

Geological characteristic and ore genesis of typical granite-related rare metal deposits in China

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Rare metal deposits are often related to granitic magmatism and the most important types include alkali-feldspar granite type, alkaline granite type, and granitic pegmatite type. The alkali-feldspar granite type is widespread and the most important ones occur in eastern China, such as the giant Yichuan Ta–Nb–Li deposit in Jiangxi Province. In this deposit, four granite phases occur from bottom to top including the two-mica granite, muscovite granite, albite granite and lepidolite-albite granite. In all the rocks, feldspar belongs to albite with $An < 5$. Ore minerals include columbite, tantalite, lepidolite, and Nb-Ta-rich cassiterite and they all are of magmatic origin. LA-ICP-MS U–Pb dating of zircon yields an age of ~ 155 Ma for the granite. Zircon $\varepsilon_{Hf}(t)$ ranges from -11 to -9 , indicating a crustal source for the magma. The most representative example of the alkaline granite type in China is the giant Baerzhe Zr–REE–Nb deposit in Inner Mongolia of northeastern China. In this deposit, the ore-related granites include albite granite, arfvedsonite-aegirine granite and pegmatite-aplite dyke, and the ore minerals consist of zircon, yttrioberyllite, synchysite, pyrochlore, ferrocolumbite, monazite and fergusonite. LA-ICP-MS dating of zircon yields an age of ~ 123 Ma for the arfvedsonite-aegirine granite. The lanthanide tetrad effect of both whole rock and zircon indicates a strong melt-fluid interaction for petrogenesis and ore genesis. The recently found Yushishan Nb–Ta–Zr–Hf–REE deposit in Gansu Province of northwestern China occurs in the metamorphosed and deformed felsic volcanic rocks (called as leptynite by local geologists) as disseminated, banded and vein type ores. The ore minerals include columbite, tantalite, aeschynite, polycrase, bastnäsite, monazite, zircon and thorite. The monzonite occurs in the north of the mining area and aegirine syenite occurs as dyke and vein within the ore layers. LA-ICP-MS dating of zircon and apatite from both rocks show an age of ~ 500 Ma indicating their emplacement age. However, the titanite in both rocks show two stage formation ages of ~ 500 Ma and ~ 460 Ma, and their trace element signatures indicate either magmatic or metamorphic origin. Hence we suggest the formation of this deposit is likely related to the syn-tectonic alkaline granite magmatism and related hydrothermal events.