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AN EARLY PERMIAN GARNET-BEATING PERALUMINOUS GRANITIC PLUTON IN THE SOUTH TIANSHAN OROGENIC BELT, NW CHINA: PETROLOGICAL, MINERALOGICAL AND GEOCHEMICAL CONSTRAINTS

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Paleogeodynamics

The Ku'erchu granitic pluton (283±4 Ma) was exposed in the eastern part of the South Tianshan Orogenic Belt. The granites from the intrusion are mainly composed of orthoclase (~45 vol. %), plagioclase (~15 vol. %), quartz (~20 vol. %), muscovite (~10 vol. %) and biotite (~5 vol. %), with accessory minerals including garnet, zircon and Fe-Ti oxide. Garnet is the dominant accessory mineral, shows growth zoning, and is rich in FeO_T (24.30 % ~ 29.90 %) and MnO (12.15 % ~ 16.89 %) contents. The rocks show high SiO_2 (72.46 wt. % ~ 76.79 wt. %), Al_2O_3 (13.80 wt. % ~ 15.28 wt. %), Na_2O (3.84 wt.% ~4.62 wt. %), K_2O (3.67 wt. % ~ 4.73 wt. %), and have A/CNK values ranging from 1.14 to 1.12, suggesting a strongly peraluminous affinity. Besides, the samples display low Zr (29.6 ppm ~ 47.7 ppm), Zr/Hf (16.61~31.80), Na/Ta (3.05~5.71), Eu/Eu*(0.05 ppm ~ 0.24 ppm) and ∑REE (19.5 ppm ~ 49.2 ppm). These features indicate that the Ku'erchu granite is a highly evolved S-type granite. Mineral chemistry analysis reveals that the crystallization temperature for biotite is 576~608 °C and the solidification pressure is 0.9~1.3 kbar, corresponding to solidification depth 3.25~4.83 km. Petrographic features show that Al-rich minerals (biorite+muscovite+garnet) are the late-stage crystallization phases. Feldspars were crystallized earlier than biotite and garnet, and the latter two phases was related with much lower crystallization pressure.

Garnet crystallized from the MnO-rich evolved melt after fractionation of felsic minerals. The relatively high positive $\varepsilon_{Hf}(t)$ values (–4.78~+2.59) and ancient Hf model ages (1.13~1.61 Ga) suggest that the rocks were probably formed by partial melting of the Paleoproterozoic basement rocks at shallow crustal levels, with participation of depleted mantle in an extensional setting.