

# Zona Alteration and Mineralization at Cilodog Area Cilodog District Sukabumi Regency West Java Province Indonesia

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## Abstract

Hydrothermal alterations formed in the research area are carefully grouped into three types of alteration zoning and they are argillic alteration, propylitic alteration, and sub-propylitic alteration. The mineralization then is carefully classified as pyrite ( $\text{FeS}_2$ ), chalcopyrite ( $\text{CuFeS}_2$ ), galena (Pbs), bornite ( $\text{Cu}_5\text{FeS}_4$ ). In the research area, the mineralization process is controlled by geological structure such as fault and joint. The appearance of the mineralization is abundant and can be found many fulfilling the joint zone mainly shear joint. This study will emphasize on the measurement and detailed analysis to know more about the gold mineralization process and other minerals controlled by structures patterns. The structural control analysis can really be a good helping hand in locating the mineralized areas because basically the activity and geological structure control process are corridor for magma and the its rest compound that brings minerals, so the methods of mineral ores exploration by structure control can be used in determining ore gold mineralized deposits precipitate on gold deposits system and other minerals on a different area.

**Keywords** : Hydrothermal, alteration, structure, mineralization, deposits.

## INTRODUCTION

Patterns and models of geological structures is crucial in determining the whereabouts of gold mineralization and other ore deposits at a certain area, and when the patterns and models of geological structures are already known, then if gold mineralization and ore being found, it will be easier to determine its existence (Nikolay A Goryachev & Franco Pirajno, 2014). This area is an example area that the gold mineralization can be found relatively well in West Java, which until today is still being explore to obtain the existence of economical gold deposits.

Gold mineral and its accompanying minerals contained or crystallized in the veins of quartz (the magma residue/late magmatic) at the fracture/joint lines, both in the tension fracture and shear fractures (shear zones) as well as the fault lines (fault zones). Quartz veins structure follows the pattern of fractures and faults in the research area that is trending Northwest - Southeast, Northeast - Southwest, North - South and West - East. Based on analysis regional structure, Cilodog area and its surrounding area are a tectonic shift patterns Sumatra and Java tectonic pattern (Condon WH, et all, 1996).

From the preliminary results, the geological structure and its relationship with mineralization and gold deposits in the Cilodog area and its surrounding shows that there is an indication that the gold mineralization in quartz veins controlled by geological structure pattern. It is based on some researchers

review results, that the AAS analysis result on a sample of quartz veins in tension and compression fracture shows Au, Cu and Pb element (gold) are relatively high.

## RESEARCH METHODOLOGY

The methodology of the research is focusing in the secondary data collecting along with some previous studies results both published and unpublished. The primary data begins with Landsat imagery and topography maps analysis, then followed by surface mapping with data collecting such as geology, outcrop observation, geomorphology, geological structures (faults, fractures, and folds), alteration mineralization areas, quartz veins, as well as taking rock samples for further analysis.

## GEOLOGY

Geomorphology stadia determining needs multiple observations include morphology/ topography, geological structure, drainage patterns and the shape of the river observations. Rivers in the research area have reached the young stage towards old stage characterized by steep gradients, relatively meandering streams, V-shaped river valley, vertical erosion dominance, and loose sedimentation material velocity. The availability of any metallic minerals exist in Sukabumi other than a manifestation of the collision two plates of Eurasia and the Indian-Australian, Van Bemmelen (1949), Yaya Sumarya (1988), states that this metallic minerals is in the Old Andesite Formation and better known as the Early Miocene of Jampang Formation.

Thrust fault is generally forming an arc showing slope variation of the fault plane to Northwest - Southeast direction. The alignment that allegedly supposed to be fault section have a pattern spread such as fault patterns, and generally trending north -south, with few northeast-southwest, which in some place they were intersect. The fractures are generally found and well-developed on Tertiary and Pleistocene rocks.

