



RESEARCH ARTICLE

# Gold-Silver Mineralization in the Neo-Tectonism of Honje Formation and Cipacar Formation, in Cibaliung Block, Banten Province

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## Abstract

The gold ore mineralization region is a zone of mineralization which is inseparable from the role of geological structures, one of which is fracture. The Cibaliung and surrounding areas are epithermal gold mineralization zones, in this region there are two main mineralized zones, namely Cibitung Zone and Cikoneng Zone. It has almost the same characteristics where the fractures formed are quite large so that it influences the class of rock mass, but the other side is the presence of many fractures which make it easier for scattered mineralization to fill the fracture so that the formed vein is thick enough. This study aims to analyze the relationship of Rock Mass Rating (RMR) and Rocks Quality Design (RQD) to tectonic movements in the region to prove the neo-tectonic phenomena in the Honje Formation and Cipacar Formation using surface mapping methods. The methods used are rock type mapping, rock structure mapping, mapping and RQD measurements, rock descriptions and rock sample collection. All the data obtained are then verified and validated before processing and statistical tests. Statistical tests are carried out to ensure an analysis with a basis that is recognized by all parties. Both formations above have different ages, which is for the Honje Formation (Andesite Lava) with the final Miocene age and Cipacar Formation (tuff) at the age of Pleistocene. The findings of this study are the two formations measured by RQD and RMR on rock cracks and surrounding conditions; the RMR observation station made around 125 points in the Honje Formation and 117 points in the Cipacar Formation. The R2 value of the RMR value of the Honje Formation and the Cipacar Formation shows a positive relationship of 67%; The biggest RMR value is in Tuff rock. In addition, the relation between RMR Andesite Lava Value and RMR Tuff Value is done with T-Test between Andesite Lava and Tuff where the result shows no difference of mean between RMR Andesite Lava and RMR Tuff Value. Therefore, the tectonic processes that occur in the Honor Andesite Lava Unit of Honje Formation with the preceding position are formed, and the older age at the end of the Miocene age that is blocked by the field of unconformity experienced Continuity on Cipacar Formation Tuff Unit with the upper position that is formed after Honje Formation and younger age in Pleistocene. The continuation of the tectonic process proves the existence of active tectonic activity better known as Neo-tectonic.

**Keywords:** Neo-Tectonic, Gold Mineralization, Andesite Lava, Tuff, Low Sulfide

## 1. Introduction

The magmatism pathway characterized by a row of intrusion stones along the Sumatra axis parallel to the subduction zone is a path formed by the collision of two tectonic plates of the Indian Ocean - Australia and Asia - Eurasia. The line spreads stretching from North Sumatra to Java and Bali, then connected to Nusa Tenggara to Sulawesi and Maluku Islands to the Philippines.

The process of forming the magmatism pathway occurs as a result of the drive of the oceanic tectonic plates forming the rising fault zones, paralleled along the subduction zone. The rising faults are the weakness zones that facilitate the hydrothermal breakthroughs of the magma to reach the top of the earth's crust. This process is followed by chemical reactions between the hydrothermal solution and the surrounding rock which

produces mineral zones starting from porphyritic, mesothermal and epithermal according to their respective regions.

The geological structure found in the research area is straight normal fault toward northeast-southwest. (Sudana et al,1992) States where it is suspected that there is a connection of the structure with the zone of the Krakatau area in the Sunda Strait which is a depression of tectonic volcanic activity (Zen, 1983 in Sudana, et al., 1992). This study wishes to convey the purpose by which tectonic movement and activity can be demonstrated by RMR and RQD values of two different formations, in which case the two formations are the Honje Formation (Andesite Lava) and the Cipacar Formation (tuff).

To support and respond to the desired objectives in this paper, a method of mapping the surface geology is applied to obtain an overview of the pattern and

distribution of cracks from 2 different formations, observations and RMR measurements in the field, which is then assisted by verification and validation of data as evidenced by data processing Through correlation regression analysis method.

## 2. Geology Setting

Volcanism during Paleogene to Neogene is recorded both in several basins on Java and Sumatra, such as the Sibolga Basin, Bengkulu Basin and the Basin of South Sumatra. Paleogene and Neogene Volcanism in Java are characterized by the presence of Jatibarang Formation (Paleogene) and Merawu (Neogene).

