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Thickness of the oceanic crust and the mantle transition zone in the vicinity of the Tristan da Cunha hot spot estimated from ocean-bottom and ocean-island seismometer receiver functions

Wolfram Geissler (1), Wilfried Jokat (1), Marion Jegen (2), and Kiyoshi Baba (3)

(1) Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany, (2) GEOMAR, Helmholtz Centre for Ocean Research, Kiel, Germany, (3) Earthquake Research Institute, The University of Tokyo, Japan

According to classical plume theory, the Tristan da Cunha hotspot is thought to have played a major role in the rifting of the South Atlantic margins and the creation of the aseismic Walvis Ridge by impinging at the base of the continental lithosphere shortly before or during the breakup of the South Atlantic margins. However, Tristan da Cunha is enigmatic as it cannot be clearly identified as a hot spot but may also be classified as a more shallow type of anomaly that may actually have been caused by the opening of the South Atlantic. The equivocal character of Tristan da Cunha is largely due to a lack of geophysical and petrological data in this region.
We therefore staged a multi-disciplinary geophysical study of the region by acquiring passive marine electromagnetic and seismic data, and bathymetric data within the framework of the SPP1375 South Atlantic Margin Processes and Links with onshore Evolution (SAMPLE) funded by the German Science foundation. The experiment included two ship expeditions onboard the German R/V MARIA S. MERIAN in 2012 and 2013.
In our contribution we will present results on the thickness of the oceanic crust in the vicinity of the Tristan da Cunha archipelago derived from ocean-bottom seismometer data. Using the Ps receiver function method we estimate a thickness of 5 to 7 km for the oceanic crust at 17 ocean-bottom stations surrounding the islands in an area where the ocean floor has an age of approximately 10 to 30 Ma (from west to east). This indicates normal to slightly lowered magmatic activity at the mid-ocean ridge during the crust formation. There seems to be no major contribution of a mantle plume to the melting conditions at the ridge, which should cause the formation of thickened oceanic crust. The magmatic activity at the archipelago and surrounding seamounts seems to have only local effects on the crustal thickness.
Furthermore, we imaged the mantle transition zone discontinuities analysing receiver functions at the permanent seismological station TRIS on Tristan da Cunha. Our observations show evidence for a thickened and therefore cold mantle transition zone in the northwest of the islands which excludes a deep-reaching mantle plume at this position. To the south of the island we have indications for a thinned and therefore hot mantle transition zone from sparse and noisy observations which could hint to the location of a mantle plume at mid-mantle depths.