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Analysis of stratigraphy and lithology in forming gold minerals in East Java with digital elevation model and medium format photo

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Abstract. This study aims to identify and analyze the potential distribution of gold in East Java. Indicators used were stratigraphy and regional lithology. The research methods were used Digital Medium Format Photo and Digital Elevation Model. the survey method was used in this research is by observing geomorphological processes as lithological products and observing rock stratigraphy. The surveyed areas consist of southern Jember, Situbondo, Bojonegoro and Lumajang. Observation of rock stratigraphy is done by looking at the patterns and types of rocks found in each region. Digital Elevation Model (DEM) is used to determine landforms that are very closely related to the character of the subsurface processes. The results show that there are significant differences in gold potential in various regions in East Java. . The difference between the north coast and Java is a sign of differences in rock stratigraphy associated with gold formation. In addition, areas with old volcanic rock lithology have a higher intensity than young volcanic rock lithologies that have not been able to produce gold minerals.

1. Introduction

Spatial data and information needs is one of the vital data needs in various kinds of planning, management and monitoring activities in an area for various needs. This condition requires the availability of spatial data that is accurate, fast, and of course cost efficient. Various types of data acquisition systems have been widely used to obtain spatial data quickly and accurately. One of them is to use aircraft and metric digital cameras.

The development of digital camera technology has a very good impact in the world of mapping, especially in aerial photography data retrieval. The use of digital sensors for mapping activities more and more because it has advantages in terms of quality, speed, and accuracy which indirectly affects the increased efficiency of production costs.

Medium format camera technology has actually been around for a long time in Indonesia but still uses film media. In recent years, this camera technology has developed very rapidly towards the digital format. Along with the development of digital photogrammetric processing technology, the world of mapping has begun to look at the use of this medium format camera for mapping purposes.

The typical stratigraphy of volcanoes into landforms that greatly influences the presence of gold [1]. The existence of gold has also been assessed by magnetic methods [2]. The potential of gold can be known with fuzzy logic [3]. Settlement development caused by gold mining can increase the danger of landslides [4]. The gold is potentially found in quarterly volcanic mountains [5]. There is a correlation between the presence of shear faults with the potential for gold in volcanic landforms [6].

A negative impact on health if the gold mine is not managed properly [7]. High monthly rainfall in the gold mining area can increase the potential for disaster [8]. The potential of gold can be mapped in a preliminary survey by remote sensing [9]. Utilization of gold must be able to improve the welfare and health of the environment in society [10]. Interpolation is the process of determining the value of new points within a range of a known data. In engineering and science, a person often has a number of data points obtained through sampling or experimentation, representing the values of a function with a limited number of independent variable values. It is often necessary to extrapolate (aka estimate) the value of the function to the value of the free variable in the middle. This can be achieved through curve matching or regression analysis. This study aims to identify and analyze the potential distribution of gold in East Java.

2. Methods

The research methods were used Digital Medium Format Photo and Digital Elevation Model. the survey method used in this research is by observing geomorphological processes as lithological products and observing rock stratigraphy. The surveyed areas consist of southern Jember, Situbondo, Bojonegoro and Lumajang. Observation of rock stratigraphy is done by looking at the patterns and types of rocks found in each region. Digital Elevation Model (DEM) is used to determine landforms that are very closely related to the character of the subsurface processes. DEM also deals with aerial photography of medium format in the context of the use of landform analysis. The survey results are then compared with the results of the DEM interpretation as a way to find answers from this study. After that, we will get different characters related to the potential of gold to be mapped so that it can be spatially analyzed.

3. Results and Discussion

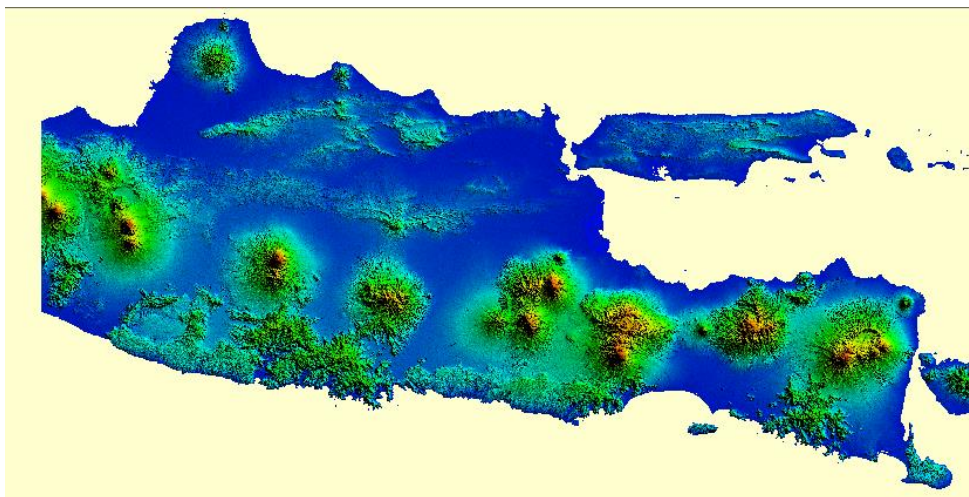The analysis shows that gold is in the southern part of the following DEM.

