

Magnetotelluric investigations in the Ubaye valley, Western Alps: a connection between electrical conductivity, fluids, and earthquakes?

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SUMMARY

The Ubaye valley is a seismically active region in the Western Alps (France), regularly struck by seismic swarms, e.g., in 2003–2004 or 2012–2015. While some earthquakes could be associated with known faults, the character of the observations (high seismicity – low deformation rate) requires complex driving processes beyond local or regional tectonics. Most conceptual models involve pressurized fluids present down to depths of several km, and/or long-range transport.

During 2020/21, a data set of 30 MT sites was acquired, covering a signal period ranging between 10^{-4} to 10^4 s. Data quality was generally satisfactory up to 3 s and sometimes up to 100 s. For the 3-D inversion performed using the ModEM code, we have chosen a joint inversion of induction vectors, phase tensors and off-diagonal impedances (previously corrected for static shift with help of phase tensor inversion and few TDEM measurements).

The main findings include (a) a prominent conductor (down to 20 Ω m) located along the axis of the swarm zone, though generally above it; (b) a regional dominance of the Penninic Front in the East and the overridden Mesozoic (Dauphinoise) sediments in the West; (c) strike directions that agree well with most of the mapped faults and focal mechanisms of the strongest seismic events.

Our sensitivity reaches the border of the seismic swarm activity, but does not cover its depth extent. Conceptual models proposed for the origin of the seismic swarm activity will be discussed in the light of the MT imaging, and the associated uncertainties.

Keywords: magneto-tellurics, pressurized fluids, seismic swarms, Penninic Front, Western Alps
