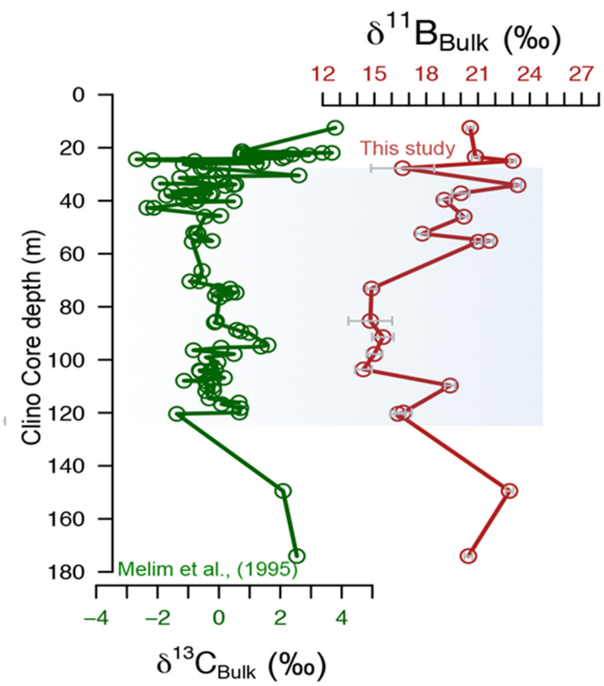

Figure 1: Changes in the $\delta^{11}B$ and co-occurring variations in the $\delta^{13}C$ values of the bulk carbonates from the Clino core taken on Great Bahama Bank. The large change in $\delta^{11}B$ values would be interpreted as reflecting changes in oceanic pH, but in this case is associated with freshwater diagenesis. Data are from Stewart et al. (2015) and Melim et al. (2001).

Scope Of Work

We will use existing core material from the Bahamas (Ginsburg, 2001) and Enewetak (Quinn, 1991; Wardlaw and Quinn, 1991). Within these samples we will measure changes in the $\delta^{11}B$ and $\delta^{34}S_{CAS}$ values and relate these to changes in sedimentology and petrology changes.

Significance

Knowledge of the past pH of the oceans is an important control on the conditions under which past carbonates formed. Similarly, the S isotopic composition of the oceans places important constraints upon the burial and oxidation of organic material. The important question which will be addressed by this research is whether these geochemical proxies can survive diagenetic processes and if not can the information contained in these records be used to understand the diagenesis of carbonates and help constrain paragenesis

References

Clarkson, M. O., S. A. Kasemann, R. A. Wood, T. M. Lenton, S. J. Daines, S. Richoz, F. Ohnemueller, A. Meixner, S. W. Poulton, and E. T. Tipper, 2015, Ocean acidification and the Permo-Triassic mass extinction: Science, v. 348, p. 229-232.

Ginsburg, R. N., 2001, Subsurface geology of a prograding carbonate platform margin, Great Bahama Bank: Results of the Bahamas Drilling Project: Society of Economic Paleontologists and Mineralogists Special publication, v. 70: Tulsa, OK, Society of Economic Paleontologists and Mineralogists, 269 p.

Kasemann, S. A., A. R. Prave, A. E. Fallick, C. J. Hawkesworth, and K.-H. Hoffmann, 2010, Neoproterozoic ice ages, boron isotopes, and ocean acidification: Implications for a snowball Earth: Geology, v. 38, p. 775-778.

Lyons, T. W., M. T. Hurtgen, and B. C. Gill, 2005, New insight into the utility of carbonate-associated sulfate: Geochimica et Cosmochimica Acta, v. 69, p. A128-A128.

Melim, L. A., P. K. Swart, and R. G. Maliva, 2001, Meteoric and marine-burial diagenesis in the subsurface of Great Bahama Bank, *in* R. N. Ginsburg, ed., Subsurface geology of a prograding carbonate platform margin, Great Bahama Bank: results of the Bahama Drilling Project: SEPM Special Publication, v. 70: Tulsa, Society of Economic Paleontologists and Mineralogists, p. 137-161.

Quinn, T. M., 1991, Meteoric diagenesis of Plio-Pleistocene limestones at Enewetak Atoll: Journal of Sedimentary Petrology, v. 61, p. 681-703.

Stewart, J. A., M. Gutjahr, F. Pearce, P. K. Swart, and G. L. Foster, 2015, Boron and meteoric diagenesis: Questioning the fidelity of Snowball Earth $\delta^{11}B$ excursions: Geology, v. 43, p. 627-634.

Wardlaw, B. R., and T. M. Quinn, 1991, The Record of Pliocene Sea-Level Change at Enewetak Atoll: Quaternary Science Reviews, v. 10, p. 247-258.