Seismic radial anisotropy in Central-Western Mediterranean and Italian peninsula from ambient noise recordings

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STUDY AREA AND MOTIVATION

- **Complex tectonic setting** resulting from a combination of **extensional** and **compressional** processes.
- "Magma-poor" hyper-extension in the **Liguro-Proveçal** and **Tyrrhenian basins** in the last **30 Ma**.
- Lithosphere-asthenosphere **interaction** largely unknown.

Radial anisotropy [$\xi = (V_{SH} / V_{SV})^2$] can unravel the amount of **coupling** between the (rigid) lithosphere and the (flowing) asthenosphere.

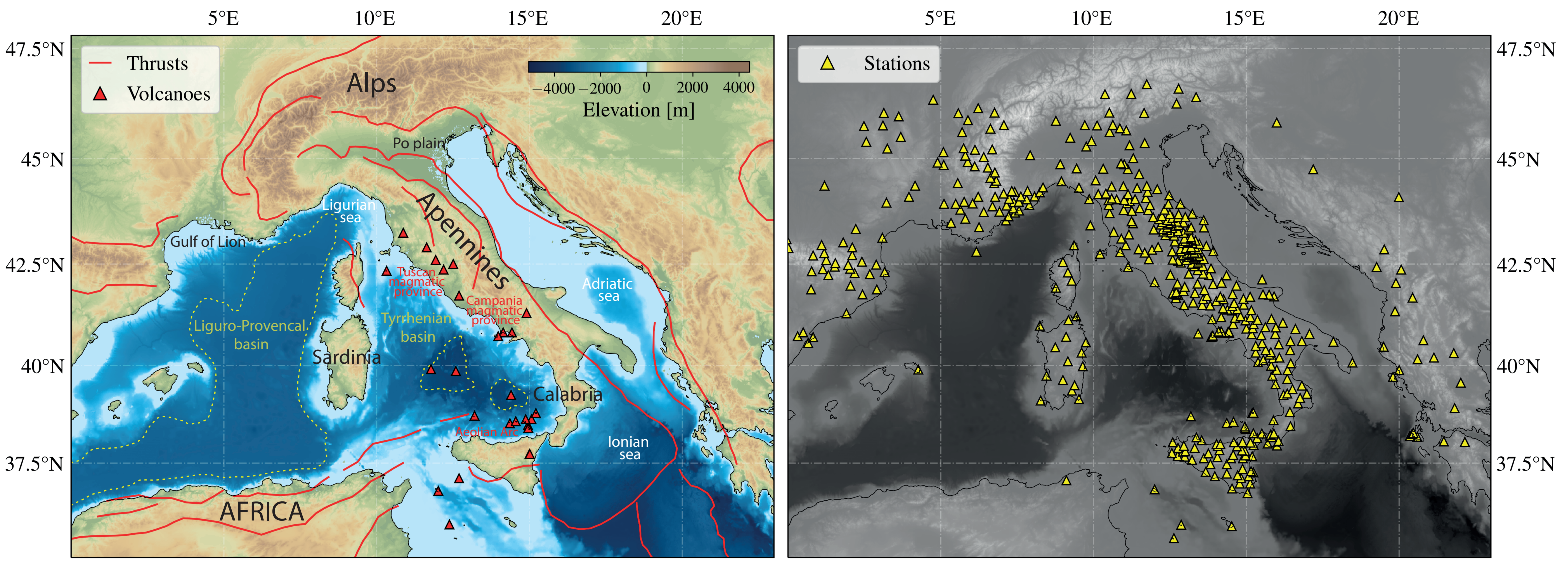


Fig.1 : Left: map of the study area. We mainly focus on the two extensional domains, Liguro-Provençal and Tyrrhenian basin, opened in the last 30 Ma. Right: location of the ~500 stations used for ambient noise tomography.

