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Identification of Mengkarang Isoclinal Folds Against the Effect of Sumatran Fault Force in Air Batu Village and Surrounding Merangin Jambi Geopark

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ABSTRACT

The Merangin area, in particular, has experienced several tectonic phases and stages of change in the direction of the regional structure. In addition, on this island found, rocks of the Paleozoic age, their unique tectonic, geological system and constituent rocks will produce fascinating geological reconstructions. The unique tectonic design and constituent stones will have an absorbing geological reconstruction. The research methods include literature review, field observations, measurements, and studio analysis. Based on the literature and the research location approach, the research area is located in the physiographic zone of the Sumatera fault. Based on field observations, it is known that the constituent rocks are sedimentary, pyroclastic materials and intrusive granite rocks. The formations that arrange these rocks are the Mengkarang formation (Permian), the Tantan granite formation (Jurassic-Cretaceous), and the Kasai Formation (Tertiary). The fault data that passes through the building is the Sumatran fault with the position of Strike/Dip N322°E/76°, Bearing N135°E, and Rake 36°. This regional fault resulted in ductile rocks being repeatedly folded with an orientation approaching West-East; this can be observed in one of the fold data with the general direction of flank 1 N2850E/440 and the general rule of side 2 N136°E/42°. The result of the analysis is an anticline; this anticline occurs repeatedly and is referred to as an isoclinal fold perpendicular to the orientation direction of the Sumatran Fault. The pattern and movement of those folds and faults are by following under the concept of the wrench fault, which states that the fault strongly influences the formation of folds. Those folds will be perpendicular to the fault pattern.

***Keywords**: Tectonics, Paleozoic, Fault, Fold, Intrusive, Mengkarang*

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ABSTRAK

Gaya Endogen yang berkembang di dalam Bumi sangat mempengaruhi bentuk, pola, serta arah permukaan bumi, gaya ini dapat berupa tektonik lempeg, vulkanisme, serta pergerakan struktur geologi. Pulau Sumatera pada umumnya daerah Merangin pada khususnya telah mengalami beberapa fase tektonik dan juga beberapa fase perubahan orientasi arah struktur regional, dibalik itu pada pulau ini ditemukan batuan yang berumur Paleozoikum, dari keunikan tektoniknya, struktur geologinya serta batuan penyusunya maka akan menghasilkan rekonstruksi geologi yang menarik. Penelitian ini dilakukan secara lansung yang dimulai dengan kajian pustaka, pengamatan dan pengukuran lapangan, serta analisis studio. Berdasarkan literatur dan pendekatan lokasi penelitian bahwa area penelitian berada pada zona fisiografi Bukitbatisan dan Sesar Sumatera. Pada pengamtan lapangan diketahui batuan penyusun berupa batuan sedimen, material piroklastik serta intrusi batuan Granit, formasi penyusun batuan tersebut yaitu formasi mengkarang (Permian), formasi granit tantan (Jura-Kapur), dan Formasi Kasai (Tersier), dari data litologi selanjutnya di dukung data sesar yang melewati formasi tersebut yaitu sesar sumatera dengan kedudukan Strike/Dip N3220 E/76 0, Bearing N1350 E, dan Rake 360 Berdasarkan hasil analisis penamaanya yaitu sesar kanan turun dengan arah orientasi baratlaut-tenggara sesar ini melewati formasi yang bersifat ductile, tekanan yang berasal dari sesar regional ini mengakibatkan batuan yang bersifat ductile terlipat secara berulang dengan orientasi mendekati barat-timur, hal ini dapat di amati pada salah satu data lipatan dengan arah umum sayap 1 N2850 E/440 dan arah umum sayap 2 N1360 E/420 Maka hasil analisis berupa antiklin,

antiklin ini terjadi secara berulang dan disebut sebagai lipatan isoklinal Mengkarang, lipatan ini tegak lurus terhadap arah orientasi Sesar Sumatera, pola dan arah dari Lipatan dan sesar diatas sesuai dengan konsep wrench fault (Moody and Hiily, 1956) yang menyatakan bahwa sesar sangat mempengaruhi pembentukan lipatan dan lipatan akan tegak lurus terhadap pola sesar.

