



Contrasting P-T-t-d paths of the polycyclic Palaeozoic tectono-metamorphic event in the Southern Chinese Altai: an example from Kalasu area

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To understand the polycyclic Palaeozoic tectono-metamorphic evolution of the Southern Chinese Altai, petrological and structural studies together with thermodynamic modelling and dating were carried out in the Cambro-Ordovician metapelitic sequence of the Kalasu area. The sequence is divided into upper, middle and lower crustal orogenic levels according to their metamorphic grade and structural patterns. Metamorphism increases from low to high-grade towards the deeper crustal levels with garnet-biotite schists in the upper crustal level, sillimanite-garnet and staurolite-garnet-sillimanite schists and gneisses in the middle crustal level, and cordierite-sillimanite-K-feldspar migmatites in the lower crustal level. Structural succession involves a sub-horizontal S1 foliation folded by NE-SW open to tight and upright F2 folds (with no metamorphism associated), reworking by an orthogonal D3 deformation, characterized by NW-SE open to close F3 folds with moderately plunging axes, steeply dipping S3 axial planes and S3 cleavage. Early Devonian calc-alkaline granitoids intruded the sequence parallel to S1 foliation, whereas Permian undeformed gabbroic bodies were emplaced in the lower crust and granites in the upper crust coevally with D3.

In the upper crustal level, the garnet-biotite-bearing schists are composed of g-bi-pl-q-ilm, with biotite and ilmenite parallel to S1, gently folded by F3. The F3 folding is connected with low-grade S3 cleavage marked by biotite. Small garnet has oriented bi-pl-q inclusion trails parallel to S1. In the middle level, the sillimanite-garnet micaschist consists of bi-sill-g-pl-q-ru parallel to S1 gently folded by F3, which is connected with low-grade S3 cleavage marked by muscovite and ilmenite. The dominant lithology in the middle level is migmatitic paragneiss with relicts of st-g-ru parallel to S1 and with bi±sill-mt-bearing leucosomes defining the S3 cleavage. Staurolite porphyroblasts have S1 oriented inclusions of pl-ilm-ru and include garnet. The lower level is characterized by cd-sill-kfs-bearing migmatites. The S1 foliation is locally distinguished by ky-st-ru inclusions in garnet, and the S3 is marked by presence of cordierite-bearing leucosome and by orientation of sill-bi-g in the melanosome. Therefore, the microstructural relationships suggest that the early LP-LT to HP-MT metamorphism is associated to Early Devonian D1 deformation and the UHT-HT metamorphism took place during the Permian D3 reworking.

The P-T-t-d paths indicate that the crystalline rocks underwent a clockwise evolution marked by Early Devonian burial associated with heating, followed by Permian decompression, in agreement with studies from other parts of the Chinese Altai. The burial is recorded in the middle and lower levels by the presence of g-st-ky-ru relicts within the S1 fabric. This stage is related to crustal thickening, whereas heating is related to intrusions of Devonian granite sheets during an extensional setting. A subsequent decompression (around 3-5 kbar) is recorded in all crustal levels, associated with intrusions of gabbro and granite along the southern border of the Chinese Altai and coeval with the last Permian deformation. This last stage is related to the collision between the Junggar arc system and the Chinese Altai orogenic belt.

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