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# Investigations of the Oligocene-Miocene opening of the Ligurian Basin using refraction seismic data - LOBSTER

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## Introduction

- The Ligurian Basin is a back-arc basin generated by SE trench retreat of the Apennines-Calabrian subduction zone.
  - ~30 Ma rifting was initiated associated with magmatism on land along the western margin.
  - ~21 Ma end of rifting and start of anticlockwise rotation of the Corsica-Sardinia block and oceanic spreading was proposed.
  - ~16-15 Ma end of opening associated with a second volcanic phase along the Corsican margin

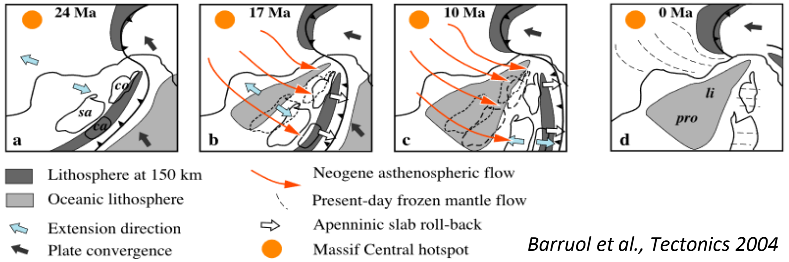


*Fig. 1: Geodynamic evolution of the Liguro-Provencial Basin after Barruol et al. (2004)*

Key questions of our study:

