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Parageneses and Th-U distributions among allanite, monazite, and xenotime in Barrovian-type metapelites, Imjingang belt, central Korea

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Abstract

The paragenetic relationships and Th-U distributions among allanite, monazite, and xenotime were investigated in a progressive sequence of garnet- to kyanite-zone metapelites of the Imjingang belt, Korea. Allanite is predominant in the garnet and staurolite zones, whereas monazite and xenotime predominate in the kyanite zone. Epidote grains in the lower garnet zone are commonly zoned, from allanite (core) to relatively Y-rich, rare-earth-element (REE)-epidote to clinozoisite (rim), although both REE-epidote and clinozoisite disappear in higher-grade metapelites. Moreover, allanite and REE-epidote often contain minute inclusions of thorium silicate. The isograd distributions and similarity of REE patterns between allanite and monazite suggest that the latter has grown at the expense of the former. In addition, the discontinuous Th zoning in monazite is apparently inherited from heterogeneous Th distribution and thorium silicate inclusions in allanite. Thus, thorium silicate possibly provided the additional Th and U necessary for the monazite formation. Paragenetic relationships of allanite and monazite inclusions within various index minerals suggest that at amphibolite-facies conditions allanite is stable at higher pressures than monazite. Xenotime grains in the staurolite zone are rarely produced by the breakdown of clinozoisite and REE-epidote, whereas those in the kyanite zone are grown primarily at the expense of garnet. Incorporation of Th and U into monazite and xenotime is governed mainly by the brabantite and thorite substitutions, respectively. Taken together, our results suggest that the allanite-to-monazite transformation is primarily responsible for the distributions of REEs, Th, and U among metapelitic phases, and that the xenotime formation was facilitated by the contribution from major silicates, particularly garnet.

Keywords: Allanite, monazite, xenotime, Th and U distributions, Imjingang metapelites