Kata kunci: Endogen, Tektonik, Paleozoikum, Sesar, Lipatan, Intrusi

INTRODUCTION

The earth is not always a flat plane, but the world has an uneven shape. The shapes of the Earth are not separated from the dynamics experienced by the surface of the Earth itself. The dynamics of the surface of the earth can be influenced by exogenous force factors as well as endogenous force. Endogenous style strongly affects changes in shape, orientation, and patterns in the earth's formations. Endogenous forces can be plate tectonics, volcanism, and the movement of geological structures.

Geological Structure is a branch of geological science that studies the architecture of the Earth and geological symptoms that cause the deformation of rocks (Twiss and More, 1992). [1]. The geology of the structure also studies the movement of the solid parts that compose parts of the earth, the actions that affect the pattern and position of the rock happen because of the force that works from within the world, will result in the formation of various types of structural geology such as folds, fault, fracture, foliation, and others.

Sumatera Island is a unique island of its lithology, geological structure, and geological processes that occur in it. From the kinds of literature that already exists, the island of Sumatera is an island formed from fragments of the Pangea Continent which are evidenced by the presence of traces of rocks and geological structures aged Paleozoic, geochronology the island of Sumatera under several tectonic phases processes of the beginning of the formation of the island of Sumatera which resulted in a change in the direction of the orientation of the island of Sumatera which resulted in various geological phenomena that can be examined deeper, especially in the Merangin Jambi Geopark area.

The Mengkarang formation is one of the oldest formations in the regional geological of the Bangko Merangin sheet and is a National Geopark area of Merangin Jambi. This stratigraphy formation exposed on the Selango of West Bangko Subdistrict, on the Mengkarang River of Rantau Panjang and Bedeng Rejo, of West Bangko Subdistrict, Air Batu and Dusun Baru of the Merangin River and Muara Karing River of Renah Pembarap Subdistrict. The lithology characteristics of volcanic lava, plastic conglomerate, tuff, and sedimentary rocks. On the Selangor of West, Bangko Subdistrict is stratigraphy consisting of limestone facies (Matysoya et al., 2018) [2].

The performance of the geological phenomenon of the Merangin area is dominated by sedimentary rock until metasediment. Igneous rocks that are relatively old, Early Permian - Quarternary, apart from the Merangin area rocks, also passed by the regional fault of Sumatera with the presence of an active spot and formations of folds. It will result in a reasonably exciting and complex reconstruction of geological structures.

Stratigraphy consists of the Mengkarang River on the Bedeng Rejo and Rantau Panjang of the West Bangko Subdistrict; in the beginning, Mengkarang is upstream of a plastic conglomerate, tuffaceous sandstone, and alternating quartz sandstone, claystone, siltstone, and shale. The lithology has a southwestern dip direction. The river crossing of Mengkarang River and Tandui downstream was called Mengkarang River with a northeastern dip direction of the lithology characteristics. This location is a marker of the anticline “Mengkarang Anticline”. Merangin River Section on the Air Batu and Dusun Baru of Renah Pembarap Subdistrict have dipping lithology of northeastern dip direction; this is believed to be Merangin Anticline, where the southwestern flank folding have an intruded by Air Batu Granitic Plutonic (Crow et al., 2019). [3]

This study aims to reconstruct the geological structure that develops in the research area in the form of fault influence on the folds of the Mengkarang Formation. Therefore, further research is needed for the types of anticline structures in the rock formations, especially in the Airbatu village, to develop models of rock and geology structures of rock formation in the area.

METHOD AND RESEARCH OBJECTIVES

This research was conducted based on several aspects, including literature studies, observations, measurements in the field, and studio analysis. In the literature study, namely the activity of understanding regional geology both in the form of tectonics, physiography, geological structure, and stratigraphy of the research area, then field observations in the form of lithology observations and measurements of geological structures, especially fault and folds contained in the research area, furthermore the studio analysis of measurement results and reconstructing field collecting data.

