Peak-metamorphic and post-collisional growth of staurolite and aluminosilicate polymorphs in the Barrovian metapelites of the Imjingang belt, central Korea

Yoonsup Kim *
Division of Earth and Environmental Sciences, Korea Basic Science Institute, Daejeon 305-333, South Korea
yoonsup@kbsi.re.kr

The parageneses, microstructures and compositions of index silicate minerals, in conjunction with the SHRIMP U–Th–Pb ages of monazite, were investigated in the Barrovian metapelites of the Imjingang belt, central Korea, to delineate the *P*–*T*–*t* path quantitatively. The peak-metamorphic assemblage of biotite, garnet, staurolite and rare kyanite (M_1) in the staurolite zone is enclosed in a skeletal porphyroblast of andalusite (M_2), suggesting a product of low-*P* overprint. In the kyanite zone, two relict assemblages are distinct: (1) high-*P*, staurolite-free assemblage defined by the inclusions of biotite and garnet in kyanite porphyroblasts (M_1); and (2) medium-*P* assemblage of biotite, kyanite and garnet enclosed in staurolite porphyroblasts (M_2). Kyanite- and andalusite-bearing quartz veins occur in the kyanite zone. These veins are folded and deformed to produce the boudinaged patches on an outcrop scale. In contrast to other aluminosilicate polymorphs, sillimanite is rare in the metapelites. Thus, the post-peak metamorphism is characterized, based upon a phase diagram calculated using the KFMASH model system, by a near-isothermal *P*–*T* path and subsequent cooling passing through the kyanite-andalusite stability boundary.

The U–Th–Pb isotopic ages of monazite, estimated using a SHRIMP-II ion microprobe, show two distinct age groups. The $^{206}Pb/^{238}U$ ages of monazite from three kyanite-zone schists were dated at 252 ± 3 Ma (tσ) and 239 ± 4 Ma (tσ), respectively, and the $^{208}Pb/^{232}Th$ ages at 254 ± 4 Ma (tσ) and 238 ± 5 Ma (tσ). The latest Permian age of monazite is coeval with that of peak metamorphism, estimated from the overgrowth rims of zircon in a paragneiss (253 ± 2 Ma). On the other hand, the lack of paragonite and phengite in the metapelites necessitated an external input of heat and/or fluid for the middle Triassic event. Small, isolated bodies of post-collisional granite crop out in the vicinity of study area, and their emplacement ages have been constrained as ~235 Ma by SHRIMP U–Pb zircon. These ages are overlapping with the middle Triassic ages of monazite within the analytical uncertainties, suggesting a possible correlation between the middle Triassic metamorphism and the emplacement of post-collisional granite. All the ages in conjunction with *P*–*T*-ometric and thermochronometric data suggest the high-*P* metamorphism (M_1) (~11 kbar and 670 ^{o}C) at ~253 Ma, the medium-*P* event (M_2) (~6.5 kbar and 630 ^{o}C) at ~238 Ma, and then the regional cooling to 500 ^{o}C at ~230–225 Ma.