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Igneous rocks related to porphyry Cu-Au mineralization at the Dizon mine, Philippines

William P. Midea[1] | **Keiko Hattori**[1] | **Gabriel Theophilus V. Valera**[2]

[1]Department of Earth and Environmental Sciences, University of Ottawa, Ottawa, Ontario, Canada

[2]National Institute of Geological Sciences, University of the Philippines Diliman, Quezon City, Philippines

Correspondence
William P. Midea, Advanced Research Complex, 25 Templeton St., Ottawa, ON, Canada, K1N 6N5.
Email: wmide063@uottawa.ca

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Abstract

The Dizon Au-rich porphyry Cu deposit, 0.67 Mt Cu and 174 t Au, is hosted by diorite and andesite porphyry intrusions, dated at ~2.5 Ma. Amphibole and Fe-Ti oxides in relatively unaltered rocks were used to evaluate the magma conditions of intrusions. Parental magma for diorite porphyry was ~950°C at a depth of ~15 km, whereas the parental magmas for the andesite porphyry had lower temperatures, 760–820°C at a depth of ~5 km. The deposit formed at the locus of multiple intrusions, with evidence for injections of hot mafic magmas, including destabilization texture of plagioclase phenocrysts. Parental magmas at Dizon were oxidized, above FMQ + 2.0, and water-rich, >5 wt%, comparable to conditions of many large porphyry deposits elsewhere in the world. The occurrence of thick opacitic bands of amphibole in the diorite porphyry at Dizon reflects the release of aqueous fluids from the magma; such magmatic fluids were likely responsible for magmatic hydrothermal mineralization of the Dizon porphyry deposit. Subduction of the Scarborough Seamount caused a compressive regime in the overlying plate, which likely contributed to favourable tectonic conditions for mineralization.

KEYWORDS

amphibole geothermobarometry, Fe-Ti oxide geothermobarometry, Luzon arc, magma oxidation, magmatic hydrothermal activity

1 | INTRODUCTION

Porphyry Cu mineralization involves the exsolution of aqueous fluids from oxidized magmas (e.g., Sillitoe, 2010). Previous studies of igneous rocks associated with porphyry Cu deposits found that magmas record a high oxidation state, with fO_2 > FMQ + 2 (two logarithmic units above the fayalite-magnetite-quartz oxygen buffer; Lu *et al.*, 2016; Hattori, 2018), whereas smaller ore deposits may form from less oxidized magmas (Shen *et al.*, 2015; Kobylinski *et al.*, 2020). Most studies have focused on magmas associated with porphyry Cu deposits formed in continental arcs (Dilles *et al.*, 2015; Shen *et al.*, 2015), with fewer studies conducted on intrusions associated with porphyry Cu-Au deposits in young island arcs (Cao *et al.*, 2018; Jabagat *et al.*, 2020). In addition, it is not known whether the association of other metals, such as Au and Mo, have a relationship to magmatic conditions.

This paper reports the magmatic nature of igneous rocks associated with the Dizon Au-rich porphyry Cu deposit in the Luzon arc, Philippines. The Luzon arc hosts many young, <10 Ma, porphyry Cu deposits, most of which also have high Au contents (Sillitoe and Gappe, 1984). The Dizon porphyry Cu-Au deposit, located 100 km northwest of Manila, is one of these young, 2.5 Ma, Au-rich porphyry Cu deposits. Previous publications presented the regional and local geology,

