Fertile magmas responsible for the Dizon porphyry Au-Cu deposit

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The Dizon porphyry Au-Cu deposit (174 t Au and 0.67 Mt Cu) on the southern slope of Mount Pinatubo was the site for numerous intrusions of dioritic and andesitic porphyry at ~ 2.5 Ma. The porphyry intrusions hosting the mineralization are hydrothermally altered to form secondary biotite, white mica and chlorite. We found diorite porphyry and andesite porphyry that are relatively unaltered to retain igneous amphibole and Fe-Ti oxides. These igneous minerals and textures were used to quantify the temperature, oxidation conditions and water contents of parental magmas.

Amphibole in the andesite porphyry is magnesiohornblende (Mg# 0.68) in composition; with thermobarometry indicating the crystallization at 820°C and a depth of ~ 5.1 km in a magma under oxidation conditions of FMQ+2.6, with water contents of 5.8 wt.%. Fe-Ti oxide thermobarometry for the andesite porphyry yield lower temperature of 760°C and oxidation conditions of FMQ+2.2 The temperature and oxidation state for the Dizon andesite porphyry are very similar to the 1991 Pinatubo dacite eruption products. Amphibole from the Dizon diorite porphyry is magnesiohastingsite (Mg# 0.68-0.75) in composition; with thermobarometry yielding crystallization temperatures of ~980°C and a depth of ~15 km under oxidation conditions of ~FMQ+2.0, with water contents of ~7.0 wt.%. Destabilization texture of plagioclase with Ca-overgrowth and zoning of amphibole suggest injections of oxidized mafic magma to the deep magma chamber for the diorite porphyry and the shallow magma reservoir for andesite porphyry. Given crustal thickness of 20-30 km in the area, these mafic magmas are likely sourced from the upper mantle. The results of this study show that the magmas responsible for the Dizon porphyry Au-Cu deposit were highly oxidized and water-rich. They share many characteristics with those associated with large porphyry Cu deposits elsewhere around the world.

Keywords: Arc magma evolution, thermobarometry, magma oxidation