

Application of chlorite to prospecting for porphyry ore deposits: An example from the Shaxi porphyry Cu-Au deposit, Middle-Lower Yangtze River Valley metallogenic belt, China

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Propylitic alteration is a key guide in the exploration for porphyry ore deposits. Previous studies of chlorite in areas of propylitic alteration show that a variety of elements, including K, Li, Mg, Ca, Sr, Ba, Ti, V, Mn, Co, Ni, Zn, and Pb, display systematic spatial variations relative to the porphyry center. We analyzed the major, minor, and trace elements of chlorite in propylitic alteration from drill holes at the Shaxi porphyry copper-gold deposit, using EMPA and LA-ICP-MS to examine the applicability of chlorite chemistry as a tool for detecting porphyry ore deposits.

The Shaxi deposit, located in the northern part of the Lu-Zong area, shows typical porphyry-related alteration zones including potassic and propylitic assemblages, which are overprinted by phyllic and argillic alteration. Chlorite together with epidote formed by replacing biotite, amphibole, or plagioclase. Based on the occurrence characteristics of chlorite, it can be divided into two types: (1) chlorite hosted in the orebody where it is associated with areas of strong potassic and phyllic alteration and (2) chlorite in the barren or weakly mineralized tonalite that has been affected by phyllic alteration.

Chlorite compositions determined by EMPA correspond to clinocllore and pennine, with an average equimolar proportion of Fe/(Fe+Mg) of 0.2. Using the chlorite geothermometer, the calculated crystallization temperatures of chlorite range from 198 to 272°C with an average of 241°C, and with an irregular spatial distribution of temperature variations. The Ti in chlorite decreases from the orebody to the wallrocks, whereas Mn increases. The content of Ti and Mn do not correlate with the crystallization temperature. We infer that the minor and trace elements in chlorite are mainly controlled by the composition of primary minerals such as biotite and amphibole that it replaces, and the systematic variation of Ti reflects the composition of biotite in the potassic alteration zone. Alteration that overprints the propylitic alteration may result in changes in the chlorite chemistry. As a result, many elements do not show systematic variations. For chlorite chemistry to be an effective tool for exploration, it is necessary to analyze chlorite that has not been overprinted by other alteration.