

Microfabric analysis of damaged zone of principal shear zone in the frontal megathrust in the Nankai Trough

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The outer wedge of the Nankai forearc is located to the south of the splay fault, which is the traditional southern margin of the seismogenic rupture zone. The evidence for seismo-tsunamigenic slip was, however, recognized on the basis of a thermal anomaly along ~2 mm thick fault gouge indicative of frictional heating at the frontal thrust. This fact suggested a rupture propagation to the Nankai Trough in the past. Recently, slow slips along the megathrust beneath the outer wedge were observed and an intimate relationship between the coseismo-tsunamigenic large and fast slip and interseismic slow slips is a matter of great concern.

The underlying micro-mechanical processes responsible for the fast or slow slips are, however, poorly known.

We revisited the recovered core sample of the frontal thrust and added further micro-textural observations for damaged zone to already reported principal shear zone. The detailed mineralogical, chemical and micro fabric analysis for a principal shear zone presents the nearly complete transformation from smectite to illite, which is consistent with frictional heating. The observed micro-texture of the gouge and its surroundings of damaged zone is characteristic of experimentally-produced brittle textures for slow slip. This suggests an overprint of slow slip on the previous seismo-tsunamigenic fast slip. This micro-tectonic based interpretation is consistent with the recent observation of inter-seismic slow slip beneath the outer wedge and around the frontal megathrust. We suggest that the illite-smectite lithology of gouge and surrounding is conditionally stable, allowing it to transition from co-seismic rapid slip to inter-seismic slow slip at different times.

Keywords: Nankai trough, frontal thrust, principal shear zone, slow slip, fault fabric, tsunamigenic fault