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3D modeling and inversion of deep tow magnetic data from hydrothermal fields at the Central and Southeast Indian Ridges

Udo Barckhausen (1), Bernd Schreckenberger (1), Ingo Dressel (1,2), Ingo Heyde (1), and Ralf Freitag (1)

(1) Bundesanst. f. Geowiss. u. Rohst., BGR, Hannover, Germany (udo.barckhausen@bgr.de), (2) Technische Hochschule Ingolstadt

Crustal accretion at mid-oceanic ridges and their related hydrothermal systems are in the focus of our investigations that concentrate on detailed near-bottom bathymetric and magnetic ROV measurements. We use data acquired during two deployments of the French ROV Victor, one exactly on the Southeast Indian Ridge (SEIR) axis and the other one on the eastern flank of the Central Indian Ridge valley. The dives resulted in high quality magnetic and bathymetric data sets. Strong magnetic anomalies measured 50 m above the seafloor over zero to 50.000 years old SEIR crust are to a large part related to seafloor topography in the 1.5 x 3 km wide survey area at the SEIR. Forward and inverse 3D models are compatible with the magnetic data when systematic variations of the magnetization intensity from 5 to 15 A/m or more for the young crust within the central rift valley are used. Remaining deviations from our basic oceanic magnetization model then indicate areas with depleted magnetization probably related to hydrothermal activity which is in this case also manifested by an active hydrothermal field. The second deep-tow survey over the flank of the Central Indian Ridge represents a tectonically more complicated situation with a more varied basement topography. Magnetic anomalies seem to be tied to only a few of several ridge-like structures present in the 2 x 3 km wide survey area. Known active and inactive hydrothermal fields do not have obvious magnetic expressions in the total intensity magnetic field data. However, modeling shows that some distinct areas measuring approx. 0.5 km in diameter appear to be depleted in their magnetic mineral content and thus could represent hydrothermally altered rocks. In both cases our modeling demonstrates the extension and depth range of the reduced magnetization of these rocks down to approx. 500 m below seafloor.