Fluid flow, fluid-rock interaction and slow earthquakes at the forearc mantle corner

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The forearc mantle corner in subduction zones is a site of deep slow earthquakes such as low-frequency tremors, very low frequency earthquakes and short-term slow slip events. Geophysical observations suggest that these seismic activities are related to updip fluid flow along the slab-mantle interface and quartz deposition in the crust above the mantle corner (*e.g.*, Audet & Bürgmann, 2014, *Nature*, 510, 389–392; Hyndman *et al.*, 2015, *J. Geophys. Res. Solid Earth*, 120, 4344–4358). The geological evidence for the fluid flow has been reported from many subduction-zone mélanges (Bebout & Penniston-Dorland, 2016, *Lithos*, 240–243, 228–258, and references therein).

The question is, how the updip fluid flow is formed and maintained at the slab-mantle interface? Fractures probably play an important role of fluid pathways, but the life span of individual fractures could be short for the rapid sealing by vein minerals. We propose that fluid-rock interaction in subduction-zone mélange would sustain the fluid flow if reaction-enhanced permeability takes place.

We present an example of fluid-rock interaction and reaction-enhanced permeability in subduction-zone mélanges. The Nagasaki metamorphic rocks in Kyushu, Japan, consist mainly of Late Cretaceous schists and contain serpentinite mélanges. The metamorphic pressure and temperature are close to those of the forearc mantle corner (~0.8 GPa and ~440 °C). The serpentinite typically occurs as mélanges, in which metapelitic tectonic blocks have been albitized along the rims and cracks. The albitization is considered to be the result of fluid-rock interaction. The isocon analysis indicates that the albitization involves a loss of rock volume and extraction of silica from the blocks. The volume loss increases along with the reaction progress of the albitization.

Albitization is commonly found in the subduction-zone mélanges of the blueschist to eclogite facies. This suggests that reaction-enhanced permeability widely takes place at the slab-mantle interface. As a result, the subduction-zone mélanges probably become porous media, which act as sustainable channels of the updip flow of fluids (and silica) towards the site of deep slow earthquakes.

Keywords: Albitization, Reaction-enhanced permeability, subduction-zone mélange, Slow earthquakes