Deformation mechanism of upper greenschist- to lower amphibolite-facies metacherts: A preliminary result

Takamoto Okudaira[1]; Daisuke Ogawa[2]; Katsuyoshi Michibayashi[3]

[1] Dept. Geosci., Osaka City Univ.; [2] Geosci., Osaka City Univ.; [3] Inst. Geosciences, Shizuoka Univ

Non- to highly-metamorphosed sedimentary rocks of an accretionary complex are major constituent materials of the continental crust: the deformation mechanism of the sedimentary rocks is important to clarify the deformation process of the continental crust. For quartzose rocks, such as chert, diffusion creep or dissolution-precipitation creep is dominant under low-temperature condition whereas dislocation creep of quartz aggregate is promoted under moderate- to high-temperature condition at geological strain rate. However, physical parameters controlling the mechanism switch from the diffusion creep to dislocation creep are not understood fully. In this study, to clarify some of the physical parameters, we analyzed lattice preferred orientations (LPOs) of quartz grains in the very-fine grained metacherts by SEM-EBSD method, which can not been measured by conventional universal stage method.

Fine-grained metachert samples were collected from the low-grade (chlorite-biotite zone) metamorphic rocks of the Mino-Tamba accretionary complex and the Ryoke metamorphic belt in the Wazuka-Kasagi district, SW Japan[3,4]. Metamorphic temperature for the chlorite-biotite zone has been estimated to be 490 C based on occurrence of fully ordered graphite in the zone [2]. The metachert samples exhibit a distinct schistosity that is parallel/subparallel to lithological boundaries. Weak stretching lineation is observed on the schistosity. The metacherts are not folded mesoscopically[3]. Thin sections are prepared normal to the schistosity and parallel to the stretching lineation. The constituent minerals are mainly quartz (ca 95 vol.%) with minor amount of plagioclase, muscovite and chlorite. In these samples, there are deformed radiolarian fossils and they are used as strain marker to analyze strain geometry and magnitude of the metacherts. According to the results of strain analysis using Rf-phi method, k-value and strain magnitude are 0.36 and 0.69, respectively. LPOs of quartz are measured using SEM-EBSD system at the instrumental center for chemical analysis, Shizuoka Univ. LPO measurement in different areas in each section has been done. Sizes of quartz grains were also measured for each area analyzed by SEM-EBSD. Average grain size of quartz is about 10 microns. C-axis fabric patterns do not exhibit distinct patterns that could be predicted theoretically/experimentally. Fabric intensities are calculated: values of fabric intensity index[1] and M-index[5] are 0.060-0.074 and 0.027-0.073, respectively. These values are very small: they indicate also that c-axis fabric patterns are comparable with a random distribution.

The metacherts analyzed here may be deformed by dislocation creep enough to form distinct fabric patterns, because the strain magnitude estimated by included radiolarian fossils is 70%[3]. In the metacherts, therefore, it is possible that dislocation creep is not dominant deformation mechanism but diffusion creep. According to deformation map, assuming that the grain size of quartz is 10 microns, shear stress is several tens MPa, and upper greenschist- to lower amphibolite-facies condition, quartz-rich rocks could deform dominantly by diffusion creep. At that conditions, it has been considered that quartzose rocks would be deformed by dislocation creep. However, the very-fine grained metacherts formed under the upper greenschist- to lower amphibolite-facies condition deformed by diffusion creep, suggesting that the mechanism switch from diffusion creep to dislocation creep is due to the grain-size of quartz significantly, because material transport is a key parameter on the mechanism switch.

[1] Lisle (1985) J Struct Geol 7, 115. [2] Nakamura (1995) Isl Arc 4, 112. [3] Okudaira et al. (in press) J Asia Earth Sci. [4] Ozaki et al. (2000) Geology of Nara, Geol. Surv. Jpn. [5] Skemer et al. (2005) Tectonophys 411, 157.