Deformation and fluid pressure variation during initiation and evolution of the plate boundary fault in the Nankai Trough

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The plate boundary decollement zone in the Muroto region of the Nankai accretionary prism records deformation and consolidation histories that have been affected by temporal changes in fluid pressure. Microstructural observations and chemical analysis demonstrate that the decollement zone initiated in an interval of porous clayey sediments characterized by cementation due to intergranular bonding of authigenic clays. Crosscutting relations of microstructures indicate that the decollement zone records two compactive deformations. The early compactive deformation involved destruction of porous cemented structure, probably caused by fluid pressure fluctuation. The late compactive deformation was characterized by clay-particle rotation and porosity collapse along the sets of slip surfaces, resulting in zones of preferred orientation of clay particles. These compactive deformations led to significantly higher bulk densities within the decollement zone compared to the compaction trend of the overlying prism sediments. Elevated fluid pressure following compactive deformations induced an overconsolidated state within the decollement zone, with fluid-filled dilatant fractures. Bulk density abruptly decreases at the top of the underthrust sediments, but there is no microstructural evidence for cementation. Fluids in the dilated fractures and underconsolidated underthrust sediments are potential sources for the elevated fluid pressure in and below the decollement zone, resulting in mechanical decoupling of the accretionary prism from underthrust sediments. The fault-fluid interactions in the Muroto region may be applicable to other convergent plate margins where high temperature associated with the subduction of a spreading ridge or hot, young oceanic crust enhance diagenesis and cementation.