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Lithospheric structure of the westernmost Mediterranean inferred from finite frequency Rayleigh wave tomography S-velocity model.

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The Iberian Peninsula and Morocco, separated by the Alboran Sea and the Algerian Basin, constitute the westernmost Mediterranean. From north to south this region consists of the Pyrenees, the result of interaction between the Iberian and Eurasian plates; the Iberian Massif, a region that has been undeformed since the end of the Paleozoic; the Central System and Iberian Chain, regions with intracontinental Oligocene-Miocene deformation; the Gibraltar Arc (Betics, Rif and Alboran terranes) and the Atlas Mountains, resulting from post-Oligocene subduction roll-back and Eurasian-Nubian plate convergence.

In this study we analyze data from recent broad-band array deployments and permanent stations on the Iberian Peninsula and in Morocco (Spanish IberArray and Siberia arrays, the US PICASSO array, the University of Munster array, and the Spanish, Portuguese, and Moroccan National Networks) to characterize its lithospheric structure. The combined array of 350 stations has an average interstation spacing of ∼60 km, comparable to USArray. We have calculated the Rayleigh waves phase velocities from ambient noise for short periods (4 s to 40 s) and teleseismic events for longer periods (20 s to 167 s). We inverted the phase velocities to obtain a shear velocity model for the lithosphere to ∼200 km depth. The model shows differences in the crust for the different areas, where the highest shear velocities are mapped in the Iberian Massif crust. The crustal thickness is highly variable ranging from ∼25 km beneath the eastern Betics to ∼55km beneath the Gibraltar Strait, Internal Betics and Internal Rif. Beneath this region a unique arc shaped anomaly with high upper mantle velocities (>4.6 km/s) at shallow depths (<65 km) is observed. We interpret this body as the subducting Alboran slab that is depressing the crust of the western Gibraltar arc to ∼55 km depth. Low upper mantle velocities (<4.2 km/s) are observed beneath the Atlas, the northeastern end of the Betic Mountains and the Late Cenozoic volcanic fields in Iberia and Morocco, indicative of high temperatures at relatively shallow depths, and suggesting that the lithosphere has been removed beneath these areas