

Gold Deportment in the Doup Porphyry-Epithermal System, North Sulawesi, Indonesia: Implications for Recovery

Muhammad Faqih Alfyan^{1,2}, Muhammad Syahrul Rizki³, Jan-Jan Hertrijana³, Arif Iman Santosa¹, Adi Syarif Kurniadi¹, Lejun Zhang², Nugroho Imam Setiawan⁴, Muhammad Farel Diputra⁴

¹Mine Geology Department, PT. Arafura Surya Alam, Tutuyan, Indonesia, ²CODES, University of Tasmania, Hobart, Australia, ³Mine Research and Technical Valuation, PT. Pamapersada Nusantara, Jakarta, Indonesia,

⁴Geological Engineering Department, Universitas Gadjah Mada, Sleman, Indonesia

Enhancing gold recovery requires a robust understanding of the geological and mineralogical factors influencing gold deportment, particularly in complex, multistage mineral systems. The Doup Gold Project in the North Arm of Sulawesi represents a significant gold resource of 93.1 Mt at 1.04 g/t Au (Zurkic, 2024), formed through overprinted porphyry, intermediate-sulfidation epithermal (ISE), and sediment-hosted mineralisation, with structural and bedding-controlled beneath recent sedimentary cover. However, key controls on gold deportment remain poorly defined, especially those related to mineral encapsulation and refractory ore behaviour that can significantly limit metallurgical recovery. This study integrates drillhole data, geochemical analysis, short-wave infrared (SWIR) spectroscopy, mineralogical studies, and textural analysis.

Preliminary results reveal distinct in ore characteristics between the Panang and Benteng prospects. In Panang, porphyry and ISE mineralisation are hosted in quartz diorite and tonalite, with white mica+chlorite+montmorillonite alteration. Mineralisation occurs in stockwork A-veins (quartz-chalcopyrite-magnetite) that are crosscut by base-metal veins (quartz-sphalerite-galena±arsenopyrite). Gold is mainly present as dissemination and is commonly encapsulated within arsenopyrite and pyrite. Native golds grains are also observed, ranging from 3–20 µm in size, and contains 2.22 g/t Au. In Benteng, sediment-hosted and ISE mineralisation are hosted in diorite and sequences of calcareous-carbonaceous sedimentary rocks, with muscoviticillite+montmorillonite+gypsum alteration. Mineralisation is present as disseminated and veinlets (quartz-sphalerite-pyrite-arsenopyrite). Gold occurs as both interstitial free gold and inclusions encapsulated in pyrite, grain sizes ranging from 5–45 µm and contains 1.6 g/t Au.

Further mineral chemistry and quantitative clay analyses, including Electron Probe Microanalysis and X-ray Diffraction, will refine interpretations of gold occurrence, textural associations, and degree of mineral liberation, as well as identify potentially problematic clay minerals that contribute to clay swelling and may hinder gold recovery. These analyses will improve understanding of ore characteristics and processing behaviour, providing critical geometallurgical insights for optimising gold recovery in a pressure oxidation processing plant.