

Viscoelasticity of the Nankai accretionary prism: Indentation test on sediments from NanTroSEIZE Expedition 348

KITAMURA, Manami^{1*} ; SONE, Hiroki² ; KITAJIMA, Hiroko³ ; HIROSE, Takehiro⁴

¹Hiroshima University, ²German Research Centre for Geosciences, ³Department of Geology and Geophysics, Texas A&M University, ⁴JAMSTEC/Kochi

We have investigated the viscoelastic properties (stress-strain curve, Young's modulus, yield stress, and stress relaxation modulus) of sediments collected from the Nankai trough during IODP Expedition 348. To determine the evolution of viscoelastic properties in the Nankai accretionary prisms, we conducted spherical indentation experiments on the hand-picked intact cuttings retrieved from 870 to 3058 meters below seafloor (mbsf) at Site C0002. We used a spherical sapphire indenter with a diameter of 4 mm to deform the cuttings sample of >2mm thickness saturated with brine at room temperature and pressure conditions with a constant loading/unloading rate of 0.5 N/sec and maximum load of 180 N.

The load/unload-displacement curves indicate that the sediments above ~1200 mbsf show plastic behavior while the sediments below 2000 mbsf show brittle behavior accompanied by a sudden drop in stress due to the formation of radial fractures. The yield stress increases with depth from a few MPa at 870 mbsf to ~40 MPa at 3000 mbsf. The Young's modulus of the sediments increases from ~0.1 GPa at 870 mbsf to ~1.5 GPa at 2000 mbsf, then it becomes nearly constant at ~1.5 GPa below 2000 mbsf. The change of mechanical behavior most likely reflects the sediment consolidation because porosity gradually decreases from ~60% at seafloor to ~30% at 1500-2000 mbsf, then reaches to ~18% at 3000 mbsf. The plastic-brittle transition may appear between 1500 mbsf and 2000 mbsf. The strain energy for the Nankai earthquakes could be accumulated mainly in the sediments below 2000 mbsf.

Keywords: Viscoelasticity, accretionary prism, Indentation, IODP, Expedition 348