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Zhengguang Au-Zn deposit in the eastern CAOB: The oldest intermediate sulfidation epithermal deposit in the world

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Most of the epithermal deposits in Northeast (NE) China formed during Mesozoic largely related to the subduction of the Mongolia-Okhotsk ocean or the paleo-Pacific ocean. As pre-Mesozoic epithermal deposits can hardly be preserved due to their shallow-level formation and post-mineralization uplift-erosion, Zhengguang intermediate sulfidation epithermal (IS) Au-Zn deposit, forming at ca. 480 Ma, is an exception in NE China.

The Zhengguang Au-Zn deposit, situated in the eastern section of Central Asian Orogenic Belt (CAOB) and discovered in 2000, is a large polymetallic epithermal deposit endowed with over 34 t gold, 80 000 t zinc, and over 100 t silver. The host rock types of Zhengguang Au-Zn deposit comprise andesite, andesitic tuff, breccia-bearing tuff, volcanic breccia, hydrothermal breccia, tuffaceous siltstone-mudstone, and intermediate subvolcanic rock. The intrusive rocks includediorite (porphyry), dacite porphyry, monzodiorite, quartz monzonite, and sparse lamprophyre, and diabase porphyry. Besides, volcanic breccia and volcanic agglomerate representing near-volcanic vent lithofacies can be found, indicating the existence of a fossil volcanic edifice. This volcanic edifice and its associated fractures may serve as natural efficient conduits and sinks for ore-forming fluids.

Gold and zinc mineralization at Zhengguang are primarily concentrated in banded quartz-sulfide veins and calcite-quartz-sulfide veins. The predominant gold-hosted mineral species is electrum, with native gold and petzite being the subordinate phases. Most commonly, electrum, native gold and petzite mainly occur as the micro-inclusions in euhedral to subhedral pyrite, and less commonly in sphalerite particles.

The hypogene metallic minerals in Zhengguang include pyrite, sphalerite, chalcopyrite, galena, hematite, minor tetrahedrite/tennantite, magnetite, electrum, petzite, native gold, and hessite. Gangue minerals include quartz, sericite, (Mn-)calcite, dolomite, chlorite, epidote, and minor K-feldspar, illite, and fluorite. In the oxidized zone some secondary minerals can be seen such as malachite, goethite, jarosite, and limonite. The alteration includes potassic and epidotic alteration in the early stage, silicification and sericitization/illitization during the ore-forming stage, and carbonatization and minor dolomitization in the late waning stage. Silicification and sericitization are particularly intense in the vicinity of the quartz-sulfides veins.

Zhengguang belongs to an intermediate sulfidation epithermal deposit based on the following features: a. the sulfides assemblages of pyrite-sphalerite-galena-minor tetrahedrite / tennatite; b. the presence of copious Fe-poor sphalerite; c. the wide-spread occurrence of manganocalcite and calcite; d. restricted but nonnegligible potassic alteration in the early stage veins; e. spatial adjacent relationship with the Tongshan and Duobaoshan porphyry Cu deposit (~480 Ma).

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U-Pb age 469.4 ± 3.9 Ma of diorite porphyry dike cut the orebody was obtained. This impliesmineralization occurred earlier than 470 Ma. The confirmation of early Ordovician mineralization at Zhengguang makes it the oldest epithermal deposit across CAOB and also the oldest IS deposit in the world.

The discovery of the Zhengguqang IS deposit in NE China will undoubtedly spur further exploration and investigation of pre-Mesozoic precious-base metal epithermal deposits in NE China, and hence the whole CAOB metallogenic belt.