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Hydrological and mechanical properties of hemipelagic and turbidite muds from the shallow Nankai accretionary prism

AZUMA, Shuhei[1], KANAGAWA, Kyuichi[1*], TAKAHASHI, Miki[2], UEHARA, Shin-ichi[3], Atsuyuki Inoue[1]

[1]Department of Earth Sciences, Chiba University, [2]Active Fault and Earthquake Research Center, AIST, [3]Department of Environmental Science, Toho University

We found that two mud samples cored from the shallow (ca 1000 mbsf) Nankai Trough accretionary prism at Site C0002 of IODP Exp. 315 are different in origin; one is a hemipelagic mud and the other is a turbidite mud. The hemipelagic mud sample is poorer in quartz and feldspar (36-37 wt%), richer in clay minerals (36-41 wt%), uniformly fine-grained (1.40+-1.25 micrometer), and less porous (11%). In contrast, the turbidite mud sample is richer in quartz and feldspar (52-58 wt%), poorer in clay minerals (29-34 wt%), relatively coarse-grained and poorly sorted (2.27+-3.59 micrometer), and more porous (38%).

At room temperature, in-situ confining pressures of 36-38 MPa and water pressures of 28-29 MPa, the hemipelagic mud sample has a smaller permeability of 2.9×10^{-19} m^2, while that the turbidite mud sample has a larger permeability of 2.3×10^{-18} m^2. Triaxial compression experiments at these conditions and an axial displacement rate of 10 micrometer/s reveal that the former exhibits a smaller peak strength of 14.5 MPa followed by a slow failure lasting for a minute, whereas that the latter exhibits a larger peak strength of 20 MPa followed by a rapid failure within seconds. Friction experiments at these conditions and axial displacement rates changed stepwise among 0.1, 1 and 10 micrometer/s reveal that the hemipelagic mud sample has a much smaller friction (0.25) than the turbidite mud sample (0.56). Although both samples exhibit rate-strengthening behavior, the former's rate-strengthening is more pronounced than the latter. In addition, the latter may possibly exhibit rate-weakening behavior for large displacements.

Such contrasting hydrological and mechanical properties between hemipelagic and turbidite muds have important implications for faulting in the shallow Nankai Trough accretionary prism, which will be discussed.

Keywords: Nankai Trough accretionary prism, mud sediments, hydrological properties, failure properties, frictional properties