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The Geological Structures Formed Influence the Process of Mineralization in the Beruang Kanan Area, Gunung Mas Regency, Central Kalimantan

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ABSTRACT

The Schwaner Mountains stretch in the middle. Identification of geological structures that play a role in the formation of metallic mineral deposits is necessary for more efficient mining exploration and exploitation. The Right Bear is a mining site located on a remote hill in the central part of the island of Kalimantan. This study aims to determine the condition of geological structure and the influence of geological structure on the distribution of copper mineralization at the research site. In this study, surface data was collected in the form of lithological description data and data on the structure of bridles and veins in rocks. The equipment used is a geological compass, a geological hammer, GPS, a magnifier, and others. In general, the stratigraphy of the research area is divided into 3 rock units that can be seen on the geological map, in order from old to young, namely the lithology of the Sandstone Unit, the Dacitic Tuf Unit, the Andesite Unit, and the Quartz Sand Deposit Unit. The mineralization of the Right Bear area consists mainly of high Cu sulfide mineralization. It is related to copper mineralization. Associated mineralization is generally controlled by bridle and fault structures. Mineralization is hosted by volcanic and volcaniclastic rocks in the research area, especially in the middle and southeast of the research area. The geometry of a vein with a width of > 1 cm is called a vein, if it is < 1 cm wide it is called a vein, and if it is < 1 mm it is called a vein cord. These veins generally have the direction NNE SSW, NE-SW, NW-SE, and WNW-ESE.

Introduction

The research site is located in the Beruang Kanan area, Tumbang Miri District, Gunung Mas Regency, Central Kalimantan Province (Simmons, Tutolo, Barker, Goldfarb, & Robert, 2020). Based on this, it is known that this research location is part of the Corrugated Hills Geomorphological Unit in the central part of Kalimantan Island.

The Schwaner Mountains stretch across the center (KSK, 2004). The study area has elevations ranging from ± 50 meters to ± 400 meters (Desanois, Lüders, Niedermann, & Trumbull, 2019).

Generally, the landscape of the study area is steep and very steep. The topography is dominated by hills. Beruang Kanan Hill (439 m) is the highest part of the area. The surrounding hills are hilly with a range from 1 - 450 metres. (Vidal et al., 2016).

Drainage pattern characteristics are sub-dendritic to dendritic type. The rivers and creeks on the north side of the Beruang Kanan hill drain into the Beruang River which flows actively for 8-10 months of the year. Most of this area is covered by moderate to dense vegetation. The upper slopes and the rest of the summit of Beruang Kanan are protected forests. (Pirajno, 2012).

The geomorphology of the study area based on field observations and aerial photo analysis includes volcanic origin formation (denuded volcanic hill geomorphological sub-unit). The drainage pattern that develops in the study area based on observations includes a sub-dendritic pattern that resembles a tree shape controlled by erosion and denudation. (Allen, 2013). The Middle Bear River has a valley shape like the letter U which characterises the river as mature. The river empties into the Kahayan River which is the largest river in Central Kalimantan KSK, 2004).

In general, the morphology of the study area is in the form of an undulating hills morphological unit. The undulating hills morphological unit is represented by sedimentary rocks with an altitude between 300 meters and 500 meters above sea level. (Dietrich, Gutierrez, Nelson, & Layer, 2012).

Method

The research consisted of observations of rock outcrops, the position of kinks and veins, road infrastructure to get to the location, transport, and rock sampling for analysis. The equipment used was a geological compass, a geological hammer, GPS, a loupe, and others. The mapping stages include; Secondary data study of the study area, Observation of morphology and topography, Measurement of position and rock sampling, and Observation of infrastructure and roads. The data processing stage is carried out by making Track Maps, Rock Outcrop Maps, Geological Maps, Geomorphological Maps, and Alteration-Mineralisation Maps. The results of analysis and interpretation are outlined in the final research report.

