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# The Surficial Basin Sediment Investigation and Its Concerned Vertebrate Fossils in Sirtwo Island, Western Part of Saguling Dam, West Java, Indonesia

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**Abstract**: In October 2021, the depreciation of the water level of dam Saguling revealed the surficial sediment where was dam up Citarum river. Sirtwo island and surroundings are part of the body sediment were arisen which is part of the sedimentary facies in the western of Bandung Lake ancient. Several vertebrate fossils were found on Sirtwo island and Pasir Benteng island. The investigation of vertebrate fossils was carried out to understand where are deposited in Bandung lake. The geological survey lead to the recognition of types of lake deposits and was divided into 5 block observations i.e., Block A, Block B, Block C, Block D, and Block E. Geographic information system was used to determine the location points where the fossil was found and is correlated with other location. The fossils fragment is identified as vertebrate fossils i.e., Bovid sp., Rusa sp., and Elephas maximus. The detail of vertebrate fossils type and sediment petrology is under further analysis. The sedimentary facies are lake deposit and is distinguished into 3 sub-facies: 1) volcanic deposit with vertebrate fossil 2) sandstone tuff without vertebrate fossil and 3) sandstone tuff with vertebrate fossil. The age of lithology is estimated between 10.000 till >135.000 Years ago and the depositional environment is interpreted into fan lake, channel, and lake bottom. This study clearly determines lithofacies in the research area which contain vertebrate fossils.

**Keywords:** Bandung lake, stratigraphy, vertebrate fossil, depositional environment

***Abstrak:*** *Pada bulan Oktober tahun 2021, penyusutan muka air di Waduk Saguling telah menyingkap adanya endapan Danau Bandung purba. Waduk ini membendung sungai Citarum di bagian hulu. Pulau Sirtwo dan sekitarnya merupakan bagian dari tubuh sedimen yang muncul dipermukaan dan diperkirakan merupakan bagian dari fasies sedimen Danau Bandung Purba bagian Barat. Beberapa fosil vertebrata ditemukan di pulau Sirtwo dan pulau Pasir Benteng. Penyelidikan keberadaan fosil-fosil vertebrata dilakukan untuk mengetahui di mana fosil tersebut diendapkan. Survei geologi dilakukan untuk mengetahui litofasies endapan danau purba dan lokasi pengamatan dibagi menjadi 5 blok, yaitu: Blok A, Blok B, Blok C, Blok D dan Blok E. Sistem informasi geografis digunakan untuk menentukan titik-titik lokasi ditemukannya fosil dan dikorelasikan dengan temuan fosil di lokasi lain. Hasil temuan fosil di lokasi penelitian berupa fragmen-fragmen fosil vertebrata dan diperkirakan telah mengalami proses transportasi. Hasil identifikasi menunjukkan sebagai fosil vertebrata, yaitu: Bovid sp., Rusa sp., dan Elephas maximus. Analisis detail jenis fosil vertebrata dan petrologi sedimen sedang dalam analisis lebih lanjut. Hasil analisis litofasies mencirikan sebagai endapan Danau Bandung purba dan dibedakan menjadi 3 subfasies: 1) subfasies endapan vulkanik mengandung fosil vertebrata 2) subfasies batupasir tuf tidak mengandung fosil vertebrata dan 3) batupasir tuf mengandung fosil vertebrata. Umur litologi diperkirakan antara 10.000 sampai >135.000 Tahun yang lalu. Lingkungan pengendapan adalah lingkungan danau dan diperkirakan sedimentasi terbentuk pada bagian lake fan, channel dan dasar danau. Studi ini merupakan survei pendahuluan untuk mengetahui secara jelas jenis litologi endapan danau dengan subfasiesnya dan identifikasi keberadaan fosil vertebrata di daerah penelitian.*

