G123-P003 **Room: Poster Session Hall** **Time: May 16**

Deformation-reaction and water distribution in an inner shear zone of the Ryoke belt in the Kishiwada area, Osaka Prefecture

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Water in rocks is included as -OH in mineral crystal structures and as molecular H2O in grain boundaries and fluid inclusions. These water species play key roles on rock deformation as classically confirmed by laboratory experiments. Recent rock deformation experiments have revealed that mica groups in host rocks contribute to deformation and reaction of feldspar and change strengths of bulk rocks (e.g. Holyoke and Tullis, 2006). Observation from natural deformed rocks also infers that exchanges of chemical substances are achieved via water excluded from mica groups and grain boundaries under deformations. As a consequence, myrmekites are formed around feldspar rims and strain localizations are also induced. Thus, water has much connection with deformation-reaction mechanisms.

Water distribution in deformed rocks can be evaluated by mean of infrared spectroscopy. Infrared spectroscopy sensitively reflects chemical species of water such as -OH or H2O and their contents. However, contrary to the important background of water-related deformation-reaction processes, reports concerning on the water distribution in deformed rocks are limited (e.g. Muto et al., 2004; O'kane et al., 2007; Gleason and DeSisto, 2008). Moreover, there are little reports which account for reaction processes under deformation (e.g. Seaman et al., 2006).

The aim of this study is to report water distribution in natural mylonite by infrared spectroscopy. We also report the water-related deformation-reaction processes. Mylonite samples were taken from Tsuda River, Kishiwada, Osaka Prefecture. This area shows Ryoke granodiorite as a host rock and a sequence of deformation to ultramylonite within NS 500m. Therefore, this area must be one of the suitable areas to consider the deformation and deformation-induced reaction processes. Some K-feldspars in mylonites exhibit the brittle deformation. K-feldspars and plagioclases grains show ca. 2 mm in a maximum length and aspect ratio of 1:2. These feldspars gradually decrease their grain sizes with deformation and show a few hundred micrometers in maximum in ultramylonite. Myrmekites are often recognized at grain rims of feldspars and fractures of K-feldspars. On the other hand, quartz grains in mylonites show non-deformation to ductile deformation in a same block. Grain sizes of quartz also vary from 50 to 250 um. The variation of quartz elongation in the same blocks indicates the strain localization. Ductile deformation of quartz grains exhibits 1:3 of aspect ratio in an average. Quartz grains in ultramylonites are nominally ca. 10 um, but some quartz veins which contain 50 um of grain size are recognized in a few centimeters scales.

We evaluate water distribution by infrared spectroscopy using these deformed rocks of Tsuda River which exhibits the series of deformation processes as described above. The obtained infrared spectra show the following characters. Molecular H2O is included in inner parts of feldspar grains as broad band at 2800-3700 cm-1. Feldspars contain this water species of 450 ppm on average and 1800 ppm in maximum. Most of this water in feldspar is stable after 400C heating. Therefore, the speciation of water trapped in feldspars must be fluid inclusion. On the other hand, significant amounts of molecular H2O are not confirmed in inner part of quartz grains. The average water content in quartz is 190 ppm and 400 ppm in maximum. We performed mapping measurements of infrared spectroscopy on 1 x 1 mm area which contains myrmekite-formed feldspar and quartz and mica with feldspar, masking 30 x 30 um region. Mapping infrared spectra were also measured for quartz veins as described above in ultramylonites. We will try to understand water distribution which contributes to reaction of feldspar and dependency of water distribution on grain sizes in quartz grain boundaries.