

Ligurian Ocean Bottom Seismology and Tectonics Research (LOBSTER)

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The LOBSTER project constitutes the offshore component of the DFG Priority Program “Mountain Building Processes in Four Dimensions” (SPP 2017, 4DMB) and aimed to expand the densely spaced AlpArray broadband seismic network to the offshore domain in the Ligurian Sea. The LOBSTER program encompassed research cruises on the French RV *Pourquoi Pas?* in 2017 to deploy a long-term ocean bottom seismology network that was recovered using the German RV *Maria S. Merian* in 2018 (Fig. 1). The LOBSTER long-term seismic network consisted of 7 French (from IPGP) and 22 German (from the DEPAS pool and from GEOMAR) stations. During the second cruise an active seismic experiment was conducted to complement the passive seismology study. The refraction seismic data acquisition was conducted along two wide-angle profiles: P01 runs from the Gulf of Lion to Corsica and P02 trends parallel to the center of the Ligurian Basin in a NE-SW direction. Both profiles were analyzed using a travel time tomography (Dannowski et al., 2020 and in prep). The combined data set in addition to high-resolution bathymetry data shed light on today’s active deformation of the Ligurian Sea (Thorwart et al., 2021). In addition, the 3-D crustal and upper mantle structure of the Ligurian Basin was inferred from surface wave tomography (Wolf et al., 2021). The main technical aim of the LOBSTER project is to provide consistent data that can be smoothly integrated with the onshore seismology data. Key features in the data pre-processing are the correct timing, determining of the orientation of the horizontal seismometer components, and the searchability and availability of the data based on FAIR data standards.

LOBSTER studied the Ligurian Sea at the transition from the western Alpine orogen to the Apennine system. This complex geodynamic setting is manifested in pronounced variations in crustal thickness. Topographic gradients in the area are the largest for the entire Alpine-Mediterranean domain, rising from -2500 m in the Ligurian basin to > +3000 m in the Alpine-Apennine orogen over a distance of less than 100 km. The Ligurian Basin is a back-arc basin opened by the south-eastward trench retreat of the Apennines-Calabria-Maghrebides subduction zone, which also triggered the opening of the adjacent western Mediterranean basins. The recent deformation in the Ligurian Sea results from compression along its northern margin (0.3 - 1.5 mm/year shortening), but no significant convergence is evident from GPS data, and rates of deformation are very low.

The LOBSTER data set offers a better understanding of the complex geodynamic setting of the Ligurian Sea, which is characterized by pronounced variations in crustal thickness. Based on the LOBSTER data the following conclusions were documented:

- Extension in the Ligurian Basin led to stretched and very thin continental crust or exhumed, partially serpentinised mantle.
- Continental crustal thinning from north to south is related to the increase of extension with increasing distance from the rotation pole of the anticlockwise rotation of the Corsica–Sardinia block.
- Seafloor spreading and formation of mantle-derived oceanic crust was not initiated during the extension of the Ligurian Basin.
- The Ligurian Sea is currently closing while Africa and Eurasia are converging. Part of the stresses are taken up in the basin center through re-activation of extension-related faults.

Data analysis is still ongoing and further results are expected from local earthquake tomography in the area of the Alps-Ligurian Junction conducted with the data from the long-term ocean bottom seismometer deployment.



Figure 1: Ship track of RV Maria S. Merian cruise MSM 71 from Las Palmas de Gran Canaria (07.02.2018) to Heraklion (27.02.2018) with profiles acquired in the Ligurian Sea northwest of Corsica.