

## ABSTRACT

The Tumpangpitu deposit is located in the south eastern coast of East Java, Banyuwangi District, East Java Province, Indonesia. This area lies within the central portion of the Cenozoic Sunda-Banda magmatic arc which trends southeast from northern Sumatra to west Java then eastward through east Java, Bali, Lombok, Sumbawa and terminating at Banda sea. The geology of the Tumpangpitu is predominantly occupied by Late Oligocene to Middle Miocene low-K calc-alkaline to alkaline andesitic volcanic rocks and interbedded with volcanoclastic rock sequences, which are associated with low-K intermediate intrusions.

The hydrothermal alteration is hosted by andesite lava, lapilli tuff and hydrothermal breccia. The alteration of Tumpangpitu area can be identified as the silicic alteration, advanced argillic alteration, argillic alteration and propylitic alteration depend on the characterization of mineral assemblages and alteration mineral. Alteration assemblages of the Tumpangpitu prospect comprises of silicic alteration (vuggy and massive) which is surrounded by advanced argillic alteration (quartz, alunite, diaspore, pyrophyllite, dickite/ kaolinite), argillic alteration (quartz, kaolinite, illite, smectite, illite-smectite) and propylitic alteration (quartz, chlorite, illite, epidote, magnetite, albite).

The mineralization style at the Tumpangpitu area is composed of a high-sulfidation (HS) epithermal system which is typically associated with concealed gold-rich porphyry copper system. The HS epithermal mineralization is hosted by volcanic and volcanoclastic rocks in this research area. The mineralization domains are divided into Zone A, Zone B and Zone C which are situated along NW-SE-trending silica ledges zones. The HS epithermal mineralization is texturally occurs as vuggy replacements mineralization as well as stockworks, disseminated forms, fractures and veins. The permeable rock unit of lapilli tuff is prominent to host of mineralization and a strike-slip fault system is developed to imply hydrothermal activity. The right-lateral strike slip faults and associated features (East fault, cliff fault, central fault and west fault) displaced in NW-SE trending by NE cross structure and the mineralization is developed in NW to NNW controlled by the structures. Both lithology and structures play important controls in the formation of hydrothermal alteration and associated mineralization in Tumpangpitu area.

By plotting the geochemical data of research area, the host rocks belong to basaltic andesite, andesite, dacite, rhyolite and silexite (quartzolite) fields and occupied in Island arc basalt setting but some are plotted in mid oceanic ridge basalt (MORB) setting. The intrusive igneous rocks of research area is exactly displayed in diorite and granodiorite field. All of igneous rocks from research area (basaltic rocks and intrusive igneous rock) are generally formed at arc magmatic tectonic setting. Based on comparing the trace spider diagrams of research area with two of alkali oceanic island basalt, and island arc calc-alkaline basalt, the trace elements of research area resemble to island arc calc-alkaline basalt.

Homogenization temperature ( $T_h$ ) and melting temperature ( $T_m$ ) can be determined by fluid inclusion analysis. The average homogenization temperature ( $T_h$ ) of the fluid inclusions gives 180 to 342°C and melting temperature are from -0.1 to -1.4°C. The melting temperature ( $T_m$ ) corresponds to the salinities ranging from 0.1 to 4.5 wt% NaCl equivalent. The microthermometric data point out that the Tumpangpitu deposit formed at moderate temperature and low salinity by magmatic fluid mixing and dilution by meteoric water during the hydrothermal

fluid evolution. On the basis of the fluid inclusion microthermometric data and its other key characteristics, the Tumpangpitu gold mineralization shares some similarities compared to other typical HS-epithermal gold deposits worldwide although it also shares few differences.

**Keywords:** Tumpangpitu deposit, East Java, Indonesia, high-sulfidation epithermal deposit

## SARI

Endapan Tumpangpitu berlokasi di pesisir tenggara Jawa Timur, Kawasan Banyuwangi, Provinsi Jawa Timur, Indonesia. Area ini membentang di bagian tengah busur magmatik Sunda-Banda Kenozoikum yang cenderung berarah tenggara dari Sumatera bagian utara hingga Jawa bagian barat, lalu berarah timur di sepanjang Jawa bagian timur, Bali, Lombok, Sumbawa dan berakhir di Laut Banda. Geologi daerah Tumpangpitu didominasi oleh low-K calc-alkaline berumur Oligosen Akhir-Miosen Tengah hingga batuan vulkanik andesitan dan berseling dengan sekuen batuan vulkaniklastik, yang berasosiasi dengan intrusi intermediet rendah K.

