

Scheelite elemental and isotopic signatures: Implications for the genesis of skarn-type W-Mo deposits in the Chizhou Area, Anhui Province, Eastern China

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ABSTRACT

Scheelite is well developed in hydrothermal deposits, providing a window into genetic processes and facilitating comparative studies, however, few studies have focused on characterizing scheelite in skarn-type W-Mo deposits. The primary ore mineral in the Jitoushan and Baizhangyan skarn-type W-Mo deposits (Anhui Province, Eastern China), scheelite was analyzed for major, trace, and rare earth element (REE) abundance and for Sr-Nd isotopes. The analysis revealed two unique geochemical characteristics that distinguish the scheelite from skarn-type W-Mo deposits to that from vein-type Au-W and porphyry-type W-Mo deposits: higher Mo content with a negative correlation between MoO₃ and WO₃ and a strong HREE depletion.

Skarn-type scheelite mainly inherited REE signatures from ore-forming fluids, and the early precipitation of skarn minerals (e.g., garnet, diopside, and amphibole) has most likely resulted in the observed strong HREE depletion in scheelite and the decoupling of LREEs and HREEs. Of the numerous substitution mechanisms suggested by previous workers, $3\text{Ca}^{2+} = 2\text{REE}^{3+} + \square\text{Ca}$ (where $\square\text{Ca}$ is a Ca-site vacancy) is preferred for the substitution of REE³⁺ for Ca²⁺ and in this study, particularly given the low salinity of ore fluids.

As the scheelite Eu anomalies were inherited from ore-forming fluids with variable redox conditions and pH, the complex $\delta\text{Eu}/\text{Mo}$ correlation indicates that Mo increasingly entered the scheelite under oxidizing conditions and reached a maximum at δEu values of 0.8 to 1. In contrast, under reducing conditions, Mo contents in scheelite decrease gradually and Mo is precipitated as molybdenite as a result of the change in dominant valence state.

Unlike the Sr-Nd isotope compositions of scheelite from vein-type Au-(W) and W-(Sb-Au) deposits, the scheelite from skarn-type W-Mo deposits has low (¹⁴³Nd/¹⁴⁴Nd)(t) (most <0.5125) and intermediate (⁸⁷Sr/⁸⁶Sr)(t) values (most between 0.708 and 0.715). The $\epsilon\text{Nd}(t)$ values of the scheelite varied from -16 to -12.3 in the Baizhangyan deposit and from -9.5 to -9.1 in the Jitoushan deposit, indicating that the ore-forming materials in the two W-Mo deposits were mainly derived from crustal sources.

Keywords: Skarn-type, scheelite, trace element, substitution, REE, Sr-Nd isotope, Eu anomaly, W-Mo deposits, Chizhou