***Kata kunci:*** *Danau Bandung, Stratigrafi, fosil vertebrata, lingkungan pengendapan*

## INTRODUCTION

In the Western part of ancient Bandung Lake (Figure 1), where the finding vertebrate fossils are located by the local community in October 2021. This is a new vertebrate fossil and original which was found in the body of sediment in Sirtwo Island or Pasir Benteng Island. Bronto & Hartono (2006) separated Bandung Basin into three-part i.e.: the western part, middle part, and eastern part. The morphology of Bandung lake is anciently formed in the Bandung Basin due to tectonic activity and volcanism (Brahmantyo, 2005). So far, not many paleontological studies have been carried out in this area since 1980. The last report of the fossil by Soewarno (1984) obtained two fossil pieces of a water fish from villagers of Cililin and discovered at the bank of Cipatik River and other fossils at Citarum River (Aziz & de Vos, 1999). It was in consequence of the construction of the Saguling Dam and development planning in Kabupaten Bandung Barat (KBB). Saguling Dam is under-managed by PT. Indonesia Power at KBB where is damming the Citarum River. Therefore, the chance to study new vertebrate fossil phenomena is quite to plausible create the correlation between biostratigraphy and lithofacies study in Bandung Basin. This study is a preliminary survey to ascertain and identify vertebrate fossils and lake sediment.

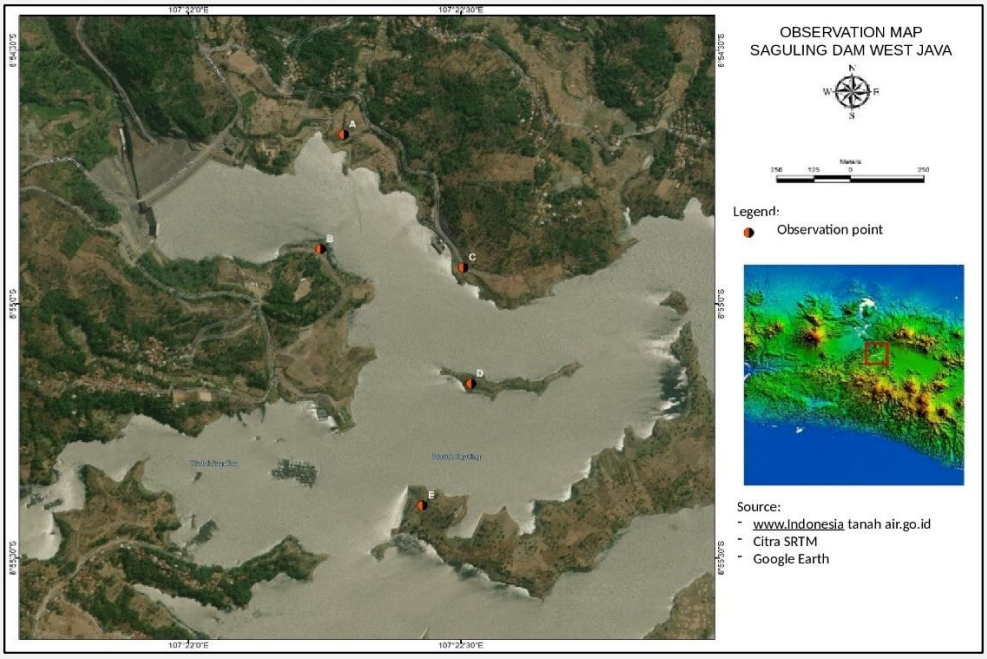


Figure 1. The observation map and study area is located in the western part of Saguling Dam, West Java

Figure 1 is a map of the observation point divided into five blocks (Block A, Block B, Block C, Block D, and Block E) and located in KBB, the West Java Province, Indonesia, with an elevation ranges between 660 and 2,750 m above sea level. It is surrounded by the Burangrang-Tangkubanperahu Mountain Complex to the North and the Wayang-Windu-Mandalawangi Mountain Complex to the South. The basin was constructed by the unconsolidated and undifferentiated Quaternary volcanic products which bed layer is Tertiary sediment and lake deposits dried up (Sudjatmiko, 1972; Silitonga, 1972; Dam, 1994; Van Gorsel, 2013). Some normal faults mark its eastern and western, northern and southern borders. While, some active fault has been interpreted by the bourger anomaly method which influences the basin and shape of an ancient lake (Soehaimi, 2010). The Bandung Plain has a more or less elliptical shape, with axes of approximately 35 km and 15 km in east-west and north-south directions on respectively (Delinom, 2009). The purpose of this study is to define the lithofacies and depositional environment where concerned the outcrop of a vertebrate fossil using surficial mapping. The authenticity of fossils is

determined based on the physical properties of fossil material (color, texture, structure, fracture, and mineralization). It is expected that this study will reveal new insight into ancient fauna in West Java. In this case, the vertebrate fossil is a fossil that has age of more than 10.000 Years ago. Dam (1994) estimated the age of the lake deposit between 16.000-136.000 Years ago.

