Paleotemperatures and paleofluids recorded by both carbonate clumped isotope and fluid inclusion thermometries from calcite cements of the Paris Basin

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Constraining the thermal and fluid-flows histories of sedimentary basins is crucial to understand their geodynamic evolutions and predict hydrocarbon maturation and migration. However, the reliability of available temperature (T) or fluid composition proxies are often limited by many factors and requires their comparison and/or combination to provide the best constraints on a basin's history. In this context, the Δ_{47} thermometry show high promises since it allows to determine both the T *and* the oxygen isotopic composition of the mineralizing fluid ($\delta^{18}O_{fluid}$) from which one carbonate grew. However, on carbonates that experienced high-T histories, its accuracy might be weakened by reordering of ^{13}C–^{18}O bonds though solid-state diffusion into the mineral lattice [1].

Here, we studied a core drilled in the Dogger of the Paris Basin (with maximum burial T< 90°C [2]) and ran both Δ_{47} and fluid inclusions microthermometry (FI) measurements on two generations of blocky calcite cements. Importantly, we found that both T *and* fluid compositions out of the two independent proxies are consistent. More specifically, the first generation of cement crystallized at T ~ 60°C from a high salinity fluid (14-17wt.% NaCl eq. and $\delta^{18}O_{fluid}$ of 1.5 ± 1‰) that we interpret as slightly evaporated seawater trapped in sediment porosity at the moment of the deposition (i.e. lagoon environment). In contrast, the second generation precipitated at T ~ 78°C from a meteoric-type fluid with variable salinity ($\delta^{18}O_{fluid}$ of -5 ± 1‰ and salinity of 0-9wt.% NaCl eq.) probably related to lateral water-infiltrations during the Cretaceous/Tertiary compressive phases [3]. More widely, the good consistency between the precipitation temperatures, the origin of fluids and the link to geodynamic events confirm the reliability of the Δ_{47} thermometry as a powerful tool to simultaneously reconstruct the temperature and $\delta^{18}O_{fluid}$ of paleofluids related to burial environments in "low" temperature sedimentary basin, like the Paris basin.

[1] Passey and Henkes (2012) *EPSL* **262**, 309-327. [2] Amir et al. (2005) *Tectonophysics* **400**, 227-240 [3] Carpentier *et al.* (2014) *Marine Petrol. Geol.* **53** 44-70.