Structural inversion of the North Ligurian margin: results from the SEFASILS experiment

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The north Ligurian margin is a stretched continental margin located at the junction of the Western Mediterranean Sea and the Alpine belt. This region underwent several phases of contrasting deformation styles. The Ligurian basin opened from late Oligocene to early Miocene times, as a result of a back-arc extension induced by the rollback of the subducted Apulian plate. Since then, it has been evolving in the immediate vicinity of the active Alpine orogen, in a regional compressional setting between the Corsica-Sardinia continental block and mainland Europe.

Nowadays, continuous seismic activity, with mainly reverse focal mechanisms, is recorded in the northeastern part of the Ligurian Basin. It is attributed to the compressional phase at work in the Gulf of Genoa since about 5 Myrs, which led to a significant uplift of the north margin documented by a vertical offset of the Messinian stratigraphic markers by more than 1000 m offshore Imperia. Although active seismogenic faults are still poorly known, a fault system outcropping at the foot of the continental slope, offshore Liguria and the French Riviera, is suspected from previous joint high-resolution seismic reflection data interpretation and sismotectonic studies.

The SEFASILS project (Seismic Exploration of Faults And Structures In the Ligurian Sea) aims to better understand the mechanisms of the ongoing tectonic inversion of the margin and the crustal-scale tectonic structures –active or not– marking its evolution. We also aim to better characterize the sharp transition from the South Alpine belt to the Ligurian basin. Acquiring quality deep seismic data in the Ligurian Sea is challenging due to the complexity of structures beneath the margin and to the screening effect of the thick Messinian evaporitic series interlayered in the sedimentary cover farther seaward. To this end, joint acquisitions of deep, long-streamer multichannel seismic (MSC) reflection data and dense sea-bottom wide angle refraction data (WAS) have been carried out along a 150 km long profile offshore Nice, perpendicularly to the basin’s axis.

The MCS data, thanks to pre- and post-stack migration, highlight faults at the foot of the
continental slope rooting deeper than the salt decollement level. A first arrival travel time tomographic inversion of the wide angle data allowed us to build a velocity model of the study area reaching down to the uppermost mantle. Here, we present the results obtained from the joint analysis of MCS and WAS data. On the southern part of our profile some deep reflectivity, closely mirrored by the 7 km/s tomographic isovelocity, likely corresponds to the Moho. It is lost to the north, where shallower reflectivity, which could be interpreted as the base the thick sedimentary cover, coincides with the 5 km/s isovelocity. These two features are separately observed on both sides of what appears to be a major structural discontinuity between two contrasting basement domains, coinciding with an anomalously large salt diapiric complex in the sedimentary cover, also observed farther east in the basin. Such observations and their potential consequences will be discussed, in the light of previous regional studies.