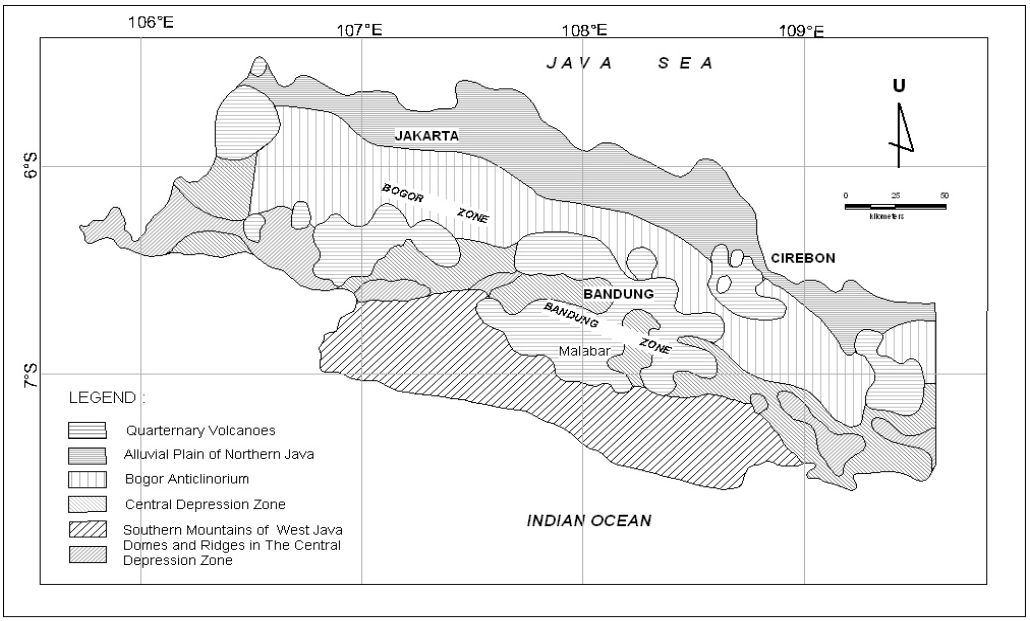


Figure 2. Tectono-physiographic regional map of West Java (Van Bemmelen, 1949 in Delinom, 2009)

## Geology and Paleontology

Currently, the Citarum River has been utilized by three dams for electricity energy, i.e.., Jatiluhur Dam, Cirata Dam and Saguling Dam. Abdurrokhim (2017) states western part of the Saguling Dam area is included as a part of the Saguling Formation but is not exposed. The Saguling Dam area included a geological map scale of 1:100.000, Cianjur sheet (Sudjatmiko, 1972), and Bandung sheet (Silitonga, 1973) and known as Bandung Basin. The physiography regional of West Java is divided into 4 zones (Van Bemmelen, 1949), where the physiographic of the research area is the Bandung High Zone and bordered by the Bogor Anticlinorium Zone as shown in Figure 2. The Bandung Basin belongs to the second structural region and is part of a chain of depressions in West Java, which is called the Bandung Zone (Van Bemmelen, 1949) which formed an ancient lake. Now, the ancient Bandung Lake become Bandung plains and is arranged by old volcanic rock, young volcanic rock, and lake deposits. The subsurface of the Bandung Basin comprises horizontal Quaternary deposits consisting of floodplain deposits, channel deposits (as lenses), lake deposits, lake fan deposits, Bandung (clastic) fan deposits, and alluvial fan deposits representing the oldest products (Silitonga, 1973). The evolution of the tectonic activity (Cimandiri fault, Lembang fault, Baribis fault and Citandui fault) and volcanism (Tangkubanparahu Mountain (Mt.), Manglayang Mt., Patuha Mt., Malabar Mt., Kencana Mt. and Wayang-Windu Mt.) on Quarter-Tertiary period have been an important factor in the history of the Bandung Basin (Haryanto, 2006). The geological history of Bandung Basin as well as lithologic and structure details of this area have been reviewed in numerous publications i.e., van Bemmelen (1949); Sudjatmiko (1972); Silitonga (1973); Koesoemadinata & Hartono (1981); Dam (1994); Koesoemadinata (2004); Brahmantyo (2005); Bronto & Hartono (2006); Marjiyono et al. (2008); Soehaimi (2010); Hutasoit (2009). The comprehension study of Bandung Basin has been done by Dam (1994) and the results of geology data in detail using various methods (surficial mapping, geophysics, age dating, Geotech drilling, etc.). He also arranges the stratigraphy and sediment facies model in Bandung Basin.

