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南海トラフ付加体中の半遠洋性およびタービダイト性泥岩の水理特性・強度・摩擦特性の違いについて
Contrasting hydrological and mechanical properties between hemipelagic and turbidite muds from the shallow Nankai Trough

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We found that two mud samples cored from shallow (c.a.1000 mbsf) accretionary sediments 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 (34 wt%), richer in clay minerals (41 wt%) and uniformly fine-grained, whereas the turbidite mud sample is richer in quartz and feldspar (51 wt%), poorer in clay minerals (37 wt%) and poorly sorted. The former has a small porosity of 11%, while the latter has a large porosity of 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 micron/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 c.a. 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 micron/s reveal that the hemipelagic mud sample has a much smaller friction (friction coefficient = 0.25) than the turbidite mud sample (friction coefficient = 0.53). Although both samples exhibit rate-strengthening behavior upon velocity stepping, the velocity dependence of the former is much larger than that of the latter. In addition, a certain type of flow likely contributes to the former's frictional strength.

Such contrasting hydrological, mechanical and frictional properties between hemipelagic and turbidite muds have important implications for faulting in the shallow Nankai Trough accretionary prism. Faulting would preferentially occur in the hemipelagic mud, because it is weaker than the turbidite mud. The faulting in the hemipelagic mud would occur slowly, and therefore is a possible source of very low frequency earthquakes recently found in the shallow Nankai Trough accretionary prism. Faults formed in the hemipelagic mud are also much weaker in strength than those in the turbidite mud. In addition, the hemipelagic mud is much less porous and permeable than the turbidite mud so that in the former pore pressure likely builds up during deformation and thermal pressurization is expected to occur during faulting, which results in further weakening and large displacements. Our results may constrain the possible properties of mud to generate tsunami earthquakes in the shallow Nankai Trough accretionary prism.

キーワード: 南海トラフ, 半遠洋性泥岩, タービダイト性泥岩, 浸透率, 強度, 摩擦挙動
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