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Epithermal gold and porphyry copper mineralization in the Zamboanga Mineral District, Mindanao, Philippines

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Owing to its complex tectonic setting, the Philippines is host to a number of epithermal, porphyry copper, and volcanogenic massive sulfide deposits, among others (Figure 1). Located in the southwestern portion of the Philippine archipelago, the Zamboanga Mineral District in Mindanao Island is considered as one of the most promising areas of study because of its complex geology and mineralization potential. It is characterized by several occurrences of epithermal gold deposits throughout the peninsula, as well as porphyry copper prospects limited to the Siayan-Sindangan Suture Zone (Figure 1). The NW-trending suture zone separates two distinct terranes that collided during the Late Miocene: the Sulu-Zamboanga Arc terrane of continental affinity, and the Negros Arc terrane of island arc origin. The study focuses on the geology, ore mineralogy and ore-forming fluid characteristics of three deposits hosted in Miocene igneous rocks: the Sibutad epithermal gold deposit in the Negros Arc terrane, the Sirawai epithermal gold prospect in the Sulu-Zamboanga Arc terrane, and the Tamarok porphyry copper prospect in the Siayan-Sindangan Suture Zone.

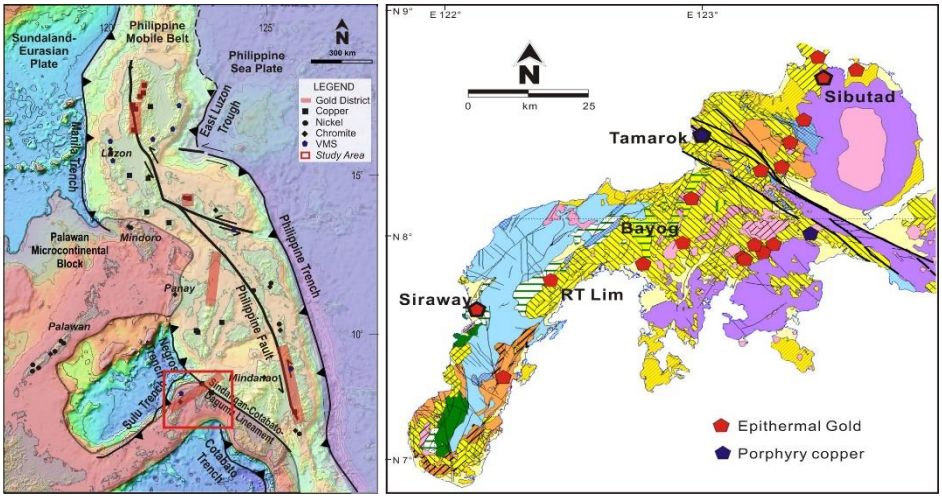

Figure 1. Location of mineral deposits in the study area. (Left photo) Tectonic setting and mineral deposits in the Philippine archipelago (red box indicates location of the Zamboanga Mineral District, featured on the right); (Right photo) Location of epithermal gold deposits and porphyry copper deposits in the Zamboanga Mineral District.

Both epithermal gold occurrences, although from different terranes, share several similarities: mineralization is hosted in Miocene volcanic rocks associated with quartz vein and breccia, dominant alteration type is silicification and argillic alteration, and major minerals consists of pyrite, chalcopyrite, sphalerite, and electrum. The fluid inclusions in both deposits are liquid-rich and homogenize at 150-315

°C with salinities of 2.6 - 5.1 wt% NaCl. The Tamarok porphyry copper prospect is defined by quartz and sulfide stockwork veins hosted in silicified and potasically-altered diorite bodies. Major minerals are chalcopyrite, bornite, magnetite, and minor pyrite. Homogenization temperatures range from 400°C to >530°C, with hypersaline inclusions at 38-55 wt% NaCl. The deposits share dominant NW-trending structures and minor NE structures, which could be attributed to the formation of the Siayan-Sindangan Suture Zone. Magmatic activity in the Late Miocene resulted in the formation and circulation of the hydrothermal fluids that circulated and precipitated the metallic deposits, with porphyry copper deposits forming at deeper depths compared to the epithermal gold deposits. The continuous suturing after the Miocene collision in the Siayan-Sindangan structure might have caused the uplift and emergence of the porphyry copper deposits localized within the suture zone.