The relationship between clumped isotope temperatures and burial depth in dolomitic sequences

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Clumped isotope analysis offers a robust method to determine temperature and fingerprint the isotopic composition of paleo-fluids in carbonates. The method has been widely used on surface and near-surface samples but in this study, we investigate the effects of burial on clumped isotope systematics in subsurface samples.

We present clumped isotope data from a suite of Upper Jurassic dolostones and limestones from the Aquitaine Basin, southwest France. Early Cretaceous rifting led to burial of these carbonates [1] to depths ranging from 1.0 to 5.5 km, depending upon their location in the basin. Limestones from 1.0 to 1.6 km and dolostones from 2.6 to 5.5 km were analysed for clumped isotopes. Preliminary data from a subset of samples revealed that both temperature and palaeo-fluid $\delta^{18}O$ composition increase with depth: a relatively low-burial limestone sample (1.6 km depth) records a temperature of 45 °C and a palaeo-fluid $\delta^{18}O$ (SMOW) of 2.4 ‰; the deepest sample measured so far, a dolostone from 5.3 km depth, records a temperature of 146 °C and a palaeo-fluid $\delta^{18}O$ (SMOW) of 7.7 ‰. The calibration of Passey and Henkes [2] was used to determine temperature in the CDES scale [3]. Palaeo-fluid $\delta^{18}O$ compositions were calculated using the equation of Land [4] for dolomite and Friedman and O' Neil [5] for calcite.

Our initial interpretation is that the increasing temperature and palaeofluid $\delta^{18}O$ composition with depth suggest multiple burial recrystallisation events. However, a higher depth-resolution dataset is being acquired to further constrain the processes affecting clumped isotopes during burial diagenesis.

[1] Biteau *et al* (2006) *Pet. Geo.* **12**, 247-273 [2] Passey and Henkes (2012) EPSL **351-352**, 223-236 [3] Dennis *et al* (2011) *Geochim. Cosochim, Acta* **75**, 7117–7131 [4] Land (1980) *SEPM Spec. Pub.* **28**, 87-110 [5] Friedman and O' Neil (1977) U.S. Geol. Surv. Prof. Paper **440**