Heat flow measurements in the Kumano Trough through long-term temperature monitoring in seafloor sediments

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Terrestrial heat flow is a product of the temperature gradient and the thermal conductivity. In deep-sea areas where the bottom water temperature is stable, the temperature gradient can be accurately measured by penetrating a several meters long probe with multi temperature sensors into sea floor sediment. In shallow-sea areas, the sub-bottom temperature profile may be significantly affected by the bottom water temperature variation (BTV), which makes it difficult to determine the temperature gradient by the conventional method for deep-sea measurements. As a result, few heat flow data have been obtained in shallow seas.

We may be able to remove the effect of BTV and determine the heat flow in shallow seas through analyses of long-term records of the temperature profile in surface sediment and the bottom water temperature. Pop-up type temperature monitoring instruments have been developed to obtain long-tem data and deployed in shallow sea areas (1000 to 2000 m in water depth) landward of the Nankai Trough. At a station off Shikoku with the water depth of 1040 m, a long sediment temperature record for 229 days was obtained We could successfully remove the effect of BTV from this record and the heat flow was estimated to be 52 mW/m2 (Hamamoto et al., 2002). Analyses of sub-bottom temperature data for 30 to 96 days at other stations showed they are too short for heat flow determination.

The Kumano Trough is a fore-arc basin with a water depth of about 2000 m located southeast of the Ki-i Peninsula. We have been conducting long-term temperature monitoring experiments in the this area since 2001. Bottom water temperature records for five months to one year obtained at two stations show large temporal variations and suggest the surface sediment temperatures must have been disturbed by the BTV. We have recently obtained long-term data of sediment temperatures down to 2 m below the seafloor for 299 days (from March 2002 to January 2003) at 2070 m water depth with a pop-up type instrument. By removing the effect of BTV, heat flow at this station was determined to be about 45 mW/m2. This value is consistent with the heat flow estimated from the depth of gas hydrate BSR (bottom simulating reflector) in the vicinity of this station, about 50 mW/m2 (Ashi et al., 1999). It is necessary to investigate the general pattern and characteristics of BTV in the Kumano Trough area for more accurate and effective heat flow measurements through long-term temperature monitoring. We are therefore conducting long-term monitoring of the bottom water temperature at three stations in this area as well as sediment temperature monitoring at one station.