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Composition and formations conditions of andalusite-kyanite-sillimanite pegmatoid segregstions in metamorphic rocks of the Tseel block (Mongolian Altai)

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Quartz veins and pegmatoid segregations containing polymorphous Al2SiO5 modifications often occur in metamorphic complexes. Metapelites abound in various combinations of two Al2SiO5 polymorphs, e.g., andalusite + sillimanite and sillimanite + kyanite (Kerrick, 1990). Rocks with three polymorphs are much scarcer; they result from subsequent crystallization during progressive metamorphism or combined regional and contact metamorphism or from metastable crystallization (Kerrick, 1990). Study of veins containing various Al2SiO5 modifications can give insight into the PT-conditions of metamorphism and their temporal changes. The Tsel block is localized in the basins of the Tseliyn, Hudjertiyn, Sharin, and Deresetuin Rivers and is part of the Hercynides structure on the southern flank of Mongolian Altay. Pegmatoid segregations containing polymorphous Al2SiO5 modifications were discovered in the vicinity of the western contact of one of the largest basic-rock massifs, Buren-Hairhan.They are hosted by schists bearing paragenesis Bt +
Ms + St + Grt + Ky + Sill + And + Fibr + Pl + Qtz. Visual examination of the pegmatoid segregations showed the presence of large (up to 4–5 cm) mineral aggregates —kyanite pseudomorphs developed after andalusite. They are prismatic, with rhombic sections, and are composed of chaotically arranged kyanite crystals with irregular-shaped andalusite relics between them. The samples also contain large (1 cm) muscovite plates localized between the pseudomorphs as well as quartz grains. The pegmatoid segregations bear the following mineral assemblage: And + Ky + Sil + Fibr + Ms + Qtz + Pl + St +Grt + Bt. Predominant minerals are Al2SiO5 polymorphs (30–50 vol.%), muscovite (30–60 vol.%), and quartz (up to 20 vol.%). Biotite and plagioclase are present in small amounts; staurolite and garnet are occasional. Based on the observed mineral correlations, the following sequence of formation of Al2SiO5 polymorphs has been established: First, andalusite was replaced by kyanite to form pseudomorphs; then, fibrolite was produced, which, in turn, gave way to prismatic sillimanite. The fact that fibrolite formed after kyanite is proved by its presence in muscovite developed after the latter mineral. Sillimanite was, most likely, produced later than or synchronously with large muscovite replacing andalusite grains and kyanite pseudomorphs developed after andalusite. 2. Though the estimated P and T values are close to those of the triple point (Pattison, 1992), the studied rocks bear evidence for the replacement of andalusite by kyanite and sillimanite. The mineral assemblages pointing to the kyanitesillimanite type of metamorphism of the host rocks and the presence of andalusite relics in the latter suggest that the andalusite formed during earlier metamorphic events. This polymorph formation sequence agrees with Kozakov's (1986) data on change of the regional metamorphism from andalusite-sillimanite to kyanite-sillimanite one. 3. The great amounts of muscovite in veins containing Al2SiO5 polymorphs and its presence at phase contacts suggest a great role of muscovite in the phase transitions between different polymorphs. Since phases other than Al2SiO5 and muscovite are present in negligible amounts, it is not ruled out that the polymorphs were transformed by the ion exchange mechanism (Carmichael, 1969).

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