STRUCTURAL GEOLOGY AND MAGMATISM/VOLCANISM ACTIVITY TOWARD GEOMORPHOLOGY IN BANDUNG BARAT-CIRANJANG, WEST JAVA

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ABSTRACT

Geomorphology along Ciranjang to Bandung Barat is dominated by structural hills while others are related to the magmatism/ volcanism activity. The others morphological features are plain land which belong to Ciranjang and Bandung depression. In interpreting geological structures, topography map and DEM were used together with field data particularly the landscape faulting indication and flow pattern. The compiled data of morphology, stratigraphy and landscape in the study area showed that the geomorphology of the area could be differ into several unit which are structural hill, non-structural hill, and plain morphology units. Sedimentary structural hill unit were develop in Rajamandala hills starting from the Cianjur-Bandung border, Solitary hills geomorphological unit developed in Cililin area, and the developed plain unit developed in Ciranjang and Cililin area.

Keywords*: Subduction, geological structurem magmatism, volcanism, geomorphology.*

Introduction

Most of the morphology of the area of West Bandung-Ciranjang is steep to moderate hills, and some of it is in the form of plain. Hilly morphology is composed by Paleogen-Neogen sedimentary rocks, and Plio-Plistocene to Quaternary volcanic rocks. With the exception of Quaternary age rocks, all of these rocks have been deformed to form a folded structure of the tiller accompanied by tear faults and normal faults which are entirely contruted from the landscape formation in the region.

The geology of this area is motivated by the tectonic activity of the Eurasian plate collision with the Indian-Australian plate which causes the entire sediment content in the Paleogen-Neogen basin to be lifted, folded and enlarged, and simultaneously followed by the activity of magmatism / volcanism. It is this aspect of lithology and geological structure that then most plays a role in the formation of the landscape in this region. The morphology of the hills can be divided into several units, including elongated hill units with a certain orientation, irregular hill morphology units, solitary hill morphology units with perfect and imperfect cone shapes. This paper discusses the background of the morphological units formation mentioned above.

Regional Geology

The Cililin-Ciranjang area, is part of the Rajamandala hillsides that stretch from the Cianjur-Sukabumi border to West Bandung. The constituent rocks consist of carbonate rocks of the Oligocene-Lower Miocene Rajamandala Formation, Lower Miocene-aged Jampang Formation volcanic rocks, Middle Miocene-aged Citarum Formation sedimentary rocks, Middle Miocene-aged Beser Formation volcanic rocks, Pliocene-aged Beser Formation volcanic rocks, and Quaternary-aged volcanic rocks.

Sedimentary rocks aged from Oligocene to Neogene, are marine sediments ranging from the neritic environment to the deep sea. All of them were deposited in the basin which is in the intra-arc of the plate collision system that has been going on since the beginning of Palogen until now. Since the beginning of Paleogen, the position of subduction has been in the south of Java Island with the west-east direction, so that the compression stress system at that time had been trending north-south. Based on the tectonic history, the type of geological structure especially developed in West Java is the fold thrust belt accompanied by a local horizontal fault (tear fault).

The regional fault structure that crosses the study area is the Cimandiri Fault which is part of the pattern of fold structure of the steps (Haryanto, 2014). The Cimandiri Fault was concluded differently by previous researchers,

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namely as an reverse Paleogenic fault which was later reactivated by younger tectonics into a sinistral fault (Pullunggono and Martodjojo, 1986).