Tectonics in this area is at least having two periods, which results in a different structure. The first structure occurs in Middle Miocene and produce thrust feature followed by the intrusion of andesite and basalt. Formation Jampang, Pemali, Rambatan, Lawak and Kalipucang Limestone are folded and faulted, especially forming normal faults trending northwest-southeast and northeast-southwest. The second period took place on Plio-Pleistocene epoch, produces strike slip fault and a thrust fault trending northwest-southeast and northeast-southwest. The Plio-Pleistocene tectonics period faults are formed generally in the boulder faults forms. Geophysical data shows that this latter tectonic activity is intensified back some normal faults (Asikin S., Handoyo A., B. Pratistho, and Gafoer S., 1992).

The geomorphology of research area is dominated by sloped hills that steep and relatively trending northeast-southwest and northwest-southeast, with the erosion level about weak until strong. In general, the landscape is controlled by lithology, geological structure and processes of erosion factors. Classification then this research area can be divided into 4 original form units (volcanic, structural, karst, fluvial), and 10 units of land forms, namely: Volcanic hills landform unit, Volcanic plateau landform unit, Intrusion hill landform unit, Anticlinal hill landform unit, Sinklinal valley landform unit, Sloped sinklinal valley landform unit, Faulted Valley landform unit, Monoclinical hills landform unit, Eroded and sloped karst landform unit and Alluvial Plain landform unit.

Based on data collection in the form of initial interpretation, previous research data, field data and laboratory analysis, the column stratigraphy of research area is being generated by the sequence of lithologies following the age from old until recent time. Basic naming technique on each lithology on the

research area refers to Indonesian Stratigraphy Cipher (SSI) at 1996 by naming the unofficial unit based on the characteristics of the dominant lithology.

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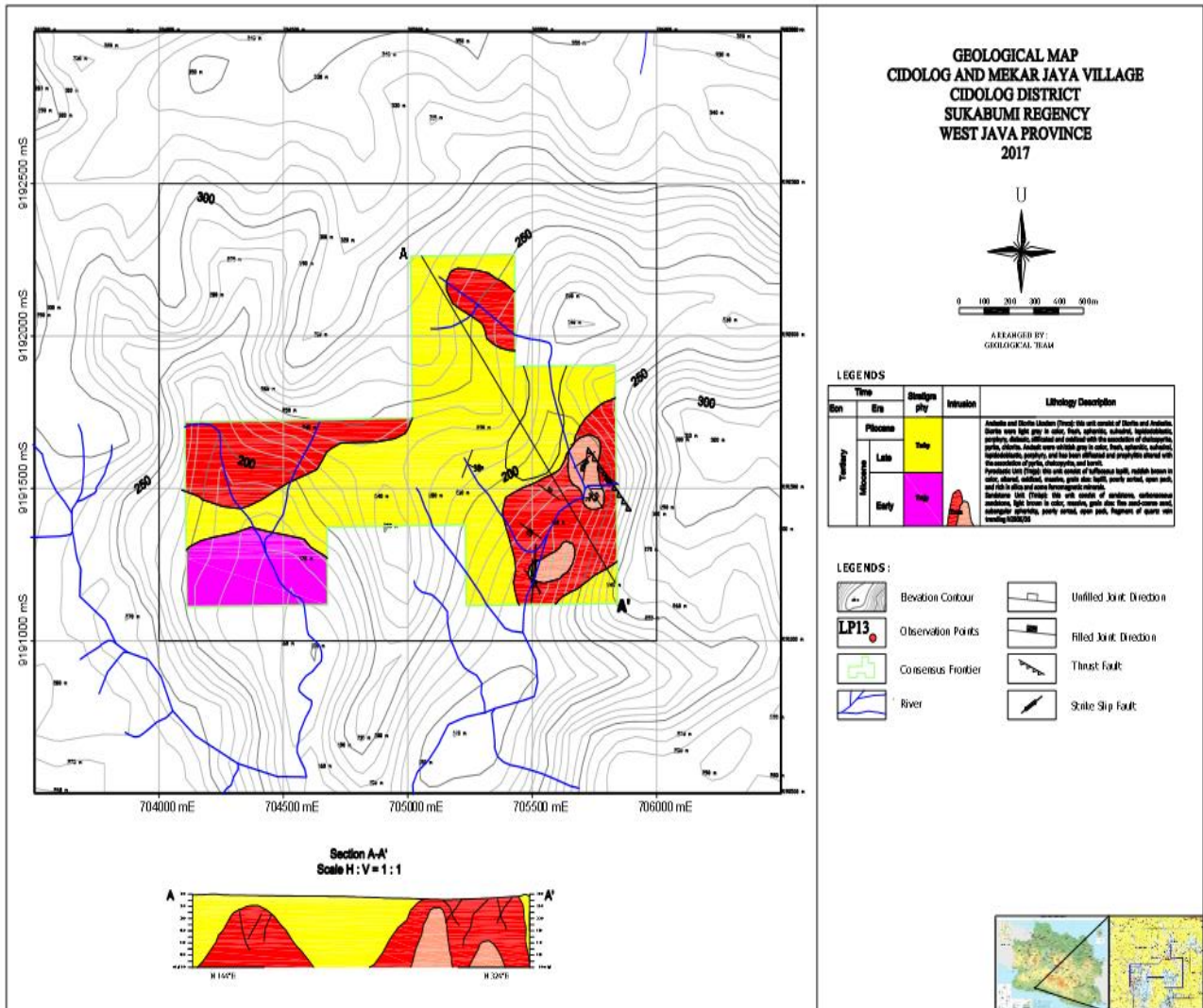


