Long-term temperature monitoring at the biological community site on the Nankai accretionary prism off Kii Peninsula

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Nankai subduction zone off Kii Peninsula is one of the most intensively surveyed areas for studies on the seismogenic zone. Multichannel seismic reflection surveys conducted in this area revealed the existence of splay faults that branched from the master megathrust fault [Park et al., 2002]. Along the splay faults, reversal of reflection polarity was observed, indicating elevated pore fluid pressure along the faults. Cold seepages with biological communities were discovered along a seafloor outcrop of one of the splay faults through submersible observations. At one of the biological community sites, a gamma ray intensity anomaly mainly attributed to U-series contents was detected [Ashi et al., 2002; Hattori and Okano, 2002]. Long-term temperature monitoring at the biological community site revealed anomalous high heat flow [Goto et al., 2003]. These observation results strongly suggest upward fluid flow along the splay fault. In order to investigate the cold seepage activity again at the same saite, we conducted long-term temperature monitoring again in the same cold seepage site. In this presentations, we present results of the temperature monitoring and estimate heat flow related with upward fluid flow from the temperature records.

In this long-term temperature monitoring, we used stand-alone heat flow meter (SAHF), a probe-type sediment temperature recorder. Two SAHFs (SAHF-3 and SAHF-4) were used in this study. The length of the probe is 61 cm and five thermistors are installed at an interval of 11 cm in the probe. We also deployed a small water temperature recorder to monitor bottom-water temperature variation (BTV). These instruments were deployed during YK03-03 cruise in 2003. SAHF-4 was inserted into a bacterial mat, located within several meters of which the previous long-term temperature monitoring was conducted. SAHF-3 was penetrated into ordinary sediment 4 m away from the bacterial mat. A small water temperature meter was installed 4 m away from SAHF-3. These instruments were recovered during YK06-03 in 2006.

We successfully obtained bottom-water temperature records for up to 2.5 years. The records shows that predominant periods were about one year with an amplitude of 0.05 K and 20-60 days with amplitudes of ~0.15 K. Diurnal and semi-diurnal components were also observed. The period that sub-bottom temperatures were obtained were only 8 months because of the life of battery. The subsurface temperatures oscillated reflecting the BTV but the amplitudes decayed and the phases delayed with depth.

For sub-bottom temperatures measured with SAHF-3 (outside of bacterial mat), we could explain that the effects of BTV propagated into sediment by conduction only. By correcting the effect of the BTV, conductive heat flow was estimated at 126 mW/m^2. This value is slightly higher than that outside of the bacterial mat in the previous long-term temperature monitoring (111 mW/m^2).

In the previous long-term temperature monitoring, sub-bottom temperatures measured within bacterial mat could be better explained by a model with upward fluid flow at a rate of 10^{-7} m/s order, than by conduction only. The estimated heat flow was 183 mW/m^2. In the present study, however, sub-bottom temperatures measured within bacterial mat (SAHF-4) except for the topmost sensor could be explained by a conduction model. The heat flow estimated based on conduction model is 138 mW/m^2. The topmost temperature is slightly higher than that expected from conduction model. To explain the high temperature, upward fluid flow at a rate of 10^{-7} m/s order, similar order to previous monitoring, is needed.

Heat flow value expected from the distribution of heat flow around this area is 70-80 mW/m^2. The high heat flow values inside and outside the bacterial mat estimated in the present and previous studies may result from upward flow from deep depth.