Long-term monitoring of bottom water temperature for heat flow measurement

Hideki Hamamoto[1]; Makoto Yamano[1]; Shusaku Goto[2]

[1] ERI, Univ. Tokyo; [2] AVL, Kyoto Univ.

Terrestrial heat flow is determined as a product of the temperature gradient and the thermal conductivity. In deep-sea areas, the temperature gradient is measured in surface sediment by penetrating a 2 to 6 m long probe with multi temperature sensors. In shallow seas, however, reliable heat flow values have not been obtained because the bottom water temperature variation (BTV) is large and it disturbs the sub-bottom temperature profile. We have been conducting long-term temperature monitoring in shallow-sea areas off-Shikoku to off-Tokai with pop-up type heat flow instruments. At a station off Kumano with a water depth of 2070m, sediment and bottom water temperature records for about 300days were obtained. The heat flow value at this station could be determined by removing the effect of the water temperature variation from the sediment temperature records

Investigation of characteristics of BTV in a specific area would enable us to examine appropriate monitoring period and probe length for pop-up type heat flow instruments as well as the applicability of ordinary deep-sea probes. If we measure the temperature profile with an ordinary probe after long-term monitoring of BTV, we may be able to estimate the undisturbed thermal gradient. For these purposes, we have been conducting long-term monitoring of BTV using pop-up type bottom water temperature recording systems, together with small temperature recorders attached to pop-up type heat flow instruments and ocean bottom electromagnetometers. We have successfully obtained BTV data at 8 stations with water depths from 1795m to 2500m in the Kumano Trough area. At four of these stations, which are several ten km away from each other, BTV records for almost the same period (about 120days) were obtained. The BTV at the four stations have some common features, including strong components with periods longer than 120 days. At one of the stations, we had obtained BTV and sub-bottom temperature data for about 300 days just before the 120-day record. Spectrum analysis of the combined BTV record for 420 days showed that the predominant periods are 100 to 200days. BTV with these long periods should significantly affect the thermal gradient down to 1 to 2 m below the seafloor. Taking account of other frequency components as well, the observed BTV may disturb the temperature profile appreciably even at 3m below the seafloor. In order to examine possible importance of any longer period component, BTV monitoring at this station will be continued. We plan to measure the sediment temperature profile with a deep-sea probe after recovering the recording system and attempt to estimate the undisturbed temperature gradient based on the BTV record. We are also conducting BTV monitoring at seven other stations in shallow-sea areas off Kumano and south of the Ki-i Peninsula. Temperature records at these stations will provide information on more general features of BTV in this area.