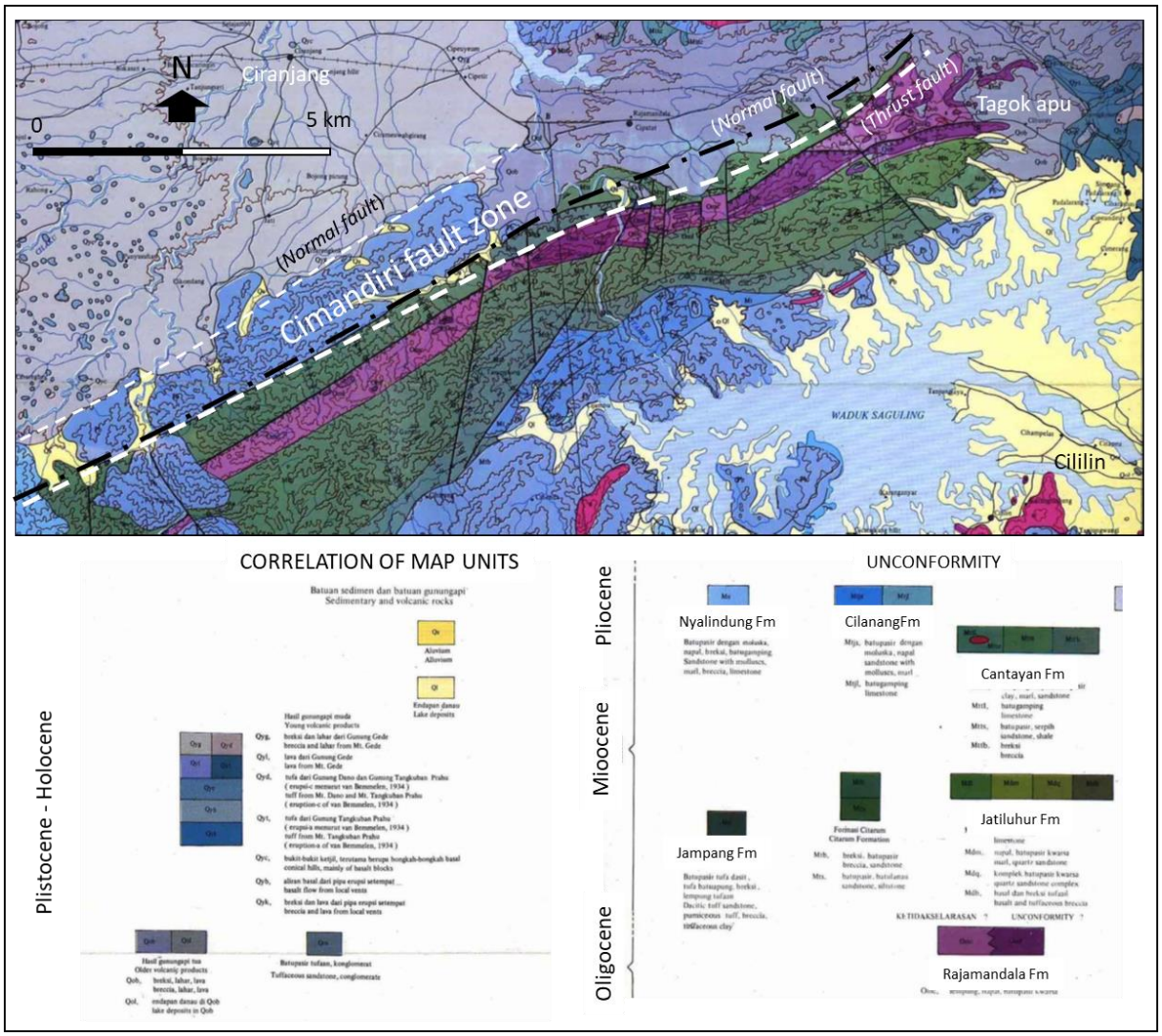

Figure 1. Geology of study area belongs to Geologic map of the Cianjur quadrale (Modified from Sudjatmiko, 1972).

Tectonic and Structural Geology

From the results of the measurement of dip and angle of the rock layer and the indication of fault in the field, it is known that the main geological structures develop in the study area are the structure of anticline folds, reverse and normal faults. All of these geological structures contribute to the formation of the landscape in the study area. The horizontal faults are often found in the study area, but they contribute less to the formation of the landscape.

Fold Structure

Its structure is determined based on the slope of the rock layer caused by tectonics. From the results of field measurements, it is known that there is a regional anticline fold that folds the rock layers of the Rajamandala Formation and the Citarum Formation, as well as the equivalent rock layers of the Bayah Formation and the Batuasih Formation.

