Type of Gold Deposit in Arinem Cisewu and Its Surrounding Garut Regency, West Java, Indonesia

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***Abstract*—Gold deposit based on the mineralization of gold and other ore minerals in Arinem area and its surrounding was found in the quartz vein. The research area is in Arinem area and its surrounding, Garut Regency, West Java. Arinem and the vicinity was the location for early stage of research program of mineralization in Papandayan area. This area has good mineralization, and according to previous studies, is a low sulfidation area with the presence of pyrite, chalcopyrite, galena and sphalerite (Antam, 2014). The presence of galena and sphalerite mineral has suggested that instead of low sulfidation, the area may be in intermediate sulfidation zone state supported by other data such as quartz breccia, banded quartz and shear as control structure. Lithology in the area consists of breccia Quaternary and lava unit of Jampang formation in Miocene and unit of andesite and basaltic in Quaternary and intrusion of dacite, andesite and diorite. The alteration and mineralization of research area was classified as propylitic alteration zone with the presence of chlorite, epidote and calcite mineral, argillic alteration zone with montmorillonite, kaolinite mineral, silicic alteration zone with the presence of quartz-sericite, a bit of calcite mineral. The observed ore minerals are pyrite, chalcopyrite, galena, sphalerite. The geological structure was controlled by horizontal fault in almost north-south direction of N 170O-180O E and northeast – southwest horizontal fault in N 40O – 50O E, while the mineralization zone was controlled or following fault pattern of N 170O - 175O E. The epithermal deposit of the study area can be classified as intermediate sulfidation epithermal deposit for zones with galena and sphalerite mineral particularly on several locations near fault zones and brecciated quartz. Meanwhile, the study area is generally low sulfidation epithermal type deposit.**

***Index Terms*—Mineralization, alteration, sulfidation, sheared, deposit**

I. Introduction

The southern area of West Java, particularly Garut Regency and its surrounding is mainly comprised of igneous rock resulted from volcanic activities, indicating a potential of ore mineral deposit. Arinem Cisewu region is an area of alteration and mineralization, among them are gold, copper, lead, and zinc. There are lithology units resulted from ancient volcanism activities in the form of volcanic sediments and intrusions, and other geological processes supporting ore mineral deposit formation. Geological structure controlling ore mineral deposit potential were identified in the area. The research was conducted in the area belongs to IUP of Aneka Tambang mining company and also artisanal mining that was closed where residents used to mine gold, copper and galena ores. Previous studies had pointed that the area and its surrounding has low sulfidation epithermal type deposits which were mainly manifested in quartz veins. This research aims to identify lithology and geological structure, particularly zones of alteration, ore mineralization and deposit types in the study area by carrying surface geological mapping. In order to know the ore mineral deposit potential, laboratory analysis such as AAS (Atomic Absorbtion Spectrophotometry), XRD (X-Ray Diffraction) and mineralography were conducted to certain vein samples.

In this research, we found presences of galena, sphalerite, and bonite minerals in several fault zones and also brecciated quartz, which indicated an intermediate sulfidation epithermal type deposit zone, though the area mainly has epithermal low sulfidation type deposits.

II. Research Aims and Purposes

This research aims to identify lithology and geological structure, particularly to conduct more detailed data collection on the manifestation of ore mineral in alteration zone in order to know other deposit types in the area.

III. Regional Geology

Physiographically, the research area is a part of Southern Mountain of West Java, it is slight sloping hills area and is a part of flat and mountainside of Papandayan. Stratigraphy of the area is comprised of Jampang and Bentang Formation. The Early – Mid Miocene Jampang Formation has lithology of breccia overlain by tuffaceous sandstone and andesite lava in different thickness at different locations. On top of Jampang Formation, Late Miocene of Bentang Formation is unconformably deposited and consists of tuffaceous sandstone with a bit of lava section in the lower part. The lower part of formation is made of tuffaceous sandstone interbedded

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with lava section, and thereupon conglomerate with many limestone fragments was deposited, then well-laminated tuffaceous sandstone, and claystone interbedded with sandstone on it. Geological structure developed in West Java is generally identified into; dextral fault in northwest – southeast direction and synistral fault in northeast – southwest direction. In West Java, some of the faults were reckoned to have been rejuvenating since Pliocene Age until present [1].

