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Characteristics of Gold Mineralization at the River Reef Zone, the Poboya Prospect, Central Sulawesi, Indonesia

Tomy Alvin Rivai,[1] Kotaro Yonezu,[1] Syafrizal,[2] Kenzo Sanematsu,[3] Damar Kusumanto[4] and Koichiro Watanabe[1]

[1]*Department of Earth Resources Engineering, Faculty of Engineering, Kyushu Unversity, Fukuoka 819-0395, Japan*

[2]*Earth Resources Exploration Research Group, Faculty of Mining and Petroleum Engineering, Institut Teknologi Bandung, Bandung 40132, Indonesia*

[3]*Geological Survey of Japan, National Institute of Advanced Industrial Science and Technology, Tsukuba 305-0045, Japan*

[4]*Bumi Resources Minerals, Jakarta 12920, Indonesia*

Abstract

An academic study has been conducted to reveal the nature of gold mineralization at the River Reef Zone. The gold mineralization is hosted within granite and metamorphic rocks. Veins cutting the host rocks are composed mainly of quartz-calcite and indicate open-space fillings and multiple stages of hydrothermal activity. Zoned hydrothermal alteration suggests a near-neutral fluid and well-preservation of the system. From this fluid, ore minerals are precipitated in two stages within an epithermal environment. The ore-forming fluid lies on the general trend of Se-bearing Au-Ag epithermal deposits and evolved from low to intermediate sulfidation states. Incorporating these characteristics, the gold mineralization can be classified as a low-intermediate sulfidation epithermal deposit.

1. Introduction

The Poboya prospect is situated approximately 11-14 km northeast of the City of Palu. It includes three mineralization sites, namely the River Reef Zone, the Hill Reef 1 Zone and the Hill Reef 2 Zone. Exploration conducted at the River Reef Zone concludes that the gold mineralization can be classified as an Au-bearing vein deposit hosted by metamorphic rocks.[1] However, several different speculative models have been proposed to explain the occurrence of the gold mineralization.[2] Accordingly, an academic study is attempted to reveal the nature of the gold mineralization.

2. Methods

Several methods were employed to characterize gold mineralization occurring at the River Reef Zone. Petrography study, XRD bulk analysis and XRF analysis were used to study host rocks and veins. Hydrothermal alteration was analyzed through XRD clay and bulk analysis as well as petrography study. Ore and gangue minerals were described by using ore microscopy, petrography study and SEM-EDS. Lastly, fluid inclusion study was performed to elucidate ore-forming fluid condition.

3. Results and Discussion

The gold mineralization is hosted by granite, biotite gneiss and biotite schist intercalated by feldspar porphyroblasts biotite schist and amphibolitic schist. Granite and biotite gneiss can be classified as weakly peraluminous magnesian granitic rocks resulted from arc calc-alkaline mag-mas within either a volcanic arc or a post-collisional setting. The host rocks are cut by veins with individual sizes ranging from less than 1 cm up to 14 m and composed mainly of quartz-calcite, quartz, calcite and propylitic minerals. The veins show several textural groups such as primary growth, replacement, recrystallization and breccias indicating open-space filling and multiple stages of hydrothermal activity.

Zoned hydrothermal alteration can be delineated by the proximity from the main fluid conduit: silicification, argillic, high-T propylitic and low-T propylitic zones (Fig. 1). The siliceous deposit at the Watuputih Hill, in the southwest of the River Reef Zone, preserves steam-heated and supergene advanced argillic zones marking the paleowater table level. If these zones belong to the River Reef Zone, its occurrence suggests that the mineralization system is well preserved. In addition, the zoned hydrothermal alteration indicates a near-neutral hydrothermal fluid.

