Correlation of rock characteristics to gold content in the Honje Formation and Cipacar Formation, Pandeglang, Banten

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Abstract. Gold deposits are economic deposits, the formation of gold deposits in nature is one of them epithermal gold deposits in the Au-Ag mineralized zone. Gold mineralization is influenced by a hydrothermal solution that flows through rock permeability, resulting in an alteration process that changes the chemical composition, mineralogy, and texture of the original rock. One variable that affects the presence of veins carrying valuable ore minerals is fracture structure. This study aims to determine and analyse the relationship/correlation of rock solids to the level of gold deposits using the correlation regression method. The methodology used is massive data collection through geological mapping, log-drill data analysis, Data Assay analysis, data processing and analysis assisted by using correlation regression through validation and verification of drill data. The results of processing and analysis of muscular data notified by the RQD value and log-drill data obtained the results of multivariate normality test based on the Au model = 8,219 - 2761 RQD and Ag = 90,388 + 0.977 RQD as follows: 1) When the RQD is zero, then the Au will be valued amounting to 8,219. However, when the RQD increases by 1 unit, the Au will decrease by 2,761. 2) When the RQD is zero, then Ag will be worth 90,388. However, when the RQD rises by 1 unit, then Ag will rise by 0.977. Then the Meaning Mean Test is performed where the result H0 is Received, with the understanding that there is a significant relationship between RQD on Au-Ag levels, understanding that the change in thickness of a thicker ore is followed by an increase in the higher Au level, tcount = 0.382 and the significance is 0.703. The understanding is that Au levels are correlated with the presence and presence of hefty that is notified by RQD.

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 the Maluku Islands to the Philippines [1].

Geological processes that occur during and after the formation of rocks affect the nature of rock mass (rock mass properties), including the nature of engineering (engineering properties). In nature, rock masses tend not to be ideal in some ways [2], such as being heterogeneous, anisotropic and discontinuous. The existence of the discontinuity results in the distribution of strength and stress in rock...
masses not being distributed evenly in all directions. As a result, the nature of rock mass elasticity is changing and ultimately resulting in disruption of the rock mass strength balance which can cause landslides. The orientation of the discontinuous plane is a major geological factor affecting rock stability [3]. The process of tectonic movement that will form a hefty rock as a medium that encourages changes on earth both for surface and subsurface [4]. When considering field conditions, where the study area shows a river flow pattern dominated by recta-angular and dendritic patterns, this is evidence that the study area has experienced quite active and repetitive tectonic movements in the past. A rock condition with rock geomechanical unit characteristics will give a different picture such as differences in location, structure, rock type and geological conditions. In the area of mineralization, there is a spatial relationship between major structures and the process of mineralization that occurs. Regionally, a structural system in the area of magmatic arcs will form intrusions that both fill the existing openings and form new openings.

The pattern has a relationship to the lineament values of the river formed. In addition, the formation of flow patterns and relatively complex lineages associated with burly formed on rocks in the region can be seen based on the RQD value. Therefore to see whether this phenomenon has similarities or not in the two regions and different formations, it is necessary to conduct a study and analysis of quantitative data. Data analysis was carried out using a multivariate analysis method of variance with 3 variables, namely river flow patterns, straightness and RQD values. Comparative test analysis of 2 average vectors that can be used to see whether there are differences in the direction of river flow, alignment, and RQD on the Cipacar Formation and Honje Formation are T2 Hotelling. However, T2 Hotelling has the assumption that each formation has multivariate normal distribution data.

This research activity was carried out with the aim of obtaining a picture related to the relationship between rock solids to gold content in the epithermal mineralized zone especially in the Honje Formation and Cipacar Formation.

2. Methodology
The methodology used is mapping the geological structure at the study site, analysing drill data for rock stratigraphy, analysing core vein gold ore data, analysing data using statistical methods.

