Estimates of heat and fluid fluxes by means of long-term temperature monitoring on the Nankai accretionary prism

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Fluid flow along fault may yields thermal anomaly in earth material along and around the fault, because advective heat transfer transports heat more effectively than conductive one. In an area where the bottom-water temperature variation (BTV) little disturbs temperature of sediment close to the seafloor, such as deep marine area, time-independent vertical heat and fluid fluxes can be estimated by comparing observed vertical temperature profile with theoretical ones (called “type curves”) that are obtained by solving heat equation including an advective term with time-independent boundary conditions and Darcy flow rates (e.g., Bredehoeft and Papadopulos, 1965). In most shallow sea areas, in contrast, sediment close to the seabottom is thermally disturbed by BTV with large amplitude. In such areas, time-independent heat and fluid fluxes can be estimated from the thermal response of earth material to the BTV (e.g., Goto et al., 2005).

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 the area revealed the splay faults that branched from the master megathrust fault (Park et al., 2002). Reversal of reflection polarity was observed along the splay faults on the seismic profile, indicating elevated pore fluid pressure along the faults. Cold seep sites with biological communities were discovered along seafloor outcrops of the splay faults on the Nankai accretionary prism through submersible observations (Ashi et al., 2001, 2002). These observation results suggest upward fluid flow along the splay faults.

In order to investigate thermal and hydrological natures of the splay fault, we conducted twice long-term temperature monitoring observations at one cold seep site along the seafloor outcrop of one of the splay faults. The obtained long-term bottom-water and sub-bottom temperature records indicate that near-surface sediment was thermally disturbed by BTV. In this presentation, we report the results of estimates of heat and fluid flux from the long-term temperature records applied by the method of Goto et al. (2005).

Keywords: long-term temperature monitoring, heat flux, fluid flux, Nankai Trough, accretionary prism

