Early evolution of the decollement zone in the Nankai Trough accretionary prism: results from ODP Leg 190

Kohtaro Ujiie[1], Toshio Hisamitsu[2], Asahiko Taira[3]

[1] Department of Geology, National Science Museum, [2] Marine Core Res., Kochi Univ., [3] Ocean Research Institute, Univ. of Tokyo

Microstructural, X-ray computed tomography (CT) scan image and magnetic fabric analyses were conducted to reveal the early evolution of the decollement zone in the Nankai accretionary prism using samples and data collected during ODP Leg 190. Heterogeneous brittle shear and consolidation characterize the early evolution of the decollement zone. High CT and density values in the decollement zone as well as the rapid drops of CT and density values at its base suggest that the decollement zone prevent the consolidation of underlying sediments. Despite intense brittle fracturing in the decollement zone, the underconsolidation due to the decollement sealing may induce high fluid pressure at the top of underthrust sediments, resulting in strain decoupling at the base of the decollement zone.

Ocean Drilling Program (ODP) Leg 190 successfully completed a transect of the decollement zone in the Nankai Trough accretionary prism: one site at the prism toe (Site 1174) and the other one seaward of the prism (Site 1173). Using samples and data collected at Site 1174, we conducted microstructural, X-ray computed tomography (CT) scan image and magnetic fabric analyses to reveal the early evolution of the decollement zone. The decollement zone at Site 1174 is developed in Lower Shikoku Basin Facies and is characterized by the 32.6-m thick heterogeneously deformed brittle shear zone, which shows marked variation in size of brecciated fragments, foliated aspect, and variable presence of intact intervals. Within the decollement zone, bedding is irregularly steepened, and there is an irregular downward increase in intensity of brecciation.

The CT scan images of the decollement zone were obtained from brecciated fragments bounded by closely spaced discrete slip surfaces and intact pieces embedded in brecciated intervals. In contrast to the CT scan images of deformation bands and faults, no samples of the decollement zone display bright bands and seams on CT scan images. CT values of Site 1174 show fairly good correlation with the shipboard bulk density data. Samples from the decollement zone have high and various CT and density values. There are sharp CT and density values decrease at the base of the decollement zone.

The magnetic fabrics obtained from the anisotropy of magnetic susceptibility (AMS) data show a marked contrast between above and below the decollement zone. In the accretionary prism above the decollement, the magnetic fabrics record NW-directed shortening that is consistent with the present convergence vector between the Eurasia and Philippine Sea plates. In contrast, the magnetic fabrics of underthrust sediments document uniaxial strain associated with compaction. In the accretionary prism, the inclination of minimum AMS axes (Kmin) decrease toward the decollement zone. The shallowly but irregularly inclined Kmin characterizes the decollement zone. The abrupt changes in the Kmin inclinations occur at the base of the decollement zone, and the steep Kmin inclinations are maintained in underthrust sediments. The anisotropy degree of the AMS ellipsoids increases sharply at the top of underthrust sediments. These AMS data indicates that strain decoupling occurs at the base of the decollement zone.

In summary, heterogeneous brittle shear and consolidation characterize the early evolution of the decollement zone. High CT and density values in the decollement zone as well as the rapid drops of CT and density values at its base suggest that the decollement zone prevent the consolidation of underlying sediments. Despite intense brittle fracturing in the decollement zone, the underconsolidation due to the decollement sealing may induce high fluid pressure at the top of underthrust sediments, resulting in strain decoupling at the base of the decollement zone.