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Dynamic recrystallization and metamorphic evolution of ca. 1.85 Ga quartzofeldspathic and cordierite-garnet gneisses, western Gyeonggi Massif, Korea

Moonsup Cho (1), Soh-young Yang (1), Taehwan Kim (1), and Keewook Yi (2)

(1) School of Earth and Environmental Sciences, Seoul National University, Seoul, Korea (moonsup@snu.ac.kr), (2) Korea Basic Science Institute, Ochang, Korea

Quartzofeldspathic orthogneisses together with cordierite-garnet gneisses occur in the Mt. Cheonggye area, western Gyeonggi Massif, where the transition from weakly-deformed gneiss to mylonite is revealed. These gneisses consist primarily of biotite, garnet, K-feldspar, plagioclase, and quartz with or without sillimanite (or kyanite) and cordierite. Microstructures in mylonites and gneisses were investigated to delineate the relationship between dynamic recrystallization and pressure-temperature (P-T) path, based on field and petrologic studies. For constraining the timing of deformation and metamorphism, zircon and monazite were dated using a sensitive high-resolution ion microprobe (SHRIMP) housed at the Korea Basic Science Institute.

Recrystallization microstructures systematically vary in accordance with the degree of strain in weakly- to intensely-deformed gneisses or mylonites. Quartz shows the subgrain rotation (SGR) to grain boundary migration (GBM) recrystallization such as the ribbon structure, and K-feldspar is characterized by the core-and-mantle structure together with occasional development of myrmekite. Some isolated grains of K-feldspar appear to be the product of the solution-precipitation growth. Plagioclase was recrystallized by SGR and high-T GBM, forming fine-grained polygonal aggregates in weakly- and moderately-deformed gneisses. With increasing strain, plagioclase grains are connected with each other to form the interconnected weak layer. The microstructures described in the above suggest the deformation temperatures of ca. 490–650°C. Mineral assemblages and reaction textures in cordierite-garnet gneisses suggest a clockwise P–T path, evolving from the kyanite- to sillimanite-stable fields.

The SHRIMP U-Th-Pb analyses of zircon and monazite in both cordierite-garnet gneisses and orthogneisses yielded the Paleoproterozoic metamorphic ages of ca. 1.86–1.85 Ga. Some zircons are overgrown by low Th/U rims dated at ca. 240–220 Ma. Monazite occurs as fine-grained inclusions in the almandine-cordierite corona or as neoblastic phase in the matrix. The weighted mean U-Pb ages of monazite in two cordierite-garnet gneisses are 1850±8 Ma and 1856±8 Ma, respectively, suggesting the Paleoproterozoic high-T metamorphism. On the other hand, the majority of monazite grains in leucocratic and migmatitic gneisses yielded U-Th-Pb ages of 235–228 Ma. In one mylonite sample, monazite was dated at 232 ± 2 Ma. In addition, zircons from a granitic vein free of deformation fabric are dated at 226 ± 4 Ma. These SHRIMP ages suggest that the deformed gneisses and mylonites in the Mt. Cheonggye area is the product of Middle Triassic tectono-metamorphism, associated with the collisional orogeny between North China and South China cratons.