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Syntectonic fluid-flow along thrust faults: Example of the South Pyrenean fold-and-thrust belt

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Estimation of the P-T conditions during evolution of sedimentary basins and characterization of petrophysical properties of fault zone are of major interests to oil companies, since they could allow to understand paleohydrological characteristics of potential reservoirs. In fold-and-thrust belts, faults are supposed to constitute channelized pathways for fluids coming from external, either deep or meteoric sources. However, the different available studies suggest that fluid flow through such discontinuities is not so evident.
In order to constrain the paleofluid flow through the south Pyrenean fold-and-thrust belt we focus on thrust faults located at different structural levels. The microstructures observed in the different studied fault zones are similar and consist of pervasive cleavage, calcite shear and extension veins (respectively SV1 and EV1) and late dilatation veins (EV3). Thus, the presence of veins attests to the involvement of fluids during deformation. In order to characterize the nature and origin of fluid, petrological and geochemical (stable isotopes and trace elements) analyses were performed on calcite veins. The results suggest a high complexity in the hydrological behaviours of thrust faults evidencing a reservoir compartmentalization in the South-Pyrenean fold-and-thrust belt. In the southern part of the Axial Zone, different studies evidence the contribution of deep metamorphic water, probably derived from the Paleozoic basement, along Gavarnie related fault zones during deformation. In the Jaca basin, during the Monte Perdido thrust fault activity, we evidence the contribution of formation water. These data suggest a very closed hydrological fluid system where fluid flow didn't exceeded 70 m. In the other hand, the Jaca and Cotiella thrust faults located in the southern part of the basin, are characterized by a composite fluid-flow system. Indeed, stable isotopes and trace elements compositions of the first generation of calcite veins evidence relatively closed paleohydrological system whereas the second calcite vein generation, which is probably associated to the exhumation of the basin, suggests the contribution of both, meteoric and marine waters.