

Petrogenetic and exploration implications from study of the Late Cretaceous intrusion at the Bangbule Pb-Zn-Cu deposit, western Gangdese, Tibet

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The Bangbule Pb-Zn-Cu skarn deposit is located in the Lungar-GongboGyamda island arc in the Gangdese-Nyainqentanglha block. It is the only newly discovered polymetallic deposit in the westernmost Nyainqentanglha metallogenic belt. The measured and indicated resources include nearly 0.7 Mt of Pb+Zn. The deposit is associated with a quartz porphyry body emplaced into the Late Permian limestones of the Xiala Formation and Carboniferous sandstones of the Laga Formation. The intrusion occurs as stock in the central and northern part of the orefield.

The orebodies mainly occur as lenses, veins, and irregular masses in the contact zone between the quartz porphyry and limestone or along the boundaries between limestone and sandstone. The Pb-Zn-Cu mineralization in the Banbule deposit is closely associated with skarns. The ore minerals are dominated by galena, sphalerite, chalcopyrite, bornite, and magnetite, with subordinate pyrite, malachite, and azurite. The gangue minerals are mainly garnet, actinolite, diopside, quartz, and calcite.

The quartz-porphyry generally has high SiO₂ (72.78~77.12 wt%), and Na₂O+K₂O (5.20~8.02 wt%) contents. It belongs to the high-K calc-alkaline series and shows enrichment in Rb, Ba, U, Pb, and light rare earth elements, and depletion in Nb, Ta, P, and Ti. In situ LA-ICP-MS zircon U-Pb ages for the quartz porphyry from different locations in the orefield are 77.20±0.81 Ma and 77.31±0.74 Ma. The zircons from the intrusion display ¹⁷⁶Yb/¹⁷⁷Hf and ¹⁷⁶Lu/¹⁷⁷Hf ratios ranging from 0.003895 to 0.098611 and 0.000852 to 0.003833, with ε_{Hf}(t) values of -7.92 to 0.39 (average=-0.56) and two-stage model ages (T_{DM2}) of 1651 to 1121 Ma (average=1502 Ma). The quartz porphyry shows (⁸⁷Sr/⁸⁶Sr)_i values ranging from 0.7148 to 0.7258, with ε_{Nd}(t) values ranging from -9.01 to -7.32. The two-stage Nd model ages (T_{DM2}) are 1612 to 1477 Ma. The lead isotopic analyses yield ²⁰⁶Pb/²⁰⁴Pb of 18.686 to 18.781, ²⁰⁷Pb/²⁰⁴Pb of 15.699 to 15.762, and ²⁰⁸Pb/²⁰⁴Pb of 39.131 to 39.344. All the lead isotope data are constrained around the growth curves of upper crust and orogenic belt according to the tectonic discrimination diagrams.

Based on detailed field work and Pb isotope data, we suggest that Bangbule is a typical skarn deposit, and the polymetallic mineralization is genetically related to the quartz porphyry in the orefield. A zircon age for the quartz porphyry shows that it was emplaced at ca. 77 Ma. Few other granitoids in this area associated with Pb-Zn-Ag mineralization are reported to have crystallization ages of 80~70 Ma. The negative ε_{Hf}(t) and ε_{Nd}(t) values reflect their derivation from mainly ancient crust with subordinate mantle materials. Therefore it is suggested that the westernmost Nyainqentanglha belt has a high metallogenic potential. It is of great exploration significance for the area and makes Nyainqentanglha a 1000-km-long belt of Pb-Zn-Ag polymetallic mineralization.