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About geomagnetic field over the Ninetyeast Ridge, Indian Ocean

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The Ninetyeast Ridge (NER) is one of the longest, linear, aseismic ridges on the Earth extending > 5000 km in the N–S direction in the Eastern Indian Ocean. Regional magnetic anomaly works are focused primarily on the spreading linear anomalies in the adjacent Central Indian and Wharton Basins, while magnetic data on NER are sparse and anomalies over NER are difficult to interpret [1].
Our new interpretation of the anomalous magnetic field over Ninetyeast Ridge is based on data collected from detailed geomagnetic survey areas (polygons) during cruise KNOX06RR of *RV Roger Rewelle* (2007) [2] and available geomagnetic data from the international database World Data Service for Geophysics *GEODAS*. This paleomagnetic analysis considers the complex heterogeneous magnetic structure of NER and negative peculiarities of its geographic position. A non-traditional approach to the estimation of magnetization direction for magnetic objects by the method of moments, based on the splitting anomalies ΔT in anomalies ΔX, ΔY and ΔZ, was also implemented. The magnetization and paleolatitude of volcanic rocks were determined at the detailed survey areas. The mutual spectral analysis and correlation evaluating of the relationship between topography and two potential fields - gravitational and magnetic- is important in understanding how morphological segmentation of NER is manifested in its deep structure. A new method of transformation of gravity anomalies in pseudomagnetic Z anomalies is free from many constraints and allows to compare nature of the sources for magnetic and gravity anomalies as well to assess the residual magnetization.

The detailed analysis of the magnetic field carried out for the 5 polygons of the KNOX06RR cruise revealed ambiguity in its correlation with topography - local magnetic anomalies may or may not be related to local features of bottom/basement relief. An intensive isometric magnetic anomaly at the northern polygon 1 near ODP Site 758 (~5°N) is related to a ~1 km high seamount (paleovolcano). Its source, a near-vertical body ~5 km wide and with magnetization of 1.5 A/m, is apparently a volcanic channel. Two local nearsurface objects with magnetization up to 1 A/m on each side of the root appear to mark some side effusive channels. Calculated average depths to the top and bottom edges of the sources of anomalies are 5.7 and 13.5 km respectively. The paleolatitude of the volcanic mountain massif is ~51°S, which is consistent with the Kerguelen Plume location. On the contrary, sources of magnetic anomalies observed at the southern polygon 7 near DSDP 253 (~26°S) are very simple. NER is magnetized here almost uniformly from its flat top up to a depth of more than 6 km. The near-zero magnetization of the conical seamount here may be due to young volcanic activity, which destroyed natural remanent magnetization of rocks due to heating or thermochemical effects.

This work reveals some details of the anomalous magnetic field over NER (heterogeneous nature of the sources of magnetic anomalies, a greater depth to their bottom edges, the differences in the spectral composition of the bottom relief and magnetic anomalies). In general, NER contrasts in the geomagnetic field quite clearly with the adjacent basins due to its high magnetization in comparison to the weakly magnetic surrounding lithosphere. High magnetic anomalies are observed on the NER flanks and appear to mark large faults, while the clear local anomalies over small local seamounts at its top evidence their volcanic nature.

References:

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