Results and Discussion

The geomorphology of the study area based on field observations and aerial photo analysis includes volcanic origin formation (denuded volcanic hill geomorphological sub-unit) (Runyon, Steele-MacInnis, Seedorff, Lecumberri-Sanchez, & Mazdab, 2017). The drainage pattern that develops in the study area based on observations includes a sub-dendritic pattern that resembles a tree shape controlled by erosion and denudation. The Middle Bear River has a valley shape like the letter U which characterises the river as mature. The river empties into the Kahayan River which is the largest river in Central Kalimantan KSK, 2004).

Rock units in the study area are distinguished based on the type of lithology, rock uniformity, rock distribution, and rock geometry contained in one area as well as the stratigraphic position of the units below and above. (Sidorov, Volkov, Starostin, & Alekseev, 2014). Rock units in the study area have generally undergone a strong alteration process as a whole so that the primary mineral composition of the rock has been replaced by secondary minerals (alteration minerals). Determination of rock sequence using cross-cutting law, using regional geological map sources and previous research data. In general, the stratigraphy of the study area is divided into 3 rock units that can be seen on the geological map, in order from old to young, namely the lithology of the Sandstone Unit, the Dacitic Tuff Unit, the Andesite Unit, and the Quartz Sand Sediment Unit, (Anjarwati, Idrus, & Setijadji, 2018).

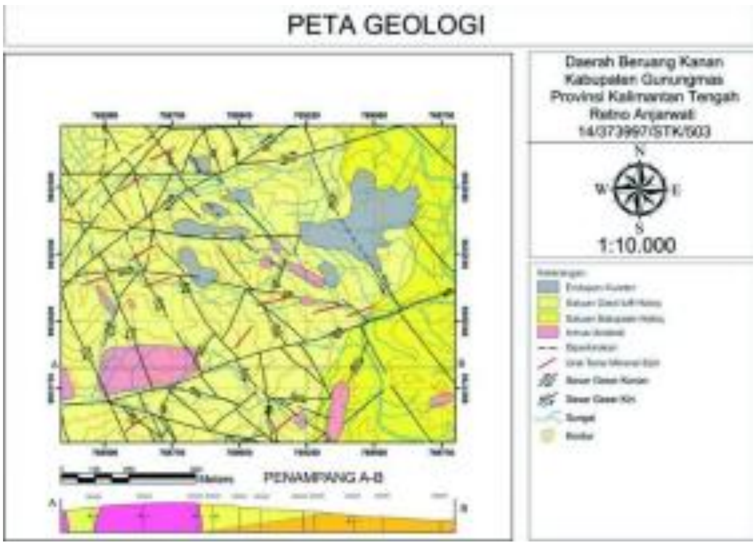

Figure 1
Geology Map of Research Area

Identification of Structures in the Field

At this stage, it is necessary to determine and measure the components of geological structures and determine the kinematics of structures in the field. Based on field observations, the identified geological structures are faults, kinks, and fault breccias (Figure 2). The existing structural data is not representative of explaining the control of geological structures in the study area.

The next approach is to identify other faults by paying attention to the topographic conditions such as continuity, contour line density, and overlaying the stratigraphic units, so it is expected that this approach can determine the type of fault that controls the geological conditions of the study area. (Holm, Tapster, Jelsma, Rosenbaum, & Mark, 2019).

Figure 2
Structure Map of the Study Area in the Beruang Kanan Area

The control of geological structure greatly influences the presence of ore minerals in the study area. Developed geological structural trends are visible on the Tewah Sheet geological map in the general direction of northeast (NE) – north southwest (NNW) and northwest (NW) – southeast (SE). These two main trends of geological structures have a major influence on the presence of mineralization. Based on geological data around the study area, the general direction of the mineralization system is parallel to the geological structure pattern (KSK, 2004).