3. Result and discussion
3.1. Result
3.1.1. Research areas
3.1.1.1. Research location. The Cibaliung gold mine is located on the Southwestern tip of Java Island, to the east of the Ujung Kulon National Park. Administratively, this location is in the Cibaliung and surrounding areas, Cimanggu District, Pandedglang Regency. The mine site is ± 197 km from Jakarta, can be reached by four-wheeled vehicles for ± 4 hours traveling by asphalt road (Figure 1). The Cimanggu area as one of the regions that are part of the Bayah Dome is geologically very influenced by the presence and presence of the meeting of the West Java plate and is closely related to the existence of Krakatau Mountain in the Sunda Strait. Mount Krakatau as part of the meeting of the plates in the Sunda Strait provides very important information to be able to describe how the activity of these plates [5,6].

3.1.1.2. Topography and geomorphology areas. The topographical and geomorphological conditions of the mining area and its surroundings are generally undulating to hilly with an altitude range of 30-300 m above sea level. Higher hills are located to the west of the study site, Mount Honje ± 620 m, which is included in the Ujung Kulon National Park. The slope of the location and its surroundings is between 10-25%. The study area lies in low undulating morphology and moderate hilly hills.
Morphological differences are controlled by the type of alteration. This weak undulating region is composed of smectite-illite altered rocks [1].

3.1.1.3. Geology. The research locations are generally located in Cibaliung and surrounding areas, Kec. Cimanggu, Kab. Pandeglang, Banten Province, in particular, includes the PT Cibaliung Resource Concession which belongs to the dome and collections in the central depressive zone, West Java. The dome and the central depressive zone are mountainous regions that show dome forms. This zone is controlled by structure and lithology (Figure 1). The morphology forming type of this zone consists of sedimentary and igneous rocks. The morphology of this zone is also influenced by geological structures such as folds, faults, and burly. Bemmelen mentions this research area as Banten Block which consists of Neogen deposits that are strongly folded and breakthrough igneous rocks [7]. This area is a relatively stable region since Neogen. There is a striking difference in the structure direction between the structures in Banten Block, which is dominated by the north-south direction and Javanese structures which are dominated east-west.

![Figure 1. Rock stratigraphic column at the research location [1].](image)

In general, gold-silver mineralization in the Cibaliung complex is around 11 Ma or is the oldest mineralization identified in western Java [8]. Mineralization can be classified as a type of low epithermal sulfide mineralization. Host rock in the form of andesitic-basaltic lava, tufa dacitic and volcanic breccia of Early Miocene age. In this area, mineralization is found in the form of veins called Vein Cibitung and Vein Cikoneng, both of which are characterized by quartz-sericite and adularia. The alteration zoning can be divided into silicic (dominant quartz), propylic (chlorite, epidote, carbonate, and quartz) and argillic (illite and smectite). The main metal minerals are electrum, pyrite, chalcopyrite, sphalerite and galena, as well as other minerals in the form of tetrahedrite, argentite, polybasite, and bornite, as well as hessite and stromeyet in small amounts.

3.1.1.4. Geological structure. The tectonic activity of the study area is the western part of Java Island where geologically the area is included in Banten Block. Bemmelen mentions this area as Banten Block with a line boundary extending south-north from Pelabuhan Ratu Bay to Jakarta Bay including geological boundaries [6]. 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 [9]. 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 [6].
3.2. Analysis and discussion

Stiffness is one of the structures that are difficult to observe, because it can form at any time of a geological event, for example before a fold occurs. Another difficulty is due to the absence of, or relatively small, shifts from the stocky, so it cannot be determined which groups formed before or after. However, in the analysis, burly can be used to help determine the pattern of affirmation with the assumption that the burly in the whole area was formed before or at the time of fault formation.

The thickness of an ore especially gold ore is influenced by many factors not only based on the thickness or thin space of the fracture formed, but the level of density of a fracture can also determine the level of cracking of an ore grade (Au). The size of the fracture density determines the size of the RQD and RMR, the condition of the mineralized zone shows the areas that have a large RQD value and the value of small RMR is a region with high levels. The formation of mineralized zones in the presence of very large fractures will encourage the formation of mineralized veins with high (Au) gold content (Table 1).

### Table 1. Sample data on thickness of veins and levels of Au value.

| No. | Grade of Minerals | Thickness |
|-----|-------------------|-----------|
|     | Au (gr/t) | Ag (gr/t) |               |
| 1   | 6   | 32  | 9.9           |
| 2   | 2.34 | 11  | 7.1           |
| 19  | 3.36 | 26  | 4.7           |
| 20  | 15.74 | 59 | 9.4           |
| 68  | 3.72 | 72  | 22.2          |
| 69  | 2.9  | 113 | 24.7          |
| 70  | 1.25 | 54  | 11.05         |

Sources: Anonymous (b) 2016.

