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Vs and Vp/Vs models of the upper mantle beneath Italy: Insight into the geodynamics of central Mediterranean

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We show high resolution Vs and Vp/Vs models of the upper mantle underneath Italy obtained by inverting relative residuals of teleseismic data.
Jointly using P- and S-wave velocity models, and computing Vp/Vs, we infer that compositional variations concur with temperature variations to generate the observed velocity patterns.
The distribution of coherent high Vs and high Vp anomalies, interpretable as thermal anomalies in the mantle (i.e. cold slab), permitted a first comprehensive picture of the main oceanic domains involved in the subduction process.
High Vs, normal Vp/Vs anomalies allow to trace the extension of the Tethys slab subducted beneath the western Alps-northern Apennines system. The generally southward subducted material is progressively more detached eastward. On top of the detached slab, normal-to-high Vs, very low Vp/Vs anomalies point to the existence of eclogitized continental lithosphere beneath both the Alps and the northern Apennines. We infer that the Adria continental lithosphere was delaminated as a consequence of the detachment of the the oceanic slab and now reaches depth of 100 km and 160 km in the northern Apennines and eastern Alps, respectively. Spots of low Vs, high Vp/Vs facing the Tethys slab reveal asthenosphere upwelling, possibly related to the break-off of the Tethys slab.
The velocity patter abruptly changes in the central-southern Apennines, where the mantle anomalies emphasize the main factor controlling the most recent tectonics event: the subduction and segmentation of the retreating Ionian ocean.
The Ionian slab appears to be fragmented in its upper portion, with more pronounced high Vs anomalies, indicating subducted oceanic lithosphere, laterally interrupted by relatively lower Vs and high Vp/Vs anomalies. The velocity pattern indicates the development of tear zones in the retreating Ionian slab and the opening of slab windows through which the sub-slab asthenosphere is up welling and flowing, in agreement with the toroidal flow around the slab edges inferred from SKS splitting data.
Such small-scale upwellings appear to involve both the sub-slab and back-arc mantle and rise from the mantle transition zone beneath the Tyrrhenian basin. Here, low Vs, normal-to-high Vp and high Vp/Vs suggest the existence of hydrated mantle just underneath the stagnant Ionian slab. The broad high Vp anomalies revealed by previous studies are not replicated by high Vs anomalies and implies that slab lengths reported in the literature may be over-estimated considering only P-wave models.