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Heat flow measurement in the Knipovich Ridge

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In Spetember, 2000, a geoscientific research cruise was carried out using a Russian R/V Professor Logachev. We made 9 heat flow measurements near the axis of the ridge, in coperatioin with Norweigean and US scientists. Although we obtained a few low heat flow in the axial valley area, the heat flow cross secton across the ridge axis basically shows an axial symmetric feature, and decreases with increasing distance from the axis. For this estimate, we need to consider that the Knipovich Ridge has a largely oblique spreading characteristics.

Knipovich Ridge, located between Greenland and Svalbard, is one of the slowest spreading ridges. Crane et al. (1991) demonstrated that the northern Norwegian-Greenland seafloor has an asymmetric evolution features, based on thermal studies. However, the heat flow data are mostly located on the northwestern side of the Knipovich Ridge (KR). This makes it difficult to discuss the thermal structure around KR, especially related to the symmetry of the system and the mechanism of how the axial valley is formed.

During the K2K cruise we performed heat flow measurements at 9 stations around KR region. First three stations were located close to Svarbard. The others were located within the axial valley of KR. Except one station located very close to the axis of neo-volcanism, all other measurements were successful. Here we present a preliminary result of heat flow measurements.

Temperature vs. depth profiles for all heat flow stations near the ridge axis are linear, indicating a basically conductive regime within surface sediment.

The obtained samples at GC-13 and 17 consist of uniform mud. Their average values were 1.11 W/m/K and 0.89 W/m/K, respectively. Although the GC-17 core has a lower conductivity, this can be an artifact because the core would probably have been stretched during the recovery due to a malfunction of the core catcher.

We made three heat flow measurements in the axial valley of the northern Knipovich Ridge, and two heat flow to the east of Logachev site. In the northern Knipovich Ridge, heat flow values are ~110 mW/m2. The other stations HF-16 and HF-18 were located 5-8 miles apart, and the bottom situation was quite similar. However, the northern station HF-16 gave a heat flow value of 70 mW/m2, whereas HF-18 ~280 mW/m2. Temperature profiles are also linear for both stations.

Other two heat flow data was obtained in the middle KR, where one of the biggest axial volcanism exists. Three stations were planned across the spreading axis within the graben. One measurement was attempted in the axial graben. This site was already surveyed by a TV-Grab (K2K-TVG-02), and some sediments were identified among volcanic outcrops. Penetrations failed due to hard bottom condition. Other two measurements were made outside the major marginal high, and they encountered normal, thick sediments. Heat flow values were similar, around 280 mW/m2.

Crane et al. (1991) compiled heat flow data in the Knipovich Ridge (KR) region, and demonstrated asymmetric distribution of heat flow across the KR. Based on this, they suggested the assymetric spreading by pure shear, hi-angle simple shear, or ridge jump. However, we should be careful when we take a cross section so that the direction be parallel to the spreading direction. They took E-W trending cross section, although the actual spreading direction inferred from the trend of axial volcanic ridges and fissures is N140E.

We recalculated a heat flow cross section along N140E strike for each segment, which is defined by axial volcanoes. The horizontal distance was taken relative to the ridge axis. The result indicates basically symmetric heat flow profiles. However, it should be necessary to carefully discriminate each section. Also, it is necessary to correct heat flow values for a rapid sedimentation rate (~1 cm/yr) in this region.

By comparing the heat flow data with the age and heat flow relationship, the 'best-fit' spreading rate is estimated as 4-5 mm/y. However, this should be treated carefully, because no corrections are made on the data. If we roughly assume that the heat flow from below will be 30% larger than the observed values, the best-fit half spreading rate will be larger than 6 mm/y.