| VAN DER MAAREL, 1932 | | TER HAAR, 1934 | | | VON KOENIGSWALD, 1934, 1935, 1940 | | SONDAAR, 1984 | |
|---|---|---|---|---|---|---|---|---|
| Biostratigraphy | Age | Lithostratigraphy | Fossil vertebrates | Age | Biostratigraphy | Age | Biostratigraphy | Age |
| Vertebrate zone | Pliocene | Gintung serie | xxx scattered occurence | Pleistocene | obere Wirbeltierschichten | Middle Pleistocene | Kedung Brubus | Pleistocene |
| | | Mengger horizone | | | | | Trinil H.K. | |
| | | Kali Glagah serie | xxxxxx N.W. Ci Saat | upper Pliocene | Jetis ? | Lower Pleistocene | Ci Saat | ? |
| | | | xxxxxx Kali Glagah (Satir) | | untere Wirbeltierschichten Kali Glagah | Upper Pliocene | Satir | Pliocene |
| *Turritella* zone | Pliocene | Kali Biuk serie | | lower Pliocene | | | | |

Figure 3. The correlation between biostratigraphy and lithostratigraphy (Sondaar, 1984)

Museum Geology has thousands of geological collections (fossils, rocks, and minerals), as well as a collection of artifacts. The fossils collection is divided into invertebrate fossils and vertebrate fossils. The collection of vertebrate fossils comes from several regions in Indonesia, most of which come from Java Island and one which is from the Bandung Basin. The discovery of vertebrate fossils from the Bandung Basin has recorded 234 collections (Suharyogi et al., 2019). Overview of paleontological, vertebrate fossils especially is old research and have been released by Stehn & Umbgrove (1929). Aziz & de Vos (1999) declare that the Bandung Basin is divided into 2 groups of ancient fauna units. First, namely is the Kedungbrubus Fauna unit and the other is the younger fauna unit. The fauna unit of Kedungbrubus was found as a result of rework deposits. These fossils consist of *Sus sp., Duboisia santeng, Rusa sp., Bovid sp., Stegodon/Elephas, Manis palaeojavanica, Panthera tigris.* It was found in Banuraja village, east of Batujajar district. The results of this rework can be seen from the rounded shape of the fossil which indicates a transportation process. Until now, the original lithology of this fossil has not been found and the age was predicted 0.8 million years ago (Leinders et al., 1985). This mean, the fauna was existing before the Lake Bandung or Bandung Basin was already inhabited by ancient fauna. While, the fauna was found in Cililin, Ciharuman, Cipeundeuy and Rancamalang. The fauna found were *Cyprinis carpio, Python reticulatus, Elephas maximus, Rhinoceros sondaicus, Bovid sp., Deer sp., Hippopotamus, Geoemydidae, Crocodillus.* The age of fauna is between 29,000 – 42,360 years ago by C14 dating (Aziz & de Vos, 1999). Van De Brink (1982) includes this fauna unit in Wajak fauna. The biostratigraphy of the Javanese mammalian fauna has been published by Sondaar (1984), as shown in Figure 3. This figure shows the correlation of biostratigraphy and lithostratigraphy of fauna vertebrates with age in range 125 ka until > 1.5 ma. Currently, the biostratigraphy of fauna in the Bandung Basin is divided into old fauna vertebrate and young fauna vertebrate (Aziz & de Vos, 1999). But, the limitation of age and lithology is not clear. Therefore, this study expected offer perspective of geological data to open up the correlation of biostratigraphy and lithostratigraphy in West Java.