The Pliocene-Quarter vollitism phase is characterized by a change in the transgressive cycle into a regressive cycle to the end of Tertiary.

Recent field data shows the presence of early Tertiary volcanic rocks in southern Sumatra Kikim Formation and Lahat Formation (Adiwidjaja, et al., 1973; Pulunggono, et al., 1984 in Soeria-Atmaja, 1997) and the northern coast of Java is Jatibarang Formation (Martodjojo, 1984 in Soeria-Atmaja, 1997).

The presence of early Tertiary volcanic rocks in Java and Sumatra has shown the magnitude of the magmatic arc. The Jatibarang Formation is known to be 29.0 million years ago (Martodjojo, 1984 in Soeria-Atmaja, 1997), not done dating on Kikim Formation and Lahat Formation. However, stratigraphically both are under the Oligocene Talangakar Formation.

The Jatibarang Formation, Kikim Formation, and Lahat Formation exhibit similar characteristics, including a thickness of tuff in addition to the presence of volcanic breccia and lava flows. Tertiary Old-age volcanic rock outcrops are also found in the western regions of Sumatra (Age K-Ar 65 million years ago), Natal (Sutanto, 1997 in Soeria-Atmaja, 1997), and SIlbagindar (West Aceh). Based on the evidence in the field, it can be concluded that the dispersal of early Tertiary volcanic rocks is wider than previously thought.

Early Tertiary volcanic rocks were also found in southern Java. Outcrop can be found in West Java (Jampang Formation), Central Java (Old Andesite Lava Formation) and East Java (Besole Formation). The Jampang Formation is 17.9-32.3 Million Years Ago in Soeria-Atmadja, et al, (1994) and can be compared to the Oligo-Miocene Old Andesite Lava Formation.

Volcanic rocks did not appear in southern Bali, but were reopened in Lombok, Flores, and Sumba. In the Lombok region, Early Tertiary volcanic rocks are represented by early Oligocene-Miocene Collector Formations.

The continuity of early Tertiary volcanic rocks in northern Java is still not known with certainty. Hamilton (1979) and Martodjojo (1984) assume that the Manunggul Formation in southern Borneo (Meratus area) is a continuation of the Jatibarang Formation. Nevertheless, the results of K-Ar age calculations show the age range of 72.2-86.9 millions years ago (Sumarso, 1985 in Soeria-Atmaja, 1997), much older than the Jatibarang Formation.

Arpandi, et al (1975) in Soeria-Atmaja (1997) state that volcanic rocks in the Bengkulu area (between

Bengkulu and Palembang), southern Sumatra and northern Java range from 50-60 millions years ago, older than the magmatic arc Tertiary Beginning in southern Java. The magmatic bows represented by Kikim Formation, Lahat Formation and Jatibarang Formation are suspected to be continuous and related to the presence of melange in Luk Ulo (Central Java) and Ciletuh (West Java). Tertiary magmatic activity is expected to begin in the north on Limestone to shift south after experiencing "dormancy" in the Eo-Oligocene. The alteration of the magmatic arc corresponds to the Sumba microcontinent docking (Sumba, East Java, Paternoster) (Fig. 3).

### 2.1 Structure and Tectonic Regional

The tectonic activity of the study area is the western part of Java Island where geologically the area is included in Banten Block. Bemmelen (1949) mentions this area as Banten Block with a line boundary extending south-north from Pelabuhan Ratu Bay to Jakarta Bay including geological boundaries. Tectonic Java - Sumatra experienced many developments through the latest scientific publications in particular. The orientation of Java Island has similarities with the island of Sumatra. Both islands are separated since the Mio-Pliocene. Java Island has changed its direction anti-clockwise while the island of Sumatra is rotated in a clockwise impact on the widening of the Sunda Strait towards the south like a triangle zone.

Geologically, the similarity of Java Island and Sumatera Island can be described as the existence of segmented basements in Banten and Lampung with north-south direction. The discovery of Horst - Graben Systems as in Ujung Kulon High - Ujung Kulon Low - Honje High - West Malingping Low.

