APPLICATION OF THE Δ_{48} PROXY TO THE REAL WORLD

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OBJECTIVE

The goal of this project is to apply the newly calibrated Δ_{48} proxy to (i) issues of non-equilibrium precipitation of carbonates, and (ii) the geothermal resetting of the Δ_{48} proxy during heating.

KEY POINTS AND PROJECT DESCRIPTION

We have established a calibration between the Δ_{48} values of carbonates precipitated at nine temperatures (5 to 73°C) and reacted at 90°C in a common acid bath. With this equation we will investigate the Δ_{48} values in a number of systems which exhibit non-equilibrium precipitation behavior as regards their Δ_{47} values. In addition, we will investigate how the Δ_{48} value compares with the Δ_{47} values during solid-state transformation.

PRELIMINARY RESULTS

We have established an empirical equation between temperature and the Δ_{48} value (Fig. 1) of carbonate precipitated in the laboratory. This equation is consistent with the theoretical relationship (Hill et al., 2014; Wang et al., 2004). Based on the theoretical work of Guo (2020) it may be possible to combine both the Δ_{47} and Δ_{48} values and therefore derive the true temperature of precipitation, even in situations in which the clumped isotope values are known to have precipitated in disequilibrium. For example, Figure 2 shows measurements from a coral in which the Δ_{47} values are known to give temperatures which are too cold. In contrast the Δ_{48} values produce temperatures which are too warm. Based on the work of Guo (2020) this pattern is completely predictable and can be used to extract the correct temperature of precipitation. Similar results, but in the opposite sense, (Δ_{47} is too low and the Δ_{48} is too high) can be obtained from cave deposits.

A second objective of this work will be to compare the behavior of the Δ_{48} and Δ_{47} value during heating. Preliminary work suggests

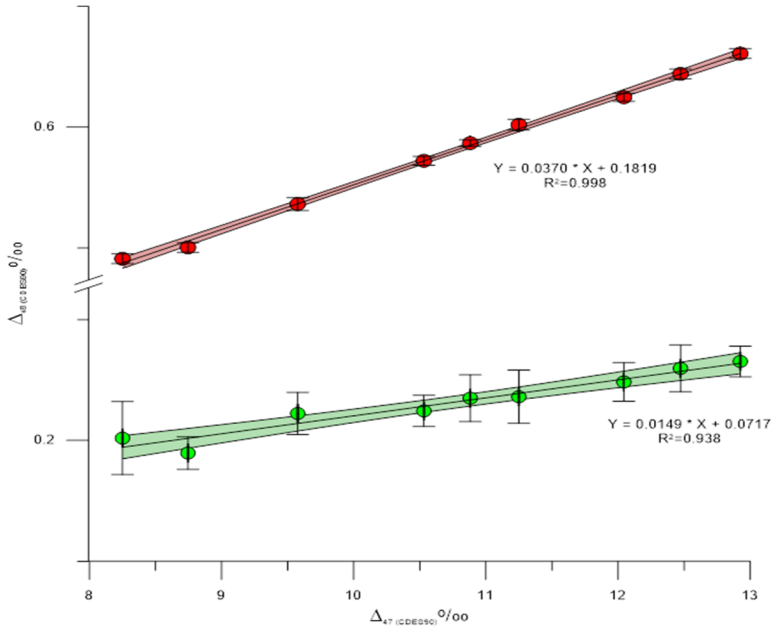

Fig. 1: Calibration between the Δ_{48} values and temperature ($10^6/T^2$) for the PBL1 method. Also shown is the calibration between Δ_{47} values and temperature measured during the same analytical sessions. Larger error bars on the 50 and 72°C samples reflect a lower number of replicates measured on these samples.

that the Δ_{48} value may be more susceptible to resetting than the Δ_{47} value and therefore may be useful in examining burial history in cases where the material has only been shallowly buried.

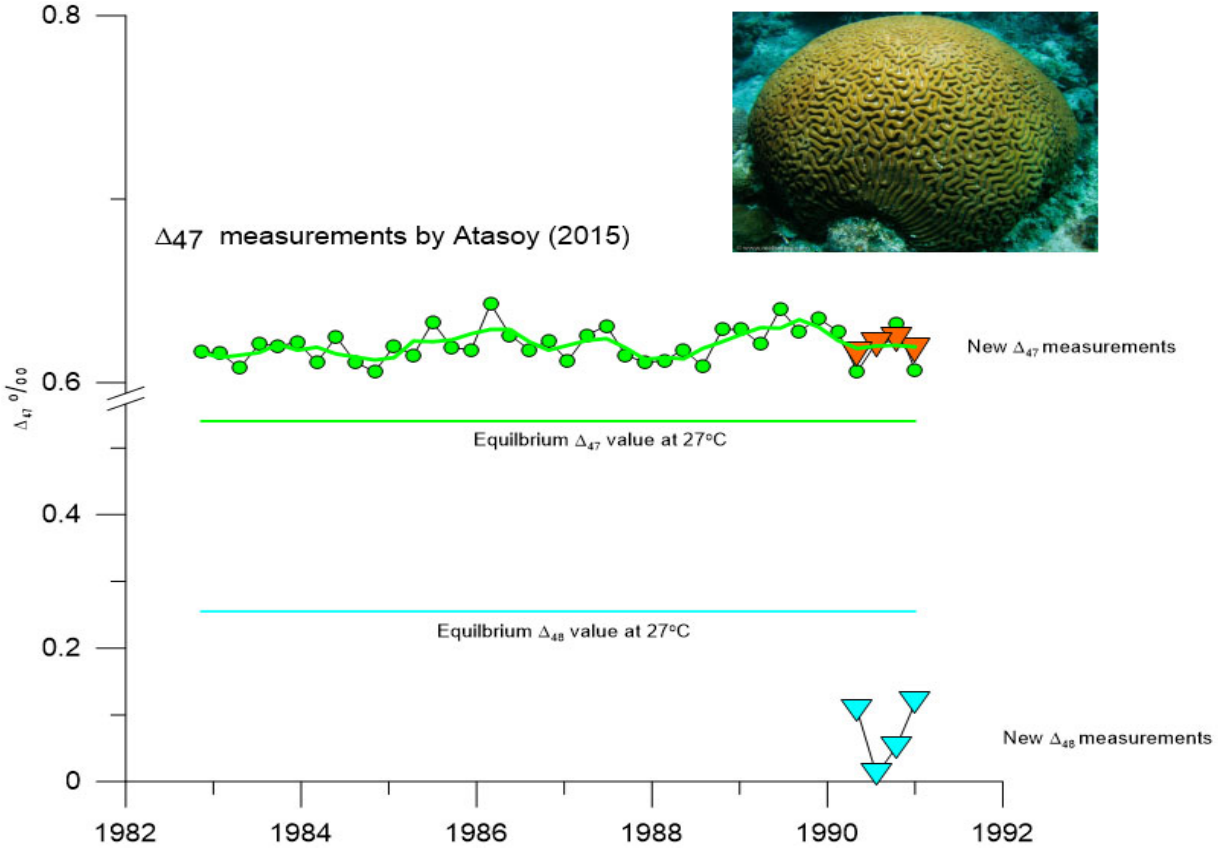

Fig. 2: Δ_{47} values (green) measured in coral collected from Tobago (Atasoy, 2015) and samples from the same coral (orange symbols) measured as the same time as the Δ_{48} measurements blue symbols. Equilibrium lines (blue and green) are based on the calibration shown in Fig. 1 for Δ_{48} and from Swart et al. (2019) for Δ_{47}.

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