

Geological Model for Mineplan Method to Support Economic Activities in a Remote Island

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Keywords: Geological model, Onyx, Selective mining.

Abstract: Mining materials are natural resources that cannot be renewed and require a long time to form so that their management and utilization must be wise. Mining has high economic value but is also a major cause of natural disasters. In this study the method of investigation is by conducting a literature review, survey and investigation of the geological and geomorphological processes that occur, then analyzing the genesis and mining activities that are in accordance with the conditions and characteristics of the onyx marble. The onyx marble mining on Bawean Island is manually very suitable because it is selective mining, which only takes onyx potential by not dismantling the entire limestone so that it is more environmentally friendly. The onyx marble marketing on Bawean Island is also not good due to the limited transportation that operates 3 times a day out / to the island in the form of cargo ships.

1 INTRODUCTION

The types of mining materials are differentiated based on economic value, benefits and difficulties in obtaining them. In Indonesia, based on Government Regulation number 27 in 1980, the materials are divided into 3 types, namely excavation materials A, B and C where onyx is included. C can be used directly as the main raw material for industry without or little through the processing process and does not require an international market.

Bawean Island Stratigraphy starts from the Gelam Limestone (Early Oligocene-Miocene) Unit, Kepongan Sandstone Unit (Late Miocene-Pliocene), Balibak Volcanic Rock Unit and the youngest is an alluvial precipitate aged Resen (Aziz et al., 1993). Physiography, Bawean Island has its own characteristics compared to the Rembang - Madura and Kendeng Zones which incorporate into magmatism behind the outer arc which is likely to be built by products from submarine volcanic activities (Van Bemmelen, 1949). Onyx is a chalcedony coating which is a group of silica minerals (WHITTEN and BROOKS, 1976), usually layered, compact, translucent with variations of calcite such as travertine coating having a good gloss and usually deposited in the form of stalactites in caves (Bates and Jackson, 1987). The definition of onyx marble is applied to layered calcite minerals,

yellowish white, gray to reddish, translucent, crystalline, compact, massive, hardness of 3 Mohs scale. There are 5 important mechanisms that can explain how the deposition of CaCO₃ and the increase in CO₂ that can be dissolved in water, (1) by the increase in temperature and evaporation, (2) by water movement, (3) by addition of salinity, (4) by organic activity, and (5) by pressure changes.

Onyx on Bawean Island in its formation process is only found (Aziz et al., 1993) in a few places with certain conditions and requires a long time so that its existence is limited / rare and different from onyx in other regions in Indonesia such as Tulungagung - East Java. Bawean Island itself is an island located on the north side of Gresik with connecting access only in the form of ships from the Gresik pier (East Java). Rural development issues in Bawean Island have previously been compared to a similar set of challenges in sub-Saharan Africa, particularly in regards to inadequate infrastructure and remoteness of markets (Booth*, 2004). The parallels further include low agricultural production, a history of supplementary livelihoods supporting subsistence agriculture and poverty-driven de-agrarianization (Booth*, 2004). These livelihood characteristics, which have been associated with the shift towards ASM in sub-Saharan Africa, are also evident in West Timor. Onyx mining in Bawean Island has been carried out by the

community (artisanal and small-scale mining /ASM) and is one of the reliable livelihoods because it has good economic value. . It is in this context that the artisanal miner themselves trying to strategically manoeuvre a complex, dynamic institutional environment to secure their livelihoods (Bersaglio and Cleaver, 2018). Not only did income from mining provide a safety net when crops failed, it also acted as an opportunity to ‘step up’, with money reinvigorating farming opportunities and creating new livelihood opportunities.(Fisher et al., 2019).

On the other hand, there are at least three factors which contribute to the underestimation of mining’s impact on the local economy. The first is the existence of money flows that result from the company’s activity on the island, but which are not taken into account in the context of input–output analysis, the most glaring example being the incomes and expenditures of retired employees who still live in the island.13 The second concerns the importance of the economic and social effects that cannot even be expressed in monetary terms, such as the contribution of mining activity to the preservation of the local community and the prevention of demographic decline or migration. Finally, mining activity possesses some special characteristics that cannot be embedded in the input–output model, the most important being that it implies the frequent development of new productive installations (mines), as well as the restoration of old ones, hence the accumulation of high expenditures (Tserkezis and Tsakanikas, 2016). This research is expected to produce genetic geological models for planning mining methods that are good and environmentally friendly.

2 METHODOLOGY

The procedure of this study is illustrated in Figure 1, however this paper only presents geology and geomorphology process in order to explain onyx genetic geological model. Base material of onyx is limestone. The dissolution process causes changing of limestone to onyx. The main factor: (1) Hot water, (2) Evaporation, (3) hot air and (4) fracture.

The presence of underground rivers, caves, stalactites, and travertine deposits is an indication of geomorphological processes which also greatly influence the control of onyx formation.

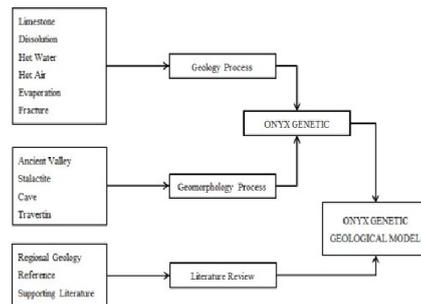


Figure 1: Flowchart of study on Onyx in Bawean Island

3 RESULT

Genesis is the sequence of events in the formation of an object in geology related to the trigger force, namely exogenous energy (originating from outside) that works on the surface of the earth and endogenous energy (from the inside) that works below the surface of the earth. The two forces that cause the formation of various forms that exist in this earth but also there are natural processes on the surface of the earth such as the process of erosion, transporting the results of erosion, transportation and sedimentation that affects.

