American Mineralogist, Volume 106, pages 1503–1519, 2021

Constraints on scheelite genesis at the Dabaoshan stratabound polymetallic deposit, South China

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Abstract

The genesis of the Dabaoshan stratabound base metal deposit has remained in dispute since its discovery. Scheelite is commonly present in both the Cu-S orebody and adjacent porphyry-style Mo-W mineralization and can provide insights into the hydrothermal history. In the stratabound Cu-S orebodies, there are three stages of mineralization: early-stage, Cu-(W), and late-stage. Two types of scheelite (here referred to as SchA and SchB) are identified in the Cu-(W) mineralization stage. SchA is anhedral and disseminated in massive sulfide ores. It coexists with chalcopyrite and replaces the preexisting arsenic-bearing pyrite. SchA exhibits chaotic cathodoluminescent (CL) textures and contains abundant mineral inclusions, including pyrite, chalcopyrite, arsenopyrite, uraninite, and minor REE-bearing minerals. Chemically, SchA displays middle REE (MREE)-enriched patterns with negative Eu anomalies. SchB occurs in veins crosscutting the stratabound orebodies and shows patchy textures in CL images. Based on CL texture, SchB is subdivided into SchB1 and SchB2. SchB1 is CL-dark and occasionally shows oscillatory zoning, whereas SchB2 is CL-bright and relatively homogeneous. Chemically, SchB1 has a high-U content (mean = 552 ppm) and REE patterns varying from MREE-enriched to MREE-depleted. In contrast, SchB2 is depleted in U (mean = 2.5 ppm) and has MREE-enriched patterns. Compared with SchB, SchA is significantly enriched in Ba.

Scheelite in the stratabound orebodies has similar Y/Ho ratios and trace-element characteristics as Sch3 in the Dabaoshan porphyry system. In situ U-Pb dating of hydrothermal apatite, collected from the Sch3-bearing veins in the footwall of stratabound orebodies, yielded a mineralization age of 160.8 ± 1.1 Ma. Zircon from the Dabaoshan granite porphyry yielded a U-Pb age of 161.8 ± 1.0 Ma. These two ages are consistent within uncertainty, suggesting that the ore-forming fluid responsible for tungsten mineralization in the stratabound orebodies was derived from the porphyry system. When fluid emanating from the deep porphyry system encountered the overlying Lower Qiziqiao Formation and stratabound orebodies, replacement reactions resulted in dramatic variations in physiochemical conditions (e.g., decrease in f_{O_2}, increase in Ca/Fe, As, Ba). During this process, U^{6+} was reduced to U^{4+}, and As and Ba were leached out of the preexisting pyrite and host rock. Fluid-rock interactions triggered a rapid discharge of fluids, forming SchA with chaotic CL textures and abundant inclusions, but uniform REE patterns. SchB (characterized by patches with different chemical characteristics) may have been formed from repeated injection of ascending fluids into fractures crosscutting the pre-existing massive sulfide ores. We propose that Jurassic porphyry Mo-W mineralization contributed to tungsten mineralization in the stratabound orebodies. Considering that Cu and W mineralization are genetically related, not only in the footwall but also in the stratabound orebodies, we infer that Cu in the stratabound orebodies was locally sourced from the Jurassic porphyry mineralization.

Keywords: Scheelite, trace elements, stratabound mineralization, Dabaoshan, apatite U-Pb dating