Impact of crystal size on clumped isotope reordering in dolomite

VEERLE VANDEGINSTE[1] AND CÉDRIC M. JOHN[1]

[1]Department of Earth Science and Engineering and Qatar Carbonate and Carbon Storage Research Centre, Imperial College London SW7 2BP, United Kingdom

The technique of clumped isotopes has been increasingly used over the last years as a paleothermometer to reconstruct the temperature of carbonate formation. However, carbonates that have seen a high temperature history, such as marbles, do not yield an accurate formation temperature, but provide an 'apparent equilibrium temperature' sensu Passey and Henkes (2012). This apparent (cooler) temperature relates to a 'locking' of carbon-oxygen bond reordering within the crystals during cooling, and thus most likely during uplift of the carbonate rocks. Solid-state reordering of carbon-oxygen isotope bonds seems to be influenced by mineralogy, for example calcite versus dolomite (Bonifacie *et al*., 2013), as well as optical quality or trace and minor element concentrations within the mineral (Passey and Henkes, 2012).

This study, funded jointly by Qatar Petroleum, Shell and the Qatar Science and Technology Park, tests whether or not crystal size impacts on solid-state reordering of the clumped isotope signal. Zebra dolomite, characterized by alternating fine and coarse crystalline bands and collected in the central Oman Mountains is an ideal candidate to test this hypothesis because the two crystal size populations in this dolomite formed during one dolomitization event involving the same type of fluid and fluid temperature and have seen the same uplift history.

Our results show that the apparent equilibrium temperature is slightly but statistically significantly higher in the coarse crystalline dolomite bands than in the fine crystalline dolomite bands of the zebra dolomites. Apart from a difference in clay content between the two types of bands, no geochemical difference in terms of major and minor elements was detected between the fine and coarse dolomite. Therefore, we conclude that the crystal size does have an impact on the degree of clumped isotope reordering.

[1] Bonifacie, M., Calmels, D., Eiler, J.M., 2013. Clumped isotope thermometry of marbles as an indicator of the closure temperatures of calcite and dolomite with respect to solid-state reordering of C-O bonds. *Mineralogical Magazine*, **77**(5): 735

[2] Passey, B.H., Henkes, G.A., 2012. Carbonate clumped isotope bond reordering and geospeedometry. *Earth and Planetary Science Letters*, **351**: 223-236