Figure 1. Andesite outcrop , show any argillic and silisific alteration and also some quartz veins



Figure 2. Andesite outcrop show any argillic and silisific alteration and also some quartz veins

Figure 3. Geological Map, Cidolog District, Cidolog Regency, West Java, Indonesia



## ALTERATION AND MINERALIZATION

Alteration and mineralization process is an altering process in a rock on its chemical, physical, and others as a result of a process with hot solution media influence. In this case, the rock which is have been influenced or changed known as wallrock. While the process that happen on the wallrock known as wallrock alteration process, which is a chemical process that changes the original rock by hot flowing solution medium. After all, the most important aspects in the rock alteration and mineralization is the presence of fractures in the rock (channelway) which can be the path to discharge the hot solution to the surface and consequently interact with the wallrock, and the result is some new mineral deposits. The association of these new minerals is usually known as a type of alteration.

Most of the rocks in the research area have undergone alteration or change, especially in the diorite and andesite intrusive rocks as well as some pyroclastics rocks. Alterations in this area are silicification, argilication, prophyllitication or chloritization. In the other hand, common mineralization occurrences are chalcopryrite, galena, pyrite, sphalerite mineral found in rock alteration zone especially in quartz vein and some of them still in the altered rocks itself.

Rock lithology conditions in the research area are also included in the category in experiencing the process of alteration and mineralization, making the study area was being divided into three zones of alteration, namely: argillic zoning, propylitic zoning, and sub-propylitic zoning. This determination is based on the megascopic observation in the field using the helping tools such as loop and mineralography (poles).