The strike of rock layer is commonly in the trend of Northeast – Southwest (NE-SW) to West southwest – east northeast (WSW-ENE). The rock layer in the north is tilted to the north, while in the south it is sloped to the south. The

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anticline fold axis is in the Rajamandala Formation carbonate rock so it is named as the Rajamandala Anticline. The wing of the folds are composed of younger rocks, such as the Cilanang Formation claystone units which are exposed in the Cililin area. The north wing is still composed of carbonate rocks in the Rajamandala Formation, because most of the folded wings have eroded due to a regional reverse fault, the Cimandiri Fault.

Reverse Fault

Reverse Fault is determined based on several factors, including the discovery of rock layers that are close to vertical and the discovery of slickenside which are entirely located in the alignment zone of Rajamandala hills.

The upright layer is found in the sandstone layer of the Citarum Formation which is exposed at the edge of the Citatah highway and along the Cibogo River trajectory upstream. The stance of the rock layer ranges from N 230 ° -270 ° E / 80 ° -90 ° and based on the sedimentary structure it is known that the position of the rock layer has been reversed (Figure). This indication shows that the rock is in the compression zone which is related to the rising fault mechanism. Based on the Landsat imagery, the location is in the same line with limestone outcrops of the Rajamandala Formation in the Tagokapu area. In this location thousands of slickenside are found, one of which shows the reverse fault mechanism (Figure).

Strike Slip Fault

Strike slip faults are known to be based on slickenside data found in the Tagokapu area. The fault mirror at this location is dominated by low pitch which is below 20 ° with a type of sinistral and dextral sense of movement. The fault mirror is generally northward, but the topographic straightness in this area is northeast-southwest (NNE-SSW). This data shows that the horizontal fault at this location is local (tear fault) so that its presence does not contribute to its morphological formation.

Normal Fault

Normal faults are known to exist based on morphological aspects and mirror fault data that indicate a shift in the hanging wall downward. Strong indication of its morphological aspects, namely by the presence of topographic straightness controlled by a steep hillside which is believed to be a fault scarp (fault scarp).

In the Citatah area, the fault scarp completely cuts the carbonate rocks of the Rajamandala Formation, while in the Rajamandala to Ciranjang areas generally extends the Citarum Formation clastic rocks to the Beser Formation volcanic breccia. This normal fault line is trending northeast-southwest (NNE-SSW), located close to the fault line going up Cimandiri. Because of its close position, it is called the Cimandiri normal fault.

Magmatism/ Volcanism

In the area of Cililin to Ciranjang there are many exposed igneous and volcanic rocks, ranging from Neogene to Quaternary age. Magmatism activity at Neogene age is represented by the Citarum Formation volcanic breccias and Beser Formation volcanic breccias. More igneous rock intrusions are found in the Cililin area, while in the north they are only found in the Citatah area, namely andesitic intrusion that breaks through the Kaliwangu Formation sedimentary rocks and Rajamandala Formation carbonate rocks. Backing effecks are found around intrusion contact with claystone, causing strong and glossy litification with a blackish gray color. The distribution of intrusion is relatively small and its position on the surrounding sedimentary rocks is relatively parallel, so it is concluded as sill intrusion. Therefore, the presence of intrusion at this location does not play a significant role in the formation of morphology.

Volcanic rocks and igneous rock intrusions are more common in the Cililin area. Most of the rocks form solitary hills in the shape of a perfect cone until the wavy cone that calls the rock has been deformed so that it experiences advanced weathering.

