A First Crustal Model beneath Portugal from Teleseismic Rayleigh Wave Ellipticity Inversion

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Accurate seismic crustal models are important for interpreting seismicity and tectonics and predicting strong ground motion. These interpretations and predictions are particularly important in regions prone to significant seismic hazard such as Portugal, where considerable destruction has taken place from large on- and offshore earthquakes (e.g. 1755 M$\sim$8 Lisbon and 1909 Benavente M $\sim$6.0 earthquakes). The lack of high quality countrywide broadband data in the past has hindered quantitative characterization of regional Earth structure in Portugal. Due to a significant expansion of the Portuguese seismic network, however, a large volume of data is accumulating since 2006. We used this new high quality dataset to measure multi-period Rayleigh Wave Ellipticity (RWE), which we inverted to build the first seismic crustal model beneath Portugal. RWE is defined by the Horizontal-to-Vertical (H/V) amplitude ratio at a given seismic station, and theoretical studies demonstrate it to be strongly sensitive to the structure immediately beneath that particular station. We measured teleseismic RWE between 15 s and 60 s from 33 permanent and temporary stations in Portugal and inverted it for shear wave velocity (Vs) structure of the crust using a fully non-linear Monte Carlo method. Our results show that both RWE and Vs are spatially correlated with surface geology. Notably, sedimentary basins produced by Mesozoic rifting (e.g. Lusitanian Basin (LB) and the Lower Tagus-Sado Basin (LTSB)) are correlated with higher RWE (lower Vs). Similar high RWE values are observed in the interior of Central Iberian Zone (CIZ), which is an older metamorphic belt. We interpret this to be the signature of an extensional episode that the CIZ has undergone possibly simultaneous to the Mesozoic rift event. The Galicia-Tras-os-Montes-Zone (GTMZ)- a Paleozoic metamorphic belt - in Northern Portugal exhibits the lowest RWE (highest Vs), whereas other metamorphic terrains have RWE intermediate to Basins and GTMZ.