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Tracking temperature and δ18Ofluid evolution during diagenesis with carbonate clumped isotopes

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Carbonate clumped isotopes allow to reconstruct the temperature of carbonate mineral formation as well as the δ18O of the precipitating fluids in the temperature range between ambient temperatures and 200–250 °C. When different diagenetic carbonate phases are identified and dated at least relatively to each other, the burial temperature and the δ18Ofluid composition at different stages of the diagenetic and thermal history can be determined without the need for any assumptions about the fluids involved as it is the case when using conventional oxygen isotopes.
However, the use of carbonate clumped isotopes in diagenetic studies requires great care because the original temperatures of formation may not be recorded or preserved if 1) the temperatures during mineral formation are above the temperature range that the clumped isotope thermometer is able to record (Stolper & Eiler 2015), 2) the carbonate phase is altered or recrystallized by interaction with a fluid and 3) the carbonate phase is heated in absence of a fluid so that the clumped isotope composition is changed through bond reordering (Passey & Henkes 2012).
In this study, we reconstruct the diagenetic and thermal history of several Mesozoic formations at different locations in the Swiss Molasse Basin and in the adjacent Jura mountains. Thereby, we focus on the effects of different sediment properties and different burial and tectonic histories on the diagenetic evolution. Sample material originating from the two tectonic regimes is available from outcrops and deep boreholes from the national cooperative for the disposal of radioactive waste of Switzerland. Analyzed carbonate phases include early marine to late burial as well as sub-recent cements, veins, mineralogically preserved and recrystallized fossils, nodules and diagenetic dolomite phases. Our approach includes carbonate clumped isotope geochemistry combined with optical microscopy, scanning electron microscopy, cathodoluminescence and X-ray diffraction. Here, we present data from Triassic and Jurassic formations from northern Switzerland and southern Germany. The temperatures observed in the analyzed diagenetic carbonates range between ambient and approx. 140 °C and the calculated δ18Ofluid compositions are very heterogeneous. We will discuss the effects of mineralogy and texture on observed clumped isotope signatures and partial bond reordering due to deep burial during Cretaceous and/or Neogene.

References:

Passey, B.H. & Henkes, G.A., 2012. Carbonate clumped isotope bond reordering and geospeedometry. Earth and Planetary Science Letters, 351–352, pp.223–236.

Stolper, D.A. & Eiler, J.M., 2015. The kinetics of solid-state isotope-exchange reactions for clumped isotopes: A study of inorganic calcites and apatites from natural and experimental samples. American Journal of Science, 315 (5), pp.363–411.