Geological evidence of postseismic fluid discharge along an fossilized megasplay fault

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The final stage of Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE) drilling will be held on 2018-2019. Recent geophysical observations suggest that low-velocity, high pore fluid pressure zones are widely distributed beneath the targeted megathrust (Tsuji et al., 2014, EPSL). What types of deformation and fluid flow are expected in such a setting? To answer this question, here we review fluid-related deformational features of Nobeoka Thrust in Shimanto accretionary complex, Japan, regarded as a fossilized megasplay fault recording deformations of seismogenic depths (Kondo et al., 2005, Tectonics).

Numerous quartz-carbonate mineral veins occurs in the footwall damage zone of the Nobeoka Thrust. Yamaguchi et al. (2011, EPSL) pointed out veins filling fault plane is dominated by ankerite, while high-angle extension veins are filled with quartz-calcite. They interpret that change in mineralogy reflect the temporal fluctuation in redox state of preseismic/coseismic stages. Recently, Otsubo et al. (2016, Island Arc) and Kawasaki et al. (2017, Island Arc) reanalyzed orientations of veins, and presented that high-angle quartz veins were more likely to reflect postseismic stress field of vertical sigma-1. Saishu et al. (2017, Scientific Reports) demonstrated that timescale for silica precipitation into the veins is comparable to recurrence interval of large earthquakes in subduction zones, and therefore precipitation potentially controls earthquake recurrence.

Along the principal slip zone (PSZ) of the thrust, Fukuchi et al. (2014, EPS) pointed out that plagioclase has been altered to form while mica, suggesting the existence of fluid flow along the PSZ. Recently Hasegawa et al. (this meeting) found pseudotachylyte in the PSZ, and at least ~24-512 times of fluid compared to the mass of fault material is necessary to explain relative concentration of fluid-mobile elements in the pseudotachylyte. Timing of such fluid flow is limited to postseismic stage, because adjacent rocks do not show remarkable chemical anomalies.

All the structural, mineralogical and geochemical findings from the PSZ and the footwall damage zone of the Nobeoka Thrust imply that postseismic fluid discharge widely occurred along the thrust. Similar fluid flow pattern is expected in the megathrust at ~5km below the seafloor of the Nankai Trough.

