The Link Between Epithermal Pb-Zn-Sb Mineralization and Magmatic Fluid: The Zhaxikang Deposit in Tibet, China

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The Zhaxikang Pb-Zn-Sb polymetallic deposit, which is located 60 km west of Longzi county, Tibet, is one of the most important deposits in the southern Tibet antimony-gold metallogenic belt, Qinghai-Tibet plateau. Most of the Zhaxikang district is covered by the Lower Jurassic Ridang Formation. The intrusive rocks in the district include two-mica granite dikes/stocks, granodiorite, with minor rhyolite porphyry and diabase dikes. The two-mica granite occurs as small stocks and dikes in outcrop to the north and south of Zhaxikang, with a fine-grained to porphyritic texture. The mineral assemblages include K-feldspar, albite, quartz, muscovite and biotite, with minor zircon, apatite, and ilmenite as accessory minerals. The mineralization occurs mainly in the Ridang Formation and is controlled by NS and NE high-angled normal faults. The dominant mineralization styles are structurally controlled veins and massive ore, with minor breccia and stockwork ore. The alteration types in the district are principally Fe-Mn carbonatization, silicification, chloritization, limonitization, pyritization, argillation, sericitization, pegmatization, and greisenization. Greisenization and pegmatization occur in the surrounding area of two-mica granite. Fe-Mn carbonatization occurs distal to pegmatite and is closely related to Pb-Zn-Sb mineralization. The deposit shares many characteristics with low sulfidation epithermal deposits both in mineralization and alteration, such as the occurrence of bladed calcite, well-developed breccia veins and Mn-rich carbonate alteration.

Tourmaline is abundant in pegmatite and pegmatitized two-mica granite, indicating high B and F content in the parent magma. B and F can efficiently lower the solidus of the magma, and lead to long-lived magmatism and late fluid exsolution. The coexistence of CO_2-rich fluid inclusions and melt, melt-fluid inclusion in pegmatite beryl indicate an unmixing origin of primary magmatic fluid. LRM and microthermometric results show that the primary magmatic fluid is a low-salinity CO_2-rich fluid with minor CH_4 and N_2. Coexistence of AC, C, and ADV fluid inclusions in pegmatite quartz implies a boiling/phase separation process. The LRM and SEM/EDS results confirmed the existence of gahnite in beryl and in fluid inclusions hosted in beryl, indicating high Zn in the parent melt and primary magmatic fluid. Rhodochrosite daughter phases were also detected by LRM and SEM/EDS in CO_2-rich fluid inclusions and melt-fluid inclusions, indicating a possible contribution of magmatic fluid to ore formation. C-O isotope results for rhodochrosite indicate mantle-derived C and a dominant magmatic fluid origin. The H-O isotope results of fluid inclusions hosted in rhodochrosite show a predominantly magmatic origin of ore-forming fluid, with meteoric water (e.g., hot-spring water) contamination.

The styles and spacial distribution of varied mineralization and alteration, together with fluid inclusion results and C-H-O isotope results, give strong evidence for the link between epithermal Pb-Zn-Sb mineralization and magmatic fluid.