The geological structures developed in study area are right-lateral strike slip fault in northwest – southeast direction (N 330^0 E) (Fig. 1) which is the main fault controlling mineralization in the area and left-lateral strike slip fault in N 030^0 E direction. Mineral bearing veins were found as quartz veins filling shear joints in N 330^o E direction and extension joints in N 005^0 E direction.

Figure 1. The main fault zone in N 330^O E direction, is "quartz breccia".

IV. Alteration

Hydrothermal alteration is a complex process which involves changes in chemical composition, texture and mineralogy of rock. The process is a result of interaction between hydrothermal fluid and the rocks passed by it in a specific physical and chemical condition [2]. Alteration zone has distinctive patterns and characteristics to be identified. The zonation pattern begins from the nearest zone with ore deposit.

The results of megascopic and petrographic observation on several altered rock samples in the field indicated three alteration zones:

1) Silicic type (indicated by quartz mineral)
2) Argillic type (indicated by kaolinite and sericite mineral)
3) Propylitic type (indicated by albite, chlorite, ±epidote, ±sericite, ±halloysite, ±smectite)

A. Silicic Type

Silicic alteration type is indicated by a group of silicic mineral (SiO_2), such as quartz. The alteration occupies small area which is only 5% of the study area and is generally found in epithermal mineralization system. The silicic alteration found in the study area had strong alteration and could be found in dacite and andesite lava. It was formed in the earliest phase in volatile rich condition and after fluid rich phase, this alteration was exposed to leaching and became vuggy, and even could be brecciated which would open space for deposition of metals brought by hydrothermal fluid. This alteration spreading pattern was influenced by structures developed in the area (Fig. 2).

Figure 2. Manifestation of silicic alteration (A), argilllic alteration (B) and propylitic alteration on the lithology of andesite lava.

B. Argillic Type

Argillic Alteration is characterized by the presence of a collection of clay minerals based on the set of kaolinite and sericite. In the field, this alteration was generally manifested in white color. Argillic alteration was formed in the final phase when volatile rich hydrothermal fluid seeped out through cracks during post – magmatic with pH of 4 – 5 and relatively low temperature of 200 - 250˚C [3]. The spreading pattern of argillic alteration was controlled by geological structure developed in the study area and it covers about 20% of the area.

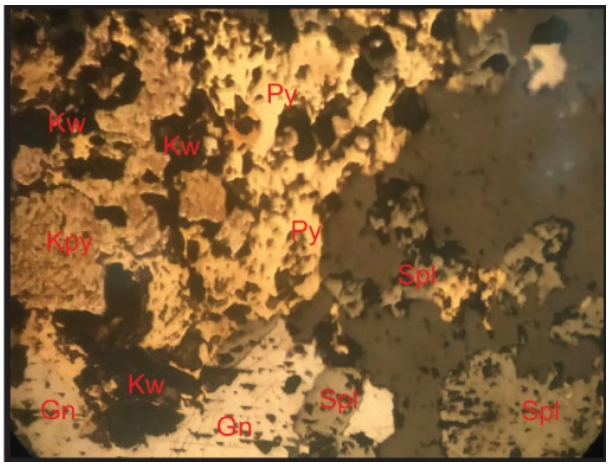
C. Propylitic Type

Propylitic alteration is characterized by the presence of albite and chlorite mineral which substitute parts of pyroxene in andesite and epidote rocks. The propylitic alteration is categorized in weak up to strong alteration. The field manifestation of this alteration still had the texture of its origin rock, but started to have the green

color of chlorite mineral on certain places and there were spots that had been strongly altered and had strong green color. The spreading pattern of propylitic alteration in the area was controlled by geological structure developed there and it was about 75% of the study area. It occurred in the early stage of alteration with high temperature so it was found on almost all over the study area.

