Role of metasomatic reactions on plate-boundary shear localization near mantle wedge corner

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Geophysical observations have shown that fluids play an important role on the generation of slow earthquakes along the subduction plate boundary near the mantle wedge corner. However, the plate boundary processes remain poorly understood. We examined the subduction mélanges in the Nishisonogi metamorphic rocks, Kyushu Island, Japan, which were deformed at depths of ~25–30 km and temperatures of ~520 ˚C, comparable to environments of deep slow earthquakes. The subduction mé langes are composed of metabasite, pelitic schist, serpentinite, and chlorite-actinolite schist (CAS). The shear deformation is localized along the 0.02–5 m-thick CAS, resulting in the composite planar fabric defined by strong shape and crystallographic preferred orientations of actinolite and chlorite. The localized shear along CAS is accompanied with ~0.1–2 m-thick metasomatized metabasite. The metasomatic reactions between metabasite and CAS are characterized by decreased calcium (Ca) associated with consumption of actinolite and epidote and water release. The coexistence of metasomatized metabasite and localized shear zone suggest that the Ca-metasomatism and associated dehydration may lubricate the plate boundary fault by reaction-enhanced shear, resulting in the shear localization along CAS.

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