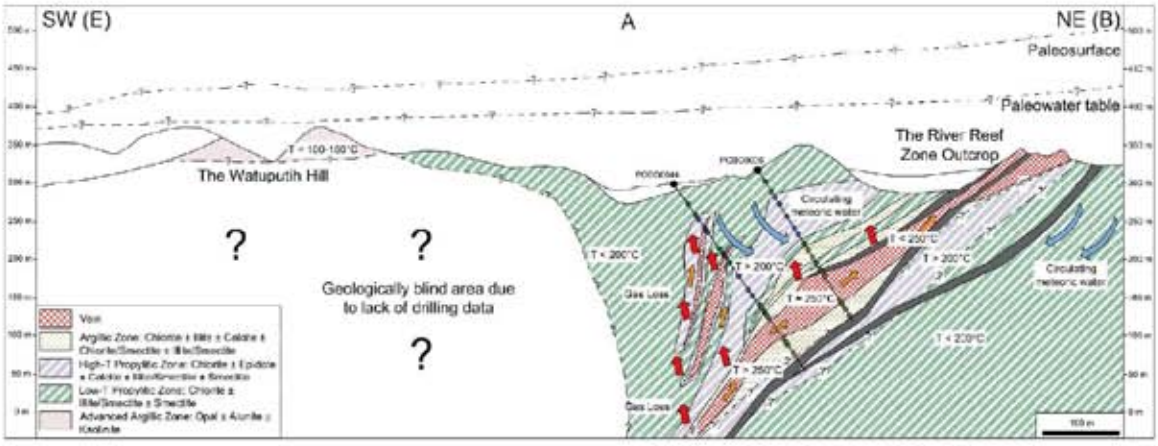

Figure 1. Alteration descriptive model.

Ore minerals are observed within the presence of ubiquitous quartz and calcite as gangue minerals. The precipitation of ore minerals can be divided into the early and late stages. Chemical composition of electrum, Ag_2S-Ag_2Se solid solution and freibergite changes based on the stages of gold mineralization. Additionally, selenium is frequently identified as sulfur replacement as contained in Ag_2S-Ag_2Se solid solution, argyrodite, selenopolybasite and pyrargyrite.

Fluid inclusions are characterized by liquid-vapor inclusions. Boiling of the ore-forming fluid is implied by the coexistence of liquid-rich and vapor-rich inclusions in addition to the presence of lattice calcite texture. These fluid characteristics are constrained by a salinity range of 0.3-0.7 wt.% NaCl equiv. and homogenization temperature of 240-250°C. The combination between the salinity and homogenization temperature suggests an epithermal environment.

The physicochemical environment of the ore deposition is constrained by T-log fS_2-log fSe_2 approximately of (290°C, -11.3, -13.5) and (250°C, -11.8, -14.1) for the early and late stages, respectively. This environment favors sulfur replacement by selenium thus restraining Se-enrichment in the ore-forming fluid and precipitation of selenide minerals other than Ag-selenides. Additionally, the ore-forming fluid evolves along the equilibrium of naumannite and argentite as it occurs in the general trend of Se-bearing Au-Ag epithermal deposits (Fig. 2). In terms of sulfidation state, this gold deposit shows an evolution path from low to intermediate sulfidation states within the trend of geothermal fluids. These fluids are analog with the ore-forming fluid of low and intermediate sulfidation epithermal deposits.

4. Conclusion

Incorporating characteristics of gold mineralization, such as the vein textures, zoned hydrothermal alteration, ore mineralogy and ore-forming fluid characteristics leads to a conclusion that the gold deposits at the River Reef Zone can be classified as a low-intermediate sulfidation epithermal deposit.

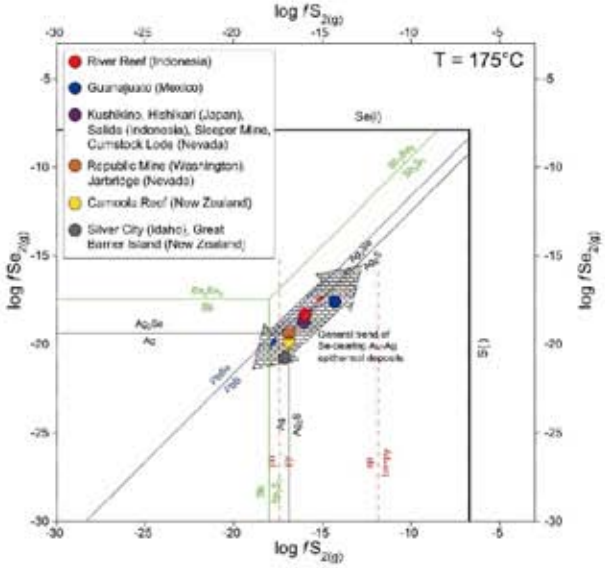

Figure 2. Phase relation of ore minerals.

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Email: tomyalvinrivai@mine.kyushu-u.ac.jp