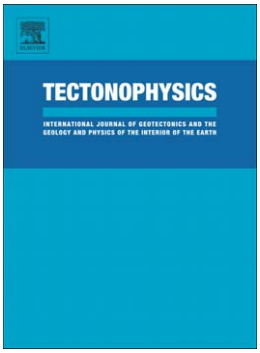

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Asthenosphere and lithosphere structure controls on early onset oceanic crust production in the southern South Atlantic

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Abstract

The southern South Atlantic has often been considered a classic example of continental break-up in the presence of a starting mantle plume. Evidence for a mantle plume includes the Paranà-Etendeka continental flood basalts, which are associated with the Rio Grande Rise and Walvis Ridge, and the wide-spread presence of seaward dipping reflectors and high-velocity lower-crustal bodies along the conjugate margins. Observations from seaward dipping reflector distributions suggested that lithospheric segmentation played a major role in the pattern of volcanism during break-up in this region, and consequent numerical modelling was used to test this. We tested this hypothesis ourselves by measuring the thickness of the earliest oceanic crust generated. This was done through the use of 37 measurements of initial oceanic crustal thickness from wide-angle and multichannel seismic profiles collected along the conjugate margins. These measurements show that at 450 km south of the Paranà-Etendeka flood basalts the oceanic crust is thicker than the global average at 11.7 km. Farther south the oceanic crust thins, reaching 6.1 km at a distance of 2300 km along-strike. Overall, the along-strike trend of oceanic crustal thickness is linear with a regression coefficient of 0.7 and little indication of segmentation. From numerical models representing extension of the lithosphere, we find that observed melt volumes are matched with the presence of a hot layer. If we assume this region of hot mantle has a thickness of 100 km, its excess temperature relative to the asthenosphere has to decrease from 200 to 50 °C, north to south. This decrease in temperature, also seen in published thermobarometry results, suggests that temperature was the primary control of volcanism during the opening of the southern South Atlantic.

Keywords: South Atlantic volcanic margins, rifting, volcanic passive margin, melt generation,