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上越沖ガスハイドレート胚胎域，メタン湧水サイトにおける熱流量稠密観測とその経年変化
High-density heat flow measurements and their temporal variation in the Joetsu Gas Hydrate Field, Japan Sea

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Joetsu Gas Hydrate Field, located in the western Joetsu Basin in the eastern margin of the Japan Sea is one of the best fields for gas hydrate studies. There are many methane plumes and active methane seeps associated with massive gas hydrates on and around several gas hydrate mounds on the Umitaka Spur and Joetsu Knoll. Evolution of gas hydrate mounds depends on the development of gas chimneys, and is closely related with the formation and collapse of surface-type gas hydrate accumulation (Matsumoto et al., 2009).

The result of heat flow measurement through nine research cruises in 2004?2008 is summarized in Machiyama et al. (2009). They observed not only extremely high heat flow anomalies but also non-linear temperature profile such as concave/convex profiles and negative geothermal gradients on the mounds. The distribution of high heat flow anomalies and non-linear temperature profiles is important to understand a hydrological regime in the high methane flux area of the Joetsu Gas Hydrate Field. To clarify a detailed fluid activity and temporal variation in the high methane flux area, high-density heat flow measurement using SAHF (Stand-Alone Heat Flow meter) was conducted at the methane seep site on the Umitaka Spur and at the crater site on the Joetsu Knoll in the ROV surveys of R/V Natsushima NT10-10 Leg 2 Cruise.

1) Heat flow around bacterial mats on the Umitaka Spur

We conducted precise observations around bacterial mats, where very high heat flow 4 W/m^2 with a temperature reversal profile was measured in 2007. After two years (in 2009), high heat flow value 970 mW/m^2 with a similar temperature reversal profile was observed at the same point, though subsurface temperature went down. Eight months later (in 2010), approximately 350 mW/m^2 of heat flow was measured and no temperature reversal profile was observed at the same bacterial mat. Fluid activity, therefore, shows a steep decline and a temperature reversal profile disappeared in the last two years and eight months. This result suggests that fluid pathway has temporal dependence. Thus, it seems very possible that heat flow at the bacterial mat declined due to the change of fluid pathway, such as clogging of conduits.

2) Heat flow around the crater site on the Joetsu Knoll

Heat flow measurements were conducted in and around a crater-like depression, which was probably formed by self-collapse and floating up of gas hydrate block under the condition of high methane flux (Matsumoto et al., 2009). Seafloor in the crater is covered by about 30 cm-thick muddy sediments in the last two years and eight months. Methane gas bubbles discharging from seafloor are found, when SAHF was penetrated into the seafloor by 20-30 cm. Approximately 250-520 mW/m^2 of heat flow were observed around the crater, and maximum heat flow value in the crater is similar to that measured in 2007. Thus, methane seep activity seems to be still high. A kinked temperature reversal profile is observed in the crater, though there are no methane seep phenomena, such as bacterial mats. The cause of this temperature reversal is still under consideration.

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