USING CLUMPED ISOTOPES TO CONSTRAIN DIAGENETIC TEMPERATURES IN OCEANIC AND PERIPLATFORM CARBONATES

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PROJECT OBJECTIVES

- Use of the clumped isotope proxy as a method to constrain rates of diagenesis in oceanic sediments.
- Calibrate existing diagenetic models based on geochemical and physical data.

PROJECT RATIONALE

Estimating recrystallization can be carried out by (i) physical examination of the sediments, (ii) measuring the concentration of trace elements in the interstitial pore waters and in the sediments themselves (Swart and Guzikowski, 1988), (iii) measuring the $\delta^{18}O$ values of the sediments and pore waters (Lawrence, 1989), (iv) measuring the $\delta^{44}Ca$ and $\delta^{26}Mg$ of the sediments and porewaters (Higgins et al., in Preparation). Results from the geochemical analyses need to be modeled while making numerous assumptions about the depositional history. In this project we propose to compare rates of diagenesis calculated using these methods with those estimated using the clumped isotope technique.

SCOPE OF WORK

The work outlined here proposes to analyze materials collected from several Ocean Drilling Program (ODP) and International Ocean Discovery Program (IODP) locations.

Bahamas: Seven cores were drilled during Leg 166 on the margin of Great Bahama Bank (GBB). Five of these were taken on an extension of the seismic line (Eberli, 2000) which

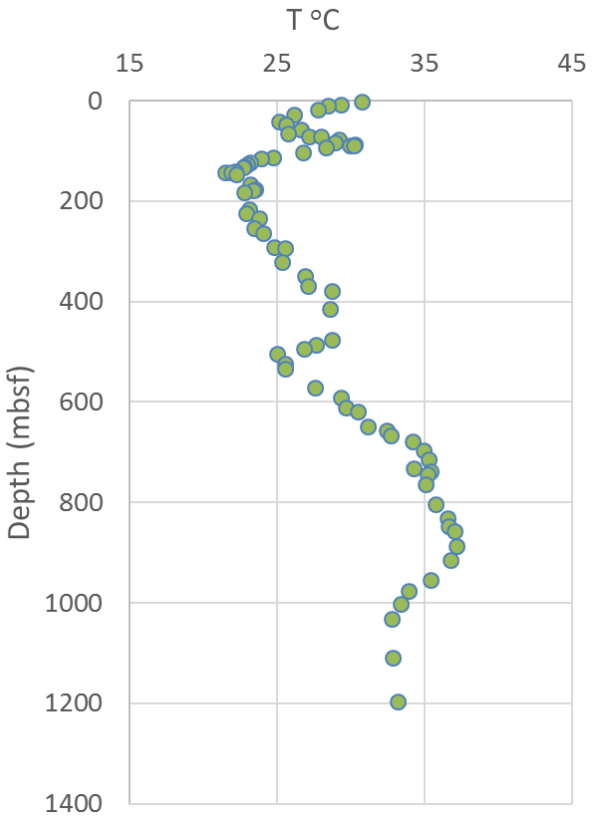

Figure 1: The clumped isotopic derived temperature from Site 1003. Points represent a five sample smooth value.

intersected cores (Clino and Unda) drilled on the surface of GBB. The deepest of these cores (1003) penetrated earliest Miocene at a depth of 1300 mbsf. All of the cores show extensive recrystallization. Geothermal profiles, pore water and carbonate $\delta^{18}O$ values exist for all sites. Preliminary clumped isotopic temperatures are shown in Figure 1 and indicate the recrystallization/neomorphism of shallow water derived sediments in colder waters in the upper 200 mbsf, followed by increasing equilibrium with the geothermal gradient further down the core.

Maldives: We have collected materials (sediments and porewaters) from cores retrieved during Expedition 359 in the Maldives. This expedition drilled sites adjacent to carbonate platforms similar to the Bahamas. These locations appear to be heavily diagenetically altered, but in contrast to the Bahamas there is little evidence of active diagenesis in the pore fluids and there is a very weak geothermal gradient.

SIGNIFICANCE

The work outlined here aims to measure the Δ_{47} in a variety of different types of modern carbonate sediments and then trace this signature through recrystallization in the marine burial realm. This work will be an essential prerequisite before utilizing the Δ_{47} in ancient carbonate sediments to indicate the temperature of sediment formation and/or recrystallization as well as the $\delta^{18}O$ of the diagenetic fluid. Although there have been a number of calibrations which have dealt with individual biogenic components, there have been no studies attempting to explain the Δ_{47} of bulk carbonate sediments. This is in spite of the fact that an increasing number of studies utilizing clumped isotopes as diagenetic indicators have been applied to samples where the original rocks were not composed of a single component, but rather mixtures of many biogenic allochems.

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