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Texture and geochemistry of multi-stage hydrothermal scheelite in the Tongshankou porphyry-skarn Cu-Mo(-W) deposit, eastern China: Implications for ore-forming process and fluid metasomatism

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Abstract

Scheelite from the Tongshankou porphyry-skarn Cu-Mo(-W) deposit occurs mainly as disseminated grains in the altered granodiorite porphyries at depth (Sch A), in the skarn coeval with retrograde alteration (Sch B) and in distal quartz veins crosscutting marbles (Sch C). Cathodoluminescence (CL) responses within a single Sch A grain reveal two subtypes: CL-clear Sch A-I and CL-turbid, densely veined Sch A-II. The CL contrast, coupled with geochemical data, suggest Sch A-I was metasomatized to form Sch A-II. CL images reveal that Sch A-I, Sch B and Sch C are all homogenous, with blue luminescence and are depleted in heavy rare earth elements (HREE), indicating a primary origin. However, Sch A-II is characterized by higher contents of light REE and heavy REE as well as higher Sr isotopes (0.7080–0.7100) than the primary scheelite (<0.7080). These differences indicate that Sch A-II formed through dissolution-reprecipitation. The Sr isotopes of the primary scheelite (0.7073–0.7078) are generally consistent with those of the mineralized granodiorite porphyries (0.7061–0.7063) and mafic enclaves (0.7058–0.7073). The granodiorite porphyries contain low tungsten contents (3–11 ppm), whereas high tungsten contents were detected in mafic enclaves (48–75 ppm). The coexistence of mafic enclaves and tungsten mineralization at depth, and their consistent Sr isotopes, indicates that the interaction of mafic enclaves and exsolved magmatic fluids from the granodiorite porphyries may have played an important role in the extraction of tungsten from the mafic enclaves and formation of scheelite mineralization. Our work shows that scheelite geochemistry can be used to trace the mineralizing conditions but the compositions may be significantly modified during the ore-forming process. Thus, detailed textural relationships should be investigated before using scheelite geochemistry to constrain the hydrothermal fluids and ore genesis.

Keywords: Scheelite, metasomatic alteration, dissolution-reprecipitation, mineral textures, mineral geochemistry