***What is the nature of the Ligurian Sea basement?***

***Where is the transition from continental to oceanic crust?***

***How is the geometry of the continent-ocean transition (COT) zone?***

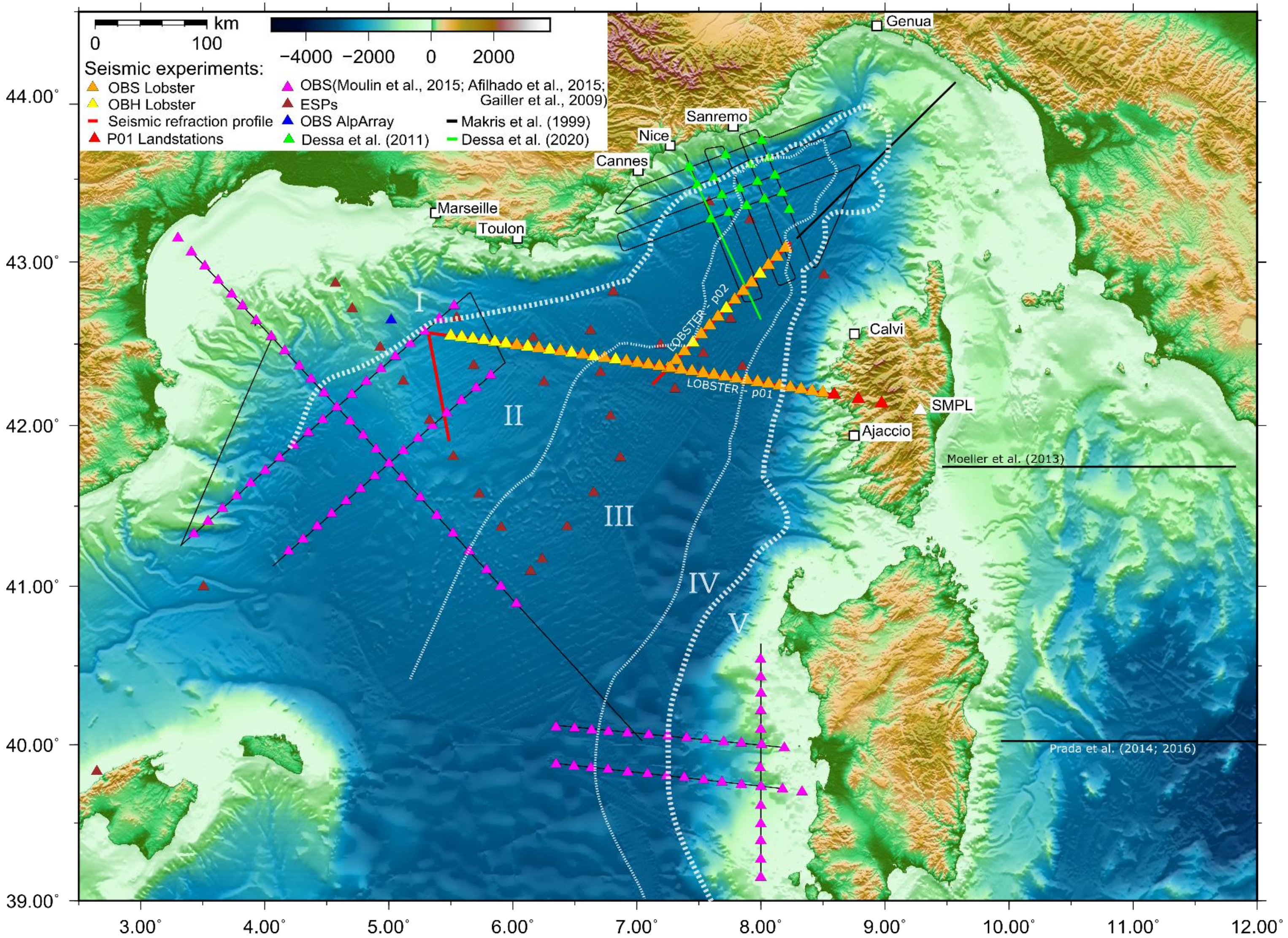


*Fig. 2: Topographic map (GMRT data, Ryan et al., 2009) of the Liguro-Provencial Basin displaying recent seismic experiments including the LOBSTER profiles p01 and p02 studied here. Previous studies divided the basin into different zones of continental and oceanic domains based on seismic, magnetic and gravity data (white dashed lines and numbers I to V).*

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## Results and interpretation of LOBSTER profile p02

- Stacked picks along p02 show a nearly 1D structure (Fig. 4a)
- Clear arrivals from sediments (Psed < 4.6 km/s) and a small velocity gradient
- Abrupt change to mantle phases (Pn ~ 8 km/s) (Fig. 4b)

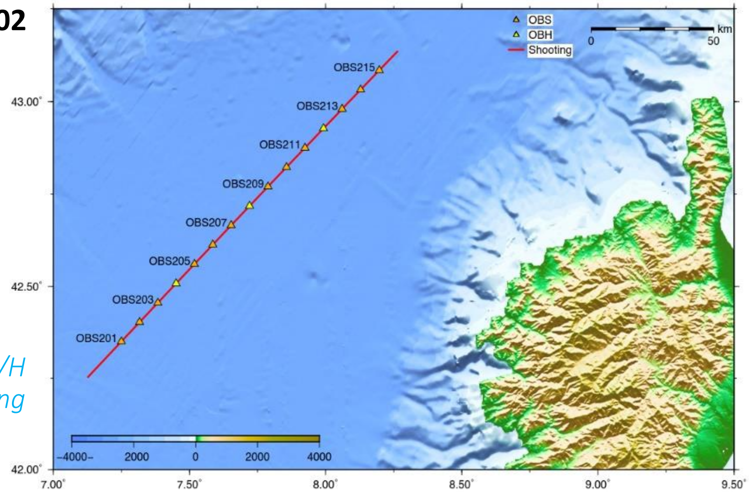



*Fig. 3: In total 15 OBS/H were deployed along profile p02.*

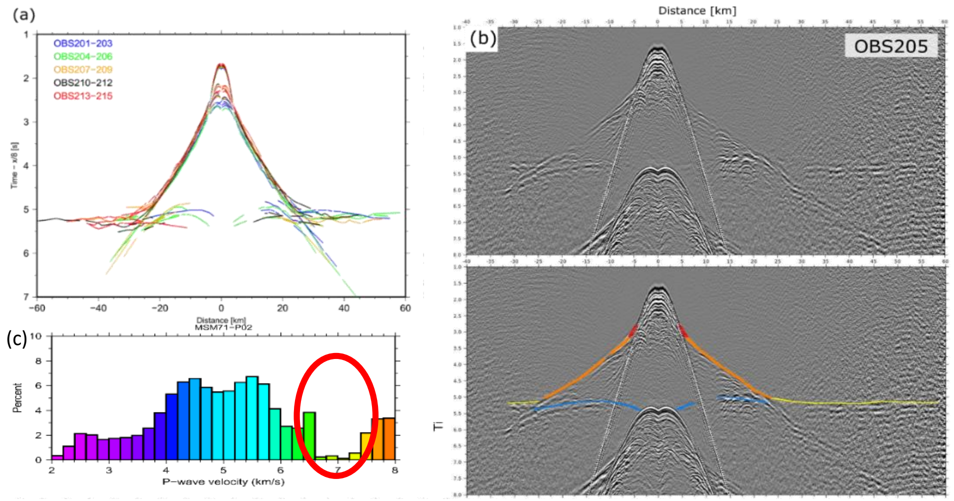



*Fig. 4: (a and b) Data and travel time picks of LOBSTER profile p02 (modified, Dannowski et al., 2020). (c) The shows the velocity distribution of the final velocity model and indicates a gap of velocities typical for oceanic crust.*

