

### **Initial Investigation of Geology and Litho-Geochemistry in North Halmahera, Indonesia: Implications for Porphyry Copper and Epithermal Deposit Potential**

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The Halmahera Volcanic Belt on Halmahera Island may have valuable mineral deposits, similar to the famous Gosowong gold deposit. Our research focuses on Galela in North Halmahera, which has not been previously explored for gold. We aim to identify its potential through geological mapping and geochemistry methods. In this study, we use several methods: petrography, ore microscopy, X-ray diffraction, fire assay-atomic absorption spectrometry (FA-AAS), and X-ray fluorescence (XRF). Our mapping lithologies include pyroclastic breccia, andesite lava, diorite porphyry, diatreme breccia, and limestone. Diorite porphyry is a key host rock for mineralization, and we classify it as hornblende diorite, showing a variety in grain size textures: fine, medium, and coarse textures, associated with calc-alkaline magma. We found two prospect areas of interest: the North and the South. In the North Prospect, we suggest a possible porphyry copper deposit where the hydrothermal fluids are associated with multiple intrusive diorite hornblende with textural variation from fine- to coarse-grained, associated with diatreme breccia. The significance of hydrothermal alteration of this prospect can be classified into two types: chlorite-epidote-magnetite and quartz-calcite±sericite±biotite embedded in both diorite hornblende and diatreme breccia along with the diverse mineralization of sulfide minerals such as pyrite, sphalerite, covellite, chalcocite, and chalcopyrite. Furthermore, according to FA-AAS analysis, data from rock samples shows a copper anomaly level of 228 ppm. The South prospect has different characteristics, with hydrothermal activity influenced by faults. Here, we see pyroclastic breccia intruded by fine-grain diorite hornblende associated with hydrothermal alterations like quartz-alunite alteration and dickite-kaolinite-illite alteration spread following the pyroclastic breccia distribution, which is a unique feature. This prospect area is commonly associated with a quartz vein brecciated system that contains sulfide minerals such as pyrite and galena, with a gold level of 21.6 ppm, indicating potential for an epithermal deposit.