The Slab Puzzle of the Alpine-Mediterranean Region: Insights from a new, High-Resolution, Shear-Wave Velocity Model of the Upper Mantle

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The fascinatingly complex tectonic make-up of the Mediterranean region comprises small, strongly-curved retreating subduction zones, associated back-arc basins, and the continental collisions along the northern and eastern margins of the Adriatic microplate. It remains a challenge to resolve the geometry of the subducted slabs in the Mediterranean upper mantle. Here, we present new evidence for the location and lateral and vertical extent of slab segments from a new, high-resolution, Rayleigh-wave tomography. The tomographic model spans the depth range from the crust down to 300 km and is complemented by intermediate-deep seismicity data in the circum-Mediterranean region.

An automated procedure to measure inter-station Rayleigh wave phase velocities is applied to a large, heterogeneous dataset from all publicly available stations around the Mediterranean in the time period from 1990 to 2015. Furthermore, for the first time, data from the Egyptian National Seismological Network (ENSN) are used regional seismic tomography. The resulting large set of about 200,000 inter-station phase velocity measurements is inverted for a set of phase-velocity maps spanning a very broad period range (8 - 350 s). The maps are then inverted, point by point, for a 3D, S-velocity model using a stochastic, particle-swarm-optimization inversion.

We distinguish between attached slab segments reaching down to the bottom of the model and shallow slabs of shorter length or detached slab segments resulting both from horizontal tearing. We discuss evidence for continental subduction east of Cyprus, for continuous NE-dipping subduction in the Antalyan region and NW dipping subduction in the SE Aegean in the area of Rhodes. An attached slab is imaged beneath the Hellenides reaching down to at least 300 km depth whereas beneath the Dinarides a short slab is found down to about 150 km depth above a slab tear. The slab in the southern Carpathians seems to be partly detached. A south-dipping slab is imaged in the central Alps but shallow bivergent subduction is favoured in the eastern Alps. In the western Alps, a shallow slab east-dipping Eurasian slab segment is in close proximity to the...
nearly vertically dipping attached slab segment beneath the northern Apennines and the southern Po plain. In the central Apennines a slab gap is found whereas the NE-dipping Calabrian Slab seems to partly detached along the northern Sicilian coast. The Kabylides Slab that appears to be attached along the North African coast but detached along the margin of the shelf in the Sicily Channel, is clearly separated from the Calabrian Slab in the NE and the Alboran-Betics Slab in the west. According to our model, the latter slab consists of two segments: a shallow Alboran one and a detached Betics slab segment. We summarize our interpretations in a map of the Mediterranean slab segments and indicate open questions.