## METHOD

The surficial mapping conducted to find out lithology data and vertebrate fossils. Our investigation is focus on measurement of lake sediment and identified fossil findings in Sirtwo Island and surrounding. The analysis of facies and depositional environment also conducted to ensure the existence of vertebrate fossil which is in situ or not. Identification of fossils vertebrate described as well as by physical properties and bone fragment dimension. It deals with the study of biostratigraphy vertebrate fossil in our research area which is limited. Stratigraphic and sedimentary facies correlation in Bandung Basin refers to Dam (1994), provides a depositional environment model dan sedimentary facies types (floodplain, channel, lake, lake-fan, swamp, green paleosol and alluvial fan). Other analysis is correlate the biostratigraphy sequence with other fossils in zona of Citarum River and at last is concerned with biostratigraphy of Java fauna as well as shown in Figure 3.

## RESULT AND DISCUSSION

The result of surficial survey is presented based on the observation points which discovered vertebrate fossils, as show in Figure 4. This study is referring to geological values with the theme of vertebrate fossil. Sirtwo Island is the two body of lake deposits and be marked with red point. Those islands were arising up after depreciation of water level in Saguling Dam. The red point in Fig 4 also show the outcrop of vertebrate fossils. The geology map of study area dominated by lake sediment (Ql) which included Saguling Dam (SG) area. While, volcanic rock (Pb) interpreted as material resources to fill lake and bedrock.

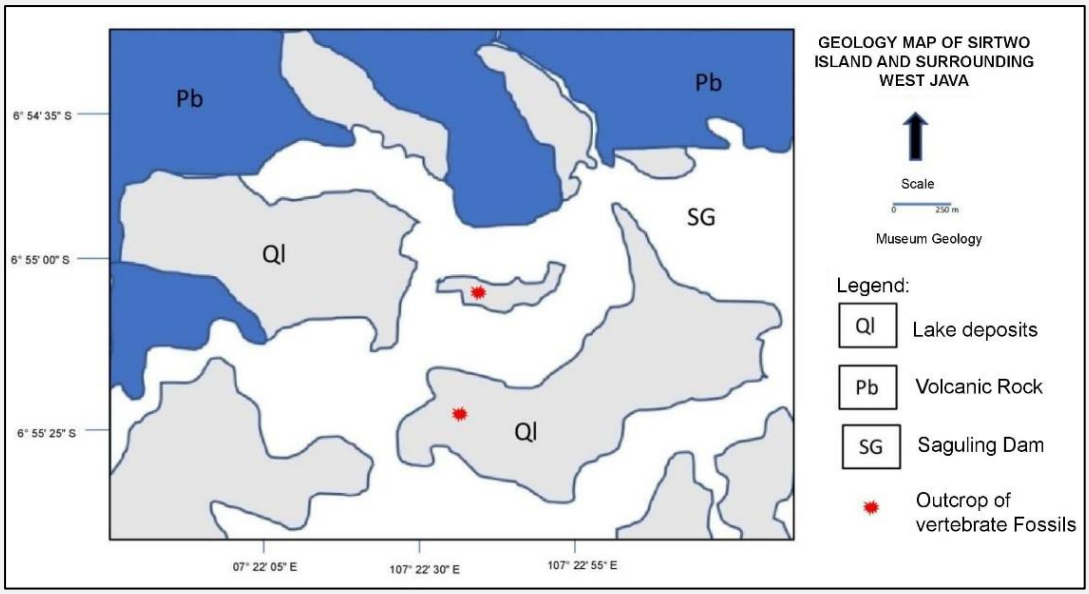


Figure 4. A modified geology map from Sudjatmiko (1972) and study area

### Geomorphological Approach

The morphological regional of KBB consists of plain area, hills and mountains. Citarum river is most fluvial system that is influence the landform of Bandung basin which include the study area. The landform in the study area is dominated by Saguling Dam, where there are Sirtwo Island and Pasir Benteng Island (Fig. 1). We are predicting that the two islands are part of the ridge which is known as the Pasir Benteng area in the past. Currently, the small island is called Pulau Sirtwo (Block D) and the larger island is Pulau Taman Sirtwo (Block E). The new name of islands given by local community. Brahmantyo (2005) was classified the research area into the western part of the ancient Bandung Lake. The research area included lake (lacustrine) landform and is divided into three lake zone, i.e.: shore zone, slope zone and bottom zone, as shown in Figure 5.