REGIONAL GEOLOGY

According to Van Bemmelen [4], stated that the physiography of the island of Sumatera is divided into six physiographies, namely the Outer arc zone, Barisan hill zone, Semangko fault zone (Sumatera fault), Tigapuluh hill zone, Bukit hill undulating zone, and Sunda exposure zone (Figure 1), the research area is located in two zones, namely Barisan hill zone and Sumatera fault zone, Bukit Barisan zone is a zone of Sumatera island that is composed by a range of active volcanism oriented from the Northwest–Southeast island of Sumatera with the elongated pattern. Furthermore, the Semangko fault zone/Sumatera fault is a zone located in the row hill zone with the same pattern as the row hill and the formation of geological structures in the form of strike-slip fault; these two zones have a significant influence on genes and phenomena that occur in the research area (Natawidjaja, D.H. 2018)[5].

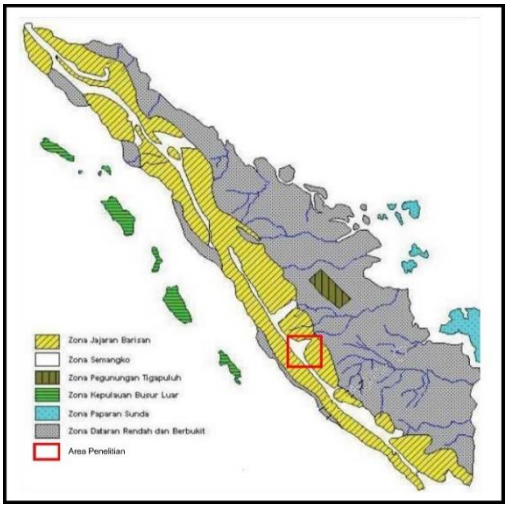

Figure 1. Fisiography of modification research area *Van Bemmelen* [4].

Tectonically the research area is part of the Sundaland, which is a shallow sea that is exposed to the surface characterised by the discovery of shallow sea fossils in the Mengkarang area; in the process of Sumatera is composed of several blocks of continents formed during Late Paleozoic period (Carbon-Permian) which merges to form a landmass Sundaland, especially the island of Sumatera (Figure 2), a series of blocks that compose the island of Sumatera including Woyla nape block which is in the outer western part of Sumatera island, then the West Sumatera block on the western mainland of the island of Sumatera, and contact with Sibumasu block stretches from east to south Sumatera island and Indochina which is located in the outermost part of Sumatera (Metcalfe, 2011) [6]. The research area is a region situated between Sibumasu and West Sumatera.

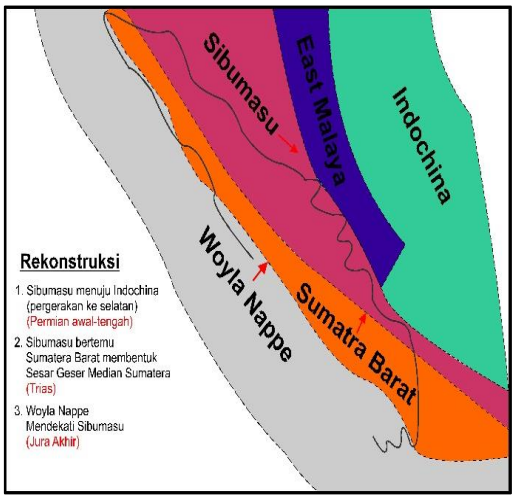

Figure 2. The constituent continental block of Sumatera Island (Modification from [6])

Based on field observations and based on the regional map of the Sarolangun Sheet (Suwarna et al., 1994) [7], it was obtained that the rock formations that make up the research area, namely the construction of Mengkarang, which is an aged Permian, composed of sedimentary rocks with marine transition deposition sediment facies (Crippa, 2014) [8], then followed by the Jura senior Tantan Granite formation with collecting rocks in the form of intrusion Granite. Kasai's youthful appearance is composed of Tertiary volcanic products of volcanoes, covering the old building below Figure 3.

