Can clumped isotope thermometry help our understanding of dolomite recrystallisation at low temperature?

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Dolomitization is a diagenetic process in which magnesium ions are substituted to calcium ions in the lattice of carbonate rocks. Because dolomitization alters carbonate reservoir quality, it is critical for the oil and gas industry. Two parameters are key to our understanding of this process: the temperature of the reaction and the chemistry of the fluid from which the dolomite has precipitated. Constraining the environment of dolomitization requires the dolomite samples to be representative of the condition of formation [i.e., not recrystallized]. Yet, recrystallization features, especially in shallow reservoir and at low temperature can be challenging to identify using petrographic and geochemical methods.

Here, we use clumped isotopes thermometry (Ghosh et al., 2006; Eiler, 2007) to independently determine the temperature of early dolomite formation in samples of two Miocene carbonate platforms on the Marion Plateau (NE Australia). Results show that temperature of dolomite precipitation ranges between 15 and 37°C with an average of 22°C. The diagenetic fluid is sea water. Despite a very shallow-burial for the dolomite (maximum of 700 meters), the deepest samples show a relative increase of temperature, which could indicate an onset of recrystallization. This points out that early dolomite might equilibrate rapidly during early burial before reaching a stable mineralogical phase.