The bridle structures that develop in the study area are generally scour bridles and tensile bridles. The general direction of the faults is N 312° E/43°. Fault data in the field is characterized by different morphologies and river alignment from the interpretation of aerial photographs. The structures in this area are dominated by north-northeast trending faults (van Leeuwen et al., 1990) and are either parallel or accretionary arcs. The trend of normal fault arc or shear fault cuts the northeast-directed structure. Based on the analysis and data of geological structures found in the field, the geological structures that develop in the study area are in the form of bridle and fault structures. The following is an explanation of both.

The joint structures developed in the study area can be divided into (1) a shear joint or “compression joint”, which is a bridle formed due to pressure force, and (2). Tension joint, which is a bridle formed by a pulling force (Figure 3).

Figure 3
The appearance of brecciation in the field (a) and also the appearance of brecciation (b).

Fault

Based on observations and measurements in the field and interpretation of topographic maps in the form of hill alignments, it shows that there is a fault structure in the Beruang Kanan area (Figure 4). The faults in the study area also follow the same pattern as the regional geological structure, namely North (N)-Northeast (NE) in the direction of N 244°E- N 250°E, and North (N)-Southwest (NW) in the direction of N 337°E – N 354°E. The fault, located in the center of the northern part of the study area, extends from northeast (NE) – southwest (SW) along 3.5 km. The evidence of the Beruang Kanan horizontal fault in the field is fault valleys and fault scarps in the northeast-southwest direction (KSK, 2013). As for the normal fault, it may be caused by the reduction of compression force. As a result, the rock will return to a balanced position (isostasy).

The forces that form faults in this area are southeast–northwest-orientated. The right horizontal fault that runs relatively east northeast – west southwest is the main fault in this area. This fault zone produces a right strike-slip fault orientated east southeast – west-northwest which is the R shear of the previous fault zone. In the north, there is a northeast-southwest trending right horizontal fault which is the P shear of the main fault zone. One left horizontal fault in the northwest of the map, which is the antithesis of the acting force, probably originates from the subduction of the South China Sea in the northwest part of the study area (Riedel, 1929 in Goerge et.al, 2000).

Figure 4

Presence of a North (N)-Northeast (NE) trending fault plane at LP 58

At this stage, we integrate the existing structural data. Based on the previous explanation, several general directions of geological structures identified in Beruang Kanan and its surroundings were obtained, including the following: The mineralization of the Beruang Kanan area mainly consists of high sulphidation Cu mineralization. It is associated with copper mineralization.

Associated mineralization is generally controlled by bridle and fault structures. Mineralisation is hosted by volcanic and volcaniclastic rocks in the study area mainly in the central and southeast of the study area. The geometry of veins with a width > 1 cm is called a vein, if the width is < 1 cm is called a veinlet, and if it < 1 mm is called a vein string. These veins generally have directions of NNE SSW, NE-SW, NW-SE, and WNW-ESE.

Conclusion

The fault structures formed in Beruang Kanan and its surroundings are interpreted as the result of geological events that occurred during the formation phase of a rock formation. Rising faults are interpreted to occur due to the process of uplift in bedrock accompanied by compression tectonics, causing blocks or parts of the old/basic rock formation to experience shear faults in the sandstone unit and andesite tuff unit. The existence of these shear faults is interpreted to have occurred in more than one tectonic phase based on the direction of the shear fault planes formed. The geometry of veins with a width > 1 cm is called a vein, if the width is < 1 cm is called a veinlet, and if it < 1 mm is called a vein string. These veins generally have directions of NNE-SSW, NE-SW, NW-SE, and WNW-ESE. Delineation of the existence of common descending faults is found in the dacitic tuff unit as evidenced by the descending topography indicating landslides that form the morphology of the Kanan Bear Hills. The presence of this thrust fault is interpreted as the result of strain tectonics that caused some blocks in the dacitic tuff unit to decline. The horizontal faults generally cut through the presence of ascending faults. These horizontal faults are evenly distributed in every stratigraphic rock unit in the study area. This fault is interpreted as the final phase of the geological structure formation process that affects the geological conditions in Beruang Kanan.

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