Fluid flow regime in the Nankai accretionary complex inferred from heat flow measurements and other observations

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In order to reveal the characteristics and dynamics of seismo- and tsunami-genic faults in the Nankai Complex, intensive geophysical measurements as well as geological observations or geochemical analyses have been carried out. They can be used as site-survey data for IODP drilling/observatory project.

During the series of cruises KR02-10 (R/V KAIREI), KY02-02 (KAIYO), KY02-12 (KAIYO), and YK02-02 (Yokosuka), intensive heat flow measurements were carried out across the western and middle Nankai Trough areas, in order to reveal thermal and hydrological process across the frontal thrust and the Large Thrust Slice Zone (LTSZ). Previous heat flow data suggest that the Nankai accretionary complex is basically thermal-conduction dominant, except for strongly channelized flow along the faults.

Heat flow was measured using two types of geothermal probes: a 4.5m geothermal probe lowered from the ship, and two 60cm probes manipulated by ROV KAIKO. Probe positions were controlled using SSBL acoustic navigation with the accuracy of 30-70 m.

We obtained 19 heat flow data across the second frontal thrust off Muroto. Heat flow is highest at the base of the second frontal thrust. Maximum heat flow reaches up to 280 mW/m2 and its width is probably less than 50 m. We observed no indication of seepage activity at this site. Upslope we found a cold seep site, which was distributed along a topographic contour of 4620 m. Although we measured heat flow in the middle of seep site, no heat flow anomaly was detected.

We obtained 12 heat flow data across the lower part of LTSZ off Muroto. Two local heat flow anomalies of up to 250 mW/m2 were detected, both of which are related to cold seep activities. The amplitude of heat flow anomalies is similar to that observed in the frontal thrust area, although the basal heat flow here, 60-80 mW/m2 , is much lower that in the frontal thrust area. Also, the width of the anomaly seems similar to frontal thrust area. These data indicates that fluid flow is restricted within the fault or in the hanging wall, and otherwise the thermal regime in the accretionary complex is conduction dominant. On the other hand, difference in heat flow anomaly locations between two areas may provide insights into the maturity of cold seep activity and the thrust as fluid conduits.

Heat flow values stay around 160-180 mW/m2 apart from the base of each thrust, and they generally decrease landward. This indicates that the thermal regime in this region is dominated by thermal conduction, except for some focused fluid exit and possibly for cold seep on the hanging wall side of the thrust.