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Metal source and hydrothermal evolution of the Jiaoxi quartz vein-type tungsten deposit (Tibet): Insights from textural and compositional variations of wolframite and scheelite

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Abstract

We evaluate the controlling factors of hydrothermal wolframite and scheelite precipitation in the quartz vein-type Jiaoxi tungsten deposit situated in the western part of the Lhasa terrane (Tibet, China) using texture, major and trace element mineral geochemistry, and sulfur stable isotope geochemistry. Pyrite and chalcopyrite that are intergrown with Fe-enriched wolframite and siderite, have distinct in situ S isotope compositions ($\delta^{34}S_{V\text{-}CDT}$) of −31.38 to +1.77‰, and +2.07 to +2.30‰, respectively. Major and trace element contents and in situ S isotope compositions of pyrite and chalcopyrite indicate that the hydrothermal evolution involved fluid-fluid mixing and greisenization. We report evidence for an early magmatic fluid, which is characterized by the enrichment of W, Mn, Zr, Ti, Sc, and Sn and depletion of Fe. This magmatic fluid was diluted by meteoric water and interacted with biotite monzogranite porphyry to leach Fe, Mg, and Zn into the system to form wolframites with variable Fe/(Fe+Mn) ratios ranging between 0.06–0.84. The late Fe-enriched magmatic fluid released from the muscovite granite mixed with meteoric water that leached minor Fe and S from shale to form late shale-hosted wolframite with a Fe/(Fe+Mn) mass ratio of >0.75 and coeval siderite and sulfides. This study highlights that multiple Fe sources were present in the system, including muscovite granite-released Fe through fluid exsolution, biotite monzogranite porphyry-released Fe during greisenization, and minor Fe released from the shale as a result of meteoric water leaching.

Keywords: Wolframite, scheelite, trace element geochemistry, in situ S isotope, multiple Fe sources, Jiaoxi quartz vein-type W deposit