Fig 1. DEM of East Java

The picture above shows the different textures between the southern, central, and eastern mountains in East Java. In the following picture, many faults are found that can support gold accumulation. Fig 1. Shows that central and southern Java have identical colors. That is caused by the existence of the same lithology with different ages of formation. In the middle, there is a dark warrants war because of the influence of very active volcanic activity. The resulting eruption material forms igneous rock at a young age so there is no other rock intervention to form gold. In the southern part of East Java the color is green which shows the differences in characteristics with the middle part of East Java. Southern East Java does not show volcanic activity that occurred in the last 500,000. That causes the freezing process of magma not to occur intensively and there is more structural activity in the form of active faults caused by subduction zones, so there is process to be able to change the structure and type of rock into gold.
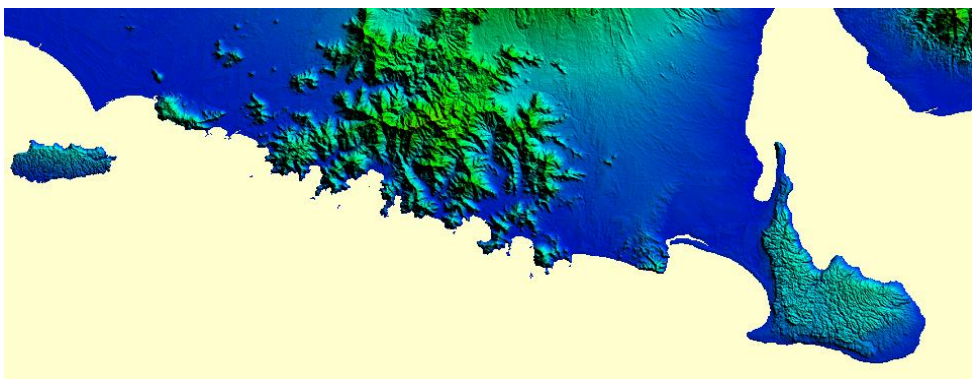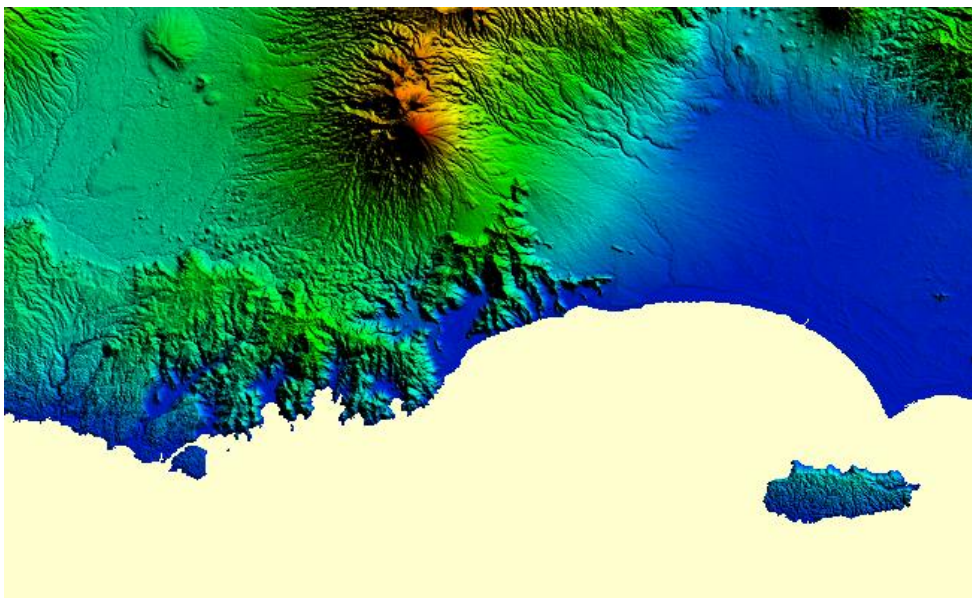

