Veining Paragenetic Sequence of The Randu Kuning Porphyry Cu-Au Deposit At Selogiri Area, Wonogiri

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Veining Paragenetic Sequence of The Randu Kuning Porphyry Cu-Au Deposit At Selogiri Area, Wonogiri

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Abstract

Many Tertiary hydrothermal altered dioritic composition intrusive rocks were found at the Randu Kuning area and its vicinity, Selogiri, including hornblende microdiorite, pyroxene diorite and quartz diorite. The hydrothermal fluids which responsible for the alteration and mineralization at the area is associated with the occurence of the horblende microdiorite intrusion.

The alteration zone at the Randu Kuning area and its vicinity can be divided into several hydrothermal alteration zones, such as potassic zone (magnetite-biotite-K feldspar), prophyllitic zone (chlorite-magnetite-epidote-carbonate), phyllic zone (quartz-sericite-chlorite) and argillic zones (clay mineral-sericite). The alteration pattern in the Randu Kuning porphyry Cu-Au deposit is tipically a diorite model characterising by the domination of potassic alteration and prophyllitic zone. Phyllic and argillic alteration types are restricted found within the fault zones.

A lot of porphyry vein types were found and observed at the Randu Kuning area, and classified into at least seven vein types. The paragenetic sequence of those veins from the earliest to the latest respectively are 1). Magnetite-chalcopyrite±quartz-biotite veinlets, 2). Quartz±magnetite (A type)veins, 3). Banded/Laminated quartz-magnetite (M type) veins, 4). Quartz±K feldspar (B type)veins, 5). Quartz with thin centre line sulphide (AB type) veins, 6). Pyrite±chalcopyrite (C type) veinlets, and 7). Pyrite-quartz+chalcopyrire+carbonate (D type) veins. Gold and copper mineralisation of the Randu Kuning Porphyry Cu-Au deposit, mostly related to the presence of quartz veins/veinlets containing sulfide *i.e.* Quartz with thin centre line sulphide veins, Pyrite±chalcopyrite veinlets, and Pyrite-quartz+chalcopyrire+carbonate veins.

Key words: porphyry, veins, paragenetic sequence

Introduction

The Randu Kuning Porphyry Cu-Au prospect area is situated at Selogiri district, Wonogiri regency, Central Java, Indonesia. This location is reachable with four wheel or two wheel vehicle, about 40 km to the south-east from Solo city, or approximately 70 km east of Yogyakarta city. The Randu Kuning area and its vicinity is a part of the East Java Southern Mountain Zone, mostly occupied by both plutonic and volcanic igneous rocks, volcanic clastic rocks, silisic clastic rocks as well as carbonate rocks. Magmatism and vulcanism in this area is represented by the Mandalika Formation consisting mostly volcanic igneous rocks such as andesit-dacitic lavas, volcaniclastic rocks namely dacitic tuffs, and volcanic breccias. The rock unit was intruded by dioritic intrusive rocks. Volcaniclastic rocks of the Semilir Formation , as a product of the huge eruption, are exposed and scattered at the south of Selogiri area such as tuffs, lapilli tuffs, dacitic pumice breccias, tuffaceous sandstones and tuffaceous shales.

Many dioritic composition intrusive rocks were found at the Randu Kuning area, both pre-mineralisation intrusive rocks and syn-mineralisation intrusive rocks as well as post-mineralisation intrusive rock. However, it is difficult to distinguish this kind of dioritic intrusive in the area, due to the similar composition and texture with varying relationship to alteration-mineralization. Imai *et al*. (2007) have identified three different type of intrusive rocks, namely hornblende andesite porphyry, hornblende diorite porphyry and hornblende diorite. Muthi *et al*.,(2012) recognized there are at least four type diorite at the Randu Kuning area *ie*. coarse grain diorite, medium diorite, microdiorite and porphyrytic plagioclase diorite.

Mineralisation type of Randu Kuning prospect was interpreted as a porphyry Cu-Au ore deposit and a number gold-base metals epithermal deposits in its surrounding (Imai *et al*. 2007; Suasta and Sinugroho, 2011; Corbett, 2011, 2012 and Muthi *et al*., 2012). The intensive erosion process has uncovered the upper parts of the porphyry deposit, whereas several gold-base metal epithermal are preserved along adjacent ridge (Suasta and Sinugroho, 2011). Many epithermal veins also found and crosscut into deeply porphyry veins and related potassic alteration (Suasta and Sinugroho, 2011; Corbett, 2012). In this study wil be focused on the paragenetic sequence of the porphyry vein type only.

Porphyry copper-gold deposits and epithermal gold-base metal deposits are both associated with subduction related at convergen plate margins and many are found and spread in the southwest Pasific rim (Corbett and Leach, 1996). Although the two deposit types have a different alteration and mineralization characteristic, but commonly show a close spatial and temporal relationship (Hedenquist *et al*., 1998; Corbett, 2008; Sillitoe, 2010). Related the magmatic source, Corbett (2011) suggested the possible mechanisms for the formation low sulphidation epithermal Au overprinting the porphyry Cu-Au system at the Randu Kuning, that are a). The gold-base metal epithermal were deposited from the cooling magmatic source at depth as a late stage event of the main porphyry Cu-Au system, and b). The epithermal Au related with the emplacement of new magmatic source at depth.

