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Chlorite Composition as a Tracer for Mineral Exploration of the Disseminated Gold Deposit

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Orogenic gold deposits are one of the most important styles of gold mineralization. Despite extensive research that has been published, some crucial questions regarding metallogenic process of disseminated ore remain unresolved. Much of this uncertainty is due to the absence of fluid inclusions, which significantly complicates understanding the mechanisms of mineral precipitation. Chlorite is one of the most widely developed altered minerals in orogenic gold deposits. In this contribution, we conducted petrographic and geochemical analyses on chlorite in barren and ore-bearing marble, granite, and leptynite to better understand the hydrothermal alteration processes, Au precipitation mechanisms, and to provide insights into ore-forming tracer. Ripidolite was identified as the primary chlorite phase in the wall rocks, replacing biotite, hornblende, and plagioclase through dissolution-crystallization processes, which suggests relatively low water-to-rock ratio conditions. In contrast, the chlorite in the ores consists primarily brunsvigite and pyrochlore, often coexisting with pyrite, with no residual precursor minerals, which suggests formation from dissolution-migration-crystallization processes under high water-to-rock ratio environment. Mineral chemistry analyses show that chlorite in ores exhibits relatively higher Mg / (Fe + Mg) ratio, which possibly indicating a relatively higher oxygen fugacity in a reducing environment. A comprehensive investigation revealed that the relative increase in fO_2 leads to a drop in the concentration of HS^- and consequently, metal precipitation. Chlorite formed during this process also exhibits increased Mn concentration and decreased Ti, Ni, Co, and Rb concentrations, with a lower Rb/Sr ratio, indicating the limited mobility of weakly reactive elements within the ore-forming fluid. Thus, we conclude that Mg / (Fe +Mg) ratio, Rb/Sr ratio, and concentrations of Ti, Ni, Co, and Rb in chlorite could potentially serve as an ore-forming indicator in the Guocheng gold deposit.