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Overpressured fluid imaging from focal mechanisms during the 2003-2004 Ubaye seismic swarm (Southern-Alps, France)

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The development of fluid pressure is thought to play a major role in earthquake triggering and in fault reactivation (Nur & Booker, 1972; Sibson, 1985; Miller et al., 2004; Hainzl et al., 2006; Cappa et al., 2009; Terakawa et al., 2010)
In this study, we present an analysis of the potential key role of fluid pressure on the triggering of the 2003-2004 Ubaye (France) seismic swarm. Our aim is to provide a better understanding of fluid pressure build-up along fault zones and its influence on earthquake triggering. More than 16,000 microseismic events were detected during the Ubaye swarm. This swarm occurred over an area located between the Argentera-Mercantour and the Pelvoux crystalline massifs, below the Embrunais-Ubaye nappes (Jenatton et al., 2007). Hypocentral depths were comprised between 3 and 8 km and the spatial distribution of hypocenters was parallel to the azimuth of major regional NW-SE faults. This suggests that seismic ruptures reactivated a preexisting fault zone in the crystalline basement (Leclère et al., in press).
Based on Mohr-Coulomb theory and a fault zone orientation of the seismic swarm computed by Daniel et al. (2011), we estimate the overpressured fluid required to reactivate this fault to be between 7 and 26 MPa (Leclère et al., in press). This result is in good agreement with a previous study by Daniel et al. (2011). We propose a mechanism for the development of overpressured fluid conditions that accounts for the presence of thermal springs, fault zone compaction processes and hydraulic barriers (Leclère et al., in press).
In a further step, we analyze an extended focal mechanism dataset and we focus on overpressured fluid conditions required to reactivate individual fault planes related to each focal mechanism. We then investigate the correlation between changes in overpressured fluid conditions and changes in the seismicity rate. We also discuss the spatial heterogeneity of overpressured fluid conditions.