Fig 2. DEM of Jember

Fig 3. DEM of Lumajang

Fig. 2 and Fig. 3 shows that although the Jember region is close to Lumajang, but with different lithological influences, it will produce different gold potentials. The lithology of Lumajang is greatly influenced by the volcanic activity of Semeru volcano which affects the area in the north and south of Lumajang. This causes changes in rock stratigraphy unlike the Jember region which is not affected by Semeru volcano. The rock stratigraphy in the Lumajang region will always be renewed by material originating from Mt. Semeru, so the gold mineral alteration process will be slower.
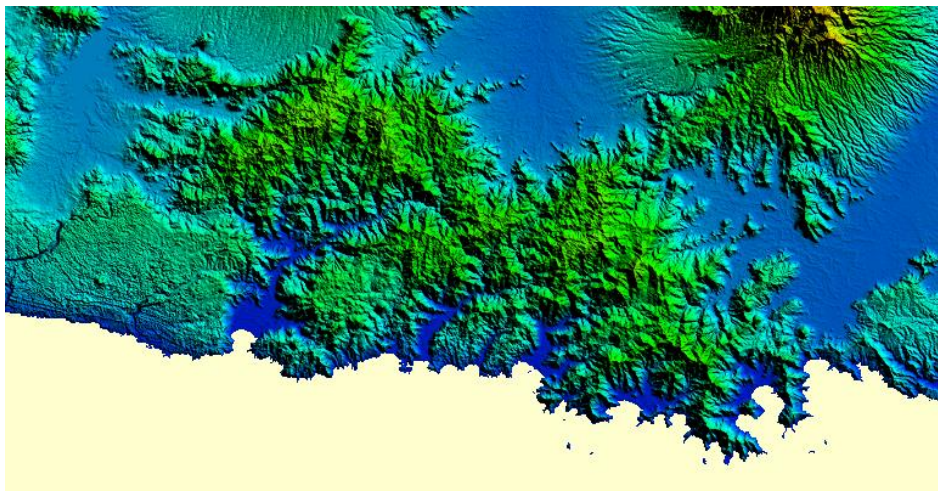

Fig 4. DEM of Trenggalek

Fig. 4 shows the difference with the previous picture. The difference is the number of local faults with a combination of green and white and a rather rough texture. This shows that the Trenggalek region is strongly influenced by lithology of carbonate rocks which is included in one type of sedimentary rock. While the formation of gold is more supported by lithology of old volcanic rocks.

Table 1. Analysis of Stratigraphy

Region	Stratigraphy	Lithology	Landform	Gold
Jember	Regression	Aluvium, tuf argopuro, andesit, ofiolit	Tertiary mountains	High
Trenggalek	Transgresion	Carbonate, andesit, alvium	Karst mountains	medium
Malang	Regression	Aluvium, andesit	Tertiary Mountains	medium
Tulungagung	Transgresion	carbonate, andesit, alvium	Karst mountains	medium
Bojonegoro	Regression	napal, sand stone, gamping	Tertiary folding	low
Situbondo	Regression	Aluvium, napal, sandstone, carbonate	Tertiary folding	low