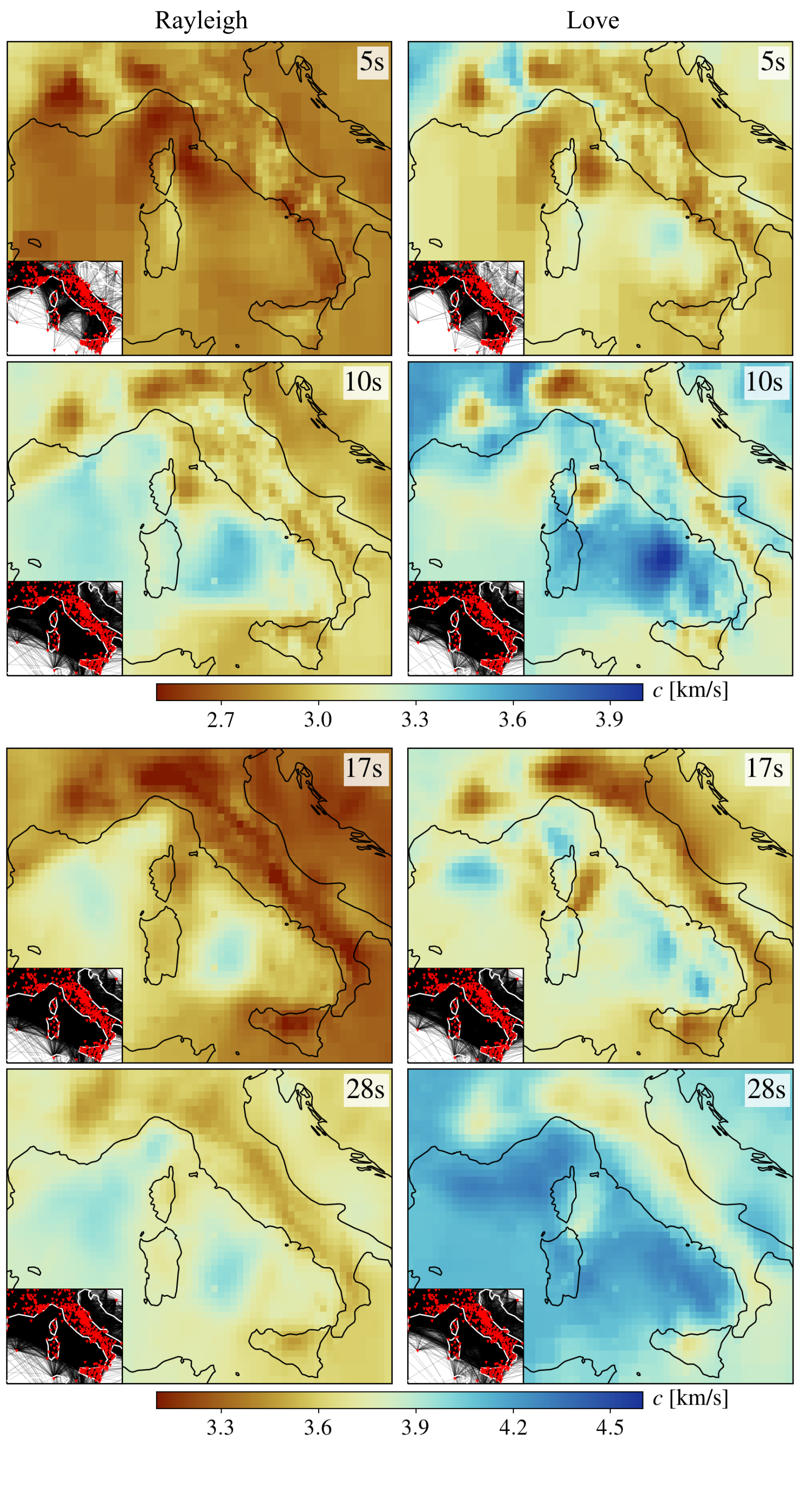


Fig. 2: Phase velocity maps at different periods for Rayleigh (left column) and Love waves (right column). Ray-path coverage is shown in the bottom-left corner of each panel.

