

Detailed mapping of heat flow and flow rate observation at the seepage site off Hatsushima Island in Sagami Bay

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Deep seafloor southeast off Hatsushima Island in Sagami Bay is one of the most significant cold seepage sites. This site, whose water depth is about 1,200m, lies along the topographic boundary zone between the Izu peninsula and the basin floor of the Sagami Trough. Around this site a north-south oriented reverse fault was recognized by the multi-channel seismic reflection survey carried out by Hydrographic Department, Maritime Safety Agency. About 7 km southwest of this site earthquake swarms have occurred repeatedly and Teishi Knoll that is located in the earthquake swarm area erupted in 1989.

In the vicinity of vesicomyid clam (*Calyptogena*) colonies that seemed to distribute along the fault at this site, detailed mapping of sub-bottom temperature gradients and seepage flow rate observations were carried out by a remotely operated vehicle (ROV) 'Hyper Dolphin' during three cruises from February to July, 2002. The temperature gradient were measured at more than 80 points along several east-west oriented transects, as long as 400 m, that run across clam sites by using a sub-bottom temperature probe. The length of the probe was 30 cm with three thermistors installed in 10 cm intervals from the top of the probe. One of transects run across gray colored bacteria mat site, as large as 30 m, adjacent to the clam colony and patched reddish mats were recognized in the center of the mat. The flow rates were observed by benthic flux meters - CAT (Chemical Aqueous Transport) meters developed by Scripps Institution of Oceanography. Four CAT meters together with sub-bottom temperature probes were deployed on February 25 and 26, 2002 and recovered on April 14 and 15 for long term observation.

Temperature gradient profile of the transect that run across the reddish mat had a steep peak as high as 40 K/m at reddish mat site and the gradient decreased toward the both margin to 0.8 K/m.

In another transect located 150m south of the reddish mat temperature gradients were zero or negative only in the clam colonies. The possibility is that the down-flow took place in the clam colonies as a counter flow, or the result of biological activity of clams.

The CAT meters were deployed at a gray mat site, two clam sites (one is sparse clam colony and the other is the edge of the clam colony, distance between them was about 10 m), and a reference site (seafloor of 'normal' sediment). Complete datasets were obtained from CAT meters except from the meter at the reference site.

Observed flow rates were rather low (0.8 to 5.5 mm/yr) than expected. Temperature gradients that were monitored beside the meters for the same period were 4.2 to 12.0 K/m. Deepest thermistor (30cm below the seafloor) of the thermometer at the sparse clam colony showed tidal fluctuation as large as 0.1K. This might reflect convective heat transfer. Considering the lateral variation of temperature gradient, those results indicate the heterogeneity of the seepage site consisted of the low permeability materials like carbonates and fractures within them in the shallow underground.