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Seismic imaging of the western Iberian crust using ambient noise: Boundaries and internal structure of the Iberian Massif

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The Iberian Massif one of the major structural units of the Iberian Peninsula is composed by rocks with ages ranging from the Upper Precambrian to Upper Carboniferous. The massif outcrops in Central and Western Iberia and the location of its limits, as well as the relationship between its shallow and deeper structures are still a matter of debate.

Several problems like source-receiver geometry, irregular seismicity distribution or, for some methods, low seismicity occurrence did not allow obtaining high-resolution models of Iberian structure using traditional imaging methods. Seismic interferometry/ambient noise surface-waves tomography allows imaging regions with a resolution that mainly depends on the seismic network coverage.

This study aims to map the boundaries of the Iberian Massif particularly those that are covered or in contact with recent (Cenozoic) and older (Mesozoic) basins. Whenever possible, we intend to characterize second-order structures inside the Massif. We present new Rayleigh-wave dispersion maps of the western Iberian Peninsula for periods between 8 and 30 seconds, obtained from correlations of seismic ambient noise, following the recent increase in seismic broadband network density in Portugal and Spain.

Group velocities have been computed for each station pair using the empirical Green's functions generated by cross-correlating one-day-length seismic ambient-noise records. The resulting high-path density allows us to obtain lateral variations of the group velocities as a function of period in cells of 0.5º x 0.5º with an unprecedented resolution. As a result we were able to address some of the unknowns regarding the lithospheric structure beneath SW Iberia.

The dispersion maps allow the imaging of the major structural units, namely the Iberian Massif, and the Lusitanian and Algarve Meso-Cenozoic basins. The Cadiz Gulf/Gibraltar Strait area corresponds to a strong low-velocity anomaly, which can be followed to the largest period inverted, although slightly shifted to the east at longer periods. Within the Iberian Massif, second-order perturbations in the group velocities are consistent with the transitions between tectonic units composing the massif.