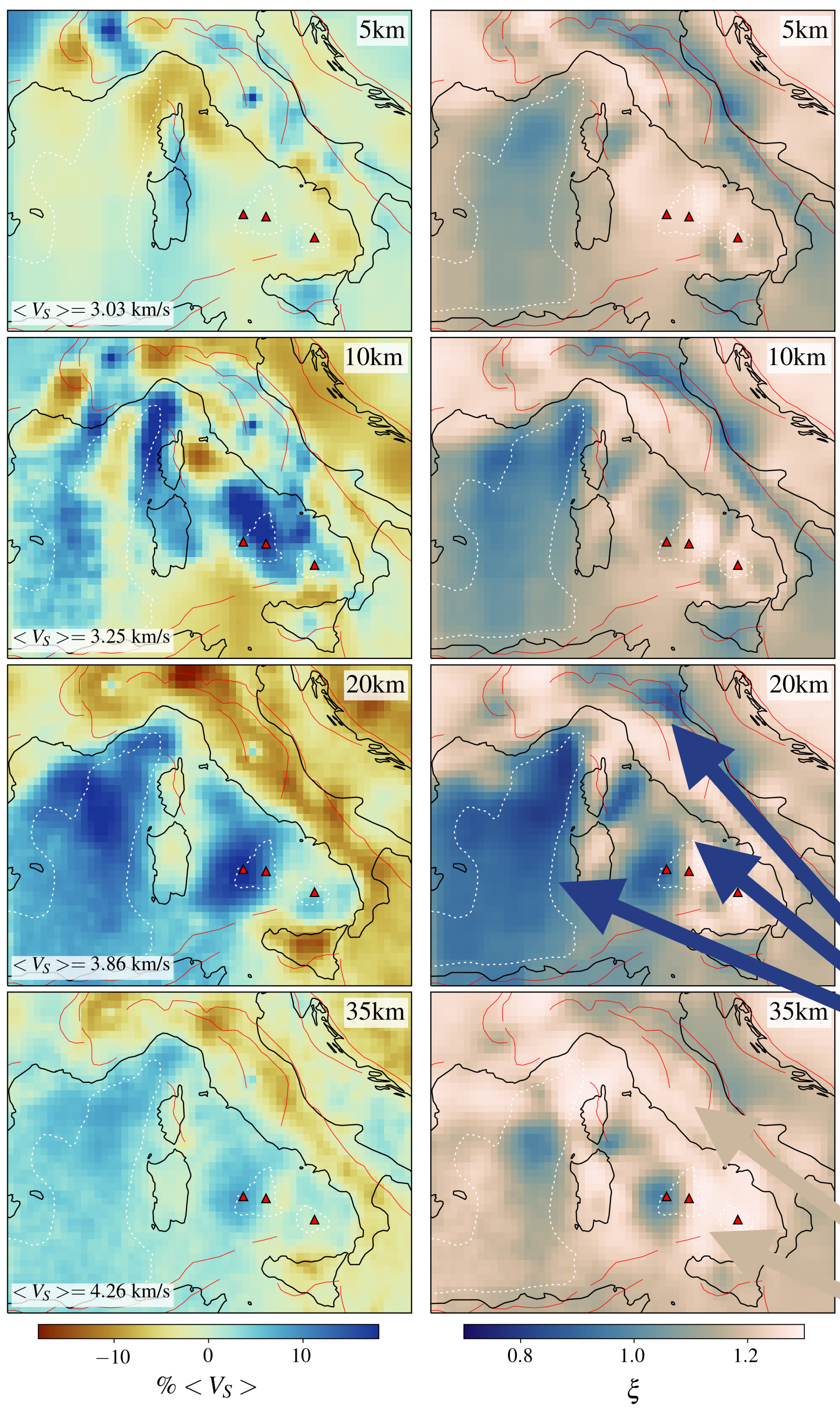


Fig. 3: Left column: variation of isotropic shear-wave velocity from the mean value at different depths. Right column: radial anisotropy ($\xi = (V_{SH} / V_{SV})^2$) at the same depths. Red triangle and yellow lines indicate the active seamounts and the extensional basins, respectively. Thrust are indicated in red.

