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Characteristics and Significance of Chlorite from Xinliaodong Cu Polymetallic Deposit in Western Guangdong Province, China

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1 Introduction

Eastern Guangdong Province is located in the intersection part of Nanling E-W tectonic-magmatic belt and the southeastern China N-E volcanic belt (Xu et al., 1999). The Xinliaodong is a newly-discovered copper ore deposit in eastern Guangdong Province, the genesis and type of which remains unclear until this moment. Chlorite is one of the main ore associated alteration minerals, which perhaps genetically related to copper mineralization in this ore district. Based on the field geological survey, microscopic observation and electron microprobe analysis, we systematically studied the category, elemental composition, forming temperature, forming environment and the formation mechanism of the chlorites with various occurrences from the Xinliaodong Cu polymetallic deposit. This paper tries to conduct preliminary studies on the relationship between chlorite and mineralization.

2 Mineralogy of the Chlorite

According to the mineral association, chlorites from Xinliaodong Cu polymetallic ore deposit can be classified into two types and both types of chlorites show light gray-green or kelly color under polarized light. The first type is assumed that unrelated to mineralization as they do not coexist with sulfide, and we call them type I chlorite in this study. This type of chlorite shows light green color in hand specimen and they normally distribute along fissures and/or surrounding quartz grains. Sometimes, biotite or feldspar are replaced by chlorites, thus exhibit pseudomorphism metasomatic texture, and this type of chlorites show an appearance of vermicular aggregation, scalelike shape or crumby under microscope. The second

type of chlorite usually coexists with pyrite and chalcopyrite, which is considered to be genetically associated with Cu mineralization. We call them type II chlorites here. This type of chlorite shows blackish green color in hand specimen. Foliate and fibrous are the commonly observed occurrences.

3 Chemical Composition of the Chlorite

The electron microprobe analysis data indicates that the contents of Fe and Mg in the two types of chlorites varies significantly, and there is a coupling relationship between them, which probably reflects a mutual interchange of the two elements in the chlorite crystal. In addition, type II chlorite, which is closely associate with Cu mineralization are more Fe rich than the type I chlorite. However, there is no obvious distinction between the contents of SiO₂, Al₂O₃ and MnO between the two types. In the Fe-Si classification diagram, the two types of chlorite are mainly categorized to be Fe-rich chlorite (prochlorite and brunsvigite). According to the previous understandings, the formation of Fe-rich chlorites is believed to be associated with boiling of the ore-forming fluids (Inoue, 1995). Furthermore, a relatively more reduce environment is suggested more favorable for the formation of Fe-rich chlorites (Inoue, 1995).

The high value of Fe/(Fe+Mg) of the chlorites from the Xinliaodong indicates that the hydrothermal fluid showed a characteristic of reducibility during the formation of the chlorites. Generally, chlorite from argillaceous rock related hydrothermal alteration have a higher ratio of Al/(Al+Mg+Fe)(>0.35) than that of mafic rocks associate alteration (Liao et al., 2010). In this study, almost all of the ratios Al/(Al+Mg+Fe) are more than 0.35 or close to 0.35, indicating most of the formation of chlorite from

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Xinliaodong ore deposit was contributed by the hydrothermal alteration of argillaceous rocks. The correlations between these characteristic values of the chlorite indicate that Fe-Mg substitution dominates the octahedral substitution and Al^{VI} -Mg substitution takes a secondary position. In general, if Fe replaces Mg, then it means that the chlorites are formed in a relatively acidic environment. Conversely, if Mg replaces Fe, then it indicates that the chlorites are formed in a relatively alkaline environment (Ai et al., 1998). So the two types of chlorites from Xinliaodong ore district were formed in a relatively acidic environment.

4 Formation Mechanism of the Chlorites and Significance

The chlorite is suggested to be a good geothermometer. According to the computational formulas which were forwarded by Stefano (1999), the authors estimated the formation temperatures of the chlorites from Xinliaodong ore district in this study. Through calculation, we arrived the conclusion that the two types of chlorite were formed at temperatures of 166.3°C to 245.62°C (averagely 219.15°C). Moreover, our data demonstrates that the chlorite related to mineralization had a relatively higher formation temperatures. Besides, the main formation mechanism of the two types of chlorites were dissolution - crystallization and dissolution - migration - crystallization in accordance with their occurrences and paragenetic

association. Consequently, based on the above discussions, combining with their geological characteristics and available geophysical data, we speculate that there may be a concealed porphyry in depth, and the discovered copper orebodies probably close to the epithermal type. It has potential to discover porphyry deposit at depth.

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