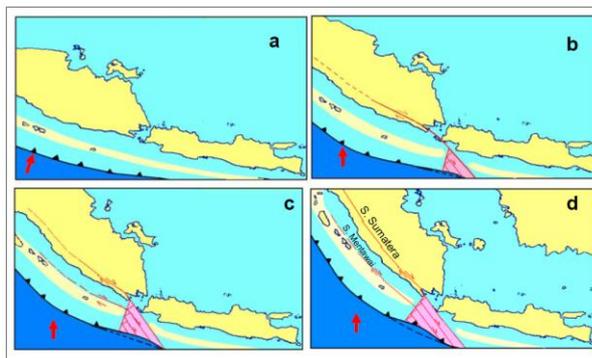


Fig 1. Tectonic Development of Transitional Zone between Sumatera and Java. (Handayani, 2008)

The existence of the horizontal fault of Sumatera is active in the form of dextral and Ujung Kulon horizontal fault (off the Southwest coast of Pelabuhan Ratu) with step-over position, such as in order from Sumatera Fault to Ujung Kulon Fault. Other evidence that gives the belief that during the time of Sumatera Island and Java Island is one that is the existence of synthetic faults are releasing, both in Lampung and Banten, implicate "basal lava flood" in Lampung and Banten because of these faults to encourage the release of magma Rise to the surface. The subduction model

that occurs in the Sunda Strait region is the convergence between the Indian plate and the Eurasian Plate causing changes in the movement of the surrounding plates. One of the expected changes due to the collision is the change in the direction of the Indo-Australian Plate convergence of the Eurasian Plate (Fig. 1)

### 3. Materials and Methods

The area of Cimanggu as one of the areas that is part of Bayah Dome is geologically strongly influenced by the presence and presence of the Western Java plate meeting, and closely related to the presence of Mount Krakatau in the Sunda Strait. Mount Krakatau as part of the meeting plate in the Sunda Strait provides very important information to be able to describe how the plate activity.

In addition to the existence of Mount Krakatau as evidence of the encounter and movement of Western Java plate, other phenomena present such a fairly complex rock types with different each of age, the presence of other mountains in the land area of the Cibaliung Region and surrounding areas, as well as the findings The presence of mineralized zones as part of tectonic activity in the region.

The geologic structure that developed in the research area is stocky with dominant south-western direction. Stump is generally filled with quartz veins with varying thickness, 0.5 to 5 cm. Evidence of fault structures in the fault section, scratch lines, and traces of other structures that can be found in the field. Faulting is indicated from the river straightening pattern that can be observed on topographic maps, DEM SRTM images, and Landsat images. It is estimated that the fault developed in the study area is a northwest-southeast trending shear fault.

Observation and measurement activities other than rock outcrop dimensions also performed solid measurements. Measurement results obtained data direction and stance of varying heavily. The data are then sorted and separated into shear joints and extensional joints. The crusher has an azimuth range of N 0 - 90° E and N 180 - 270° E, while the tensile strength has an azimuth range of N 90 - 180° E and N 270 - 360° E. The rash is present in pairs and the fracture part is not filled with secondary minerals. Tensile strength tends to be solitary, has a relatively uniform stance, and is filled with secondary minerals which then form quartz veins (quartz veins).

The result of the stout dynamical analysis shows that the main emphasis ( $\sigma_1$ ) in the research area tends to be S-SW and SW-W oriented. The main emphasis has a steep slope, while the smallest tendency tends to slope. This indicates that the geological structures in the research area, especially stocky are dominated by extensional activity.

The strain force acting on the rocks produces tensile strengths that have northwest-southeast direction and are relatively perpendicular to the direction of the main firm.

Handayani (2008) writes in his writing that the Sunda Strait area is a transitional area between the subduction of the western oblique of Sumatra Island

and the south-western subduction of Java Island that began in Kala Oligocene. The fault of Sumatra that moved horizontally causes the Sunda Strait facial area to experience strain activity.