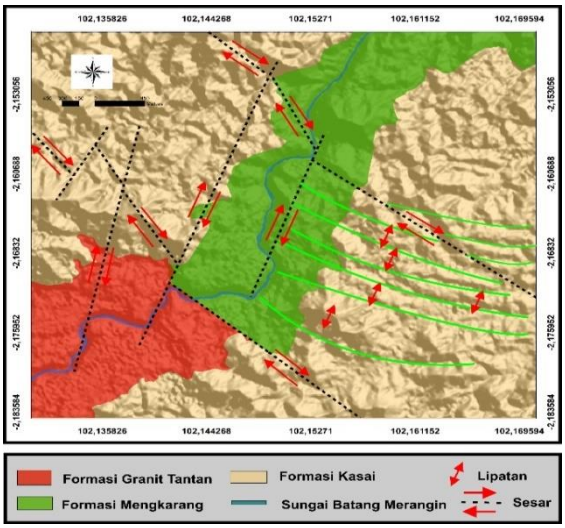

Figure 3. Research Area Geology Map

Tectonic the island of Sumatera has undergone several phases of geological structure changes, consisting of three stages of geological structure transition; according to Pulunggono et al. (1992) [9], the geological structure that developed namely from the first phase in the form of compression processes at Cretaceous-Jura to produce West-East Dexstral Fault such as Lematang, Kepayang, Saka and others, with the state of Sumatera island is still oriented four shear, and subduction of Sumatera island is in the Eastern part of Sumatera island so that it produces the Granite Belt, in the second phase in the Cretaceous until Tertiary is the tensional process by creating normal fault and strike-slip with West-East and North-South orientation until the formation of basins on the island of Sumatera, in this phase is also characterised by the active Cretaceous-Tertiary volcanism. The third phase is in the Tertiary period with the conversion process and the uplift of the rim of the basin and active sedimentation; in this phase, there is the orientation of Sumatera island from figure share to simple share, as the active Sumatera Fault with Northwest-Southeast exposure that forms Barisan hills order from the displacement of subduction of Sumatera island from East to West.

RESULT AND DISCUSSION

According to Crow et al. [10], the Merangin River Section on the Air Batu and Dusun Baru of Renah Pembarap Subdistrict have dipping lithology in the northeastern dip direction; this is believed to be Merangin Anticline, where the southwestern flank folding have intruded by Air Batu Granitic Plutonic.

This study focused on local faults and folds formed from the main force of the Sumatera regional fault in the Mengkarang formation dominated by metasediment rocks to the Tantan Granite Formation consisting of igneous rock intrusion as a marker for the occurrence of meta-changes in rocks resulting from regional structure processes, resulting in reconstruction of interesting geological structures and make a model of the fold along with the pattern of the distribution of rocks in the fold.

Figure 4. (1) *Striasi* structure (2) Gawir Sesar

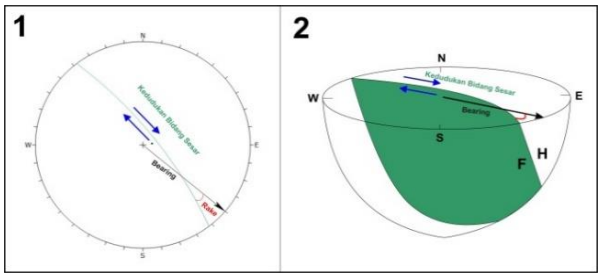

Figure 5. (1) Stereography Analysis and (2) 3D fault on Observation P4 Analysis

For the fold control fault in the research area as a first-order fault, namely in the observation of P4 in the form of gear fault data by measuring the scratches (striation) and fault field position (Figure 4), then obtained Strike/Dip N322°E/76°, Bearing N135°E, and Rake 36°, based on the results Stereographic analysis and also 3D analysis (Figure 5) of field data, it can be known that the result is the Normal Right Fault with orientation the Sumatera Fault.

