Deformation mechanisms and plagioclase aggregates in mylonitized quartzofeldspathic gneisses

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We studied the P–T evolution and microstructures of garnet–biotite gneisses, containing retrograde cordierite, in the Gyeonggi Massif, Korea. Grain-scale deformation mechanisms of each mineral, especially those of plagioclase, were analyzed in order to understand their contribution to the mylonitization of melt-bearing gneisses in the continental crust.

The quartzofeldspathic gneisses, partly migmatitic, are variably deformed to produce protomylonite to mylonite, together with rare ultramylonite. Based on post-kinematic growth of cordierite and the presence of syn-kinematic melt, P–T pseudosection calculations with water in excess suggest that the deformation has occurred at ca. 660–750 °C and mid-crustal pressure. Plagioclase occurs as near-monomineralic fine-grained (ca. 100 μm on average) aggregates, whereas K-feldspar shows a typical core-and-mantle structure. Quartz occurs as relatively coarse-grained bands or ribbons. The subgrain rotation and grain boundary migration recrystallizations were dominant deformation mechanisms responsible for the grain size reduction of feldspars and grain growth of quartz, respectively. The electron backscatter diffraction analysis of plagioclase aggregates suggests that their CPOs are apparently unrelated to the orientation of tectonic fabrics, but the strength of CPO decreases with increasing amount of bulk strain. We propose that: (1) the strongest CPO is a remnant fabric inherited from the precursor plagioclase; and (2) the decrease of the CPO strength in plagioclase aggregates is attributed to the transition of dominant deformation mechanism from dynamic recrystallization to grain size-sensitive creep. Although K-feldspar films and zircon overgrowths may indicate the former presence of syn-kinematic melt, the details of melt effect on deformation mechanisms are unclear.

In summary, under the upper-amphibolite facies condition, sodic plagioclase is apparently weaker than K-feldspar and behaves as one of major strain-accommodating phases in quartzofeldspathic gneisses. The dominant deformation mechanisms change from dynamic recrystallization to grain size-sensitive diffusion creep during the high-T exhumation, which may account for the extensive and diffuse deformation of rigid crystalline blocks such as the Gyeonggi Massif.