

## Heat flow anomaly around the methane hydrate and seep area, off Joetsu, eastern margin of the Japan Sea

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Methane hydrates are distributed around the Umitaka Spur and the Joetsu Knoll, off Joetsu in the eastern margin of the Japan Sea. In the previous research cruises, many mounds, large pockmarks (20 - 50 m deep and 200 - 500 m across), and gas plumes were found in this area, and many methane hydrates were also sampled by piston coring. Also, methane hydrates exposed on a seafloor were discovered around the mounds in the Umitaka Spur and Joetsu Knoll. We present the summary of heat flow measurement and its anomaly, and the outline of seafloor observation, based mainly on the diving surveys using ROV *Hyper-Dolphin* (NT07-20) around the mounds in these areas.

Heat flow measurement was carried out by the following two methods: 1) *in situ* measurement using SAHF (Stand-Alone Heat Flow meter) in the ROV diving surveys, and 2) the measurement using the piston corer equipped with several small temperature data loggers under the piston coring. Approximately 80 - 100 mK/m of geothermal gradient and 80 - 100 mW/m<sup>2</sup> of heat flow around the survey area are comparable to the ambient heat flow in the Japan Sea. The result of heat flow measurements in each survey areas are summarized as follows.

**Umitaka Spur:** Geothermal gradient value was anomalously high, more than 2000 mK/m within a bacteria mat with intermittent methane bubbling on the southern margin of the mound in the middle part of the spur. Fluid migration with methane from deep subsurface is quite active around this site, because geothermal gradient values show 300 - 800 mK/m within a radius of 10 m. Geothermal gradient values are commonly high (more than 200 mK/m) in 'methane blowout zone' which has an undulating, rugged seafloor with carbonate nodules and gravels. In the northern part of the spur, about 700 mK/m geothermal gradient value was measured adjacent to methane hydrate wall within a depression. On the other hand, geothermal gradient values within bacteria mats are comparable to 'normal' muddy seafloor.

**Joetsu Knoll:** Two depressions with an outcrop of methane hydrate were discovered on the mound in the middle part of the knoll. More than 500 mK/m geothermal gradient was measured at the depression in the southeastern part of the mound, whereas negative geothermal gradient values and anomalous temperature profiles were recognized at the depression in the middle part. These anomalies may be influenced by the presence or dissociation of methane hydrate near surface. Geothermal gradient values in bacteria mats varies from normal, about 70 - 80 mK/m, to high, more than 600 mK/m.

Single channel seismic profiles show the presence of gas column just below the mounds both in the Umitaka Spur and Joetsu Knoll. Since geothermal gradient values vary from a few meters to a few tens of meters within the mound, therefore, methane migration from the deep subsurface to seafloor is considered to occur on an extremely local scale. As mentioned above, the presence of bacteria mats may not automatically mean the strong methane flux from subsurface.