Crustal structure of an extensional basin (Granada, Spain) at the convergent zone contact between the Eurasian and African plates.

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We have determined a detailed three-dimensional P- and S- wave velocity structure of Granada Basin (South Spain) to 40-km depth.We used the tomographic method of Zhao et al. (1992) to invert arrival times from 2889 local earthquakes. The results at shallow layers reveal in the western basin the existence of several bodies of high seismic velocity and large velocity variations of up to +6at SE basin.

The tomographic images at intermediate layers show a strong low-velocity throughout the Granada basin dipping toward the SW.

The results of ratio of Poisson indicate strong contrasts of the values at shallow layers from 0.13 to 0.32. These findings indicate the existence of strong crustal heterogeneities in the region.

Seismic activity in southern Spain is associated with the interaction between the Eurasian and African plates. The spatial distribution of the earthquakes is consistent with a well-defined plate boundary in the western side. In contrast, the seismicity between Iberian Peninsula and Algeria is dispersed and the plate boundary is less clear. The zone delimited by the seismicity reaches a maximum width of 300 km with earthquakes in this area attaining magnitudes of Mw less or equal than 6.0. Inside this region is located the Granada Basin, this term is given to an outcrop of Neogene to Quaternary sedimentary rocks lying over the NE-SW trending area between the External and Internal Zones of the Betic Cordillera (southern Spain).

The main aim of this study is to analyze in detail the features of the crust below Granada Basin and surrounding regions from results of seismic tomography. The study region is a good example of an extensional Neogene basin located at a convergent plate boundary. The existence of a local seismic network (Andalusian Seismic Network) has allowed us to precisely locate the abundant microseismicity in the region with a high accuracy than in previous studies. The Granada Basin and neighboring areas have the highest rate of microseismic activity in the entire Iberian Peninsula, with earthquakes of magnitude mb less or equal than 5.5. The seismic activity is fundamentally located in the upper crust. Most of the earthquakes are generally deeper than 9 km, and shallower than 16 km in the central sector, gradually deepening up to 25 km in the southwestern sector (Morales et al., 1997). There are also very deep earthquakes in a depth of 640 km although there is a lack of intermediate earthquakes.

We have determined a detailed three-dimensional P- and S- wave velocity structure of this region to 40-km depth. We used the tomographic method of Zhao et al. (1992) to invert P- and S- waves arrival times from 2889 local earthquakes during the period from 1983 to 1999. The selected earthquakes are uniformly distributed in this region. To determine the 3-D P and S wave velocity and ratio of Poisson structure we set up a 3-D grid in the study area with a grid spacing of 4 to 5 km in the horizontal direction and 2 to 4 km in depth. Also we determine the structure with another 3-D grid with a grid spacing of 7 km in the horizontal direction and 2 to 4 km in depth.

The starting velocity model comprises a first layer of 10 km thick with P-velocity of 5.9 km/s and a second layer of 30 km thick with Vp of 6.7 km/s. We used the checkerboard resolution test (Zhao et al., 1992) to asses the adequacy of the ray coverage and to evaluate the resolution.

The results reveal in the western Granada basin the existence of several bodies of high seismic velocity of P wave (+8 per cent) located between 2 and 18 km in depth. The magnetic and gravimetric data indicate superposition of bodies at different depths in this zone with complex structure. This high velocity in the intermediate layers may correspond to a basic rock body of the Iberian Massif located under Betic Cordillera.

Large velocity variations of up to +6 per cent are imaged at SE basin from 2 to 10 km depths. This small region is characterized by a very high rate of seismic activity and the existence of important faults. These results show a tendency for regions rich in seismicity to be associated with higher velocities (Zhao and Kanamori, 1993).

The tomographic images at intermediate layers are of special interest. In this region a strong low-velocity zone is clearly visible throughout the Granada basin dipping toward southwest.

The results of S-wave velocity are similar to P-wave velocities but with some differences. The results of ratio of Poisson show strong contrasts of the values at shallow layers, from 0.13 to 0.32. These findings suggest the existence of strong crustal heterogeneities in the Granada basin.