

International Ridge-Crest Research: 4D Architecture

Preliminary results from the first InRidge cruise to the Central Indian Ridge

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The InRidge program, the Indian initiative for ridge research, was launched in 1997, primarily to study the Central Indian Ridge (CIR). The program plans targets geophysical and geological studies around four major fracture zones of the CIR - the Vityaz (5°44'S), Vema (8°45'S), Argo (13°45'S) and Marie Celeste (16°37'S) fracture zones and the ridge segments between them. The program envisages documentation of the regional tectonic fabric, with special reference to the growth and evolution of fracture zones and near-axis seamounts. Petrological implications of fracture zones on the generation of new crust and the sub-crustal hydrothermal budget are other objectives of this program.

During the first InRidge cruise aboard the ORV *Sagar Kanya* (Jul./Aug. 1997) single beam bathymetric, magnetic and gravity surveys were carried out along the CIR axis between the Zhivago and Vema fracture zones and also across the Vema fracture zone. Geological sampling was also carried out at the Vema and Vityaz fracture zones.

Sea-floor depth along the ridge axis varies between 1500 m to 6200 m in the Vema area, but on average is between 2500 to 3800 m, although the north-eastern part of the ridge is generally deeper. The topography is rugged with relief ranging from a few hundred meters to 2700 m. The average width of the axial valley is 15 km. The depth of the valley across frac-

ture zones ranges from 2000 m to 6000 m, with the deepest parts being in the center of the fracture zones, which are about 35 km wide.

The steep valley walls and elevated topography along the ridge axis in the VM area are associated with magnetic anomalies of a few hundred nT (upto 400). The northernmost part of the ridge axis appears to be an active spreading center and spreading can be traced upto anomaly 3. The north-eastern side of the ridge is deeper and is associated with more conspicuous magnetic anomalies. Magnetic anomalies associated with the fracture zones are more subdued. The anomaly associated with the central part of the Vema fracture zone is of the order of 200 nT and appears to be offset to the south-east.

Free air gravity anomalies measured along the axial valley in the VM area are of the order of 150 mGal. The trend of these values agrees with the bathymetric and magnetic anomaly observations. Across the Vema fracture zone the free air gravity anomalies are variable with a maximum of 200 mGal recorded in the steepest part of the fracture zone. Dredging operations were carried out along the axial valley walls near the Vityaz fracture zone and at the ridge-transform intersection between the fracture zone and the ridge axis. Basalts recovered from the ridge axis were fresh and phyrlic, containing abundant plagioclase phenocrysts. The basalts had a coating of basaltic

glass between 0.5 and 5 cm and Fe-Mn crusts of variable thickness.

The dredge haul from the ridge-transform intersection yielded variably altered basalts. They occur as substrates and nuclei for the ferro manganese oxides, which are upto 3 cm thick. Some of the encrusted materials were extensively bioturbated and had burrow holes. In addition, buff white calcareous clayey sands were recovered. These sands occur as substrates for Fe-Mn deposits. Other samples recovered in this dredge consisted of porous red-black material which contained calcareous clayey sands and ferro-manganese deposits. Other samples with flat and tubular and at times honeycomb coralline structures were also dredged. The ferro-manganese nodules are extremely rich in iron and have Mn/Fe ratios in the range of 0.63 to 0.83, indicating that they are probably hydrothermal in origin.

In summary, the bathymetric, gravimetric and magnetic data from the CIR between the Zhivago and Vema fracture zones agree with each other and indicate the presence of an active spreading center. The only igneous rocks recovered from geological sampling in the ridge axis and the ridge-transform intersection at the Vityaz fracture zone were basalts. Analysis of the ferro-manganese nodules recovered in the Vityaz fracture zone ridge-transform intersection indicates the presence of hydrothermal activity in the region.