METHOD AND RESULTS

- We use **ambient noise recordings** from ~**500** stations (time span: 2016-2017) to retrieve **Rayleigh and Love phase velocities,** inverted with a **trans-dimensional Monte Carlo Markov Chain** scheme.
- Private stations deployed in **Sardinia** (LiSard experiment) assures an **enhanced ray coverage** in the two basins, even at **small periods**.
- Both the **Liguro-Proveçal** and **Tyrrhenian basins** show typical **mantle shear-wave velocities** at shallow depth (15-20 km), coherent with the large **lithospheric stretching** and **mantle unroofing**.
- **Radial anisotropy** patterns are **complex** and **uncoupled** from shear-wave velocities.

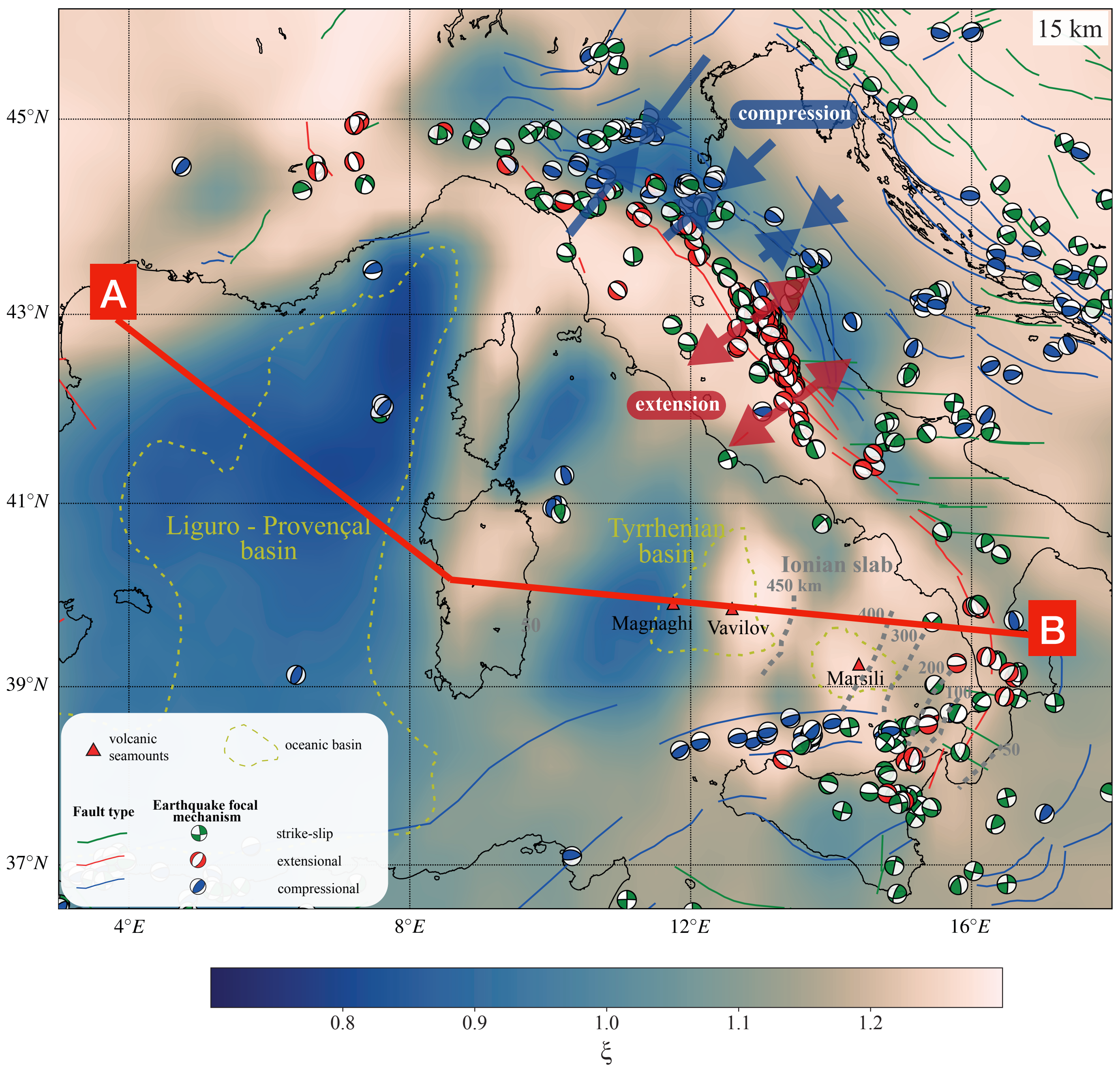
Negative anisotropy ($V_{SV} > V_{SH}$) in the Northern Apennines, Liguro-Proveçal and western Tyrrhenian basins