Dam (1994) and Koesoemadinata (2004) estimate that the development of the ancient lake from the beginning till the end show a period with range 16,000-135,000 years ago or as long as about 119,000 Years old. Meanwhile, the chronostratigraphic of Bandung Basin occurred range 0.043-4.088 ma (Sunardi, 2010). The occurrence of ancient lake affected by tectonic and volcanism (Van Bemmelen, 1949). The current surface of Bandung plain can reflect the subsurface in the past. We have a hypothesis that the evolution of ancient lakes in the Bandung Basin from the beginning to the end, which is influenced by the development of the fluvial system. The lake and material deposits indicate the fluvial materials (river, swamps and lakes) from southern part of Bandung plateau. Meanwhile, the receding of water in the lake is caused by the changes of fluvial system which due to geological processes. We are believing that is not all area in Bandung Basin flooding by ancient lake but there are still plain in the past. It is supported a survey of lake and swam in Bandung plain by Jamil (2020) state that are at least 114 lakes that have been lost or converted into

plains in Bandung Basin.

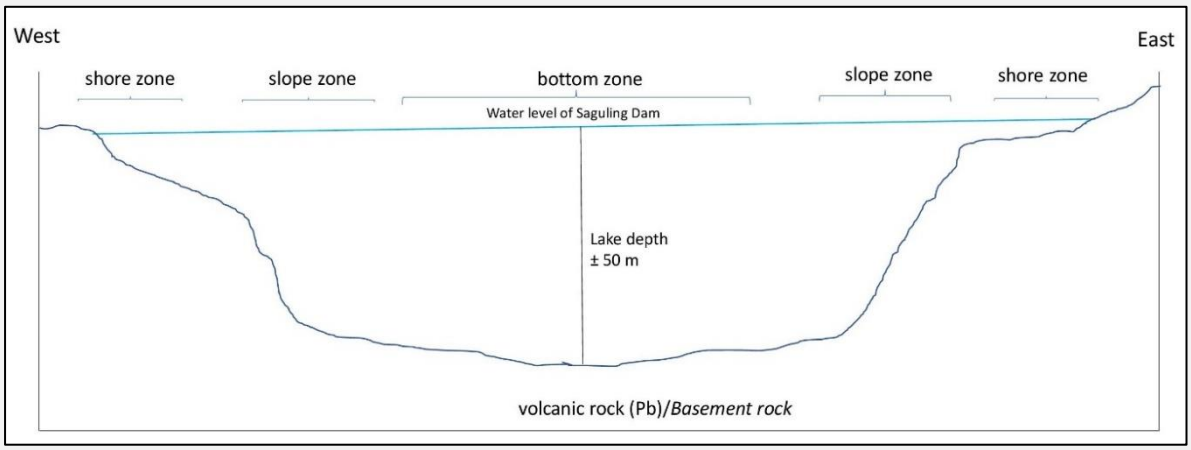


Figure 5. Topographic section illustrating the main morphogenetic units

## Sedimentary Facies and Sequence Stratigraphy

The results show that lithology of research area consist of lake deposits (Ql) and volcanic rocks (Pb). While, alluvial deposits (Holocene) are located around the shore of dam. In generally, the sedimentary facies type of study area is lake facies which is result lithostratigraphy study. Lithostratigraphy deals with the lithology or physical properties of strata and their organization into units on the basis of lithologic character (Boggs, 2006). The results of surface observations are explained as follows.

### *Geosite Block A*

The geosite of Block A is located in the northern of research area. The results of the stratigraphic sequence measurements are shown in Figure 6. The outcrops consist of alluvial, soil and tuffaceous sandstones (medium to fine grain sizes). The thin deposits of paleosoils are found in the layer of tuffaceous sandstones (silt, clay and organic material). The result of sediment consists of five layers and has different characteristics. The outcrop is show sediment layer with strike/dip is N 150° E/5° and the orientation of crossbedding direction is N 210° E.

