Thermal conductivity under high-pressure conditions of core samples from IODP NanTroSEIZE input site C0012

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Knowledge of rock thermal conductivity is necessary to understand thermal structure in active seismogenic zones such as the Nankai Trough subduction zone, SW Japan. If the drill core samples of the subduction zone are available, their thermal conductivities may be easily determined by thermal conductivity measurements using the samples. However, drill core samples at great depths more than ~3 km below seafloor in Nankai Trough subduction zone have not obtained by the Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE) scientific drilling program yet. Thus, thermal conductivity depth profile in the accretionary prism of the Nankai Trough subduction zone is not available.
The in-situ thermal conductivity of sediments in a deep part of the accretionary prism of the seismogenic zone may mainly depend on the solid grain components and in-situ porosity of the sediments. Based on this consideration, we have conducted laboratory experimental study aimed to figure out quantitative relationship between thermal conductivity of core samples and their porosity. For the experiments, we must use the core samples with the same/similar solid grain components as those from the great depths. Because sediments from sedimentary formations overlaying the in-coming subducting oceanic basement will subduct in the accretionary prism, they may have the same/similar solid grain components. Therefore, we collected whole-round sediment core samples retrieved from sedimentary formations at the NanTroSEIZE input site C0012; and then measured their thermal conductivity change with increasing confining pressure, i.e., to change the core samples' porosity to simulate the subduction process. We have successfully measured the thermal conductivities of six core samples from a depth range from ~144 to ~ 518 meters below seafloor at IODP site C0012 under high pressure conditions up to a maximum effective pressure of ~50 MPa. Consequently, an empirical equation between thermal conductivity and porosity for the Nankai Trough accretionary prism was obtained. The equation enables us to estimate thermal conductivity from in-situ porosity estimated from log data.

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