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Deep-sea Exploration of the Central Indian Ridge at 19°S

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Among the World mid-ocean ridge system, the Indian Ocean spreading centers have been poorly studied by the means of direct deep-sea exploration. In May-June 2000, the first dives of deep sea submersible Nautile in the Indian Ocean, and the second ever on a manned deep sea submersible in this ocean, have been carried out during cruise GIMNAUT of R/V L'Atalante on the Central Indian Ridge (CIR) at 19°S. As a major topic, cruise GIMNAUT (Geochronology, ridge-hotspot Interaction, Magnetics with NAUTile) addressed the problem of accurate dating methods for recent processes at mid-ocean ridges, with a particular attention to the combined use of existing geochemical absolute dating methods for recent Mid-Ocean Ridge Basalt on one hand, the observation of a dated and continuous sequence of the recent geomagnetic intensity variations on the other hand. The CIR at 19°S, the latitude of the Rodrigues Ridge, represents a good target area to address this topic because rock samples are enriched in trace elements required for an optimal quality of the ages. In addition, this target provides the opportunity to study a slow to intermediate spreading center overlying a hot mantle, and more specifically a recent ridge-hotspot interaction. We have realized two transects of the CIR from the axis to the Brunhes-Matuyama magnetic polarity boundaries (about 800 ka) on both the African and Indian flanks. These transects intersect the CIR axis at 19°11'S (9 dives, designed as the "northern section") and at 19°29'S (8 dives, designed as the "southern section"), respectively. Three additional dives have been devoted to further exploration of the CIR axis. Direct visual geological observation has been carried out along each dive. Vector magnetic field data have been continuously acquired along 17 dives. Gravity has been measured at 29 locations on the seafloor. Rock samples have been collected at about 150 sites. In addition, complementary surface geophysical data, deep-tow magnetic profiles, and dredge hauls have been completed during the nights. Although this large data set awaits detailed analyses to be carried out in the next few years, some preliminary conclusions can be derived from the direct observation as follows: a) all observed and sampled rocks are basalts, with a majority of pillow lava and a large number of dykes, in agreement with the presumed hot and magmatic character of the CIR at 19°S; b) the rapid deposition of pelagic sediment shows that active tectonics is focused in the inner valley floor and on the inner walls; similarly, active volcanism mostly occurs inside the inner valley floor; c) despite reported signs of possible hydrothermal plumes in the water column, no active hydrothermal vent has been observed, although evidence of pervasive hydrothermal circulation is widespread.

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