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The Origin of the Rodrigues Depth Anomaly: New constraints from integrated gravity inversion

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This study is focused on the Western Indian Ocean including the Central Indian Ridge. The Rodrigues Ridge is a bathymetric feature (500 km -long and 20 km -wide) situated east of the Mascarene Plateau and Mauritius, with an oblique trend with respect to the underlying seafloor spreading fabric. The trend is also different from the fracture zone and hotspot tracks in this area. The region where the Rodrigues Ridge intersects the Central Indian Ridge is characterized by broad area being shallower than it should be according to standard age-depth relations for oceanic basement.

With this contribution we aim to determine key factors controlling the formation of the Rodrigues Ridge and the development of the depth anomaly through time. In order to better constrain the nature and extent of the depth anomaly underlying the Rodrigues Ridge and surrounding region, we have carried out a 3D gravity and bathymetry data analysis. This analysis included an iterative gravity inversion approach linked to the computation of residual topography through the temperature and density model of the crust and upper mantle. We use a refined plate kinematic model of the study area for the time period ca. 30 Ma to the present. The refined kinematic model is an important element for temperature modelling at the ridge-transform intersection. Existing seismological data provide additional constraints for the gravity inversion.

The results of the 3D gravity and bathymetry data analysis support the model of enhanced production of crust at the Central Indian Ridge adjacent to the Rodrigues Ridge. The depth anomaly is composed of abrupt Rodrigues Ridge edifice sitting on top a relatively smooth and broad anomaly characterized by crustal thickness between 8 and 13 km. These values are significantly higher than those typical for the crustal thickness generated by slow seafloor spreading at the Central Indian Ridge and other slow spreading ridges. This gives rise to a large negative residual mantle Bouguer anomaly. The maps of residual mantle Bouguer anomalies, crustal thickness and residual seafloor topography show a similar pattern of the depth anomaly affecting the oceanic crust from the present to 10-15 Ma at both sides with respect to the plate boundary. The depth anomaly has a triangular shape with the base at the Marie Celeste Fracture Zone, and decreases towards the Rodrigues Triple Junction.