A SEISMOTECTONIC PICTURE OF THE ARGENTERA-MERCATOUR MASSIF

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The seismicity of the southernmost western Alps shows low to moderate magnitude ($3 < M_L < 5$). In that segment of the Alpine orogen, major earthquake occurrence and greatest seismic hazard characterize the transition zone between the Maritime Alps and the Ligurian-Provençal basin (Eva and Solarino, 1998; Baroux *et al*., 2001; Larroque *et al*., 2009). Despite the seismic potential of this sector of the belt, the active fault network sparking off the regional seismic activity is not yet clearly identified, and is currently under investigation.

Ongoing brittle deformation in the southern Western Alps is largely controlled by inherited Alpine faults. These faults include the frontal thrusts developed beneath the External Massifs, and the major strike-slip faults crosscutting the Frontal Pennine Fault (e.g., the Stura Fault; Malusà *et al*., 2009). The Stura Fault now juxtaposes the European continental crust that has escaped Alpine metamorphism, to the SW, and Alpine metamorphic units to the NW, and possibly acted as a lateral ramp accomodating post-Oligocene Adria-Europe convergence (Malusà *et al*., 2015, and references therein).

From a seismotectonic point of view, the Argentera-Mercantour Massif is characterized by a diffuse seismicity that becomes very firm to the north-east in correspondence of the Stura Fault. However, when dealing with seismotectonic studies, the accuracy of routinely located earthquakes is not sufficient to clearly define the active faults. In this study, we analyzed the distribution of seismicity after relocation with the algorithm HypoDD (Waldhauser and Ellsworth, 2000). This code solves the problem of both inaccurate phase picking and reference model being independent from the initial velocity model. We selected 2900 well locatable earthquakes for the period 1986-2014 adopting selection criteria based on both location parameters reliability and number of phase (8) picks. The high quality relocated database consists of more than 2600 entries with values less than 1.0 km and 1.5 km for horizontal and vertical errors respectively.

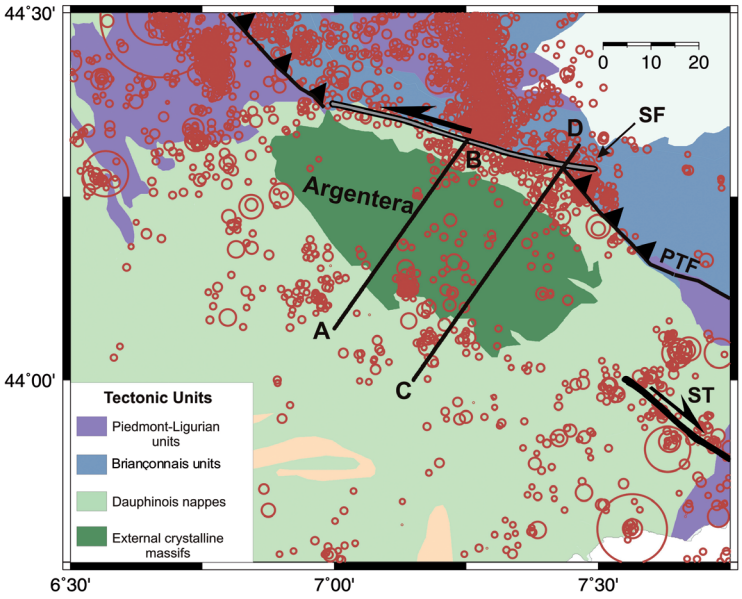

Fig. 1 – Distribution of HypoDD relocated seismicity. PFT: Penninic Thrust Front, SF: Stura Fault, ST: Saorge-Taggia fault.

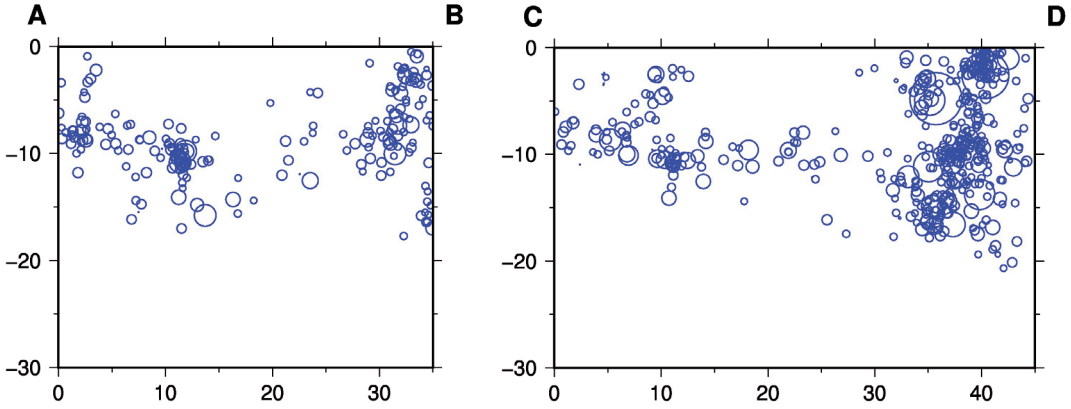

Fig. 2 – Seismic cross-sections oriented as in Fig. 1.

