Deformation, consolidation, and pore fluid pressure fluctuation at the Nankai decollement zone

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Origin and evolution of the plate boundary decollement zone in the Nankai accretionary prism were examined using core and logging while drilling (LWD) data collected during Ocean Drilling Program Legs 190 and 196. The decollement zone initiated at the interval of arrested consolidation that reflected the cementation of smectite-illite mixed layer at grain contacts. Compactive deformation under pore fluid pressure/shear stress fluctuation characterizes early deformation in the decollement zone. Failure of cementation bonds and isotropic consolidation occurred under negligible shear stress that may result from high pore fluid pressure, whereas preferred clay orientation along sets of shear surfaces developed under relatively high shear stress and low pore fluid pressure. Consequently, 30 percent volume loss was achieved by these compactive deformations, and the decollement zone has significantly lower porosities than those do of sediments above and below. Thus, later high pore fluid pressure generation has induced the overconsolidation state in the decollement zone, resulting in dilative deformation that is marked by the fluid-filled fractures and the decreasing density/resistivity values in LWD data. This dilative deformation accompanied at least 6 percent volume increase in the decollement zone. In total, both compactive and dilative deformation in the Nankai decollement zone is considered to occur in closely association with pore fluid pressure fluctuation.