Geomorphology

On the basis of the constituent rocks, the geological structure, the shape, and pattern of the hills include the slope, the ridge shape and the flowing pattern of the river, the study areas are grouped into 5 morphological units, namely the morphological units of the folded and elevated sediment hills, the morphological units of the folded and enlarged volcanic hills, Volcanic hilly morphology unit is enlarged, Volcanic / intrusion cone morphology unit and Plain Unit

Faulted and Folded Sedimentary Hill Unit

This whole morphological unit is located along the hills of Rajamandala which stretches from the Cianjur-Sukabumi border to the West

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Padalarang-Bandung area. The main constituent rock consists of carbonate rocks in the Rajamandala Formation and sandstone units and Citarum Formation volcanic breccias. The ridge pattern is trending northeast-southwest (NNE-SSW), all controlled by the rock stance, only in the north is also affected by the reverse fault and Cimandiri normal fault. Lithology aspects do not play a role in the formation of morphology, except that locally formed karst is associated with the type of rock that is easily dissolved by water.

The alignment of the ridge ridge pattern extends to the Cihea river valley in the Ciranjang area, proving that this area is controlled by the structure of the fold of the steps accompanied by normal faults as the antithetic fault of the Cimandiri rising fault. One of the characteristics of the structure of anival folds is the alignment of the fold structure and reverse fault, so that the position of the valley and the hills are also parallel to each other

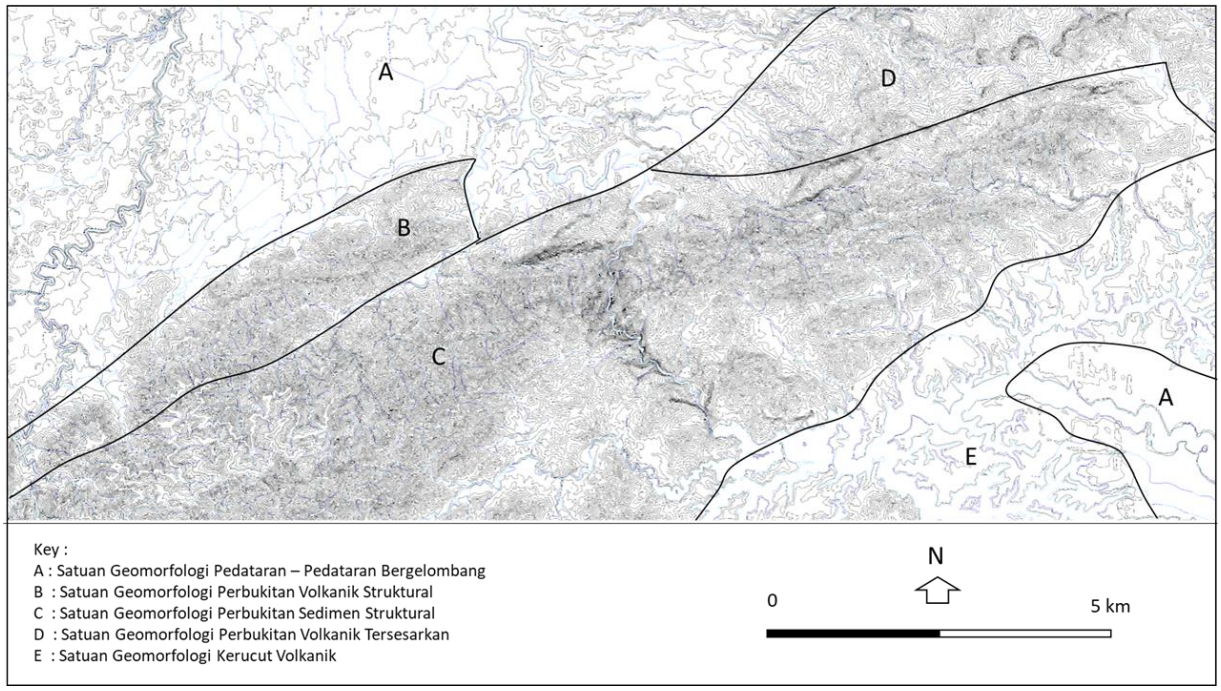

Figure 2. The division of geomorphological aspect based on lithology, structural geology, and topography.

Faulted and Folded Volcanic Hill Morphology Unit

This morphological unit is known based on the existence of topography arranged by Beser Formation volcanic rocks, as well as the presence of fault scarp which limits the morphology of the hills and plain in the Ciranjang area.