After relocation, seismicity mainly rims the Argentera-Mercantour Massif on three sides, with an aseismic corridor some 10 km wide observed on the southeastern side of the massif (Fig. 1). This corridor marks the transition to the Saorge-Taggia Fault. In the map of relocated events, only few of them occur within the massif, in particular in the south-western sector. The dense distribution of seismic events north-east of the Stura Fault is confirmed, although it now appears less chaotic and partly organized in separate sectors, one linked to the Stura Fault and the other one linked to the Penninic arc.

The SW-NE cross-sections of Fig. 2 provide new insights about the distribution of seismicity under the Argentera-Mercantour Massif. Both cross-sections show a rimming of the seismicity around the massif extending to 9-10 km depth. One important feature is the subvertical trend shown in section CD in correspondence of the Stura Fault, where a few moderate magnitude earthquakes possibly attest to its ongoing activity.

Although the kinematic framework on a more regional scale is well constrained by some focal mechanisms computed for earthquakes with magnitude > 4, only few focal mechanisms

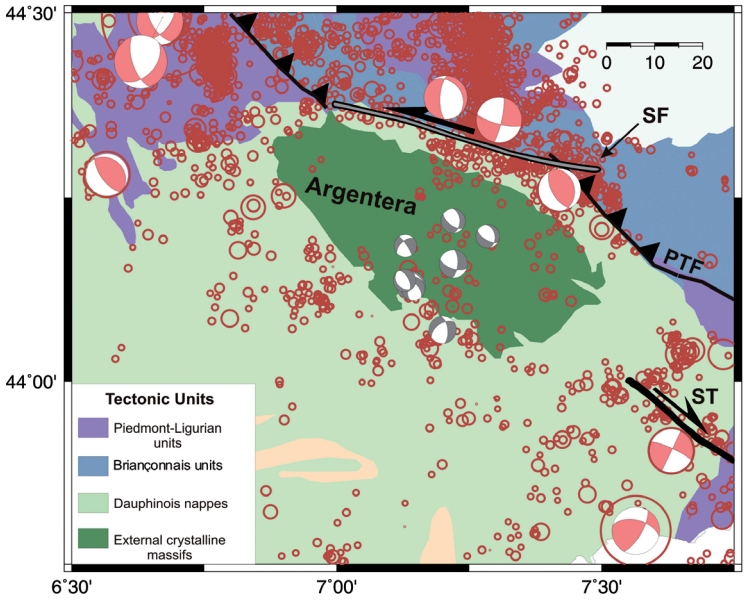

Fig. 3 – Distribution of HypoDD relocated seismicity with principal fault plane solutions. In red focal mechanisms for events with magnitude greater than 4 and in grey focal solutions for the Argentera area.

are available for the study area due to the low magnitude of recorded events. Focal mechanisms provided for the Argentera-Mercantour Massif were computed starting from the accurate hypocentral parameters in output from HypoDD, on events for which at least 15 polarities were available. The final picture (Fig. 3) displays compressional focal solutions on the external and internal sectors of the Alps, extensional solutions in the central part, and strike-slip solutions towards the Ligurian-Provençal coast. The Argentera-Mercantour Massif shows extensional mechanisms with slight strike-slip component.

In conclusion, the seismicity under the Argentera-Mercantour Massif apparently marks the geometry of the frontal thrusts controlling the Neogene exhumation of the massif. Based on our dataset of relocated earthquakes, the depth of these thrusts should range from 12 to 10 km. The extensional focal mechanisms observed under the massif suggest that these tectonic structures are now reactived under an extensional regime. On the northeastern side of the massif, the near-vertical Stura Fault is still active, and clearly identified down to 18 km depth.

References

Baroux E., Bethoux N., and Belier O., 2001. Analyses of the stress field in the southeastern France from earthquake focal mechanisms, Geophys. J. Int., 145, 336-348.

Eva, E., Solarino, S., 1998. Variations of stress directions in the western Alpine arc. Geophys. J. Int. 135, 438–448.

Larroque, C., Delouis, B., Godel, B., Nocquet, J.-M., 2009. Active deformation at the southwestern Alps–Ligurian basin junction (France–Italy boundary): evidence for recent change from compression to extension in the Argentera massif. Tectonophysics 467, 22–34

Malusà M.G., Polino R. and Zattin M., 2009. Strain portioning in the axial NW Alps since the Oligocene, Tectonics, 28, TC3005.

Malusà M.G., Faccenna C., Baldwin S.L., Fitzgerald P.G., Rossetti F., Balestrieri M.L., Danišík M., Ellero A., Ottria G., Piromallo C., 2015. Contrasting styles of (U) HP rock exhumation along the Cenozoic Adria-Europe plate boundary (Western Alps, Calabria, Corsica). Geochemistry, Geophysics, Geosystems, 16, 6, 1786-1824.

Waldhauser F. and Ellsworth W. L., 2000. A double-difference earthquake location algorithm: method and application to the northern Hayward fault, California. Bull. Seismol. Soc. Am., 90, 1353-1368.