

Imaging an active fault in the eastern Guadalquivir basin (Southern Spain) with high-resolution seismic tomography

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The Torreperogil seismic series took place in the Guadalquivir Basin (Southern Spain), a large flexural foreland basin with a linear ENE-WSW trending bounded to the north by the Iberian Massif and to the south by the Betic Cordillera and filled from a middle Miocene to Plio-Quaternary sedimentary sequence characterized by a large number of low magnitude (below Mw 3.7 or Md 3.9) and very shallow microearthquakes. We calculated the high resolution seismic velocity, Poisson's ratio, crack density and saturation ratio structures in and around the source areas of the Torreperogil seismic series (October 2012-April 2013).

In the upper layers of the crust, strong low-velocity anomalies are extensively distributed under the central zone, which together with high Poisson's ratio and crack density values may correspond to rocks which are less likely to fracture, perhaps due to the accumulation of tectonic and seismic stress. 93% of the earthquakes occurred at depths of up to 8 km, which could indicate that the base of the seismogenic zone lies at this depth. The seismic series was concentrated in layers of strong structural heterogeneities (in the boundary area between low and high anomalies), which were likely to generate earthquakes due to differential strain accumulation beneath the region. The high velocity areas are also considered to be strong yet brittle parts of the fault zone, which are likely to generate earthquakes (at depths of between 5 km and 9 km). In contrast, low velocity areas are probably less likely to fracture, allowing seismic slippage to take place (from 2 to 4 km depth).

The best estimate of the depth of the main shock (mbLg: 3.9) is 7.6 km, which could tend to nucleate at the base of the seismogenic zone, at the "fault end" on the boundary between a low velocity zone to the east and a high velocity zone to the west, indicating the fault plane which separates both areas laterally. Assuming that this seismic contrast is one of the main Torreperogil faults it could imply that stress has accumulated in an existing fault zone with lateral heterogeneity in velocity.

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