

Metamorphism and geochronology of garnet amphibolite from the Beishan Orogen, southern Central Asian Orogenic Belt: Constraints from P-T path and zircon U-Pb dating

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Numerous lenses of garnet amphibolite occur in the garnet-bearing biotite-plagioclase gneiss belt in the Baishan area of the Beishan Orogen, which connects the Tianshan Orogen to the west and the Mongolia-Xing'an ling Orogen to the east. The study of metamorphism in Beishan area is of great significance to explain the tectonic evolution of Beishan orogen. According to the microstructures, mineral relationships, and geothermobarometry, we identified four stages of mineral assemblages from the garnet amphibolite sample: (1) a pre-peak stage, which is recorded by the cores of garnet together with core-inclusions of plagioclase (Pl₁); (2) a peak stage, which is recorded by the mantles of garnet together with mantle-inclusions of plagioclase (Pl₂) + amphibole (Amp₁) + Ilmenite (Ilm₁) + biotite (Bt₁), developed at temperature-pressure (P-T) conditions of 818.9–836.5 °C and 7.3–9.2 kbar; (3) a retrograde stage, which is recorded by garnet rims + plagioclase (Pl₃) + amphibole (Amp₂) + orthopyroxene (Opx₁) + biotite (Bt₂) + Ilmenite (Ilm₂), developed at P-T conditions of 796.1–836.9 °C and 5.6–7.5 kbar; (4) a symplectitic stage, which is recorded by plagioclase (Pl₄) + orthopyroxene (Opx₂) + amphibole (Amp₃) + biotite (Bt₃) symplectites, developed at P-T conditions of 732 ± 59.6 °C and 6.1 ± 0.6 kbar. Moreover, the U-Pb dating of the Beishan garnet amphibolite indicates an age of 301.9 ± 4.7 Ma for the protolith and 281.4 ± 8.5 Ma for the peak metamorphic age. Therefore, the mineral assemblage, P-T conditions, and zircon U-Pb ages of the Beishan garnet amphibolite define a near-isothermal decompression of a clockwise P-T-t (Pressure-temperature-time) path, indicating the presence of over thickened continental crust in the Huanishan arc until the Early Permian, then the southern Beishan area underwent a process of thinning of the continental crust.

Keywords: Beishan Orogen, Garnet amphibolite, P-T-t path, Zircon U-Pb dating