

The application of the dual clumped isotope thermometry analyses (δ_{47} and δ_{48}) to the understanding of dolomite formation

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Recent studies have suggested that the dual clumped isotope proxy (δ_{47} and δ_{48}) can be a valuable tool to understand kinetic effects present during the formation of carbonates minerals. While it is well known that certain aragonites and calcites are not in equilibrium with respect to their δ_{47} values, few studies have explored the disequilibrium with respect to the δ_{48} proxy. Here, we investigate the δ_{47} and δ_{48} values of Cenozoic dolomites from the Clino, Unda and San Salvador cores in the Bahamas. The mechanisms of dolomitization in these cores are different. The massive dolomite in the Unda forms from the normal seawater at slightly colder temperatures compared to the modern surficial seawater, while the San Salvador dolomite have more elevated temperatures, forming under the influence of the reflux of the evaporative brine. The scattered dolomite in the Clino, generally termed “background dolomite”, is dolomitized by the diffusion of Mg from the overlying seawater with the mediation of the bacterial sulfate reduction (BSR). These dolomites therefore provide the template to explore the potential of the dual clumped isotope thermometry for tracing the nature of dolomitizing fluids and probing kinetic behaviors during dolomitization. The δ_{47} and δ_{48} values of the massive dolomites in Unda and San Salvador fall on the calibration line indicating the equilibrium with the parent dolomitizing fluids. In contrast, the “background” dolomite in the Clino shows the significantly negative shift, deviating from the calibration line of δ_{47} and δ_{48} values with respect to temperature. Although such disequilibrium is attributed to the kinetic processes, with the elevated alkalinity induced by BSR, further modelling work is needed to examine the hypotheses. Overall, the dual clumped isotopic thermometry is a promising tool to decipher the mechanism of dolomite