Onyx on Bawean Island is a type of onyx marble which is milky white, milk chocolate, gray, and reddish milk chocolate, translucent, crystalline, straight wavy and homogeneous, massive and hollow, with hardness of 3-4 Mohs scale. The difference of onyx silica and onyx marble namely onyx silica is composed of quartz, the composition of SiO₂, hardness of 7 on the Mohs scale while onyx marble is composed of calcite, composition of CaCo₃, hardness of 34 on the Mohs scale.

The process of forming onyx starts from the crystalline deposits of calcium carbonate carried by water containing carbon dioxide flowing into the limestone and can convert calcium carbonate to soluble plus the help of hot water, air heat and evaporation, stalactite and stalagmite in the limestone cave. The metamorphosis process then changes the deposits to be harder and increase density. The number of onyx spreads is very limited compared to the extent of the surrounding limestone distribution because onyx which is the result of dissolution of the limestone itself and its formation is controlled by typical geological and geomorphological factors also requires a long time (thousands to millions of years) so that onyx has high economic value.

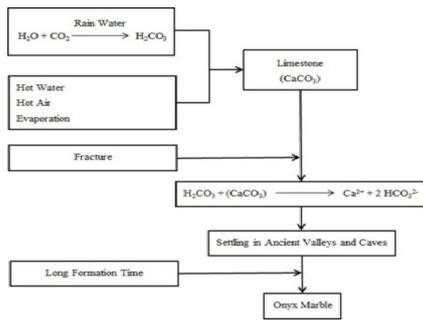


Figure 2: Onyx Genesis Process



Figure 3: Outcrop of Onyx and Limestone

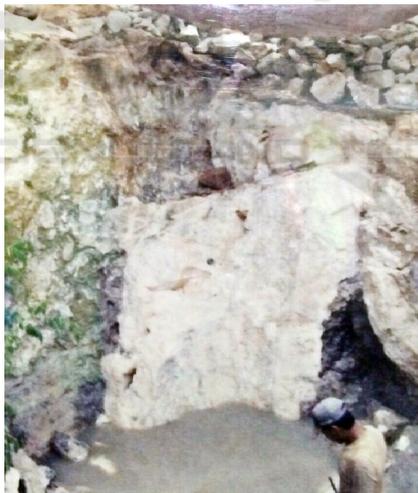


Figure 4: Outcrop of Onyx and Limestone

4 DISCUSSION

Onyx quality is a combination of the properties possessed including objective genetic factors and subjective market tastes. Quality based on genetics is objective, namely:

- a Scarcity where the onyx formation takes a long time in the geological time scale, the distribution is not evenly distributed only in places that meet the requirements for the formation of onyx, so the

less frequent onyx is in the price, the more expensive the price.

- b Violence where increasingly hard onyx is increasingly expensive, because the retrieval process (cutting and forming) requires a large amount of special and special equipment.
- c Purity is defined as authenticity, passivity, cleanliness which all determine quality and price.
- d The layer pattern shows the flow structure and onyx. The bawean island forms straight or wavy and homogeneous layers, following the slope of ancient slopes.
- e Pore where onyx has a high pore level will reduce the level of quality onyx because it is easily broken.

Quality based on market tastes is subjective, namely:

- a Beauty is determined by high aesthetics when it has artistic and suitable properties when combined with other objects in a layout arrangement. The smoother the refinement, the higher the quality and the more expensive the price.
- b The larger the size of the onyx, the higher the quality and the more expensive the price.
- c Color is closely related to beauty because it usually depends on the nature and tastes of each person.
- d Complexity where the more complex the shape, the higher the quality and the more expensive the price because it requires special expertise and the time and cost of production.

Onyx marble mining activities on Bawean Island are still manual work by man (human) and simple equipment that has the character of "selective mining" where mining concentrations are only on the onyx marble excavation material whose unique position is not to spread across limestones but only in certain places so that damage to limestone or soil around it can be minimized, making it more environmentally friendly. In addition to positive values, manual mining has a negative value, namely the risk of workplace accidents is very large, this is due to the lack of equipment and operational security and safety (K3) standard in the mine location.

The marketing of onyx marble in the form of raw materials as well as those that have been processed at this time is still minimal due to inadequate access to the entry and exit of goods to Bawean Island where it is only served by cargo ships operating 3 times a week

5 CONCLUSIONS

The genetic geology model is very important in the interpretation of determining the presence of mineral deposits, the geological and geomorphological processes that make up deposits of minerals, the association of mineral deposits and the time of formation of mineral deposits in the geological environment.

Factors that influence the genetic geology model are thin volumes of sediment, so descriptive information is needed to describe the formation of sedimentary complexes through drawing or sketching the onyx formation process, site of formation and other factors that play a role in the formation of onyx.

The genetic geological model illustrates the relationship of each data and fact in the field to the geological environment, namely geological and geomorphological processes in the form of images and formation sequences without using long explanations such as descriptive geological models, but only a short description of the image.

The geological model of onyx genetic is useful in knowing the formation process and determining mining activity planning, namely in determining the direction of mining as well as selective and appropriate manual mining methods where this will have a direct impact on the spatial layout planning of Bawean Island.

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