

Crustal Seismic Structure beneath Portugal (Western Iberia) and the role of Variscan Inheritance

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Mainland Portugal comprises most of the Western portion of the Iberian Peninsula, in a geodynamic setting associated with the Africa-Eurasia plate boundary. The crustal structure in Portugal is the result of a complex assemblage history of continental collision and extension with most of the surface is covered by rocks dating to the Variscan orogeny, the coastal ranges dominated by Mesozoic structures and Mesocenozoic basins covering partially the mainland.

The impact and extension of this complex tectonic in the structure of the Iberian Lithosphere is still a matter of discussion, especially in its western part beneath Portugal. The existing knowledge relating the observed surface geology and lithospheric structures is sparse and sometimes incoherent, the relation between shallow and deep structures and their lateral extension still widely undetermined. Some questions still pertinent are the role and influence of the several tectonic units and their contacts in the present tectonic regime and in the stress field observed today, and the relation between the anomalous seismicity and associated crustal deformation rates with the inherited structure from past orogenies.

In this study we present the results of a local earthquake tomographic study, performed to image this complex crustal structure down to 20 km depth. The relocation of the onshore seismicity recorded in the period 2000-2014 with the new 3D model allows cleansing some of the alignments and their correlation with some of the main active structures in Portugal enabling for the first time to correlate a large number of tectonic features to the small magnitude seismicity pattern. The seismicity distribution also displays a complex pattern, mainly reflecting the interaction between inherited Variscan structures with more recent fault systems created during the rifting stages of the Atlantic and diapir magmatic intrusions.

The complex history of the assemblage of the crust beneath Western Iberia is well-marked in the final models. The arcuate shape of the Ibero-Armorican Arc can be perceived over the general pattern of the V_p and V_p/V_s anomalies and the heterogeneity observed on the surface geology are clearly marked in the tomograms. Other significant features are the low V_p values associated with the Mesocenozoic rocks outcropping in the Lusitanian and Algarve basins, and the low V_p and high V_p/V_s values of the sedimentary cover of the Lower-Tagus and Sado Basin.

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