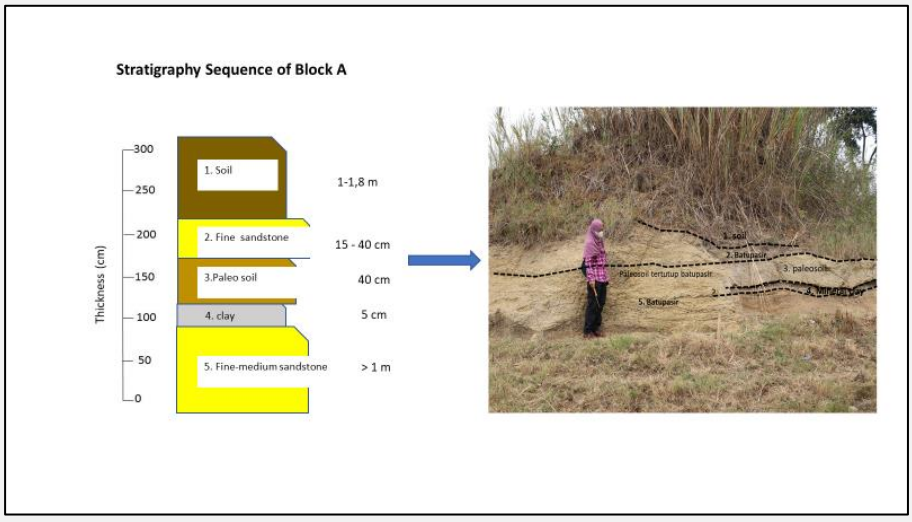


Figure 6. The stratigraphy sequence and outcrop at Block A

*Geosite Block B*

The location of Block B shows steep slope and rather difficult to reach into the outcrop (Fig. 7). The result is a sediment that are described as volcanic breccias with fragments is andesite (3-30 cm) and matrix is sandstone coarse to fine. The outcrop height is more 3 meters and width are more 200 meters. The andesite fragments show a rock mass flow in the matrix sediment. The interpretation is a sediment which precipitated in the water environment. The bottom of the sediment layer is flooded by Saguling Dam and it is not known the lower lithology. The deposits described volcanic debris with color is dark gray brown and the block-sized fragments is lapilli (3-70 cm) with spheroidal weathering. The avalanche direction is N 230°E and the environment depositional interpreted as sediment in shore of lake. Other outcrop is exposed at the lower of the Block E area and is not found in the areas of Block A, Block C, and Block D. The sourced of sediment is provenance the product of young volcanic and age is Plio-Pleistocene.

