American Mineralogist, Volume 109, pages 747–763, 2024

Scheelite composition fingerprints pulsed flow of magmatic fluid in the Fujiashan W skarn deposit, eastern China

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Abstract

Scheelite ($CaWO_4$) is an economically important W mineral in skarns that form when magmatic fluids exsolved from a granitic intrusion react with carbonate wall rocks. In the Fujiashan W skarn deposit, scheelite formed during four stages of the hydrothermal skarn development. We present cathodoluminescence (CL) images and in situ trace element and Sr-O isotope data of scheelite from these four stages, i.e., scheelite in prograde and retrograde skarn, quartz-sulfide veins, and late calcite replacements. Scheelite from prograde skarn and quartz sulfide veins are homogeneous and show oscillatory zoning textures in CL images, whereas scheelite from retrograde skarn and late carbonate stages display dissolution-reprecipitation and patchy textures. The brightness of CL textures decreases with a higher substitution of Mo. Molybdenum-rich scheelite (up to 2.1 wt%) is characterized by relatively high contents of Nb and Ta (up to 156 and 0.9 ppm, respectively), positive Eu anomalies, high-$\delta^{18}O$ values (5.2 to 5.9‰), and relatively low-$^{87}Sr/^{86}Sr$ values (0.70661 to 0.70727), and has grown in a system with a continuous supply of magmatic fluid. Molybdenum-poor scheelite (0.2 wt%) has low contents of Nb and Ta, negative Eu anomalies, low-$\delta^{18}O$ values (4.2 to 4.3‰), and relatively high-$^{87}Sr/^{86}Sr$ ratios (0.70748 to 0.70804). This type of scheelite formed in a system with a restricted flow of magmatic fluid during scheelite precipitation became increasingly depleted in elements that substitute into scheelite. The continued reaction of the magmatic fluid with the wall rocks and the precipitation of minerals from the fluid resulted in a systematic change of the $\delta^{18}O$ and $^{87}Sr/^{86}Sr$ ratios. Chemical and isotopic variations in scheelite may reflect the pulsed flow of a magmatic fluid and do not require the involvement of different fluids or contrasting redox conditions.

Keywords: Scheelite, trace element, In-situ Sr-O isotope analysis, pulsed magmatic fluid, skarn