Alterasi hidrotermal berada pada batuan induk lava andesit, lapili tuff, dan breksi hidrotermal. Alterasi area Tumpangpitu dapat diidentifikasi sebagai alterasi silisik, argilik lanjut, argilik, dan porfiritik yang tergantung pada karakterisasi kumpulan mineral dan alterasi mineral. Kumpulan alterasi di prospek Tumpangpitu terdiri dari alterasi silisik (vuggy dan masif) yang dikelilingi oleh alterasi argilik lanjut (kuarsa, alunit, diaspor, pirofilit, dickite/kaolinit), alterasi argilik (kuarsa, kaolinit, illit, smektit, illit-smektit) dan alterasi propiritik (kuarsa, klorit, illit, epidot, magnetit, albit).

Gaya mineralisasi pada area Tumpangpitu terdiri dari sistem epitermal sulfidasi tinggi (HS) yang secara khusus berasosiasi dengan sistem porfiri tembaga kaya emas. Batuan induk dari mineralisasi epitermal sulfidasi tinggi daerah penelitian ini adalah batuan vulkanik dan vulkaniklastik. Domain mineralisasi dibagi menjadi Zona A, Zona B, dan Zona C yang terletak sepanjang zona pinggir silika barat laut-tenggara. Mineralisasi epitermal sulfidasi tinggi secara tekstural berwujud mineralisasi pergantian vuggy seperti stockworks, disseminated, retakan, dan urat.

Unit batuan lapilli tuff yang permeabel sangat bagus untuk menjadi batuan induk mineralisasi dan sistem sesar geser berkembang membantu aktivitas hidrotermal. Sesar geser dekstral dan komponen berasosiasi dengannya (sesar timur, sesar cliff, sesar tengah, dan sesar barat) bergerak pada trend barat laut-tenggara oleh struktur berarah barat laut dan mineralisasi berkembang di NW hingga NNW dikontrol oleh struktur. Baik litologi maupun struktur memainkan peran penting dalam mengontrol pembentukan alterasi hidrotermal dan asosiasi mineralisasi di area Tumpangpitu.

Dengan pengeplotan data geokimia daerah penelitian, batuan induk termasuk kedalam andesit basaltan, andesit, dasit, riolit dan silexite (quartzolite) dan menempati tatanan island arc basalt, tapi beberapa data terplotkan pada tatanan mid oceanic ridge basalt (MORB). Batuan beku intrusif di daerah penelitian tergolong diorit dan granodiorit. Semua batuan beku dari daerah penelitian (batuan basaltik dan batuan beku intrusif) umumnya terbentuk pada tatanan tektonik magmatic arc. Berdasarkan perbandingan spider trace diagram antara basalt alkali oceanic island arc dan basalt calc-alkaline island arc di lokasi penelitian, unsur jejak di lokasi penelitian tergolong basalt island arc calc-alkaline.

Suhu homogenisasi (Th) dan suhu leleh (Tm) dapat ditentukan dengan analisis inklusi fluida. Suhu homogenisasi rata-rata (Th) dari inklusi fluida adalah 180 hingga 342 °C dan suhu leleh dari -0,1 hingga -1,4°C. Suhu leleh (Tm) sesuai

dengan salinitas yang berkisar 0,1 sampai 4,5 wt% setara NaCl. Data mikrotermometrik menunjukkan bahwa endapan Tumpangpitu terbentuk pada suhu sedang dan salinitas rendah oleh pencampuran fluida magmatik dan pengenceran oleh air meteorik selama evolusi fluida hidrotermal. Berdasarkan data mikrotermometrik inklusi fluida dan karakteristik kunci lainnya, mineralisasi emas Tumpangpitu memiliki beberapa persamaan ketika dibandingkan dengan endapan emas epitermal sulfidasi tinggi lainnya di seluruh dunia meskipun ada beberapa perbedaan.

**Kata kunci:** Endapan Tumpangpitu, Jawa Timur, Indonesia, endapan epitermal sulfidasi tinggi