Mixing and reaction of rocks facilitate fluid flow along the forearc slab-mantle interface

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The forearc slab-mantle interface in subduction zones is a site of mixing and reaction of crustal and mantle rocks, forming serpentinite mélanges. The studies of exhumed subduction complexes show that extensive fluid flow occurs in the serpentinite mélanges (Bebout and Penniston-Dorland, 2016, *Lithos*, 240–243, 228–258, and references therein). The fluid flow potentially modifies physical and chemical conditions of rocks along the channels, so it is an important subject for understanding subduction-zone seismicity. For example, redistribution of silica by the fluid flow likely affects elastic properties of rocks and modulates periodic events of slow earthquakes (Audet and Bürgmann, 2014, *Nature*, 510, 389–392; Fisher and Brantley, 2014, *J. Structural Geol.*, 69, 395–414; Hyndman et al., 2015, *J. Geophys. Res. Solid Earth*, 120, 4344–4358).

The Nishisonogi metamorphic rocks (a Late Cretaceous subduction complex exposed in Kyushu, Japan) contain serpentinite mélanges, which have been formed at 0.8 GPa and 460 °C. These pressure and temperature conditions are close to those of the forearc mantle corner. The mélanges have a matrix of chlorite-actinolite schist, talc schist and antigorite schist, together with tectonic blocks of meta-sedimentary, mafic and ultramafic rocks. They show various types and degrees of the mixing and reaction of rocks. The isocon analysis indicates that the reactions typically involve a decrease of solid volume and production of fluids. The loss of solid volume possibly reaches dozens percent relative to the initial volume. In addition, the reactions result in mobilization of silica without forming quartz veins. These findings suggest that the serpentinite mélanges are permeable and mechanically weak. The mélanges probably act as fluid flow channels. The fluid flow is favorable to transport silica toward the mantle corner and may induce deep slow earthquakes.

Keywords: serpentinite mélange, metasomatism, reaction-enhanced permeability, fluid flow, slow earthquakes