Heat Flow Measurements in the Tsushima Basin (Ulleung Basin)

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The Tsushima Basin is located in the southwestern part of the Japan Sea, which is a back-arc basin formed by opening between the Japanese Islands and the Asian continent. While some seismic surveys argue that the crust beneath the Tsushima Basin is thicker than normal oceanic crust, the nature of the crust remains in debate and the formation process of the basin have not been well clarified. Heat flow distribution at the surface may give key information on these issues since they should reflect the thermal evolution of the basin since its formation. In July 2007, we carried out a heat flow survey in the Tsushima Basin on a cruise of R/V 'Tamhae 2 (KIGAM)' with the cooperation between Korean and Japanese institutions (Korea Institute of Geoscience and Mineral Resources, Seoul National University, Geological Survey of Japan, and University of Tokyo).

We conducted measurement in the central part and the southwestern part of the basin using a marine heat flow probe with a capability of in-situ thermal conductivity measurement. 20 new heat flow values were obtained at 10 sites. They range from 84 to 130 mW/ m^2 and are generally consistent with the existing data. The average of the values obtained in the deepest part of the basin is about 120 mW/ m^2, which is slightly higher than those in other major basins in the Japan Sea (the Japan Basin, Yamato Basin and Tartary Trough), about 100 mW/ m^2. In contrast, the heat flow observed on the southwestern margin of the basin is significantly lower, about 85 mW/ m^2. More detailed measurements across the basin will allow us to discuss the thermal evolution of the basin throughout back-arc opening and post-opening volcanic activity.

A number of evidences for the existence of a large amount of methane hydrate within the sediment have been reported in the basin, including bottom simulating reflectors (BSRs) in seismic data and occurrence of soupy structure in numerous piston core samples. We estimated the depth of the lower boundary of gas hydrate stability zone based on the heat flow data. The estimated depths (161-188 mbsf) are slightly shallower (up to 12 %) than the BSR depths in existing seismic data.