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Microstructural observation of quartz and K-feldspar in quartzo-feldspathic granulite in Sri Lanka

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Athurupana Bhathiya Madhura Bandara[1*] ; 福田 惇一[1] ; 武藤 潤[1] ; 長濱 裕幸[1]
ATHURUPANA, Bhathiya madhura bandara[1*] ; FUKUDA, Jun-ichi[1] ; MUTO, Jun[1] ; NAGAHAMA, Hiroyuki[1]

[1]Department of Earth Science, Tohoku University, Japan
[1]Department of Earth Science, Tohoku University, Japan

Sri Lankan basement has been considered as high grade terrains which have suffered poly phase deformation and also upper amphibolite to granulite facies metamorphism during Pan-African amalgamation. In order to illuminate the rheological properties of felsic granulite in deep crustal level associated with high grade metamorphism, microstructural and petrographic observations were conducted.

A quartzofeldspathic gneiss sample (Quartz∼40%, K-feldspar∼55% and plagioclase <5%) contains highly elongated ribbon quartz which demarcate lineation, in K-feldspar matrix. The sample was collected from the hinge zone of kilometer scale large upright cuspate antiform between two large synforms named Dumbara and Huluganga in Sri Lanka.The lineation as maximum elongation direction is N35^{0}W/horizontal. Thin sections were made parallel and perpendicular to the lineation for petrographic and microstructural observations. Based on energy dispersive X-ray spectroscopic (EDS) measurement, most of K-feldspars in the matrix are sanidine [$(K_{0.59}Na_{0.41})AlSi_3O_8$]composition. Plagioclase is albite (An 0.1) composition and occurs in clusters and exsolution lamellas in K-feldspar. The grain size of sanidine is from ∼50 μm to 2 mm. Large sanidine porphyroclasts are partly recrystallized and show core and mantle structures. Grain boundaries of sanidine are sub polygonal to amoeboid shapes with increasing grain size, while plagioclase grains in clusters show perfect polygonal boundaries with grain size ranging from 50 to 200 μm. Around the plagioclase clusters, scapolite reaction corona exists with crosscutting elongated ribbon quartz. Sericite presents in the same region as very low temperature alteration of plagioclase and scapolite. Most importantly ribbon quartz grains are boudinaged in K-feldspar matrix. Any sign of undulatory extinction or dynamic recrystallization is absent in both boudinaged and large ribbon quartz. Measured average axial ratio of ribbon quartz grains is 21:7:1 with respect to X, Y and Z directions.

The crystallographic orientations of both quartz and sanidine were measured by electron backscattered diffraction (EBSD) method, including large ribbon quartz and boudinaged quartz and also matrix sanidine. The lattice preferred orientation (LPO) patterns of sanidine manifest (010)<001>as a dominant slip system with a minor activation of (010)<100>slip system. The quartz LPO indicates the activations of prism<a>and rhomb<a>slip systems.

According to the presence of K-feldspar as sanidine and their slip systems, we can point out that the sample has prevailed high grade conditions (∼550-800^{0}C and ∼0.4-0.8 GPa) during deformation [e.g. Menegon et al. 2008]. Scapolitization which occurs at granulite facies could be indicative of peak metamorphism. Also, reaction coronas of scapolite crosscutting ribbon quartz can be interpreted as strong deformation prior to the peak metamorphism. Exsolution of K-feldspar indicates the post dated cooling relative to the strong deformation and the peak metamorphism.

Reference:

Menegon, L., Pennacchioni G., Spiess R., 2008. Dissolution-precipitation creep of K-feldspar in mid-crustal granite mylonites. Journal of Structural Geology 30(5): 565-579

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