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Editorial: The structure of the central Mediterranean: Insights from seismological and geophysical data

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Editorial on the Research Topic
The structure of the central Mediterranean: Insights from seismological and geophysical data

The mountain chains of the Central Mediterranean (the Apennines, the Alps, the Dinarides, the Albanides, and the Hellenides) are shaped by complex tectonics arising from the motion and collision of several microplates. Intense onshore and offshore seismic activity puts the rich cultural heritage characterising the entire region at risk. A better understanding of the lithospheric structures and knowledge of the interaction between different tectonic units is key to unraveling the processes underlying seismic activity in this area. In recent years, top-quality seismological data from several groundbreaking experiments have yielded new insight into the orogenic systems of the region (e.g., IberArray, AlpArray, and its complementary seismic experiments, or the "THALES WAS RIGHT" EU project). Similar projects are planned to cover other parts of this critical region, for example, AdriaArray, which will cover the Adria microplate and the Balkans with a dense seismological array.

The four papers in this Research Topic shed light on unresolved questions about the collision and the relative motions of the Mediterranean region's microplates. These papers use data from the aforementioned array-experiments to touch on different geodynamic aspects, from plate motion and the deformation of crust and mantle to the influence of mantle dynamics on the evolution of surface morphology.

The scale of the analyses varies from Europe as a whole, including the Mediterranean area and its microplates (Lo Bue et al.; Serpelloni et al.) to smaller scales of the Adria microplate (Salimbeni et al.) and of the junction of two of Adria's bordering orogens, the Dinarides and Hellenides (Gemignani et al.).

Serpelloni et al. present a large, rigorously, and consistently processed GNSS solution for the European region, including the Mediterranean. They use geodetic (GNSS) data to estimate a new vertical and horizontal velocity field in the region, particularly along the Eurasia-Nubia plate boundary. The authors provide datasets of the stations' velocities, together with gridded velocities and strain-rate values, after computing multiscale, continuous, vertical, and horizontal velocities and their spatial gradients. These values are keys to defining the kinematic boundary conditions with which different geodynamic models, earthquake-cycle, or tectonic deformation models can be tested and verified.

Lo Bue et al. combine petrological thermo-mechanical 3D simulation and tomographic imaging to improve our understanding of the tectonic/geodynamic evolution of the Central and Western Mediterranean region over the last 20–30 Myr. The model at ~20 Myr exhibits features resembling those found in Central Western Mediterranean (e.g., Calabrian slab continuous from the surface down to the base of the upper mantle, or the presence of two wide windows in the Ionian slab). Based on this model, the authors calculate the flow-induced mantle anisotropy and perform 3D P-wave anisotropic tomography, evaluating its capability to image complex subduction environments under different conditions.

The study of flow-induced mantle anisotropy in the Adriatic region from the Apennines to the Dinarides (Salimbeni et al.) presents new data from the AlpArray complementary experiment AlpArray-CASE integrating existing data as a prelude to mapping the change in anisotropic properties beneath the study area. The distribution of core-refracted phases (SKS) splitting measurements in the Apennines confirms the toroidal flow generated by the slab rollback of the Calabrian Arc and, together with the measurements in the Dinaric region, are consistent with previous models of the mantle flow beneath Adria around the Apenninic and Dinaric slab gaps.

Gemignani et al. provide new insight on the interaction between lithospheric structure and surface denudation at the junction between the Dinaric and Hellenic orogens along the eastern boundary of the Adriatic Plate. This orogenic junction represents the lateral transition from oblique convergence (Dinarides) to rollback subduction (Hellenides). The authors combine cosmogenic surface exposure dating (36Cl) with geomorphological analyses to examine the feedback between tectonic and climate-induced processes. They show that faults accommodating differential convergence and mantle delamination provided a structural and erosional template upon which climate-induced erosion in Holocene time affected the reorganisation of the regional drainage pattern, including the formation and partial demise of lakes and basins.

Hence, all four papers help the scientific community understand this area's geodynamic and tectonic processes, from the mantle to the surface, integrating and linking different observations and methods, in a synthetic, but complete view. Moreover, the significance of this research extends beyond the Mediterranean region since the conclusions, and overall methods can be helpful for research focused on other regions that are similar to the central Mediterranean area.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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