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Crustal structure of La Palma and Tenerife (Canary Islands) from receiver function analysis.

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The receiver function analysis (RF) is a commonly used and well-established method to investigate crustal and mantle structures, removing the source, ray-path and instrument signatures. RF gives the unique signature of sharp seismic discontinuities and information about P and S wave velocities beneath a seismic station. In particular, using the direct P wave as a reference arrival time, and the relative arrival time of P-to-S (Ps) conversions and multiple reflections allow constraining the principal crustal structures and studying the effects of dipping interfaces and crustal layering.

We have applied RF analysis to the active volcanic islands of Tenerife and La Palma (Canary Islands). In recent years, both islands have increased their seismic activity and showed variation in geochemical parameters attributed to a magmatic-hydrothermal activity. Previous studies evidenced in La Palma and Tenerife a seismic Moho depth at 14 km and 12 and 15 km, respectively, but it is not clear because there are some others discontinuities under the stations (Lodge et al., 2012). Other RF studies indicated a depth of seismic Moho discontinuity between 16 and 30 km beneath the eastern islands to 11-15 km under the western isles, observing a thinning of the crust towards the west (Martinez-Arévalo et al., 2013).

We processed 313 teleseisms recorded by 17 stations for Tenerife and 252 teleseisms recorded by six stations for La Palma. Since the receiver functions display a significant complexity, as expected in oceanic volcanic islands, we applied a transdimensional inversion approach to image the 1D velocity structure beneath each station. We observe at least three discontinuities related with the oceanic crust and the overlying volcanic rocks layer. We compare the retrieved crustal structure with the seismicity recorded in recent years, showing how earthquakes have a radically different origin on these two islands. While in Tenerife they seem to be related to the dynamics of a shallow hydrothermal system, in La Palma they are related to magmatic intrusions in the upper mantle beneath the island.

References

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