Measurements of thermal conductivity of a basalt core sample retrieved from subducting oceanic crust in Nankai subduction zone under high temperature

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Knowledge of rock thermal conductivity is a key to understand thermal structure in active seismogenic zones such as the Nankai Trough subduction zone, SW Japan. To estimate thermal conductivity at the oceanic crust surface in the seismogenic zone, we measured the thermal conductivity of a basalt core sample retrieved from subducting oceanic basement at a depth of ~573 mbsf in input site C0012 of the Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE) under high temperature (maximum 160˚C). The high temperature condition corresponds to that at the oceanic crust surface in the updip limit of the Nankai seismogenic zone (~7 km below the seafloor). Thus, we set our high temperature condition of the thermal property measurements up to 160˚C at atmospheric pressure for a dry basalt core sample, and up to 100˚C for a wet basalt core sample at the same pressure condition.
As results of the experiments, thermal conductivity of the dry basalt core sample under high temperature and atmospheric pressure gradually increased with increasing ambient temperature. The thermal conductivity of the wet sample also showed an increasing trend, but the value measured at 100˚C might be strongly influenced by the evaporation of pore water, and consequently revealed a sharp increase between 80 and 100˚C. The thermal conductivity of the wet basalt was ~1.62 W/mK at room temperature. Under atmospheric pressure condition we could not measure the thermal conductivity of the wet basalt at 160˚C, but we estimated the value to be ~1.77 W/mK based on both measured thermal conductivity of the dry basalt sample and literature thermal conductivity data of pore water at the same temperature 160˚C. Generally, for other rock types such as sandstone and granite, however, their thermal conductivity decreases with increasing temperature, in contrast to the thermal conductivity of the oceanic basalt increased with increasing ambient temperature.
The thermal conductivity at ~7km also depends on the in situ pressure condition. We will also show our estimation of the thermal conductivity at ~7km in Nankai subduction zone not only for high temperature but also for high pressure effects.

Keywords: thermal conductivity, high temperature, basalt

