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Project WILAS: Seismic imaging of crustal and upper mantle structures beneath the western Iberian Peninsula by means of the receiver-function technique

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An accurate knowledge of the structure of the earth's interior is of great importance to our understanding of tectonic processes. The WILAS-project (REF: PTDC/CTE-GIX/097946/2008) is a three-year collaborative project developed to study the subsurface structure of the western Iberian Peninsula, putting the main emphases on the lithosphere-asthenosphere system beneath the mainland of Portugal. The tectonic evolution of the target area has been driven by major plate-tectonic processes such as the historical opening of the Central Atlantic and the subsequent African-Eurasian convergence. Still, very little is known about the spatial structure of the continental collision.

Within the framework of this research, a temporary network of 30 broadband three-component digital stations was operated between 2010 and 2012 in the target area. To carry out a large-scale structural analysis and facilitate a dense station-coverage for the area under investigation, the permanent Global Seismic Network stations, and temporary broadband stations deployed within the scope of the several seismic experiments (e.g. Doctar Network, Portuguese National Seismic Network), were included in the research analysis. In doing so, an unprecedented volume of high-quality data of a ca. 60X60 km density along with a combined network of 65 temporary and permanent broadband seismic stations are currently available for research purposes.

One of the tasks of the WILAS research project has been a study of seismic velocity discontinuities beneath the western Iberian Peninsula region, up to a depth range of 700 km, utilizing the P- and S-receiver function techniques (PRF, SRF). Both techniques are based mainly on mode conversion of the elastic body-waves at an interface dividing the layers with different elastic properties.

In the first phase of the project, PRF analysis was conducted in order to image the crust-mantle interface (Moho) and the mantle-transition-zone discontinuities at a depth of 410 km and 660 km beneath the area under investigation. While applying the common data processing steps (e.g., rotation, deconvolution and moveout-correction) to the selected data-set, we were able to create approximately 4.500 PRFs. The signals from the Moho, 410-km and 660-km discontinuities are clearly visible in many PRF stacks. The Moho depth range is from 26 to 34 km, with an average value of 29 km. No significant lateral variations in the depths of the "410-km" and "660-km" discontinuities have been identified so far.

In the second phase of this project, the S-receiver-function technique will be applied in order to map the thickness of the underlying mantle lithosphere. Additionally, joint inversion of PRFs and waveforms of SKS will be used to investigate depth-localized azimuthal anisotropy and the related past and present mantle flows.