

The Potential and Limitations of 2D Seismic Experiments for 3D Tomography

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The Liguro-Provençal Basin is located in a complex tectonic area, at the junction of the Western Alps and Northern Apennines. Despite its central location within Europe, much about the basin, including the character of the crust, and the continuation of the Alpine orogen offshore, remain ambiguous.

The basin began opening in the late Oligocene as a back-arc basin related to the retreat of the Apennine subduction zone. Opening continued into the early Miocene with the counter-clockwise rotation of the Corsica-Sardinia block to its current position. In the southern part of the basin where this rotation opened the widest, seismic tomography has shown evidence of oceanic crust, however, the extent of this spreading zone northward into the Ligurian Sea is poorly mapped. The nature of the crust in the basin, whether atypical oceanic crust or partially serpentinized mantle overlain by sediments or highly thinned continental crust is still a matter of debate.

At a larger scale there are still open questions as to the continuation of the alpine orogen offshore, and the change in polarity between the Alp and Apennine subduction zones. As well, present day seismicity with thrust-faulting focal mechanisms have been observed in the basin, indicating that the stress field is now compressive. This could potentially reactivate rift-structures in the basin, which are difficult to map due to thick sediment cover including a layer of Messinian salt with variable thickness.

These open questions, and the accessibility of the basin in the heart of Europe, have led to the collection of at least 18 active seismic profiles, and even more multi-channel seismic lines. Each of these studies have contributed to understanding the tectonics of the area through 2D tomography along the profile, but these are small snapshots of a complex setting. The amount of data that has been collected provides a unique opportunity to combine data sets and examine the possibility of gaining new information in the form of 3D tomography from existing 2D data sets.

In this project we use active seismic data from the LOBSTER-AlpArray Experiment, the GROSMarin Experiment, and the SARDINIA Experiment, as well as passive seismic data from the AlpArray Experiment and the ISC Bulletin. We explore the potential and limitations of these data sets for use in 3D tomography using two new methods. We first use off-profile stations along a 2D seismic line combined with passive seismicity to provide back-shots for the stations, then in the Gulf of Lion we use two parallel seismic profiles where stations recorded shots from both profiles. This project is part of the DFG Priority Program "Mountain Building Processes in Four Dimensions (4DMB)".

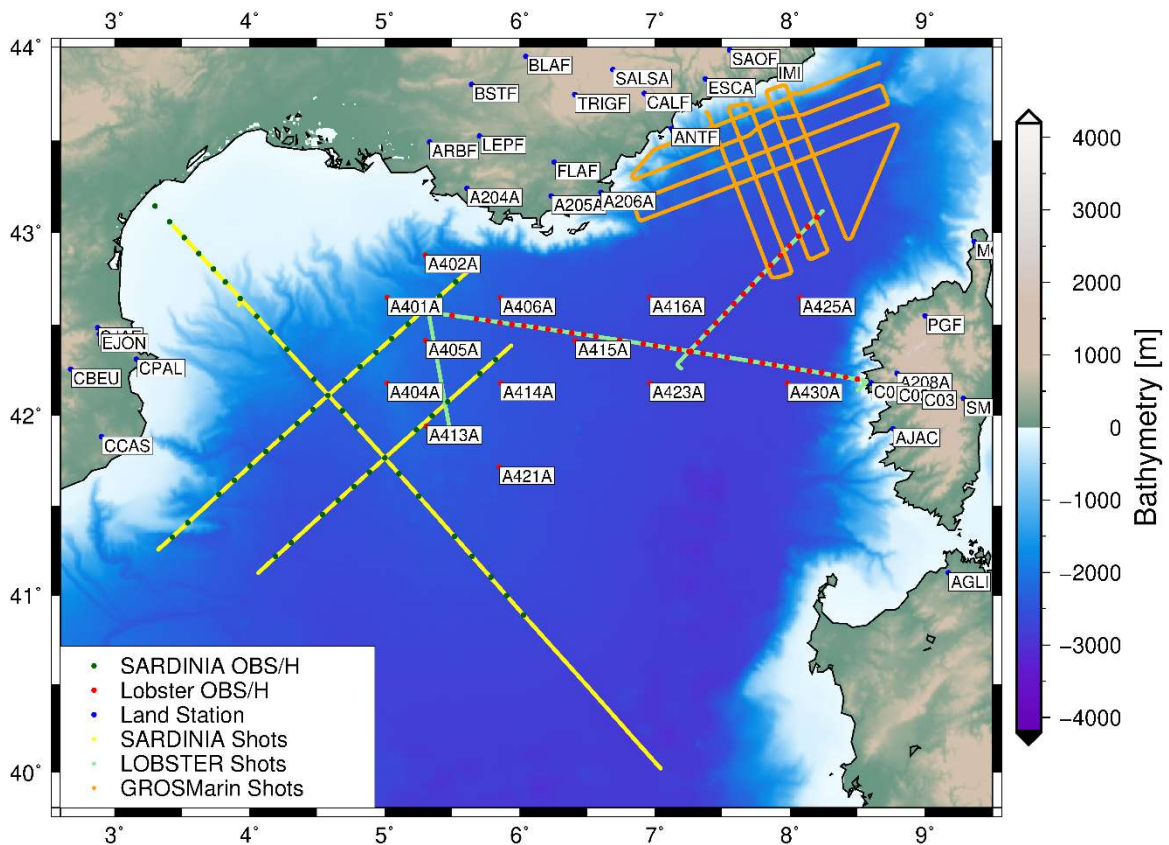


Figure 1: Overview of data used: Yellow and dark green dots show shots and Ocean Bottom Seismometers (OBS) from the SARDINIA Experiment, light green and red dots show shots and OBS from the LOBSTER—AlpArray Experiment, and orange dots show shots from the GROSMarin Experiment, OBS not shown as we do not have access to the data. Blue dots show land stations at which shots were recorded.