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Fingerprinting the source and complex history of ore fluids of a giant lode gold deposit using quartz textures and in-situ oxygen isotopes

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Abstract

Determining the source and history of hydrothermal fluids are key to better understanding the genesis of lode gold deposits. However, it is difficult to rigorously constrain the fluid history because the fluids typically have a prolonged and complicated history that may obscure the original source signature. We integrate textural characterization, trace element geochemistry, and in situ oxygen isotope analyses of quartz covering three major paragenetic stages of the world-class Dongping lode gold deposit to fingerprint the ore-fluid source and document the deposit's complex hydrothermal history. Six quartz generations were identified from three paragenetic stages. They consistently display small to large ranges in $\delta^{18}O$ values from 13.1 to 0.6‰ (VSMOW), which correspond to calculated $\delta^{18}O$ values of 7.4 to –6.0‰ for the quartz-forming fluids. These isotope data are intermediate between the $\delta^{18}O$ ranges of magmatic fluids and meteoric water and thus are best interpreted in terms of episodic fluxes of magmatically derived fluids and their subsequent mixing with variable proportions of external meteoric water. Our results highlight the important role of magmatic hydrothermal fluids and their mixing with meteoric water to form the giant Dongping gold deposit. Given the high abundance of quartz that typically spans the entire mineralization process of lode gold deposits, we envisage the versatility and reliability of in situ oxygen isotope analysis of well-characterized quartz in deciphering the origin and complex evolution history of gold-forming fluids.

Keywords: Quartz vein, textural characterization, oxygen isotope, fluid source and history, lode gold deposit; Isotopes, Minerals, and Petrology: Honoring John Valley