Fluid flow evolution of the southern Pyrenees inferred from clumped isotopes thermometry and U-Pb geochronology

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One of the most promising methods to decipher the temperature conditions under which orogenic belts evolve is clumped isotope thermometry, which combined with U-Pb geochronology of carbonate cements, becomes a powerful tool to unravel the fluid flow evolution during deformation.

Clumped isotopes data and U-Pb geochronology aplied in the south Pyrenean thrust system having Triassic evaporites along the sole thrust indicate that from Upper Cretaceous to Middle Eocene, maximum temperatures reached by migrating fluids through thrust sheets did not exced 90 ºC. In contrast, from Middle Eocene to Oligocene, temperatures reached up to 180 ºC. For each individual thrust sheet, two geochemical trends have been observed: 1) a progressive decrease of the fluid temperature together with a decrease of the $\delta^{18}O_{fluid}$ VSMOW and 2) an increase of the temperature together with an increase of the $\delta^{18}O_{fluid}$ VSMOW.

The increase of fluid temperature from Middle Eocene is interpreted either as the interaction of fluids with deeper basement units during their emplacement or higher burial conditions due to the progressive stacking of thrust sheets. The decreasing geochemical trend is interpreted as the the progressive input of low-temperature meteoric waters into the paleohydrological system as thrust sheets emerged, whereas the increasing trend is interpreted as the interaction of fluids with thick evaporite units [1].

[1] Cruset, D., Cantarero, I., Vergés, J., John, C. M., Muñoz-López, D., and Travé, A. (2018) Global and Planetary Change. https://doi.org/10.1016/j.gloplacha.2017.11.001