



The hidden magma of the oceanic islands of the southwestern Indian Ocean from the study of receiver functions

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The nature of the lithosphere below Mauritius Island and the northern track of La Réunion hotspot is debated as it was recently proposed to be either continental or oceanic. The understanding of the crustal nature and of the knowledge of the lateral distribution of underplated magmatic material are limited by the lack of data in the oceanic domain. However, these information are necessary to reconstruct the evolution of plate tectonics in this region.

In the present study, we investigate the structure and the nature of the crust around La Réunion hotspot, from the Mozambique Channel to the Central Indian Ridge using P-receiver functions analyses of data from the temporary RHUM-RUM seismic network (Réunion Hotspot and Upper Mantle – Réunion Unterer Mantel, www.rhum-rum.net). The RHUM-RUM seismic network was composed by 57 broad-band Ocean-Bottom Seismometers (OBS) and 20 broad-band stations on islands (La Réunion, Madagascar, Mayotte and the Scattered Islands). The OBS were deployed during around 1 year and the seismic stations on the islands were installed between approximately 2 and 4 years. The radial receiver functions are computed from time domain iterative deconvolution of the radial component by the vertical component. Then, the neighbourhood algorithm is applied to constrain the shear-wave velocity structure underneath each seismic station.

Our work allows determining key information on (1) the Moho depth below sea level, (2) the thickness of the sedimentary cover, (3) the height of the volcanic edifices from the top of the oceanic crust, and (4) the thickness of the igneous crust. This enables us to quantify the volume of underplated magmatic material around La Réunion hotspot and below the volcanic edifices of the Mozambique Channel. The nature of the crust is also discussed and compared to results from numerical modeling of receiver functions.

We show that the oceanic crust in abyssal plain domain, away from La Réunion hotspot, is ~6 km thick. This thickness is significantly larger (up to ~21 km) beneath the volcanic edifices of the Mozambique Channel and the Mascarene plateau, including Mauritius. It is also slightly larger (up to ~10 km) in the vicinity of La Réunion and around Rodrigues island. We attribute these thicknesses to underplated magmatic material and thus quantify the volume of magma stored below the oceanic crust.