V. Mineralization

Mineralization occurred in the study area was relatively associated with quartz vein (either vein or veinlets) in banded, chloroform, vuggy texture and quartz breccia and sheared which often filled with quartz breccia in relatively southeast – northwest direction found in sandstone and andesite – basalt lava lithology. The mineralization veins were resulted from the filling process of hydrothermal fluid along with formation of shear joint [4]. The ore mineralization in the study area were metal minerals such as main metal elements in the form of copper (Cu), lead (Pb) and zinc (Zn) and also other supporting metal mineral, such as pyrite (FeS_2), chalcopyrite ($CuFeS_2$), galena (PbS), bornite (Cu_5FeS_4), magnetite (Fe_3O_4), gold (Au) (Fig. 3). Based on AAS analysis, ore elements found in the field had the highest content as follow: Cu (14 ppm – 5.81%), Pb (15 – 3060 ppm), Zn (59 ppm – 1.02 %), Ag (0.3 – 16.4 ppm), and Au (5 – 447 ppb). The analysis result below (Table I) is data obtained from analysis of chosen quartz vein sample in the study area.



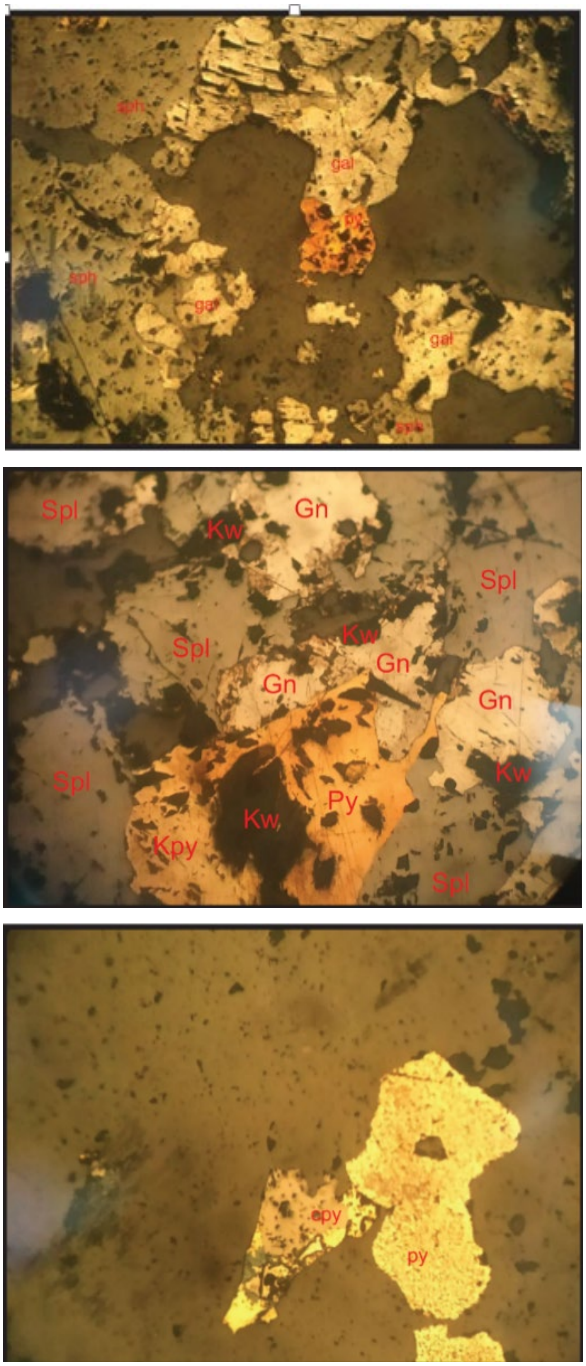


Figure 3. Sample shows Cp = Chalcopyrite, Gn = Galena and Sp = Sphalerite that growing together and crosscutting each other.

TABLE I. AAS Analysis Result of Cu, Pb, Zn, Ag and Au in Several Sampling Location

No	Kode Conto	PARAMETER					
		Cu	Pb	Zn	Zn	Ag	Au
		ppm	ppm	ppm	%	ppm	ppb
1	LP1 1H	2550	6077	-	1.62	127.20	2114
2	LP1 2H	172	3794	-	1.15	13.20	2177
3	LP1 3H	2530	6023	5345	-	91.20	2173
4	LP 17	578	3105	-	1.56	52.80	1681
5	LP22	478	891	492	-	33.80	1111
6	LP 56	18	69	39	-	10.40	202
7	LP 58A	29	68	90	-	5.70	44
8	LP 58B	21	58	32	-	4.70	1664

VI. Discussion

The study area is a closed artisanal mining where manifestation of gold was mainly related to the presence of galena, chalcopyrite and sphalerite and several secondary minerals such as malachite and covellite.

