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Lithospheric architecture of the Ligurian Basin from amphibious seismic AlpArray data

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The Ligurian Basin is located at the transition from the western Alpine orogen to the Apennine system and was generated by the southeast trench retreat of the Apennines-Calabrian subduction zone. Extension led to extreme continental thinning. It is highly debated whether oceanic or atypical oceanic crust was formed or if the crust is continental. Active and passive seismic data have been recorded on ocean bottom seismometers (OBS) in the framework of SPP2017 4D-MB, the German component of AlpArray. Two refraction seismic profiles were shot in the Ligurian Basin. Furthermore, we present seismicity recorded during the deployment from June 2017 to February 2018.

The Vp velocity model from refraction seismic data shows a crust-mantle boundary in the central basin at ~12 km depth that deepens to ~24 km within a narrow necking zone of ~30 km towards Corsica. However, extremely thinned continental crust indicates a long-lasting rifting process that possibly does not initiate oceanic spreading before the opening stopped.

We calculated cross-correlation functions for the OBS and surrounding land stations. The group velocity maps show heterogeneities for short periods (5-15 s). Shear-wave velocity results show a Moho deepening from 12 km at the southwestern basin centre to 20–25 km at the Ligurian coast and to over 30 km at the Provençal coast. We find no hint on mantle serpentinisation. We see a separation of the southwestern and northeastern Ligurian Basin that coincides with the promoted prolongation of the Alpine front.

Two seismic clusters occurred between 10-16 km depth, within the lower crust and uppermost mantle. Thrust faulting focal mechanisms indicate compression and inversion of the basin. The seismicity suggests reactivation of pre-existing rift-related structures. High mantle S-wave velocity and a low Vp/Vs ratio support the hypothesis of strengthening of crust and uppermost mantle during rifting-related extension and thinning of continental crust.