Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SCG64-26 Room:A05 Time:May 28 11:45-12:00

Dense heat flow measurements on the outer rise of the Japan Trench: Fracturing and pore fluid flow in the oceanic crust

YAMANO, Makoto[1*] ; KAWADA, Yoshifumi[2] ; HAMAMOTO, Hideki[3]

[1]Earthq. Res. Inst., Univ. Tokyo, [2]JAMSTEC, [3]Center Environ. Sci. Saitama

Anomalous heat flow values, higher than that expected for the seafloor age, are observed on the seaward side of the Japan Trench. Previous surveys revealed that the high heat flow is widely distributed on the seaward trench slope and outer rise along the northern half of the Japan Trench but does not extend beyond about 150 km from the trench axis (Yamano et al., 2014), indicating that the anomaly is related to deformation of the incoming Pacific plate associated with subduction. The seismic velocity structure of the oceanic crust also shows anomaly on the seaward side of the trench, attributable to fracturing and seawater percolation (Fujie et al., 2013). Based on these observations, Kawada et al. (2014) proposed that thickening of the permeable layer in the oceanic crust due to fracturing leads to development of pore fluid circulation, which efficiently pumps up heat from the underlying impermeable basement. They showed through numerical modeling that this process may yield a broad high heat flow anomaly at a scale of 100 km, as observed on the seaward side of the Japan Trench.

Overlapping the broad high anomaly, large local variations at a scale of a few kilometers were found at some sites where concentrated measurements were made. Such local anomalies may arise from heterogeneity of the oceanic crust, e.g., topography of the permeable basement in which fluid circulation occurs and high-permeability faults produced by plate bending. The existing heat flow data are, however, not dense enough to be compared with the detailed crustal structure.

For investigation of the origin of the local anomalies, we conducted closely-spaced heat flow measurements on the outer rise of the Japan Trench around 39^{o}N on KS-14-17 cruise of the R/V Shinsei-maru in 2014. Measurements were made at intervals of several hundred meters along an E-W pre-existing multi-channel seismic survey line (JAMSTEC SR101), in an area 60 to 80 km from the trench axis, where immature horst and graben structures are observed. The obtained 20-km detailed heat flow profile perpendicular to the trench shows prominent sawtooth-like variations (60 to 110 mW/m^2) at a scale of 3 to 5 km. This characteristic heat flow distribution has no apparent correlation with the basement topography and faults and might result from heterogeneity in deeper part of the oceanic crust. Possible causes of the observed small-scale anomalies, including local variations in the permeability structure, are discussed in another paper in this session (Kawada and Yamano). We should conduct measurements along lines parallel to the trench as well for further investigation of the relation between the heat flow distribution and the crustal structure.

Keywords: Japan Trench, Pacific plate, heat flow, oceanic crust, subduction zone, pore fluid