Rock outcrops are dominated by volcanic breccias and tuffs, both of which do not show rock layers. The indications of rock folding are based only on the ridge pattern that extends northeast-southwest (NNE-SSW), parallel to the Rajamandala hillsides which are dominated by Paloegen-Neogen sedimentary rocks. Although both stratigraphically are unconformity, they have the same distribution. This indication shows that tectonics that work during Neogene have never changed, even up to now. This morphological unit is also found locally in Quaternary age rocks, namely the existence of a hog back pattern controlled by the plane of the rock layer.

Faulted Volcanic Hill Morphology Unit

This morphological unit is found in the hills composed by Quaternary volcanic rocks. From the morphological aspect, it forms a series of moderate to weak wavy hills but does not have a specific ridge orientation. Within this morphological unit, several hills are arranged by

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layered tuffs, some of which have a tilt angle. Associated with the age of the rock, it is believed that this layer is not a tectonic formation, but as a intial dip in the bedrock. This kind of morphology is often found in the northern part of the Cimandiri fault, which is on the hanging wall of the normal fault.

Another phenomenon is found on the slopes of Mount Burangrang which belongs to the Tagokapu region and its surroundings. This location is crossed by the Cimandiri fault until it continues to the slope of Mount Burangrang which is composed of layered volcanic rocks of Upper Plistocene age. As a result of the Cimandiri fault, some streams form steep river valleys ("V" shape) on rocks composed of layered volcanic rocks that are not well-titrated. This data shows that the Cimandiri fault is still active today.

Volcanic cone geomorphology unit/ intrusion

This geomorphological unit is characterized by the presence of hilly cones that are entirely composed by Plistoesn volcanic material consisting of volcanic breccias, lava and tuff. The perfect cone shape shows that the rock has not been deformed, as seen around Cililin, while the conical shape is not perfect as seen in the Mount Halu area. The different shape of this cone indicates that the magmatism activity takes place simultaneously but takes place in a different location. Some take place in locations that are relatively close together, so that the shapes overlap each other. This phenomenon is also proven by the presence of mineralization which proves the existence of magmatism / volcanism activity sequences during this time period. Some of the volcanic hilly cones have a sub radier pattern, so it is believed that their rock bodies have been deformed by fault structures.

Plain – Wavy Plain Geomorphology Unit

The geomorphological unit of the plain is wide spread in the Ciranjang area and some others are found in the Cililin area which is partly developed between volcanic hilly cones. Most of the plain morphology is composed by surface sediments in the form of lahari breccias, tuff layers and a small portion of alluvium commonly found around the meandering streams.

The morphological boundary of the plain and hills in the southern part of the Ciranjang area is the normal fault line of Cimandiri. This conclusion is based on the existence of a fault scarp on the northern slopes of the Rajamandala hills, and the boundary between the two morphologies is relatively gradual. Surface deposition fills the valleys between the cone hills, in such a way that the accommodation space is closed and finally forms the morphology of the plain.

Conclusion

- Hills geomorphology is formed by plate tectonic collision in the south of Java Island. This tectonic event causes the research area to be deformed under compressional stress in the north-south direction. As a result, sedimentary rocks that were originally deposited in the basin were lifted, folded and raised to form a series of structural hills. These hills are part of Javanese orogenesis that is common on continents.
- A series of hills that are parallel to each other, indicating the existence of a structural control in the form of a thrust fold belt. This type of geological structure is the habitat in the plate collision system.
- Solitary volcanic hills are not directly related to geological structures but are caused by magmatism / volcanism. The different shape of the cone only indicates the existence of a sequence of age differences, and it can be concluded that the process of magmatism / volcanism activities continues to take place both in close and far locations.
- Plain morphology initially occurs due to the existence of extensional tectonics which results in the shape of a basin. The sedimentation process took place causing the full and collapsed accommodation space, and finally formed a flat morphology. This conclusion is supported by the absence of gradual boundaries between the morphology of the plain and the hills, and the development of fault scarp on the northern slopes of the Rajamandala hills.

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