Based on the existing literature, Sumatran geochronology in regional geological structure undergoes three phases of orientation towards developing Sumatera faults, namely West-East, North-South, and Northwest-Southeast direction. From the results of observations and measurements in the field and Stereographic analysis, the Normal Right Fault relative to Northwest-Southeast, it can be known that the controller of geological structure in the research area, namely the Northwest-Southeast oriented regional fault, is the final segment of the Sumatran Fault (Figure 3).

In addition to a local fault in the research area, there is also a fold structure. For the design of the folds in the research area found in the Mengkarang Formation, which is of Earl Permian, the folds in this location are closely related to the movement of the first order fault in the P4 observation above. This is evidenced by the influence of the direction of the force of the spot, which is dominated by the compressional troops to produce pressure that forms sedimentary rocks around it tend to create a slide with an average pointed angle perpendicular to the main force of the compressional, this slip formation is also caused by sedimentary rocks that have pretty good elastic physic. This is in line with that expressed by the theory of Wrench Fault theory by Moody and Hilly (1956) [10], which states that first-order faults are formed more or less 30° against the

leading express. Then the second-order mark will cut or perpendicular to the first order and so on, based on the theory above, then confirmed by a data approach that proves that the first order fault is directed Northeast-Southeast so that it gets a firm or consistent direction close to the North-South and expose the fold that tends to be West-East (Figure 6).

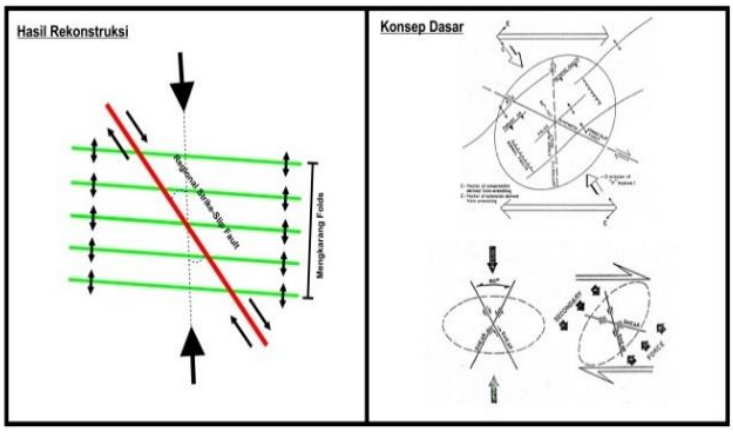

Figure 6. Reconstruction Mengkarang Fold Against field data in approaches classification fault from Moody and Hilly (1956).

Based on the geological map of the research area in the form of sedimentary rock and volcanic rock that is compressional from the primary Sumatran fault P4, which causes the appearance of stones in the Mengkarang Formation, resulting in repeated and parallel folds from the direction of the main or more known as Isoclinal Folds. Isoclinal folds are folds that have parallel and repeated axes formed as a result of the main stitches that press on the rock sustainably so that it folds in the same direction as the illustration of the formation of folds in Figure 7. Results from observation of one of the axes in the observation of P17 have then been obtained, namely the general direction of wing 1 N285°E/44° and general advice.

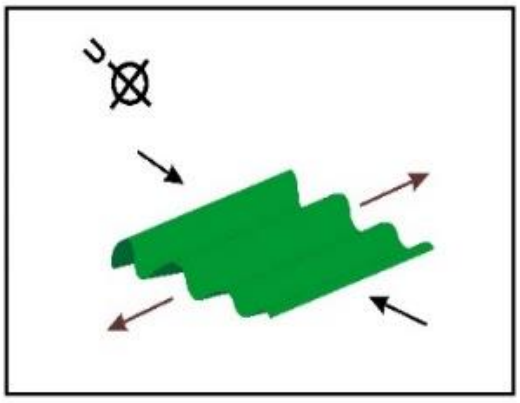

Figure 7. Illustration of Formation Isoclinal Fold.

