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Textural and chemical variations of micas as indicators for tungsten mineralization: Evidence from highly evolved granites in the Dahutang tungsten deposit, South China

Rong Yin[1], Li Han[1], Xiao-Long Huang[1,*], Jie Li[2], Wu-Xian Li[1], and Lin-Li Chen[1]

[1]State Key Laboratory of Isotope Geochemistry, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 510640, China
[2]Key Laboratory of Submarine Geosciences, State Oceanic Administration; Second Institute of Oceanography, Ministry of Natural Resources, Hangzhou, 310012, China

Abstract

The Dahutang tungsten deposit, located in the Yangtze Block, South China, is one of the largest tungsten deposits in the world. Tungsten mineralization is closely related to Mesozoic granitic plutons. A drill core through a pluton in the Dalingshang ore block in the Central segment of the Dahutang tungsten deposit shows that the pluton is characterized by multi-stage intrusive phases including biotite granite, muscovite granite, and Li-mica granite. The granites are strongly peraluminous and rich in P and F. Decreasing bulk-rock $(La/Yb)_N$ ratios and total rare earth element (ΣREE) concentrations from the biotite granite to muscovite granite and Li-mica granite suggest an evolution involving the fractional crystallization of plagioclase. Bulk-rock Li, Rb, Cs, P, Sn, Nb, and Ta contents increase with decreasing Zr/Hf and Nb/Ta ratios, denoting that the muscovite granite and Li-mica granite have experienced a higher degree of magmatic fractionation than the biotite granite. In addition, the muscovite and Li-mica granites show M-type lanthanide tetrad effect, which indicates hydrothermal alteration during the post-magmatic stage. The micas are classified as lithian biotite and muscovite in the biotite granite, muscovite in the muscovite granite, and Li-muscovite and lepidolite in the Li-mica granite. The Li, F, Rb, and Cs contents of micas increase, while FeO^T, MgO, and TiO_2 contents decrease with increasing degree of magmatic fractionation. Micas in the muscovite granite and Li-mica granite exhibit compositional zonation in which Si, Rb, F, Fe, and Li increase, and Al decreases gradually from core to mantle, consistent with magmatic differentiation. However, the outermost rim contains much lower contents of Si, Rb, F, Fe, and Li, and higher Al than the mantle domains due to metasomatism in the presence of fluids. The variability in W contents of the micas matches the variability in Li, F, Rb, and Cs contents, indicating that both the magmatic and hydrothermal evolutions were closely associated with W mineralization in the Dahutang deposit. The chemical zoning of muscovite and Li-micas not only traces the processes of W enrichment by magmatic differentiation and volatiles but also traces the leaching of W by the fluids. Therefore, micas are indicators not only for the magmatic–hydrothermal evolution of granite, but also for tungsten mineralization.

Keywords: Mica, Dahutang tungsten deposit, highly evolved granite, magmatic evolution, hydrothermal evolution, South China