Petrographic study of geological units and veins of the Co-O epithermal gold deposit, Mindanao, Philippines

*Kristine Joy Taguibao[1], Akira Imai[1], Ryohei Takahashi[1], Ciceron, Jr. Angeles[2,3], Samuel Declaro[2], Jesse Umbal[2]

1. Akita University, Japan, 2. Philsaga Mining Corp., Philippines, 3. Medusa Mining Ltd., Australia

Located in the eastern Mindanao Island, Philippines, the Co-O mine of the Philsaga Mining Corp. (a Philippine subsidiary of the Medusa Mining Ltd. of Australia) hosts two mineralization types, namely: intermediate sulfidation epithermal gold (+ Ag ±Cu ±Pb ±Zn) quartz vein and porphyry copper-gold. Eastern Mindanao belongs to the Pliocene-Quaternary calc-alkaline magmatic zone of the Central Mindanao Volcanic Zone (Mines and Geosciences Bureau, 2004). Stratigraphic units in this region include andesitic and pyroclastic basement rocks of the Eocene Anoling Andesite, intrusive rocks of the Early Oligocene Diwata Diorite, and sedimentary sequences of the Late Oligocene to Early Miocene Bislig Formation. Younger limestone units are the Lower Middle Miocene Rosario Limestone and Pleistocene Hinatuan Limestone. This study is part of a research on the structural geology characterization of this deposit and vicinity. It is a review of the general geology and mineralogical characteristics of the study area through field surveys and petrography of the main geologic units and veins, integrated with XRD analyses of clay minerals.

In the Co-O mine, the main geologic units are Eocene to Oligocene basaltic-andesitic to andesitic volcanic flows and volcaniclastic basement deposits, Oligocene andesitic to dioritic stocks and dikes intruding the volcanic basement rocks, a diatreme-maar complex that cuts and overlies these volcanic and intrusive rocks, and overlying sedimentary sequences (e.g., Sonntag and Hagemann, 2010). The porphyry copper-gold mineralization and overprinting intermediate sulfidation epithermal gold mineralization are mainly hosted in an intrusive stock and surrounding volcanic rocks. The epithermal vein system is characterized by structurally-controlled early stage hydrothermal breccias and main stage epithermal quartz veins.

The volcanic basement rocks generally contain phenocrysts of plagioclase, clinopyroxene, and hornblende crystals set in a microcrystalline matrix. In most samples, sub-angular to sub-rounded plagioclase crystals (~1-5 mm) show alteration to clay minerals. As verified through XRD, the clay minerals are smectite (montmorillonite) and chlorite (± kaolinite). The andesite porphyry and dioritic intrusive rocks mainly contain large crystals (>1 mm) of plagioclase, hornblende, and minor quartz. Andesite porphyries contain plagioclase, clinopyroxene, and opaque minerals (pyrite ±chalcopyrite), and some with xenoliths of porphyritic andesites. Plagioclase crystals exhibit alteration to clay minerals (chlorite, interstratified illite-montmorillonite ±kaolinite). Veins/veinlets cutting across these units are generally quartz ±calcite, with opaque and clay minerals. The diatreme portion of the diatreme-maar complex consists of monomictic to polymictic breccias containing clasts of andesite porphyry to diorite and andesitic volcanics. The clasts are generally lithic fragments and partly detrital crystals set in patches of fine-grained quartzofeldspathic, calcitic and chloritic minerals. Plagioclase crystals appear to be bloated and altered to clay minerals (smectite/montmorillonite, chlorite, interstratified illite-montmorillonite ± kaolinite).

Petrographic study of the veins in Co-O is partly used for fluid inclusion microthermometry. The quartz ± calcite veins are generally white to smoky/gray and exhibit massive, banded, comb/crustiform, and

mosaic textures. Initial results indicate a dominance of small inclusions (<2 microns) with only a few measurable inclusions (>5 microns). These inclusions occur within quartz and calcite crystal grains as internal trails and clusters of two-phase inclusions, including dominant liquid-rich vapor-liquid inclusions with rare vapor-rich inclusions. Previous consultancy works (Hagemann and Grignola, 2012; Hagemann and Roudaut, 2014), which investigated similar crystal grains of quartz and calcite veins, interpreted the occurrence of these inclusions as pseudosecondary, from which microthermometric analyses were measured. The occurrence of such assemblages is consistent with fluid boiling during fluid inclusion entrapment and formation of the quartz ±calcite veins (Hagemann and Grignola, 2012).

Keywords: petrography, geology, Philippines, Co-O mine