Positive anisotropy ($V_{SH} > V_{SV}$) in the central-southern Apennines and eastern Tyrrhenian basin

INTERPRETATION

- **Northern Apennines**: **negative anisotropy** anomaly aligned along the **tectonic front**, currently in compression. **Tectonization** (pervasive faulting and folding) of the upper and middle crust causes $V_{SV} > V_{SH}$
- **Central and southern Apennines**: the **positive anisotropy** corresponds to the portion of the Apennines subjected to ongoing **extension**. **Moderate tectonization**, **stretching** of the crust, **small-angle or listric faulting** contribute to $V_{SH} > V_{SV}$
- **Negative anisotropy** in the **Liguro-Provençal** and west **Tyrrhenian basins:** the lithospheric stretching caused **mantle decompression**, upward **migration** and stagnation and solidification of **melt pockets.** In addition, **sub-vertical alignment of olivine crystals** possibly contributing to the anisotropic signal.
- Strong **positive anisotropy** only in the eastern (younger) part of the Tyrrhenian basin, results from the **olivine crystals** aligned along the **sub-horizonthal direction** of **mantle-flow**, driven by the **ongoing subduction of Ionian slab.**

Fig. 4: Map of radial anisotropy at 15 km in addition to the major seismogenetic faults and earthquake focal mechanisms in the area.



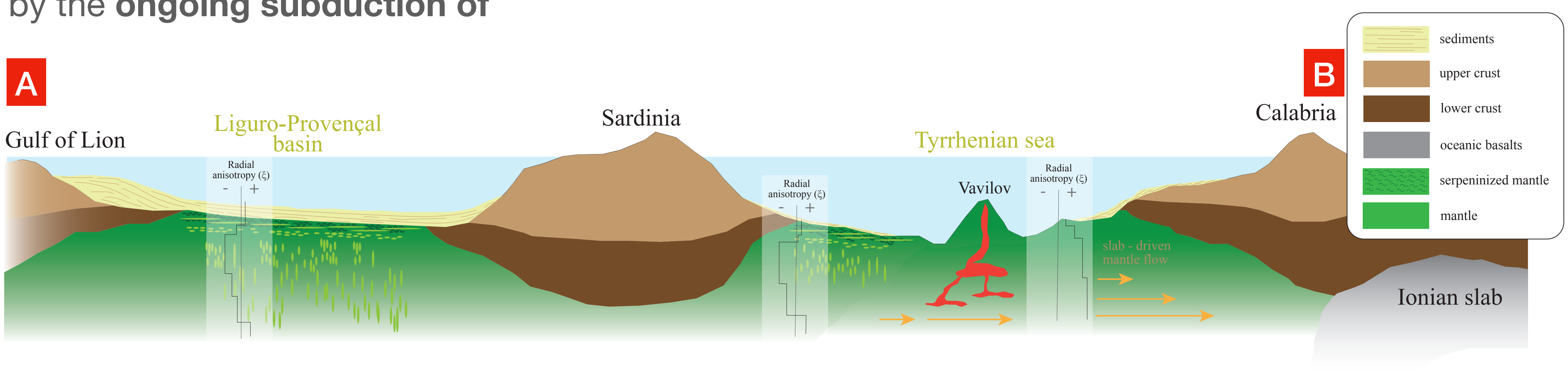


Fig. 5: Sketch along the profile AA' (Fig. 4) showing the relationship between the observed radial anisotropy and the crustal and mantle structure in the Liguro-Provençal and Tyrrhenain basins.

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