The stretching activity then forms the normal and coarse-trending faults of the north-south and northeast-southwest direction. Stretching activities in the Sunda Strait face continued to this day (Handayani, 2008)

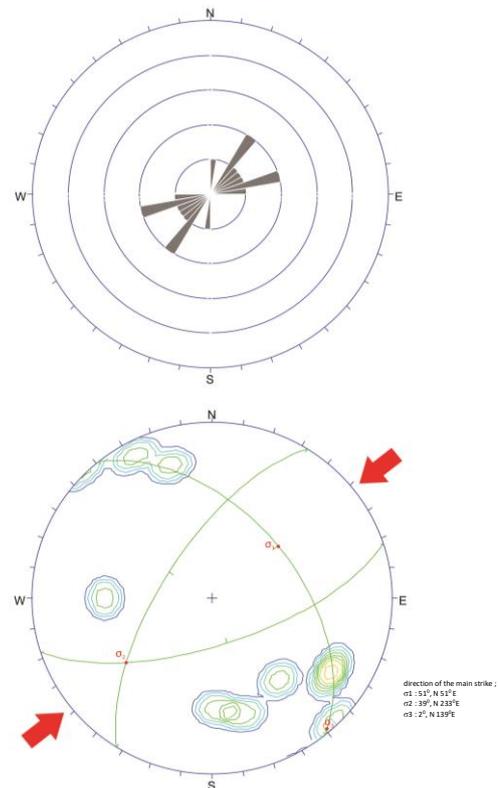


Fig 2. The results of the robust static analysis show that the main emphasis ( $\sigma_1$ ) in the research area tends to be S-SW and SW-W.

The strain force in the research area is thought to be the main geological structure of the mineralization controller. This is evidenced by the presence of quartz veins that have a thickness of more than 30 cm directed N-W and N-NW. Tensile strength is the primary opening zone for which the hydrothermal solution of metallic mineral elements, such as gold (Au), silver (Ag), lead (Pb), and zinc (Zn), rises to the surface and is concentrated. Mineralization occurs in the late Miocene Honje Formation (Fig. 3).

Fig. 6. above provides an overview of the interpretation of the western Java structure interpreted by Haryanto, 2013 where there are many geological structures with varying sizes and directions. The conditions are grouped into 4 directions of the fault line that is west-east, northeast-southwest, northwest-southeast and north-south (Haryanto, 2013).

The above matter when considering the interpretation based on Landscapes 8 (LDCM) 8 RGB567 especially for the location of study where in the west and east is a high altitude while in the middle is a low so that the grouping for the general direction of the structure alignment is divided based on the height

difference where the western block has a direction General  $154^{\circ}$ , the eastern block has a general direction of  $154^{\circ}$ , and the middle block has a general direction of  $153^{\circ}$ . So the pattern of structure that develops in this area is directed  $154^{\circ}$ . (Fig. 4).

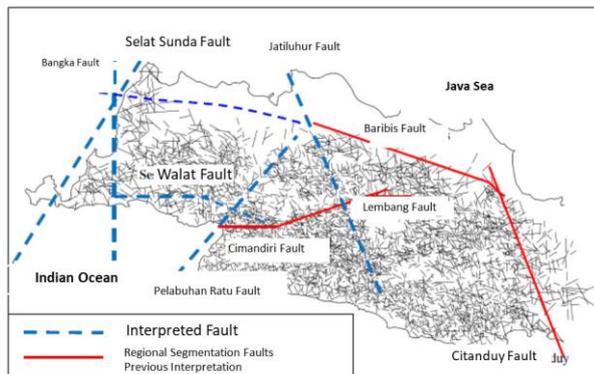


Fig 3. Structural interpreted through Topography (Haryanto, 2013)

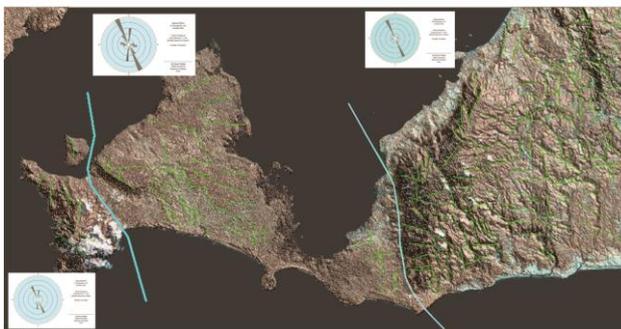


Fig 4. Structural alignment interpreted through Satellite Image Imagery Landsat Data Continuity Mission (LDCM) 8 RGB567 Acq: July 5, 2015 (Landscape Image Map 8: Geological Survey Center, 2015).

