Heat flow distribution and thermal structure of the Nankai subduction zone off Kumano

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Terrestrial heat flow gives key information for estimating the underground thermal structure. In subduction zones such as the Nankai Trough, it also gives important information for understanding physical and chemical processes in the seismogenic zone. Heat flow measurements have been carried out extensively in the Nankai Trough area. In the Muroto area (SE of Shikoku), extremely high heat flow values, about 200 mW/m2, were obtained on the trough floor. They are much higher than the value expected for the age of the subducting plate. We have recently been conducted heat flow measurents in the Kumano area (SE of the Ki-i Peninsula), which is a target area of seismogenic zone drilling in IODP.

In shallow sea regions, where the bottom water temperature variation significantly affects the subsurface temperature distribution, we conducted long-term monitoring of temperatures in surface sediments with pop-up type instruments and could determine heat flow values at four stations in the Kumano area. The obtained values are consistent with those estimated from the depths of methane hydrate BSRs. Combining the shallow sea results (long-term monitoring and BSR) with ordinary measurements in deep sea, we can delineate the heat flow profile across the Kumano area. On the floor of the trough, heat flow is 100 to 120 mW/m2, concordant with the age of the subducting plate. Heat flow decreases landward on the frontal part of the accretionary prism and are nearly constant, around 60 mW/m2, beyond about 40 km from the deformation front.

We made numerical simulation of the underground thermal structures of the Muroto and Kumano areas using finite element models. In the Muroto area, the observed heat flow is much higher than the values calculated with numerical models on the trough floor and the toe of the prism. In the Kumano area, however, the calculated heat flow profile agrees well with the observed data both on the trough floor and on the prism, indicating that the thermal structure in this area is relatively simple as compared to that in the Muroto area.