In the process of statistical data processing, there must meet the requirements one of them needs to be tested for normality of data, from 70 thickness data taken based on the drilling section data, afterward an analysis of regression test - correlation test to get the relationship between thicknesses of veins gold ore (Au) to Au content. General description of the data above; means = 6.24; Std. Deviation = 3.67; Varians = 13.48, because Lo<Ln, then the data is normally distributed. And to General description of the data above; means = 9.69; Std. Deviation = 4.27; Varians = 18.22, because Lo<Ln, then the data is normally distributed. Based on Figure 2, it can be seen that the thickness of the vein has a relationship to Au levels and Ag levels indicated by a positive relationship in the form of linear graphs upwards, with R2 (0.7693) or 76.93% expressed by the equation y = 0.9434x - 3.5247.
The graph above gives an understanding that Au levels have a linear relationship with vein thickness, if the value of vein thickness increases then followed by an increase in Au levels, with a correlation coefficient of 0.9343 at a determination of 76.93%.

3.2.1. Test data statistics. To see the relationship between the thickness of gold ore (Au) and Au levels, a statistical test was carried out (Table 2, Table 3, Table 4 and Table 5) with the following results:

Table 2. Statistical description data on Au and vein thickness.

|                  | N  | Minimum | Maximum | Mean  | Std. Deviation |
|------------------|----|---------|---------|-------|----------------|
| Grade-Au         | 70 | 1,240   | 31,50   | 7,743 | 5,999          |
| Vein Thickness   | 70 | 0,650   | 31,10   | 12,158| 7,935          |
| Valid N (listwise) | 70 |         |         |       |                |

Table 3. Variables entered/removed.

Model | Variables Entered | Variables Removed | Method
------|-------------------|-------------------|--------
1     | Thickness Vein\textsuperscript{a} |                    | Enter  \\
\textsuperscript{a} All requested variables entered.  \\
\textsuperscript{b} Dependent Variable: Grade-Au

Table 4. Model summary.

| Model | R   | R\textsuperscript{2} | Adjusted R\textsuperscript{2} | Std. An error of the Estimate |
|-------|-----|-----------------------|-------------------------------|-------------------------------|
| 1     | 0,046\textsuperscript{a} | 0,002                  | -0,013                        | 6,037                         |

\textsuperscript{a} Predictors: (Constant), Vein Thickness

Table 5. ANOVA test output\textsuperscript{b}.

| Model | Sum of Squares | df  | Mean Square | F     | Sig.  |
|-------|----------------|-----|-------------|-------|-------|
| 1     | Regression     | 5,326 | 1           | 5,326 | 0,146 | 0,703\textsuperscript{a} |
|       | Residual       | 2478,362 | 68         | 36,446 |       |
Because of the significance of \( > 0.05 \), \( H_0 \) is accepted, understanding that the change in thickness of an increasingly thicker ore is followed by an increase in the higher Au content. Based on the results of the processed data above, where the processed data conveys tcount = 0.382 and the significance is 0.703. The understanding is that the thickness of the vein is correlated with Au levels.

3.2.2. Discussion. Vein thickness is closely related to the presence of burly in the rock, the more heft in the rock where the mineralization is formed, it will have an impact on the thickness of the vein (ore). This happens where the burly formed and present in the rock will be filled by the fluid carrying the ore where the mineralization is formed.

The filling of hefty rocks by rock fluids provides an opportunity that more and even perfect mineralization is formed. It not only describes physically but chemically, that is quality. The more heft in filled rocks, the chance of thick vein formation is higher, so the chance of forming Au levels will be even greater.

4. Conclusion
Relationship between the thickness of urate and the rate of a positive precipitate, changes in thickness of an ore thicker followed by an increase in Au levels higher, with tcount = 0.382 and the significance of 0.703, his understanding that changes in the thickness of ore veins will be followed by increasing levels of Au in zone of mineralization, this is related to the existence and distribution of rocky stumps, the more burly formed, the ore body will be greater and the levels will increase.

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