Geophysical Research Abstracts
Vol. 21, EGU2019-11012, 2019
EGU General Assembly 2019

The Geodynamic Development of the Rio Grande Rise and Walvis Ridge, Central South Atlantic Ocean, from Crustal Thickness Mapping

Michelle Graça (1,3), Nick Kusznir (2), and Natasha Stanton (3)

(1) Geological Survey of Brazil - CPRM, 404, Pasteur Avenue, Urca, Rio de Janeiro, Brazil, (2) Department of Earth & Ocean Sciences, University of Liverpool, Liverpool L69 3BX, UK, (3) Faculty of Oceanography, Rio de Janeiro State University, Rio de Janeiro, Brazil

The recent report of the discovery from submersible sampling of continental material of Proterozoic age on the Rio Grande Rise suggests that the formation processes of the Rio Grande Rise and Walvis Ridge in the southern S. Atlantic need to be re-examined. Existing proposed formation processes involve ocean ridge – mantle plume interaction or simply excess 'on-ridge' magmatism.

We use gravity anomaly inversion to map crustal thickness for the central South Atlantic area encompassing the Rio Grande Rise, Walvis Ridge and adjacent South American and African rifted continental margins. We show that the Rio Grande Rise consists of three distinct bodies of anomalously thick crust (Western, Central and Eastern) separated by normal thickness oceanic crust. The Central Rio Grande Rise forms a large elliptical body with maximum crustal thickness of 25 km and Walvis Ridge also has a maximum crustal thickness of 25 km but has a narrower and more linear geometry. We use plate reconstructions to restore maps of crustal thickness and magnetic anomaly to Early Cretaceous times to examine the development of the Rio Grande Rise and Walvis Ridge. These restorations together with ages of magmatic addition suggest that the Central Rio Grande Rise and Walvis Ridge formed a single body between 90 and 80 Ma located on the ocean ridge plate boundary similar to Iceland today.

On the basis of crustal thickness mapping, the plate restorations and the magmatic ages, we propose that the Rio Grande Rise was fragmented into its 3 parts and separated from Walvis Ridge by at least 4 ocean ridge jumps during the opening of the South Atlantic Ocean between approximately 90 and 50 Ma. Plate reconstructions of crustal thickness showing rotated structural lineaments imply that the separation of Eastern Rio Grande Rise and Walvis Ridge was highly complex involving simultaneous crustal extension and magmatic addition. We propose that the continental material reported on the Rio Grande Rise, if not drop-stones, was isolated from the main continental land-mass and transported into the ocean by these ridge jumps during the Cretaceous formation of the South Atlantic.

Many important questions remain. These include: when and where did ridges jumps take place between the components of the Rio Grande Rise and Walvis Ridge; when was sea-floor spreading between them simultaneously active; and what is the generic relationship between ridge jumps, magmatism and continental crust in the oceanic realm? In addition improved plate reconstructions of the central S. Atlantic with tighter fit are required and could be obtained by using crustal thinning from gravity inversion to restore COB location. Improved plate reconstructions of the 3D rift and breakup propagation of the South Atlantic Ocean would enhance our understanding of: the origin and evolution of the Rio Grande Rise and Walvis Ridge; the deep-water connectivity between the northern and southern South Atlantic; and the formation and evolution of the São Paulo Plateau and the southern Santos Basin.