Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SCG63-09 Room:104 Time:May 23 10:00-10:15

Influence of Si-metasomatism on slab-mantle interface rheology

Ken-ichi Hirauchi[1*], Sabine den Hartog[2], Christopher Spiers[2]

[1]Graduate School of Human and Environmental Studies, Kyoto University, [2]Faculty of Geosciences, Utrecht University

Aqueous fluids liberated during dehydration of the subducting slab cause hydration of the overlying forearc mantle wedge, changing the mechanical properties of the slab-mantle interface. Antigorite, a high-temperature serpentine mineral, is expected to be the main hydrous mineral present in the forearc wedge, while slab-derived fluids are likely to contain significant amounts of dissolved silica, leading to Si-metasomatism and replacement of antigorite by talc. However, it remains unclear how the strength and internal structure of antigorite-rich rocks evolve in the presence of reacting silica-rich fluids.

To determine the effect of Si-metasomatism on the rheological properties of antigorite, we performed a series of frictional sliding experiments on 100% antigorite, 100% talc and antigorite (70%) plus quartz (30%) gouges under hydrothermal conditions, using a ring shear machine. The pure antigorite and talc gouges showed steady-state shearing at a friction coefficient of 0.63 and 0.21, respectively. In contrast, the antigorite/quartz (atg/qtz) gouges exhibited a peak friction coefficient of 0.40-0.62 followed by strain weakening towards a quasi-steady-state strength with the friction coefficient of 0.25-0.47. The degree of weakening of atg/qtz relative to pure antigorite increased with increasing temperature and decreasing sliding velocity. The weakening was mainly due to the development of through-going, talc-bearing boundary shears, which widened until the steady-state sliding was attained.

Our experiments indicate that in the lowermost part of the forearc wedge, where silica-saturated fluids infiltrate from the dehydrating slab, metasomatically produced talc slip surfaces or shear bands will form in the intensely sheared plate interface, causing a much larger weakening effect than expected for antigorite, even if the total amount of talc formed is minor ($<$10 vol%).

Keywords: antigorite, fluids, mantle wedge, metasomatism, subduction zone, talc