### 3. Result

Tectonic activity as an underlying geological process for subsequent geological products such as earthquakes, volcanology and ground motion. The effect of the geological product is one of them is the formation of mineral (mineralization). The presence of mineralization is closely related to the formation of fractures in the rocks caused by tectonic activity. The formation of fractures hence facilitate the process of mineralization itself, the more formation of fractures in the rocks the mineralized zone will be wider and thicker the veins are formed, but vice versa, if a little fracture is formed then the mineralized zone, is small.

The presence of fractures in rocks can also provide an overview of tectonic activity in the region. At the study site, the presence of fractures can be observed and measured either directly or using secondary data such as images satellite. However, to obtain fracture data related to RMR value then it must be done directly in the field. The research location is divided into 2 rock formations with different ages, namely;

1. Honje Formation with Final Miocene age
2. Cipacar Formation with Pleistocene age

Result of geological observation and mapping of both rock and structure, then got data that is identified there are 2 rocks that can be mapped and measured fracture, that is;

1. Andesite Lava as part of the Honje Formation
2. Tuff as part of Cipacar Formation

The lithology of the study area is divided into 2 units of unofficial litho- stratigraphy, the units of Andesite Lava and tuff units.

#### A. Units of Andesite Lava

Andesite Lava units cover 90% of the research area. In general, the lithology of the Andesite Lava unit has the characteristics of rock outcrops in dark gray, massive structure, degree of hypocrySTALLINE crystallization, uniformity of inequigranular crystal grains, porphyroafanitic texture, composed of 3% biotite minerals, hornblenda 3% and aphanitic base mass 94%, name of Andesite Lava rocks. The size of the crystal grains which tend to be smooth indicates that Andesite Lava comes from lava flows. Weather conditions are 10% rocky. (Fig. 5).

Locally encountered Andesite Lava with a similar texture but has a color tends to be black, allegedly Andesite Lava basaltic. This Andesite Lava unit belongs to the roct unit Honje Formation.



Fig 5. Andesite Lava outcrop in ST-8 Citeluk River



Fig 6. Quartz veins on Andesite Lava at ST-54 Citeluk River

Andesite Lava is subject to Prophyllitic and argillic alteration. Prophyllitic alteration is evidenced by the emergence of chlorite minerals as a result of alteration of amphibole minerals, as in observations at Station Observations 26 and 28.

The argillic alteration is characterized by the presence of kaolin minerals, as observed in Observation

Stations 29, 35, and 42. Hydrothermal alterations occurring in Andesite Lava also form tightly packed quartz veins with a thickness of 0.5 to 5 cm (Fig. 6). Quartz veins can be clearly observed in the outcrops at ST 14.1, 15.2, 17-i, 18-i, and vein.

The Andesite Lava is thought to originate from the freezing of lava flows. This is evidenced by the existence of brecciating structure in observation stations 4.4, and 5.2. Brecciated is a structure commonly found in extrusive igneous rocks. In addition, the size of the constituent Andesite Lavaic minerals that tend to be smooth indicates a fast magma freezing process on the surface of the earth.

#### B. Tuff Unit

Tuff units cover 10% of the research area. In general, lithology in tuff units has a characteristic gray whitish color, tuff grain size (> 2 mm), good sorting and closed packing.

Tuff consists of 5% biotite minerals and 95% of volcanic glass (Fig. 7). The tuff unit belongs to the Pliocene Cipacar Formation, unconformity with the Andesite Lava Unit. Judging from its texture and composition, Tuff rock units are thought to be formed from volcanic eruptions which then form deposits of volcanic deposits.