Suasta and Sinugroho (2011), had identified four types of hydrothermal alteration, *i.e.* potassic type, prophyllitic type, argillic type and phylic type and reported that the horblende microdiorite was potassic-propylitic altered and mineralize, otherwise the hornblende diorite was propylitic altered only. Retrograde phyllic (silica-sericite-chlorite-pyrite) only locally overprints prograde potassic-prophyllitic zone, mainly adjacent to fault zone and breccias (Corbett, 2012). In over all, the alteration zone are dominated by potassic and prophyllitic type, and lacking with argillic and phyllic type. A dioritic composition range of the intrusive rocks type and the domination of the potassic and prophyllitic zone, based on the porphyry alteration model (Pirajno, 1992;2009) suggested that the alteration model of the Cu-Au porphyry ore deposit in the study area is more similar to the diorite model rather than the quartz monzonite model.

Method

This paper is a preliminary study which is part of the dissertation research. The data used in the paper is limited to the field observation data and drilling core logging both polarisation microscopic and megascopic observation. The laboratory analyses including rock geochemistry, mineral geochemistry, fluid inclusion and scanning electron mapping have been done.

Geology of the Selogiri Area

There are many rock types found at the Selogiri area and its surounding, such as volcanic breccias, andesite lavas, tuffs, and many igneous intrusive rocks such as diorites and andesites of the Miocene Mandalika and Semilir Formation, unconformably underlie Quartenary volcanic rocks of Lawu and Merapi volcanos. Most of the Tertiary rocks have been strongly hydrothermal altered, that caused rock forming primary minerals (feldspars, hornblendes, pyroxens), were replaced by secondary minerals (chlorites, carbonates, quartzs, hematites). These

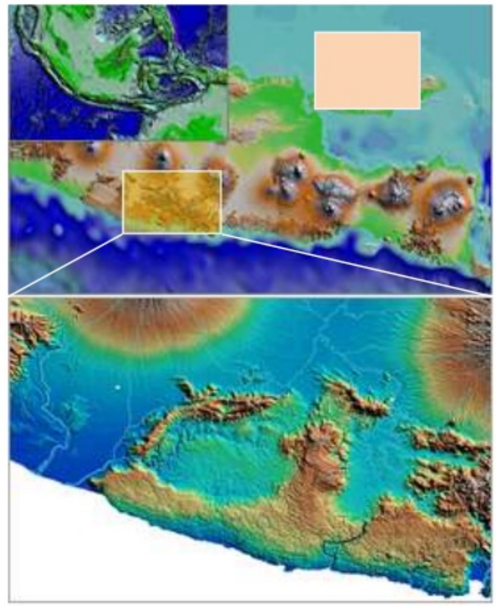

Figure 1: Location map of the Selogiri area

rocks lithostratigraphically could be grouped into 6 (six) rock units, *i.e.*: Pumice Breccia Rock Unit of Semilir, Volcanic Breccia Rock Unit of Mandalika, Intrusive Rocks, Hydrothermal Breccia, Volcanic Breccia of the Lawu Volcano, and Aluvial Deposit.

Many dioritic composition intrusive rocks were found at the research area, including pre-mineralisation intrusive rocks, syn-mineralisation intrusive rocks as well as post-mineralisation intrusive rock. In reality, it's difficult to distinguish of the dioritic rocks type in the area due to their similar composition. Based on the observation both on the surface outcrops and drilling core samples, the intrusive rocks at the study area consists of feldspar diorite (as a xenolith within pyroxene diorite), pyroxene diorite (previous researcher called as medium diorite), hornblende microdiorite and quartz diorite (coarse diorite).