Results from travel time tomography (Fig. 5):

- Uppermost sedimentary layer: 2.2 – 3.5 km/s with a high velocity gradient (Plio-Quaternary)
- Deeper layers: 3.5 - ~5.7 km/s (Messinian salt and Pre-Messinian and Tortonian sediments)
- Acoustic Basement: at ~9 km (CB-MCS) or ~10 – 11.5 km depth (CB)
- Mantle: at ~11-13 km depth and velocities >7.3 km/s
- Results from the Free-Air gravity modelling support the findings (Fig. 6).

> → Continental crust along the entire profile p02
>
> → Low degree of mantle serpentisation

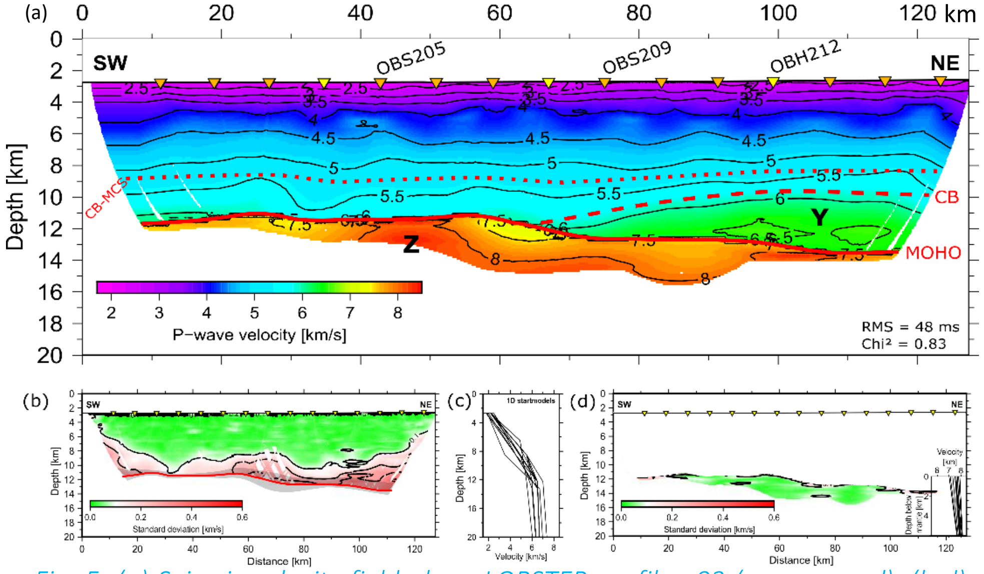



*Fig. 5: (a) Seismic velocity field along LOBSTER profile p02 (upper panel). (b-d) Statistics of the modelling procedure (modified, Dannowski et al., 2020).*

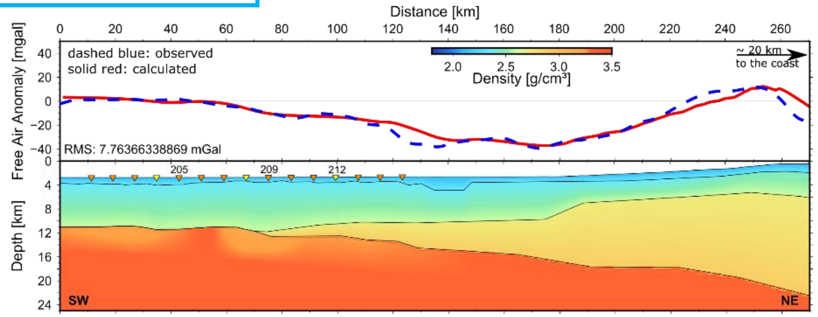



*Fig. 6: Density model along the LOBSTER profile p02 and extended northwards along the MAKRIS profile towards the NE Ligurian coast (Dannowski et al., 2020). The upper panel shows the fit between the model response and the observed Free-Air gravity data from (Smith and Sandwell (2014).*

**Preliminary results and interpretation of LOBSTER profile p01**

First results along p01 are similar to profile p02 in the centre of the basin:

- Uppermost sedimentary layer: ~2.2-3.5 km/s with a high velocity gradient (Plio-Quaternary)
- Deeper layers: ~3.5-5.6 km/s (Messinian salt and Pre-Messinian and Tortonian sediments); deeper sediment layers pinch out towards Corsica.
- Crystalline Basement (CB): at ~9-10 km in the central basin shallowing towards the Corsica coast with seismic velocities between ~5.6 km/s to 6.8 km/s and thickening in the Necking Zone (~30 km distance) from 6 km to ~24 km. The lower crust pinches out in the Central Basin.
- Mantle: at ~12 km depth and velocities >7.5 km/s in the central basin. It slightly shallows in the distal margin to ~11 km before it extremely deepens over a short distance to a depth of ~24 km.