Previous studies had categorized the deposit in this area as low sulfidation type, despite the presence of galena which unevenly distributed in alteration and mineralization zone. The galena mineral was considered as an indication of low sulfidation type deposit that is close to fault zone, the temperature of which is relatively higher. In this study however, we found a lot of galena along with pyrite, chalcopyrite, and sphalerite on fault zones, brecciated quartz, and secondary minerals such as covellite and malachite (Fig. 4).

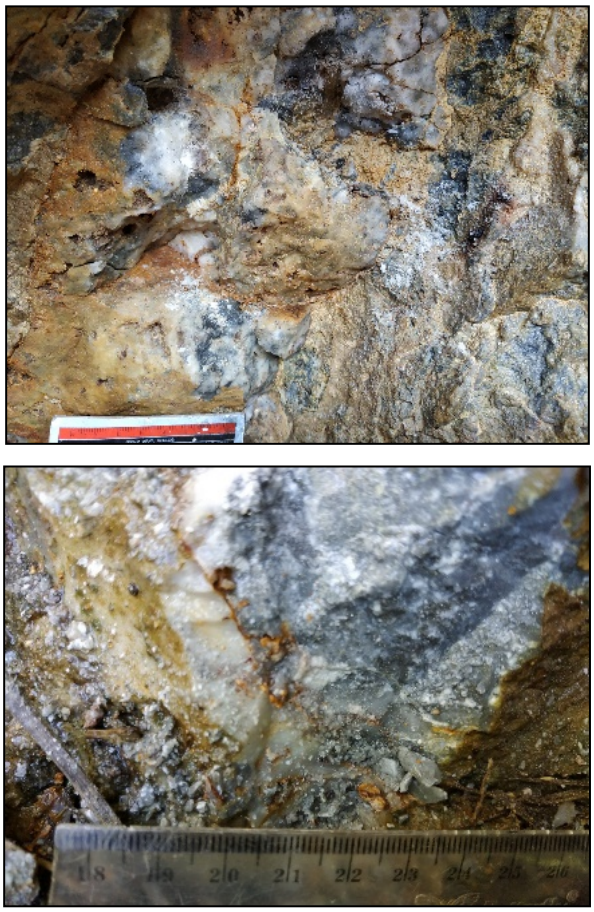


Figure 4. A. Brecciated quartz contains chalcopyrite, galena, sphalerite. B. Bended quartz in comb structure contains pyrite and chalcopyrite minerals.

The silicic, argillic and propilytic alteration in the study area generally have ore minerals carrying gold, silver, zinc and lead in the form of chalcopyrite, sphalerite, galena and pyrite. Based on classification made by Silitoe (2015) [5], [6], the epithermal deposit of the study area can be classified as intermediate sulfidation epithermal deposit for zones with galena and sphalerite mineral particularly on several locations near fault zones and brecciated quartz. Meanwhile, the study area is generally low sulfidation epithermal type deposit [7].

VII. Conclusion

Cisewu region is an area with ore mineral reserve potential carrying Cu-Pb-Zn elements in quartz vein system. The quartz veins resulted from hydrothermal activities were presented in shear joints which were controlled by right strike slip fault as the main fault. The alteration had followed the fault zones which developed gradually from silicic alteration, argillic alteration at the main zone and propylitic alteration at the outermost part. Based on the presence of ore mineral carrying Cu, Pb, and Zn found in chalcopyrite, sphalerite and galena and secondary mineral of malachite and covellite, the epithermal deposit types in the study area could be classified as low sulfidation epithermal. And some area near the fault zones and quartz breccia in the study area were classified as intermediate sulfidation epithermal type deposit.

Conflict of Interest

The authors declare no conflict of interest

Author Contributions

In this research, Heru Sigit Purwanto contributed in the field of structural geology analysis, mineralization assessment, and paper writing, while Sari Bahagiarti Kusumayudha worked for general geological data evaluations and also paper writing.

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