Wing 2 N136°E/42° (Figure 8), then obtained results in the form of Anticline. The performance of the folded wing on the conscientious area is downstream of the wall of the Inum river, Air Batu Village at observation site 17. This further proves that the Mengkarang Formation in this area has anticline.

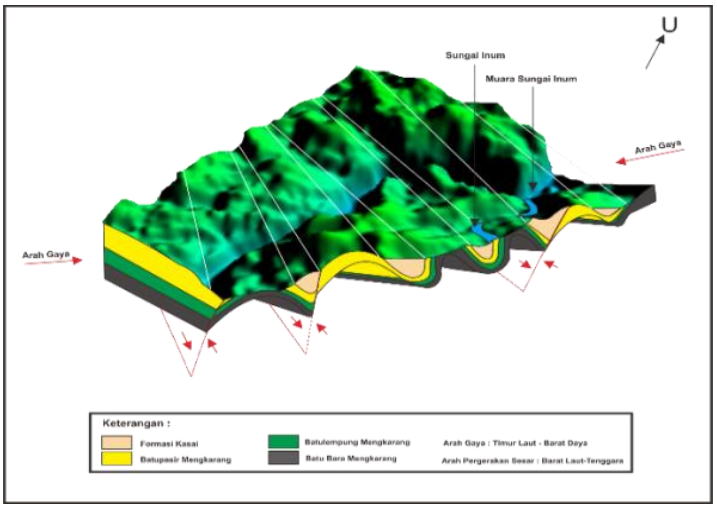

Figure 8. Observation of Fold P17 and modelling anticline in the research area

From the result of the reconstruction of folds obtained isoclinal fold models in conscientious regions as in Figure 9. The character of isoclinal folds from moral areas is more noticeable as looping layers of sedimentary rock that are not very clear in the appearance of wing folds.

Figure 9. Reconstruction Research Area Isoclinal Fold

This is due to the change in direction due to the continuous pressure force tends to form an angle between 30° below 45° perpendicular to the Sumatran fault as the primary alignment and the form factor of isoclinal folds in the research area. The valleys are as seen in Figure 10.

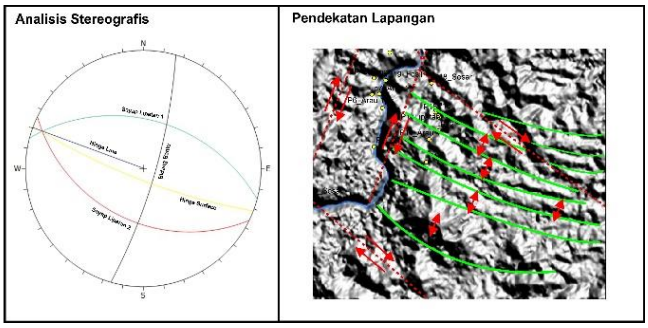

Figure 10. Result of Analysis and proof of formations based on DEMNAS Against Mengkarang Isoclinal Fold Area model pattern

By referring to the observations of DEMNAS in Figure 10, it can be known the presence of folds of the same relative direction forms the morphology of the long hills truncated by fault; this supports that this Isoklinal recurrent fold was created and controlled as a directional Sumatran mark Northwest-Southeast. In addition, the morphological character of these elongated hills is wholly owned by structures, geological structures that can be seen around valleys or ramps.

CONCLUSION

Based on the results of field observations and also supporting theories of the analysis of folds controlled by a fault by following under the concept of Wrench Fault closely corresponds to the ample proof of the field that the Sumatran fault is directed northwest-southeast and passes through old rocks reef (Permian-Cretaceous) and Kasai (Tertiary) will result in a large regional pressure force so that the clastic rock is folded repeatedly and named as the Mengkarang Isoclinal fold, then it can be concluded that the fault strongly affects the fold and the direction of the fold will tend perpendicular to the fault direction.

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