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Structure of the SW Iberian Margin from Combined Wide-angle and Multichannel Seismic Reflection Data (FRAME Project)

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The SW Iberian Margin has a complex tectonic setting and crustal structure derived from a succession of rift events related to the opening of North Atlantic and Neotethys, from the Mesozoic to the Lower Cretaceous, and subsequent compression between Africa and Eurasia from the Lower Oligocene to present. This setting led to the reactivation of pre-existing strike-slip and extensional faults enhancing the seismogenic and tsunamigenic potential of the area. Thus, understanding of lithospheric structure along the SW Iberian Margin is not only important to study the rifting evolution but also to characterize the distribution of major lithospheric-scale boundaries, currently active and potentially capable of generating great seismic events of similar magnitude to the catastrophic 1755 Lisbon tsunamigenic earthquake, with estimated M_W>8.5.

To this end, we use spatially coincident wide-angle seismic (WAS) and multichannel seismic (MCS) data collected along a ~320 km-long, NW-SE trending transect across the SW Iberian margin, during the FRAME survey in 2018. WAS data were recorded with by 24 ocean bottom seismometers and hydrophones (OBS/H), deployed each ~10km, while MCS data was recorded with a 6 km-long streamer. From NW to SE, the transect runs from the Tagus Abyssal plain to the westernmost extension of the Gulf of Cadiz area, across three major thrust faults: the Marquês de Pombal fault, São Vicente fault, and Horseshoe fault.

We applied joint refraction and reflection travel-time tomography using a combination of WAS refractions and reflections and MCS reflections to invert for the 2D P-wave velocity structure of the crust and uppermost mantle, and the geometry of the main seismic interfaces, namely the top of the acoustic basement and the Moho. The combination of WAS and MCS reflection travel-times brings a significant increase in the resolution of the tomographic model, and especially in the definition of the geometry of the inverted reflectors (i.e. top of the basement), because MCS data has a higher spatial sampling than WAS data in these shallow regions.

In the preliminary model, the Moho shallows beneath the north-eastward continuation of the Horseshoe Basin and the Gorringe Bank, coinciding with the location of the three major thrust faults mentioned before, and defining three major crustal blocks along the model. Further analysis of deep seismic phases from WAS records should provide additional information on the geometry

and extent of these three major thrust faults.