Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SCG57-P05 Room:Convention Hall Time:May 27 18:15-19:30

Formation and development of incipient shear zone in the lower crust: Example from the Hasvik gabbro, Norway

KIMURA, Takafumi[1*] ; OKUDAIRA, Takamoto[2]

[1]Department of Geosciences, Faculty of Science, Osaka City University, [2]Graduate School of Science, Osaka City University

Gabbroic rock is a major constituent of the lower crust, and it consists mainly of plagioclase and pyroxene. Although dislocation creep of plagioclase has generally been considered to govern the rheology of the lower crust, when the grain size of the constituent minerals is small enough, grain-size-sensitive creep dominates the mechanical behavior of the lower crust. The process of grain-size reduction is a fundamental factor in controlling the strength of the lower crust. Instead of dynamic recrystallization, the nucleation that results from the fracturing and crushing of minerals have to be considered as potentially important processes. In this study, to clarify the initial process of shear zone formation in the lower crust, we describe microstructural and petrological characteristics of shear zones developed in the Hasvik gabbro of the Seiland Igneous Province in northern Norway (e.g., Tegner et al., 1999).

Shear-zone networks are developed in the Hasvik gabbro, and the shear zones are made up of fine (a few tens of microns), equant, but slightly elongate grains of the recrystallized plagioclase, amphibole and pyroxene. On the other hand, in the primary magmatic crystals of plagioclase and pyroxene, intragranular and intergranular fractures are found. Newly crystallized amphiboles are found along the boundaries between magmatic plagioclase and pyroxenes, in the intragranular fractures within pyroxenes, and at the margins of pyroxene porphyroclasts in the shear zones. Recrystallized grains of plagioclase, clinopyroxene, and orthopyroxene have compositions that differ from the magmatic ones, which suggests they formed by nucleation and growth. Based on conventional plagioclase-amphibole thermobarometry (Holland and Blundy, 1994; Bhadra and Bhattacharya, 2007), the shear zones have formed at temperatures and pressures of 750-800 ℃, 0.8±0.2 GPa. The observed primary minerals cut by fractures suggest high-temperature fracturing in the absence of high pore pressures, which implies a high strength of the lower crustal gabbros and high stresses at fracturing. The viscously deformed shear zones are characterized by the lack of crystallographic preferred orientation (Okudaira et al., submitted) and a small grain size, suggesting that the mechanism of deformation of the fine-grained plagioclase and orthopyroxene has been diffusion accommodated grain-boundary sliding during and/or after their nucleation and growth.

Keywords: gabbro, lower crust, brittle fracturing, grain-size reduction, grain-size-sensitive creep