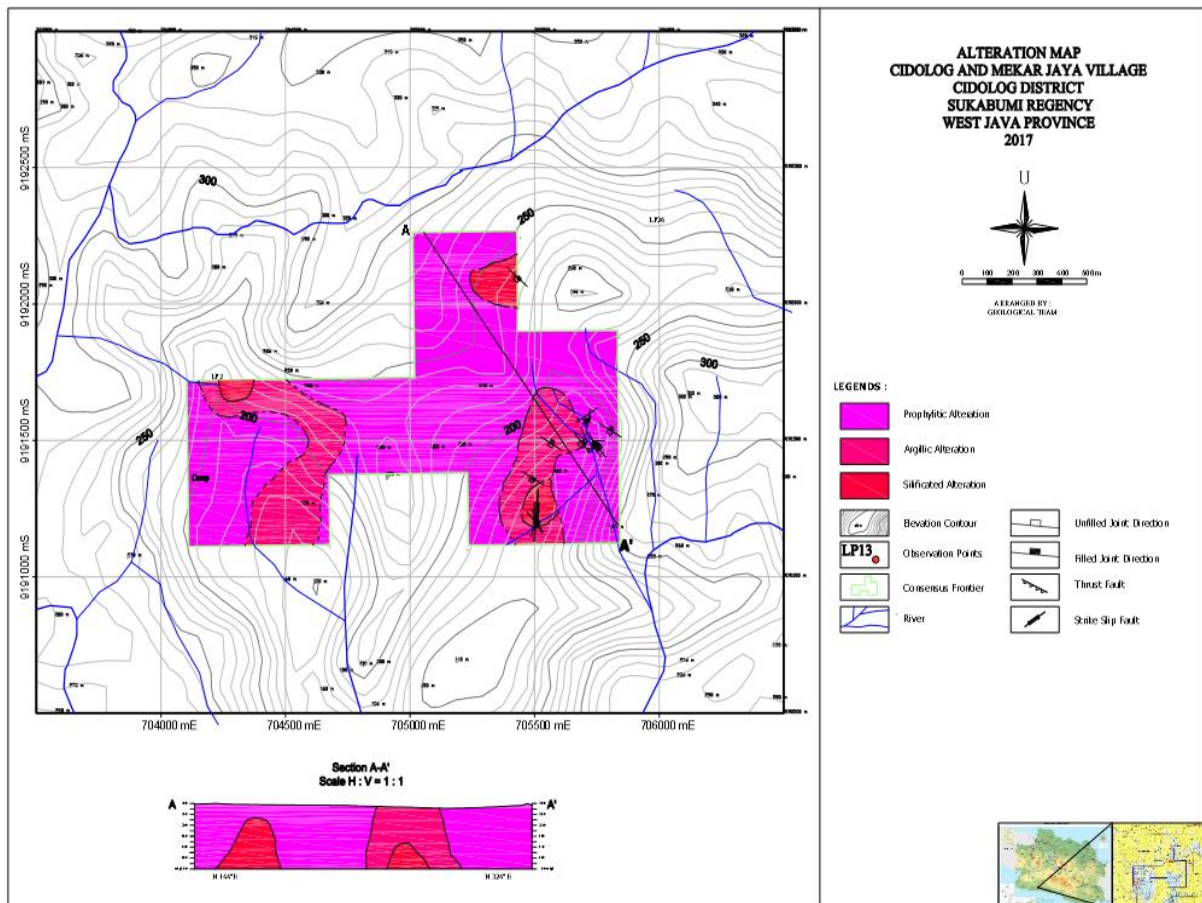


Figure 4. Alteration Map, Cidolog District, Sukabumi Regency, West Java, Indonesia

### Argillic alteration

This alteration zoning spread relatively trending southeast-northwest. This zoning is generally giving some impression of the grayish white to dark gray, milky until cream, and sometimes slightly reddish color. Possess hard-soft characteristic, sticky and fatty streak felt on the hand skin. This alteration is generally found in the Jampang sandstone unit that cannot being identified the original form caused by the alteration and there is no trace of primary mineral in the wallrock body. This assumes that this type of alteration relatively change the rock with medium-strong intensity. This alteration type is also found in several places in conjunction with the quartz vein along with the sulfide minerals in a form of pyrite and chalcopyrite.

Megascopically on the field, the set of alteration minerals seen in outcrop location of this type of alteration in the research area is dominated by a set of clay minerals, which can be seen and felt through its texture, color and streak. The alteration minerals contained in these alteration zones include: kaolinite, illite, quartz, and chlorite. In addition, the presence of sulfide minerals are relatively occurring in this zone

is in the form of pyrite and others. The observation point location of this type of alteration in the research area.

### **Propylitic alteration**

This alteration zoning spread relatively trending southeast-northwest and in the outside of former argillic alteration zone. This zoning is generally giving some impression of strong greenish white, gray to green to blackish brown color. Possess hard-soft characteristic. This alteration is generally found in the Halang sandstone unit that cannot being identified the original form caused by the alteration and there is no trace of primary mineral in the wallrock body. This assumes that this type of alteration relatively change the rock with medium-strong intensity. Megascopically on the field, the set of alteration minerals seen in outcrop location of this type of alteration in the research area is dominated by a set of minerals chlorite, calcite, kaolin, illite, quartz and clay-sized minerals, which can be seen and felt through its texture, color and streak. In addition, the presence of sulfide minerals are relatively occurring in this zone is in the form of pyrite and others. The observation point location of this type of alteration in the research area.

