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U-Pb ages and trace element of zircon from igneous rocks: Implications on the potential of porphyry-Cu field in the Sangilo Epithermal System, Philippines

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This research investigates the geochemistry and geochronology of host rocks—quartz diorite, gabbro, granodiorite, and basaltic trachyandesite—and serpentinized basaltic dike in the Sangilo epithermal Au system, Baguio Mining District (BMD), Philippines. It explores the relationship of these rocks with a 2-meter Cu mineralization zone hosted within the gabbro unit to understand the signature of porphyry Cu deposit.

A serpentinized basaltic dike intrudes an adakitic granodiorite body (16.21 ± 0.34 Ma), showing chondrite normalized rare earth elements (REE) depleted in both LREE and HREE [1]. The trace element of zircon from potassic-altered gabbro (22.23 ± 0.21 Ma) exhibits negative ΔFMQ values (-2.01 to -0.03), indicating reducing conditions unfavorable for porphyry Cu formation. This suggests recent hydrothermal alteration as the cause of Cu mineral formation in the gabbro. Other host rocks show ΔFMQ values (-0.07 to 0.89), indicating oxidizing conditions, but the major fault system may have restricted Cu mineralization in Sangilo. A quartz diorite body (22.82 ± 0.17 Ma) is intruded by a basaltic trachyandesite dike which has two types of zircons with 18.87 ± 0.23 Ma and 3.13 ± 0.15 Ma. Furthermore, zircon trace elements highlight negative Eu anomalies in the younger Pliocene grains with Th/U ratios ranging from 0.73 – 1.68. The wide-ranging values for Eu/Eu*, Hf, Ce/Nd, Dy/Yb, P, and Gd in the zircons describe the different magmatic properties for each rock type in this study.

The gathered results contrast with previous findings [2] by showing that Early Miocene gabbros formed under reducing conditions (negative ΔFMQ values), limiting metallogenic development. Trace elements of zircon from the basaltic trachyandesite dike reflect melt (Ce/Nd < 9.2; Eu/Eu* = 0.24 – 0.79; high P and Gd), challenging the notion that Pliocene events primarily involved Cu and Au-fertile magmatism in the BMD. Whole-rock composition and trace elements of zircon reveal a complex magmatic history in which the host rocks are affected by hydrothermal alteration, with U-Pb zircon ages spanning three distinct periods.

[1] Sun, S.-s., & McDonough (1989), Geological Society, Longon, Special Publications 42, 313-345

[2] Jabagat, Karl et al. (2020), Ore Geology Reviews 125, 1-15