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Tomographic imaging beneath Alboran sea and surrounding areas (southern Iberian Peninsula and northern Morocco)

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The main aim of this study is to provide a detailed analysis of the structure of the crust and upper mantle below the Iberian Peninsula, Morocco and surrounding regions using the results of global seismic tomography. We have developed a detailed three-dimensional velocity structure of this region to 700-km depth using P-wave arrival times from more than 15,000 local and regional earthquakes and 145 teleseismic events. For teleseismic events we handpicked P-wave arrival times from high-quality original seismograms from 2000 to 2005 belonging to the Andalusian Seismic Network. We also handpicked data from seismic stations belonging to the GSN (Global Seismic Network) and monitored by IRIS. All events are located between 30° and 90° from the seismic networks. This new data set is superior, in terms of both station density and arrival time accuracy, to that used in previous studies because of the higher sensitivity of the seismographs monitored by the new broad band network of the Andalusian Institute of Geophysics. In this study we modified the original tomographic method of Zhao et al. (1992) to combine teleseismic residuals with local and regional earthquake arrival times in tomographic inversions. Several bodies of high P-wave seismic velocity are located between 5 and 15 km depth and the magnetic and gravimetric data indicate superposition of bodies at different depths in this zone with a complex geological structure. Pronounced low-velocity anomalies characterize the upper crust near the Strait of Gibraltar, both in Spain and Morocco, which could be interpreted as a sedimentary basin or crustal deformation in the flysch regions. Two high-velocity anomalies were obtained in the Alboran Sea, the first, located in the middle of the basin could be related to the existence of high density lithologies, while the second, situated in the eastern Rif and trending NE-SW, could be related to the NE-SW trending magnetic anomaly in the eastern Rif. One of the most robust results in the western Alboran Sea is the low-velocity anomaly in the upper mantle in the shape of a slab that runs from the Spanish to the Moroccan coast, reaching a depth of 130 km on the southern side which is interpreted as the result of an active continental subduction in the region. In general, low-velocity anomalies characterize the lithosphere of the Alboran basin and could reflect the thickness of the lithosphere. As a general rule the Alboran Sea shows low seismic velocities from 15 to 100 km which are underlain by an irregular fast seismic anomaly in the western part. Beneath Alboran Sea and southern Spain, this body, laterally discontinuous, shows a maximum width of 300 km at a depth of 400 km. The most remarkable characteristics of the shallowest layers of the region west of the Strait of Gibraltar are the high seismic velocity anomalies trending NE-SW, located on the Guadalquivir Bank, interpreted as a basement high of mid-crustal rocks.