SEG 2017 Conference

Origin of the Eocene Porphyries and Mafic Microgranular Enclaves from the Beiya Porphyry-Skarn Au Polymetallic Deposit, Western Yunnan, China

Wenyan He,* Liqiang Yang, Xuanxue Mo, and Xinshang Bao

China University of Geosciences, Beijing, Beijing, China, *e-mail, wyhe@cugb.edu.cn

The origin of magmas with high H_2O, S, and metals that are linked to economic porphyry mineralization in continental collisional belts is controversial. We studied the host porphyries and associated microgranular enclaves (MMEs), including gabbroic and dioritic enclaves, from the large Beiya porphyry Au deposit in the Jinshajiang-Ailaoshan belt, which provide firsthand evidence of crust-mantle hybridization in the formation of fertile magma for porphyry deposit formation. Zircon LA-ICP-MS U-Pb ages indicate coeval formation for the MMEs and the felsic porphyries at ~36 Ma. The MMEs show spheroidal shapes, acicular apatites, and oscillatory zoning with repeated resorption surfaces in plagioclase, which suggest that the MMEs are globules of a more mafic magma that was injected into and mingled with the host felsic magma. One gabbroic enclave sample exhibits high MgO (5.6 wt %), high TiO_2 (1.7 wt %), enrichment in large-ion lithophile elements (LILE), and depletion in high field strength elements (HFSE), with negative Nb, Ta, and Ti anomalies. This indicates that the gabbroic enclave is similar to those of the coeval potassic mafic rocks in western Yunnan, which originated from the enriched mantle metasomatized by slab-derived fluids. The dioritic enclaves exhibit both potassic and adakitic-like features and are characterized by high contents of MgO (4.4–4.9 wt %), K_2O (6.4–7.4 wt %), and compatible trace elements (e.g., Ni: 115–142 ppm; Cr: 214–291 ppm), as well as by high Sr/Y ratios. The dioritic enclave samples yield εHf (t) values (−1.9–+3.6) similar to those of the host porphyries. Petrographic, elemental, and isotopic evidence suggests that the Beiya dioritic enclaves were formed by mixing between potassic mafic and adakitc-like melts, derived from metasomatized lithospheric mantle and lower crust, respectively. In contrast, the Beiya host porphyries are characterized by high SiO_2 (66.9–71.9 wt %) and Al_2O_3 (13.8–15.9 wt %) contents, high Sr/Y ratios (35–79), low compatible element contents (e.g. Ni = 0.9–7.2 ppm; Cr =1.0–8.2 ppm), low Mg# values (0.19–0.35), positive LILE anomalies, marked negative high HFSE anomalies, negative εNd(t) values (−6 to −2), and high $(^{87}Sr/^{86}Sr)_i$ values (0.7071–0.7081). These features indicate that the host porphyries were mainly formed by partial melting of subduction-modified lower crust with a certain assimilation of mafic melts represented by MMEs. The MMEs hosted in the Beiya porphyries formed from a hydrous, mafic magma, although they formed in a non-arc setting. High magmatic water content is probably related to an enriched mantle metasomatized by fluids from a Proterozoic subducted oceanic slab. High Cu (341–626 ppm) and Au contents of the MMEs suggest they crystallized from a metal-rich mafic melt. Complex assemblages of pyrite-chalcopyrite-apatite-rutile with hornblende are observed in the least altered MME. We suggest that the mafic melt probably supplied part of the water and metal to the Beiya porphyry Au system.