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Constraining the crustal root geometry beneath the Rif Cordillera (North Morocco)

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The analyses of wide-angle reflections of controlled source experiments and receiver functions calculated from teleseismic events provide consistent constraints of an over-thickened crust beneath the Rif Cordillera (North Morocco). Regarding active source data, we investigate now offline arrivals of Moho-reflected phases recorded in RIFSIS project to get new estimations of 3D crustal thickness variations beneath North Morocco. Additional constrains on the onshore-offshore transition are derived from onland recording of marine airgun shots from the coeval Gassis-Topomed profiles. A regional crustal thickness map is computed from all these results.

In parallel, we use natural seismicity data collected throughout TopoIberia and PICASSO experiments, and from a new RIFSIS deployment, to obtain teleseismic receiver functions and explore the crustal thickness variations with a H-κ grid–search approach. The use of a larger dataset including new stations covering the complex areas beneath the Rif Cordillera allow us to improve the resolution of previous contributions, revealing abrupt crustal changes beneath the region. A gridded surface is built up by interpolating the Moho depths inferred for each seismic station, then compared with the map from controlled source experiments. A remarkably consistent image is observed in both maps, derived from completely independent data and methods.

Both approaches document a large modest root, exceeding 50 km depth in the central part of the Rif, in contrast with the rather small topographic elevations. This large crustal thickness, consistent with the available Bouguer anomaly data, favor models proposing that the high velocity slab imaged by seismic tomography beneath the Alboran Sea is still attached to the lithosphere beneath the Rif, hence pulling down the lithosphere and thickening the crust. The thickened area corresponds to a quiet seismic zone located between the western Morocco arcuate seismic zone, the deep seismicity area beneath western Alboran Sea and the superficial seismicity in Alhoceima area. Therefore, the presence of a crustal root seems to play also a major role in the seismicity distribution in northern Morocco.