

## **Scheelite U-Pb geochronology and trace element geochemistry fingerprint W mineralization in the giant Zhuxi W deposit, South China**

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### **ABSTRACT**

Skarn-type tungsten deposits are widely distributed all over the world and contribute more than 70% of the world's W supply. The temporal relation between the W mineralization and causative intrusions and the evolution of ore-forming fluids are matters of ongoing debate. In this study, we combine in situ LA-ICP-MS U-Pb dating and trace element compositions of scheelite from Zhuxi, the world's largest W deposit, and compare them with literature data to address the above issues. Three primary ore stages exist at Zhuxi: prograde skarn, retrograde skarn, and quartz-sulfide stages. Most scheelite occurs in the retrograde skarn stage and is further subdivided into three generations: Sch A, B, and C.

The obtained LA-ICP-MS U-Pb ages for three scheelite generations in the Zhuxi deposit are  $154.0 \pm 2.8$ ,  $150.3 \pm 3.5$ , and  $150.4 \pm 6.3$  Ma, respectively, indicating that the entire W mineralization is closely related to the emplacement of the nearby Late Jurassic granites (~154 to 150 Ma, zircon U-Pb ages). In situ LA-ICP-MS trace element results demonstrate that Sch A shows the highest Mo content (mean = 1002 ppm), where those for Sch B and Sch C are 109 and 45 ppm, respectively. These, combined with the gradually increasing trend of Ce contents and  $\delta\text{Ce}$  values, indicate a shift from oxidizing to reducing conditions for the ore-forming fluid. All three scheelite generations yield significant positive  $\delta\text{Eu}$  anomalies, which are considered to be unrelated to the redox state, but caused by the addition of Eu (e.g., feldspar dissolution). The high-Y/Ho ratio of scheelite and a good correlation between Y/Ho ratio and  $\delta\text{Eu}$  ( $R^2 = 0.96$ ) suggest that intense fluid-rock interactions between ore fluids and the Shuangqiaoshan Group metasedimentary rocks as well as earlier-formed skarns drove fluid evolution. This study demonstrates that scheelite U-Pb geochronology is a useful technique when identifying the temporal link between hydrothermal W mineralization and the causative intrusion. Our results also highlight that the reactions of the ore fluids with wall rocks and earlier-formed skarns significantly modify the primary fluid compositions.

**Keywords:** Scheelite LA-ICP-MS U-Pb dating, trace element, skarn W mineralization, Zhuxi, South China