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Heat flow measurements in western Joetsu Basin, offshore Sado Island, Japan

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Heat flow is calculated by the product of the gradient of vertical temperature profile in the earth material and thermal conductivity of the material and is used to infer subsurface thermal structure and regime of fluid migration. Stability zone of methane hydrate depends on pressure and temperature. Furthermore, it is guessed that fluid flow in sediment acts as an important role for the formation and dissociation of methane hydrate. Thus, heat flow provides information on spatial distribution of stability zone of methane hydrate and formation and dissociation of methane hydrate.

The western Joetsu Basin, southwest of Sado Island, Japan, is one of target areas where methane hydrate studies have been conducted intensively (Matsumoto et al., 2009). Machiyama et al. (2009) measured heat flows on and around the Joetsu Knoll and spur (called 'Umitaka Spur') on its eastern side. They obtained heat flow values of about 98 mW/m² around the Joetsu Knoll and Umitaka Spur. On the other hand, heat flows of 150 mW/m² or more were measured at active seep sites on the summit areas of the Joetsu Knoll and Umitaka Spur, strongly suggesting upward fluid migration at these sites.

During MD 179/Japan Sea Gas Hydrates cruise using R/V Marion Dufresne, which was conducted to investigate the mechanism of formation of methane hydrate in the eastern margin of the Sea of Japan, we measured heat flows at seven positions on and around the Joetsu Knoll and Umitaka Spur to infer subsurface thermal structure and regime of fluid migration in the western Joetsu Basin. The measured geothermal gradients range from 88 to 97 mK/m. Because thermal conductivity of sediment measured from recovered sediment core samples show an increase with depth, we calculated heat flow by applying 'Bullard plot' (Bullard, 1939), which calculates heat flow by taking the changes in thermal conductivity with depth into account. The calculated heat flow values are similar to those around the Joetsu Knoll and Umitaka Spur recently measured by Machiyama et al. (2009). Using the heat flow data obtained in this study and previous studies, we will calculate thermal structure in the western Joetsu Basin and will investigate subsurface fluid migration and formation of methane hydrate in the area.

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Keywords: heat flow, western Joetsu Basin, methane hydrate, MH21