Fig 7. Brecciation Andesite Lavas in ST-5.2 Citeluk River



Fig 8. Outcrop tuff in ST-5 Citeluk River

Based on the data, data processing is performed statistically (fig . , which must meet the requirements of data normality testing, from 125 (table 1) and 117 data (table 2.) related to the RMR value as the data population, sampling is carried out as many as 35 data,

after that simple linear regression analysis to get the relationship and influence between the RMR values for each rock unit in different formations. To see the extent between the RMR Andesite Lava Value and the RMR Tuff Value then a Differential T-Test between Andesite Lava and Tuff is performed as below;  $t_{arithmetic} < t_{table}$ , then  $H_0$  is accepted, that  $x_1$  and  $x_2$  are equal, there is no average difference between the variables  $x_1$  and  $x_2$ .

The result of the mean difference test above where  $H_0$  is accepted with the understanding between  $x_1$  and  $x_2$  is equal, so there is no mean difference between the two between RMR Andesite Lava value and RMR Tuff value. It shows that the tectonic process that occurs in Andesite Lava Unit of Formation Honje with an earlier position is formed and older age at the end of the Miocene age is blocked by the field of unconformity experienced continuity on Formation Cipacar with a higher position that is formed after Honje Formation and younger age that is in Pleistocene. The continuation of the tectonic process proves the existence of active tectonic activity better known as Neo-tectonic.

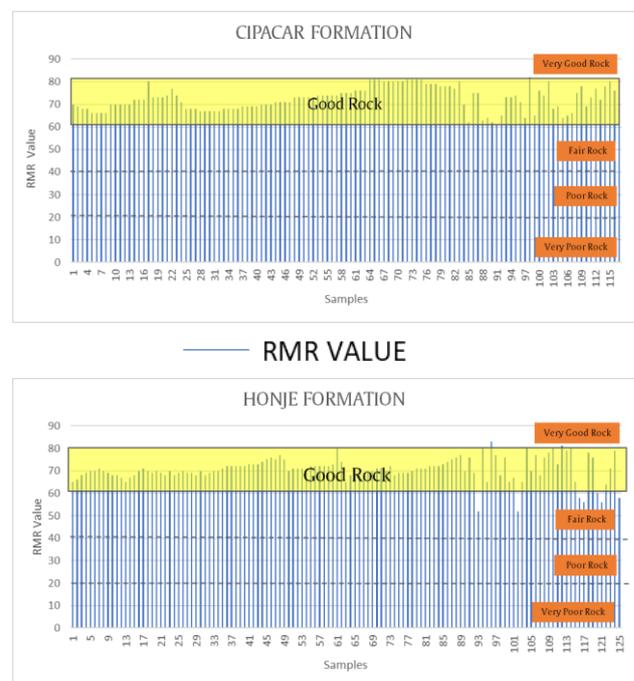


Fig 9. RMR Value of all lithology at Honje and Ciracas Formation

Table 1. The value of RMR Lava Andesite Lava Honje Formation

No.	Lithology	RMR Value	Rocks Classification
1	Lava Andesite Lava	65	Good Rock
2	Lava Andesite Lava	66	Good Rock
3	Lava Andesite Lava	68	Good Rock
.	.	.	.
.	.	.	.
.	.	.	.
123	Lava Andesite Lava	71	Good Rock
124	Lava Andesite Lava	79	Good Rock
125	Lava Andesite Lava	58	Good Rock

Source: Field Observation Results, 2016

**Table 2.** RMR Tuff Value of Cipacar Formation

No.	Lithology	RMR Value	Rocks Classification
1	Tuff	70	Good Rock
2	Tuff	69	Good Rock
3	Tuff	68	Good Rock
.	.	.	.
.	.	.	.
.	.	.	.
115	Tuff	80	Good Rock
116	Tuff	76	Good Rock
117	Tuff	75	Good Rock

Source: Field Observation Results, 2016

Description: G. Rock = Rock Class Good Rocks

#### 4. Conclusion

The tectonic activity in the study area is active tectonic activity, based on the similarity of the mean value of RMR between the average value of RMR Andesite Lava of Honje Formation with the final Miocene age with the average value of RMR tuff of Cipacar Formation with  $t_{count} = 0.555 < t_{tabel} = 1.995$ , which means that there is no difference in the mean value of the two units of the rock. The same rock mass classification as evidence that there is tectonic movement in the region continues to work from the old rock formations to the young formations constrained by the field of noncausal affecting against 2 different rock types.

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