→ Continental crust along the entire profile p01

→ No indication for oceanic crust or an oceanic spreading centre in the Liguro-Provencial Basin along LOBSTER profile p01.

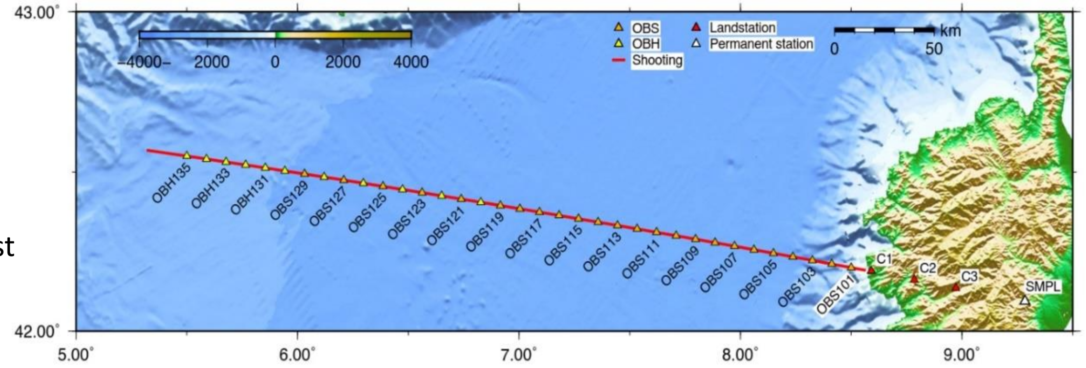
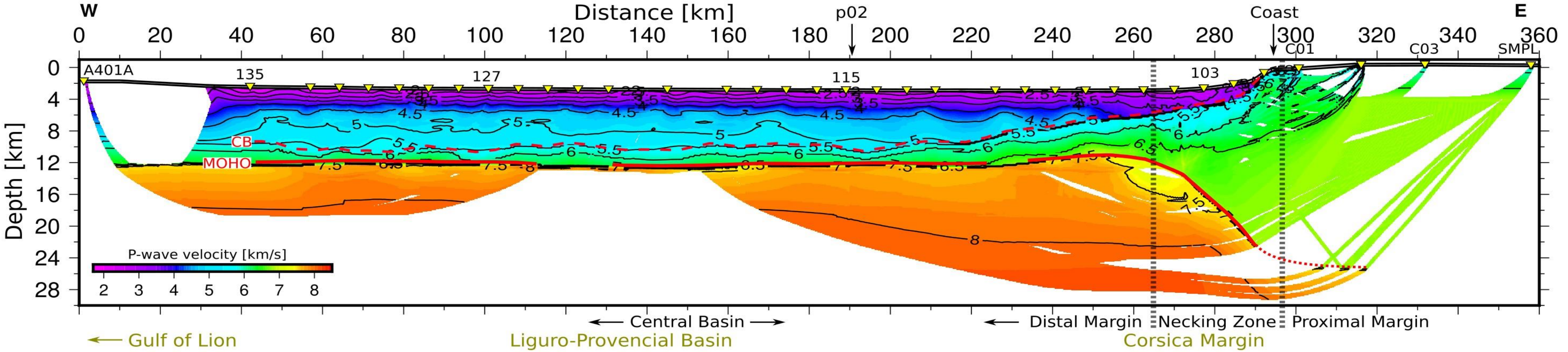



*Fig. 7: In total 35 OBS/H and 3 stations on land (C01-C03) were deployed along profile p01. The red line illustrates the position of the airgun shots that were given every ~123 m.*

*Fig. 8: Preliminary P-wave velocity model. The red dashed line marks the crystalline basement (CB), while the solid red line marks the seismic crust-mantle boundary (MOHO). Between profile KM 110 and KM 160 we observe a poor signal penetration of the deeper sediment phases and below.*



# Thank you!

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