### **Sub-propylitic alteration**

This alteration zoning spread relatively trending southeast-northwest and in the outside of former propylitic alteration zone. This zoning is generally giving some impression of greenish gray, gray to light green and brownish color. Possess hard characteristic. This alteration is generally found in the Halang sandstone unit and can be identified its original. This assumes that this type of alteration relatively change the rock with weak intensity. This alteration type is also found in several places in conjunction with the quartz vein along with the calcite veins.

Megascopically on the field, the set of alteration minerals seen in outcrop location of this type of alteration in the research area is dominated by a set of minerals chlorite, kaolin, calcite, quartz, and clay-sized minerals (clay), which can be seen and felt through its texture, color and streak. In addition, the presence of sulfide minerals are relatively occurring in this zone is in the form of pyrite.

### **Mineralization in the Research Areas**

Most of the rocks in the research area have undergone alteration or change, especially in the diorite and andesite intrusive rocks as well as some pyroclastics rocks. Alterations in this area are silicification, argilication, prophyllitization or chloritization. Mineralization found in the research area is relatively associated to quartz veins (veins or veinlets) in the Jampang sandstone unit, as well as on the intrusion body in the study area. Ore mineralization contained in research area such as sulfide minerals, such as: pyrite ( $\text{FeS}_2$ ), chalcopyrite ( $\text{CuFeS}_2$ ), galena (Pbs) and bornite ( $\text{Cu}_5\text{FeS}_4$ ) and several gold nugget. The elements found in the research area are Au, Cu, Pb, Zn, and Ag and the highest Pb,Cu.

### **CONCLUSION**

1. Hydrothermal alteration which is formed in the research area is grouped into three types of alteration zoning named argillic alteration, propylitic alteration, and sub-propylitic alteration.
2. Mineralization found in research area is pyrite ( $\text{FeS}_2$ ), chalcopyrite ( $\text{CuFeS}_2$ ), galena (Pbs), and bornite ( $\text{Cu}_5\text{FeS}_4$ ) and elements minerals are Au,Cu,Pb,Zn and Ag.
3. In the research area, mineralization process is controlled by geological structures such as faults and fractures. An area where many abundant mineralizations found is fractures area especially shear

fracture that generally trending northeast-southwest and northwest-southeast with the direction of fractures sharpness is measured relatively trending north-south.

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## REFERENCES

1. Asikin S., Handoyo A., B. Pratistho, and Gafoer S., 1992, *Banyumas Regional Geological Map Sheet* (1308-3), the Centre for Geological Research and Development, Directorate of Geology.
2. Condon WH, Pardyanto L., Ketner KB, Amin TC, Gafoer S., and Samodra H., 1996, *Map Sheet Banjarnegara-Pekalongan geological Regional* (1408-2, 1407-5), Geological Research and Development Centre, Directorate of Geology.
3. Daniel Herve Goret, Theophile Ndougsa, Arsene Maying, Stephane Patrick Assembe, Alphonse Didior, Man-Mvele Pepogo (2013). Gold mineralization channels identification in the Tindikala-Boton Area (Eastern-Cameroon) using geoelectrical (DC&IP) methods: a case study. *International Journal of Geosciences*, 2013,4,643-655.
4. Davis, B.K and Hippertt, J.F.M. 1998. Relationships between gold concentration and structure in quartz veins from the Hodgkinson Province, Northeastern Australia. *Mineralium Deposita* 33: 391-405.
5. Kastowo, 1975, *Map Sheet Majenang Regional Geology* (10 / XIV-B), the Centre for Geological Research and Development, Directorate of Geology.
6. Nikolay A.Goryachev & Franco Pirajno.(2014). Gold deposits and gold metallogeny for east Russia, journal *Oregeorev*, vol.59: June 2014.
7. Park, Charles F, Jr., *The Geology of Ore Deposits*, W. H Freeman and Company, New York.
8. Sanzhong Li, M.Santosh, Borming Jahn.2012. Evolution of the Asian Continent Margins, *Journal of Asian Earth Sciences*, Vol 47 .2012
9. Satellite image of tele atlas, 2012, Image Image Google Earth, US Navi, NGA, GEBCO.
10. Van Bemmelen, R.W., 1949. *The Geology of Indonesia*, v. IA. Martinus Nijhoff, The Hague, 792h