

Trace element composition characteristics and geological significance of sphalerite in the Dulong tin-polymetallic deposit, Yunnan, China

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The Dulong tin-polymetallic deposit, located in the eastern part of Dulong Township, Maguan County, Yunnan Province, China, is one of the most important cassiterite sulphide deposits in the world. In addition to Sn, Zn and Cu, the deposit is also heavily enriched with associated elements such as In, whose main carrier is sphalerite, but the enrichment mechanism and physicochemical conditions of the associated elements are currently unclear. Therefore, in this paper, through systematic field investigations and detailed petrographic/mineralogical work, three different generations of sphalerite were identified in this deposit, and electron microprobe and in situ compositional analysis by LA-ICPMS was carried out to identify the enrichment characteristics of the main trace elements in the sphalerite and to further explore the temperature of mineralization and the type of deposit genesis. The results show that there are significant differences in the content of the main-trace elements in the three different mineral generations of sphalerite, SpI → SpII → SpIII, with significantly lower In, Fe, Cu and Cd contents and significantly higher Co and Zn contents. Overall sphalerite is characterised by enrichment in Mn, Co, In and Fe, and depletion in Ga, Ge and Sn. The Fe/Zn, Ga/In and Zn/Cd values of the elements in sphalerite are indicative of a medium to high temperature of mineralization, and the mineralization temperature of the first generation of sphalerite → the second generation of sphalerite → the third generation of sphalerite becomes progressively lower. The ideal enrichment environment for In is likely to be higher temperatures and more adequate fluid concentrations of Cd²⁺, Fe²⁺ and Cu⁺ ions, with substitution mechanisms likely to be dominated by In³⁺+Cu⁺ ↔ 2Zn²⁺. The trace element composition of sphalerite in this deposit is distinctly different from that of MVT, VHMS and Sedex Lead-Zn deposits and is similar to that of magmatic hydrothermal deposits, further demonstrating that this deposit is a medium to high temperature hydrothermal metasomatic genesis deposit closely associated with late Yanshanian magmatic hydrothermal activity.

Keywords: The Dulong tin - polymetallic deposit; Sphalerite; Trace elements; LA-ICPMS; Skarn; indium