Structure of the crust and upper mantle beneath the Bransfield Strait (Antarctica) using P-wave Receiver Functions

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The Bransfield Strait is a tectonically active region located between the South Shetland archipelago (SSI) and the Antarctic Peninsula (AP), characterised by the presence of an incipient back-arc spreading ridge driven by on-going slab rollback of the Phoenix plate under the Antarctic and Shetland plates. Twelve broad-band seismic stations deployed in the region are used to obtain P-wave receiver functions from teleseismic earthquakes to improve the current understanding of the crust and upper mantle structures. This includes the depth and spatial variability of the Moho discontinuity, the average crustal Vp/Vs ratio and the thickness of the Mantle Transition Zone (MTZ). Results reveal a highly variable crustal thickness in the South Shetland block, ranging from ~30 km near the SW and NE ends of the South Shetland Trench to ~15 km in the central Bransfield Basin (Deception Island), where the highest Vp / Vs ratios in the region are reached (> 2). In contrast, the AP displays typical and homogeneous continental crust characteristics with an average crustal thickness of ~34 km and Vp/Vs ~1.77. A low velocity zone (LVZ) is identified under all stations suggesting partial melting in the upper mantle beneath the lithosphere, which is widespread throughout the region and not only confined to the mantle wedge above the subducted Phoenix oceanic slab. There is evidence of magmatic underplating under the SSB in accordance with the LVZ together with the active volcanism and the high crustal Vp/Vs ratio in the area. The Phoenix oceanic slab is inferred to subduct steeply, as the MTZ appears already thickened under the AP.