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Temperature- and velocity-dependent deformation structures of antigorite gouges

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On the shear deformation of granular materials, we should consider two types of the deformation mechanism; one is the friction that uses surface of the grains for sliding, the other is the creep, intra-crystal deformation. Which mechanism of them becomes to dominate the shear deformation will depend on the deformation conditions, temperature and sliding velocity. It was well known that serpentine, a type of phyllosilicate minerals, showed not only friction-type deformation style but also creep-type deformation style (Reinen et al., 1994). However, temperature-velocity dependence of their deformation mechanisms had not been enough clarified.

The deformation mechanisms of antigorite gouge (high-T type serpentine) were investigated by a velocity-step change technique, under various temperature-velocity conditions (refer to Takahashi et al., 2011, in S-SS29 at this year JpGU Meeting for details of the experimental procedure). One of the main results is a drastic change in the deformation style from the creep-type to the friction-type at around 450 deg.C, caused by partially dehydration reaction of the antigorite. This partial, small amount of forsterite (a product of dehydration reaction of the serpentine) had a possibility to control the strength and the behavior of the antigorite gouge sliding even though the dehydration was limited.

In this presentation, we will focus on the gouge structures relevant to the deformation styles. A preliminary SEM observation found streaky alignments of the sub-micron sized forsterite particles along the Riedel shears at the temperature higher than 450 deg.C. That revealed that the serpentine at the shear-localized zone were reacted preferentially. Using EDS analysis, here, we will report results of detail observations on the distributions of the forsterite particles in the antigorite gouge, supporting a possibility of the shear-induced dehydration during the deformation.

Reference: Reinen et al., 1994, Pure and Applied Geophysics, v. 143, p. 317-358.

Keywords: shear-induced dehydration, serpentine gouge, frictional deformation, creep type deformation