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# Evolution of fluid-fault interactions across the upper continental crust inferred from seismological, mechanical and geochemical analyses.

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This study aims at deciphering the interactions between fluid and fault mechanics across the upper continental crust. Here, the influence of fluid overpressures on fault reactivation and earthquake triggering are investigated at the crustal scale. In order to reach this goal, an analysis combining seismology, structural geology, geochemistry and mechanics has been carried out along an active dextral strike-slip fault system in the Ubaye-Argentera region (southern French-Italian Alps). The interests of this fault system are its relationship to the 2003-2004 Ubaye seismic swarm (Jentatton et al., 2007) having occurred in the crystalline basement and its exposure in the Argentera crystalline basement massif located further south. The presence of fluid overpressures in the fault zone has been evidenced during the analysis of the 2003-2004 seismic swarm (Daniel et al., 2011, Leclère et al., 2012) and by the presence of quartz-chlorite mineralized veins (i.e. hydraulic fracturing) along the faults outcropping in the Argentera massif.

We investigate the interactions between fluid and fault across the upper continental crust from the analysis of the 2003-2004 Ubaye swarm and the quartz-chlorite veins associated with a fault located in the continuity of the fault of the 2003-2004 Ubaye swarm.

The fluid-fault interactions during the 2003-2004 Ubaye seismic swarm were analyzed by using focal mechanisms of 74 events, mechanical model based on the Mohr-Coulomb theory and the hydrogeologic context. The results show that the seismogenic zone of the Ubaye region is characterized by the development of supra-hydrostatic fluid overpressures in fault zone and that the fluids have meteoric origins. Conversely, the mechanical (i.e. Mohr-Coulomb model) and geochemical analyses (i.e. chemical and isotopic compositions) of the quartz-chlorite veins show that these veins were formed at or near the base of the seismogenic zone and with a fluid of metamorphic origin and under a lithostatic fluid pressure.

The conditions of initiation of earthquakes at or near the base of the seismogenic zone deduced from geochemical and mechanical analyses of quartz-chlorite veins are then compared with those deduced from the analysis of the Ubaye seismic swarm occurring in the seismogenic zone. These results allow to propose a conceptual model of the interactions between fluid, fault and earthquake across the upper continental crust. This conceptual model shows that the brittle-ductile transition appears as an important limit separating two domains with different seismic and hydro-mechanical behaviors. Lastly, this study emphasizes the importance of associating seismological, mechanical and geochemical analyses to understand the fluid-tectonic interactions at crustal-scale.