Alteration and mineralization

Suasta and Sinugroho (2011), had identified four types of hydrothermal alteration at the Randu Kuning area and its vicinity, *i.e.* potassic type, prophyllitic type, argillic type and phyllic type. Potassic alteration zone scattered on hornblende microdiorite intrusive rocks body and small part of pyroxene diorite intrusive rocks especially in the contact area to the hornblende microdiorite intrusion of Randu Kuning hill. This zone characterized by secondary minerals assemblage i.e. one or both of secondary biotite and/or K-feldspar associated with magnetite (Suasta and Sinugroho, 2011; Corbett, 2011, 2012 and Muthi et al., 2012). Prophyllitic alteration is less commonly recognised typically as actinolite or chlorite-epidote-magnetite alteration at the margin of the hydrothermal system (Corbett, 2012). Prophyllitic zone mostly is widespread in pyroxene diorite and quartz diorite rocks, both visible at the surface outcrop and in drill core samples. In pyroxene diorite, prophyllitic zone dominated by the chlorite-magnetite-quartz and a lesser epidote mineral assemblages. While within the quartz diorite rocks prophyllitic zone is generally dominated by the presence of the quartz-epidote-chlorite and carbonate minerals assemblages. Phyllic alteration is commonly appear in the fault structure zones, locally overprint to the potassic alteration and prophyllitic zone, on pyroxene diorite rocks, microdiorite hornblende as well as quartz diorite (Suasta and Sinugroho, 2011; Corbett, 2011, 2012 and Muthi et al., 2012). This zone characterized by retrograde silica-sericite-chlorite pyrite is mostly limited to fault zones or selvages to late stage quartz-pyrite veins likened to D veins (Corbett, 2012). Argillic zone appear mainly adjacent to breccia and fault zone, especially in the epithermal prospect area, characterized by the present of the clay minerals. Illite and monmorillonite are the main minerals identified in the vein samples suggesting structural controlled argillic alteration (Muthi et al., 2012).

A dioritic composition range of the intrusive rocks type and the domination of the potassic and prophyllitic zone, suggested that the alteration model of the Cu-Au porphyry ore deposit in the study area is more similar to the diorite model rather than the quartz monzonite model. Although quartz diorite intrusive also were found in the area, but it crystalized after the formation of porphyry stage, which is associated with the Au-base metal epithermal mineralization stage.

Vein Type

An understanding of the veins and veinlets in the porphyry system is very important, especially in the Cu-Au porphyry deposit, as most of mineralization is associated with the presence of veins and veinlets. Many various types of veins in porphyry-type ore deposit summarized from several experts (Gustafson and Hunt, 1975; Corbett, 2008; Sillitoe, 2010; Corbett, 2012) include EB type or EDM type, M type, A type, B type, AB type, C type and D type. A lot of vein type were observed at the Randu Kuning area, both porphyry vein type and epithermal vein type. Some of them are difficult to be grouped according to the classification of previous researchers above.

Here are some vein types criterias taht were found in the study area based on observations of drilling core samples and surface outcrops (using compilation of Gustafson and Hunt, 1975; Corbett, 2008; Sillitoe, 2010; Corbett, 2012). At least sevent porphyry veins type have observed, respectively from the earliest are:

1. **Magnetite- chalcopyrite ±quartz-biotite veinlets**
   - Mostly occured as a stringer veinets
2. **Quartz±magnetite (A type)veins**
   - Comprising mostly saccharoidal and transparent quartz and minor or without magnetite
   - Associating only with potassic alteration zones
   - Vein shape commontly unsymmetry, irregular and discontinue
   - It is can be a singgle vein, ptygmatic vein, stockwork linier vein, sheeted vein and stringer vein
   - Disseminated chalcopyrite rarely present
3. **Banded/Laminated quartz-magnetite (M type) veins**
   - Consist of magnetite and quartz with minor or without sulphide
   - Showing banded or laminated structure
4. **Quartz±K feldspar (B type)veins**
   - Characterized by centrally terminated combstructure quartz and or felldspar in filled with lesser of fine sulphide. Some of them not in filled by sulphide
   - At Randu Kuning area this vein type are rarely recognised
5. **Quartz with thin centre line sulphide (AB type) veins**
   - This vein types are formed by the filling at centra termination within A vein by sulphides (chalcopyrite-pyrite±bornite)
6. **Pyrite±chalcopyrite (C type) veinlets**
   - Comprising sulphide minerals (chalcopyrite-pyrite)
   - This veinlets generally narrow and there is no alteration selvages or halos
7. **Pyrite-quartz+chalcopyrire+carbonate (D type) veins**
   - Characterized by coarse euhedral pyrite, quartz and carbonate
   - Commontly followed by silica-sericite±pyrite selvages/halos
   - Associated with phyllic zone toward to prophyllitic zone

Conclusions

The intrusive rocks at the study area consists of feldspar diorite (as a xenolith within pyroxene diorite), pyroxene diorite, hornblende microdiorite and quartz diorite. Hydrothermal fluids responsible for the alteration and mineralization is associated with the occurence of the horblende microdiorite intrusion.

A dioritic composition range of the intrusive rocks type and the domination of the potassic and prophyllitic zone, suggested that the alteration model of the Cu-Au porphyry ore deposit in the study area is more similar to the diorite model rather than the quartz monzonite model. Phyllic and argillic altertion type also present, but in a limited area, especially within the fault structure zones.

Many vein type which related the formation of porphyry deposit have identified, respectively from the earliest are Magnetite- chalcopyrite ±quartz-biotite veinlets, Quartz±magnetite (A type)veins, Banded/Laminated quartz-magnetite (M type) veins, Quartz±K feldspar (B type)veins, Quartz with thin centre line sulphide (AB type) veins, Pyrite±chalcopyrite (C type) veinlets, and Pyrite-quartz+chalcopyrire+carbonate (D type) veins.

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