Metasomatic reaction and localization of low-angle thrust-sense viscous shear recorded in subduction mélanges exhumed from source depths of slow earthquakes

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Geophysical studies suggest that fluid plays important roles on generation of slow earthquakes in subduction zones. However, it remains unknown how fluid affects slow earthquake-related deformation. The mélanges exhumed from source depths of slow earthquakes are expected to record the fluid-rock interactions and deformation that are responsible for slow earthquakes. Here, we examined the serpentine mélange in the Nishisonogi metamorphic rocks in western Kyusyu deformed at ~460 ˚C and 25–30 km depth and the Makimine mélange in the Shimanto accretionary complex in central Kyusyu deformed at ~370 ˚C and 10–15 km depth. The both mélanges record a metasomatic reaction between the pelitic schist and chlorite-actinolite schist or dolerite/basalt, resulting in albitization and consumption of muscovite and carbonaceous material in the pelitic schist. The albitization is not caused by sodium supply from albite in basic schist, dolerite, and basalt, but is rather derived from the infiltration of sodium-bearing external fluid into the subduction plate boundary. The albitized reaction zones are accompanied with localized viscous shear zones that show low-angle thrust shear sense. The kinematics of viscous shear and the temporal relation between albitized reaction zones and viscous shear zones suggest that the reaction-enhanced viscous shear occurred during subduction, which may account for the generation of slow slip events. The sodium-bearing fluid flow along the plate boundary may control metasomatism and deformation responsible for slow earthquakes.