The 6 regions in table 1 already represent the main characteristics of lithology and stratigraphy in East Java. Jember, including Banyuwangi, has a lithology that is very different from other regions, with the dominance of old igneous rocks and the influence of opiolites so that stratigraphic rocks are not intact in layers, but there are breakthroughs that cause the formation of gold. This has happened since 10 million years ago and is supported by the lack of sedimentation. The Tulungagung, Malang, and Trenggalek regions are strongly influenced by carbonate rocks, with other parts being old igneous rocks, so the gold potential is lower. The Situbondo and Bojonegoro areas are lithologically very different regions because they are dominated by old sedimentary rocks, so they are in contrast with the process of gold formation which requires igneous rock as its main source.
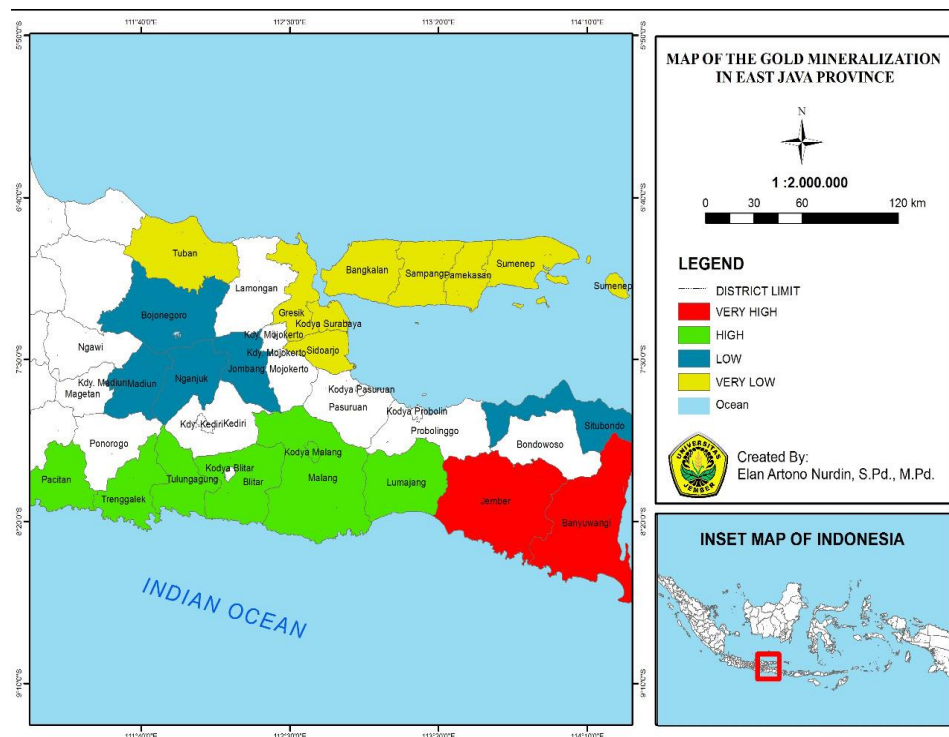

Fig 4. Map Of Gold Mineralization in East Java

DEM above shows the same pattern, which is the lineaments that cause volcanic rock intrusion. This strongly supports the occurrence of gold mineralization. The process continues since the tertiary period reflected by weathering and minimal landforms throughout the southern region of East Java. Lateral erosion intensity is higher in the Coastal region with lithology of sandstone, marl, and limestone if used with the Coastal region with alluvium lithology, this occurs in the northern part of east java which causes the potential for low gold formation. This is consistent with the study of Barabas et al which shows the shape of canals in coastal areas which are supported by lithology and erosion patterns of upstream, transportation and depositional areas [11]. Marfai et al research results show that the intensity of waves and low ocean currents will cause the sediment to accumulate optimally which is realized by the formation of deltas [12]. The results of Ervita and Marfai's research show that increased human activity will change the direction and ocean waves will cause changes in

landforms, for example changing coastlines [13]. Ghefra et al research results show that land subsidence in the Coastal region causes differences between young alluvium, groundwater use, and building loads [14]. The deposition process described in these studies shows that sedimentary rocks are only affected by exogenous energy, whereas gold requires endogenous energy.

Characteristics of Coastal Areas are generally related to material from erosion taken from upstream and lithological conditions in the middle and downstream areas. If the eroded material is carried by the river flow through the volcanic rock area, then the shape of the flow pipe is limiting. This occurs a run off that can be completed in stages along the watershed. Conversely, if material erosion results through the middle and downstream areas approved by sedimentary rock lithology, it will cause runoff build-up in downstream river channels, flood plains, and alluvial plains. The deposition process in sedimentary rocks is always related to the surface process of the earth, whereas gold in general comes from processes from below the earth's surface [15]. The results of this study also indicate that the use of GIS can be done for the purposes of several mines [16]. However, the mapping of gold potential must also pay attention to environmental aspects because old volcanic landforms are very prone to drought [17].

Coastal areas are also very important because there is a combination of fluvial and marine origin processes. This is evidenced by the delta agreement as one of the results of fluvial development supported by low intensity of currents and ocean waves. The existence of young alluvium as lithology also causes high changes to changes in land subsidence. Aside from that, increasing land use change which is more directed to the developed area becomes an increasingly burdensome area. The southern region of East Java does not have a delta, which shows that there is no intensive sedimentation process. The process of forming gold is always associated with a place that has that character.

4. Conclusions

Coastal areas have a variety of landforms with the characteristics of a combination of several origin of landform processes. It also gives rise to some unique and vulnerable to exploitation of gold mineralization. Coastal areas have different types, one of which is influenced by lithological factors, including gold forming breakthrough rocks. These different types should be interpreted with different development patterns, so that the form of coastal land will provide optimal benefits for the community. The difference between the north coast and Java is a sign of differences in rock stratigraphy associated with gold formation. In addition, areas with old volcanic rock lithology have a higher intensity than young volcanic rock lithologies that have not been able to produce gold minerals.

Acknowledgment

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