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3D Imaging of the crust and uppermost mantle of the Northeast Atlantic, from Madeira and Canaries to the Atlas-Gibraltar zone

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Madeira and Canaries are two intraplate hotspots located in the Northeast Atlantic, west of the Moroccan coast. Within project SIGHT (SeIsmic and Geochemical constraints on the Madeira HoTspot system) we propose to answer the following questions: a) Is Madeira´s volcanism fed by a deep-seated mantle plume? b) Do the Madeira and Canary hotspots have a common or distinct origin? and c) What is the lithospheric nature of the corridor between the Canaries and the Atlas-Gibraltar?

The recent work of Civiero et al. (2021), combining results from seismic tomography, shear-wave splitting and gravity along with plate reconstruction, revealed that differently evolved upwellings might exist below the volcanic Canary and Madeira islands, with the Madeira hotspot possibly fed by a later-stage plumelet. However, a clear picture of the crust and uppermost mantle is still missing, and questions about how thick the crust is and the eventual presence of crustal underplating still need to be answered.

We performed an ambient noise tomography using data from 50 seismic stations that we selected carefully to obtain the best inter-station path coverage. We processed the data in the period band between 10 to 50 sec, which will allow us to get, for the first time, a crustal and uppermost mantle tomographic model for the study region. The daily traces were cross-correlated using the phase cross-correlation technique, followed by a time-frequency weighted stack methodology developed by Schimmel et al. (2011). After computing the Rayleigh-wave group-velocity measurements, we inverted them to obtain the 2D group-velocity maps for different periods. In the period band of 10 to
20 s, the velocity maps evince low velocities beneath Madeira and Canary Islands and the Gulf of Cadiz region. Higher velocities characterize the remaining oceanic area. When the period increases (36 s) , some of the Canary Islands show slightly higher velocities, whereas others still present lower velocities. As expected, the low-velocity anomaly beneath the Gulf of Cadiz becomes stronger while the ones beneath the islands become weaker. Even so, the islands still show low velocities.

To determine the depth structure beneath the study area, we extracted velocity values at the different points of the group-velocity maps at different periods. We will then invert them to build a 1D S-wave velocity profile for each grid point as a function of depth. We will discuss the obtained 3D shear-wave velocity maps in the area's geodynamic context.

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