

Genetic Mineralogy of Chlorite from the Dongyaozhuang Gold Deposit, Wutai Mountain, Shanxi Province, China

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Abstract: Chlorite is a common mineral of metamorphism and hydrothermal alteration. Its compositional characteristics can reflect the physicochemical conditions of the fluid and provide insightful clues to the mineral genesis and related metallogenic conditions. The Dongyaozhuang gold deposit occurs in the Neoproterozoic Wutai greenstone belt, with various genetic multi-stage chloritization. In the deposit, at least three stages of chlorite have been identified. They include the chlorite formed in the Precambrian regional metamorphism (C1), the chlorite, occurred in the deformed sulfide-(tourmaline)-quartz veins, formed by the hydrothermal alteration in the late stage of metamorphism (C2), and the chlorite, occurred in hydrothermal veins of orebodies, formed in the main stage of gold mineralization (C3), respectively. The genetic mineralogy of various stages of chlorite indicates that the C1 belongs to magnesian chlorite, while the C2 and C3 belong to iron chlorite. Comparing to the C2, the C3 is relatively rich in Al. From early to late stages, the C1, C2 and C3 have calculated formation temperatures varying from 348 to 464 °C (average of 398 °C), from 288 to 490 °C (average of 380 °C), and from 145 to 259 °C (average of 215 °C), respectively. Especially, the calculated $\lg f(\text{O}_2)$ values vary from -32.28 to -24.76 (average of -28.91) for the C2, and from -50.37 to -35.71 (average of -42.07) for the C3, and the $\lg f(\text{S}_2)$ values vary from -10.24 to -6.28 (average of -8.49) for the C2 and from -19.26 to -11.98 (average of -15.23) for the C3. Generally, the metamorphic chlorite (C1) in the Dongyaozhuang gold deposit was relatively rich in MgO. The C2 which is a hydrothermal chlorite in association with the early gold mineralization is relatively rich in FeO, with the formation conditions of intermediate temperature and relatively high oxidized environment with oxygen fugacity in the HM-NNO buffer zone. The C3 which is a late hydrothermal chlorite in association with the main gold mineralization also belongs to the iron chlorite, but it was formed at relatively low temperature and in a relatively low oxidized environment with oxygen fugacity in the NNO-FMQ buffer zone. The significant spatial differences in chemical compositions and physicochemical properties of various stages of chlorites, such as the $\text{Fe}/(\text{Fe}+\text{Mg})$ ratios are gradually increased but the oxygen and sulfur fugacity values are decreased, for chlorites from the country rock to gold orebody, can be taken as indicators for tracking the evolution and flowing path of ore-forming fluids and for prospecting gold mineralization.

Keywords: genetic mineralogy; chlorite; mineral chemistry; gold deposit; the Dongyaozhuang; Wutai Mountain