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# Microtectonic characterization of the deformation in fault zone: A key to understand the mechanical evolution of a thrust fault (Monte Perdido thrust fault, Spain)

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In thrust-and-fold belts, the development of low angle thrust faults is highly related to the presence of fluids. Although increasing of fluid pressure can be an important parameter in fault reactivation, it could also be responsible for fluid-rock interaction and triggers the apparition of weaker hydrous minerals facilitating fault reactivation.

In this study, we aim to decipher the mechanical processes and the mineralogical changes accompanying the shear surfaces reactivation in thrust faults at various P-T conditions. The current investigations focus on the Monte Perdido thrust fault (South Pyrenean orogenic wedge). The fault zone is characterized by meter-thick shear zone with highly deformed foliated clay bearing rocks and shear surfaces.

Petrographic, SEM and TEM observations coupled to geochemical and thermometric analysis in the fault zone highlighted two principals stage of deformation:

The first stage corresponds to the development of calcite shear veins, opened by a combination of incremental shear surface reactivation and extension vein opening. The spatial relationships existing between shear veins and cleavage seams attest that pressure solution is the major deformation process. Fluid inclusions microthermometry and oxygen isotopic composition of cogenetic vein minerals suggest that this first stage of deformation occurs at about 210˚C and at burial depths of 6 km.

The second stage corresponding to the fault reactivation involves Fe-chlorite ($Si_{2.86}Al_{1.14}O_{10}(Al_{1.67}Fe_{2.31}Mg_{1.71})(OH)_8$) crystallization. Syntectonic chlorites precipitated along shear surface. Chlorite chemical compositions coupled with fluid inclusions thermometry allows to estimate higher P-T conditions of fault reactivation (240˚C and 6.5 km).

These results allow to propose a model of fault evolution in which a competition between fluid pressure and creep mechanisms are occuring. During the first step of deformation, the Monte Perdido Thrust Fault activation is facilitated by a high pore fluid pressure conditions. Pressure solution processes triggered a calcite departure from host sediments to veins. As a consequence, an increase of the relative insoluble clay minerals content occurs in the sediment matrix. During the second stage of deformation chlorite precipitates along shear surfaces. Although such minerals are supposed to decrease the frictional coefficient of fault zone, the contribution of fluid pressure still remains high.