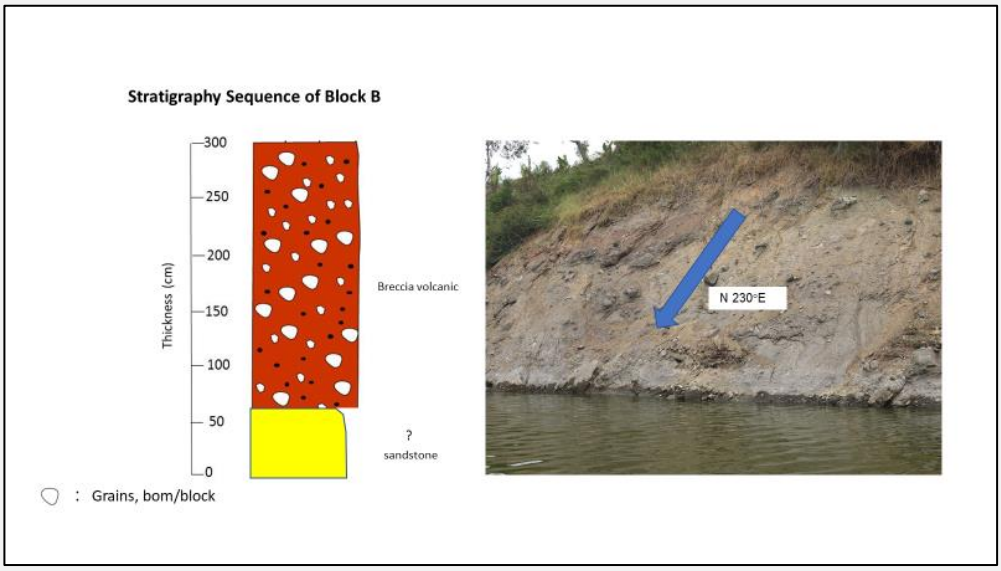


Figure 7. The stratigraphy sequence and outcrop at Block B

*Geosite Block C*

The Block C area is located at the eastern of the shaft of Saguling Dam where is close to the observation field of Block A. The results are two layers sediment and dominated by sandstone. The first sediment is volcanic rock (pyroclastic flow) and contain charcoal which is located at the top. And other is layer sediment of sandstones at the bottom which strike and dip is N 156°E/8°. This sediment consists, i.e.: sandstone (yellow), tuffaceous sandstone (brown) and clay (black and grey) contain the organic material. The detail show in Figure 8, which is the order of stratigraphy and is outcrop of Block C area. The sediment is consisting seven layers and dominated by tuffaceous sandstone. In other side show not complete layer which is four-layer sediment. An outcrop also shows a lithological boundary between pyroclastic flow deposits and layered sandstones. These sediments interpreted have formed and precipitated in a lake, systematically.

*Geosite Block D*

The Block D area is a small land that appears due to the receding water of the Saguling Dam. Before being flooded by the dam, this area is a ridge and was part of the Pasir Benteng hills. The length of island is approximate 500 meters with West-East direction. The Outcrops of vertebrate fossils are found in west side of the island as shown in Figure 9 where fossils are very abundant. The thickness of layers is about 15 meters which strike-dip is N 50°E. The results show a lithology unit that is composed by tuffaceous sandstone layers which is contain vertebrate fossils.

The stratigraphic sequence consists four layers sediment and dominated by tuffaceous sandstone with fine-medium grain size. We are ensuring that vertebrate fossil is original and insitu as shown in Figure 10. But there are found surface fossils which due erosion and sedimentary processes. This study was found twenty outcrops which contain various fossil as shown in Table 1. The vertebrate fossils were found in third layer and fourth layer. The sedimentary structures show flow, channel and parallel lamination/bedding. Meanwhile, the rate of cross bedding measurement is approximate N 20° E. The presence of observable sedimentary structures, so allows us to interpret the direction of the depositional deposit and the source of vertebrate fossils were deposited.

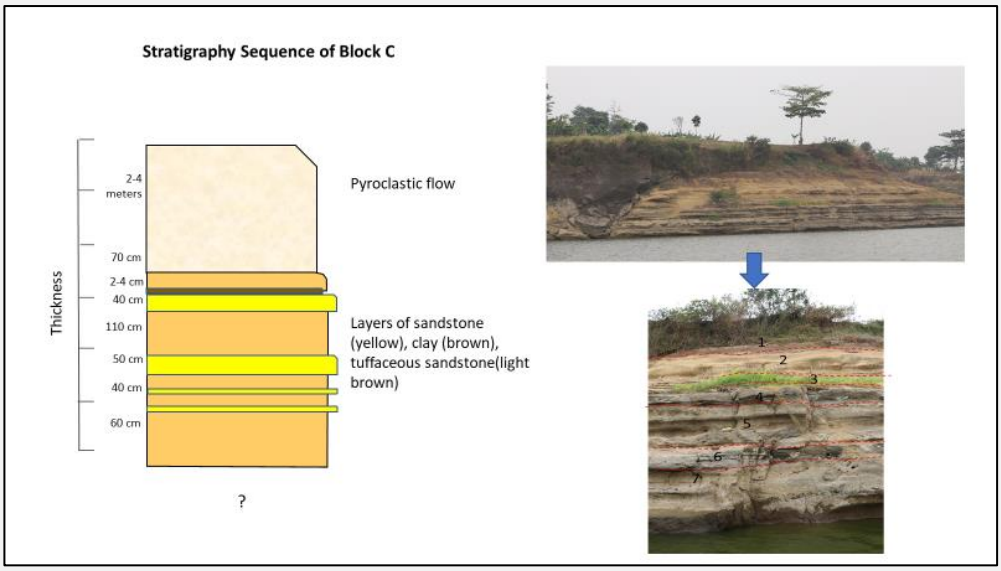


Figure 8. The result of stratigraphic sequence and outcrop at Block C

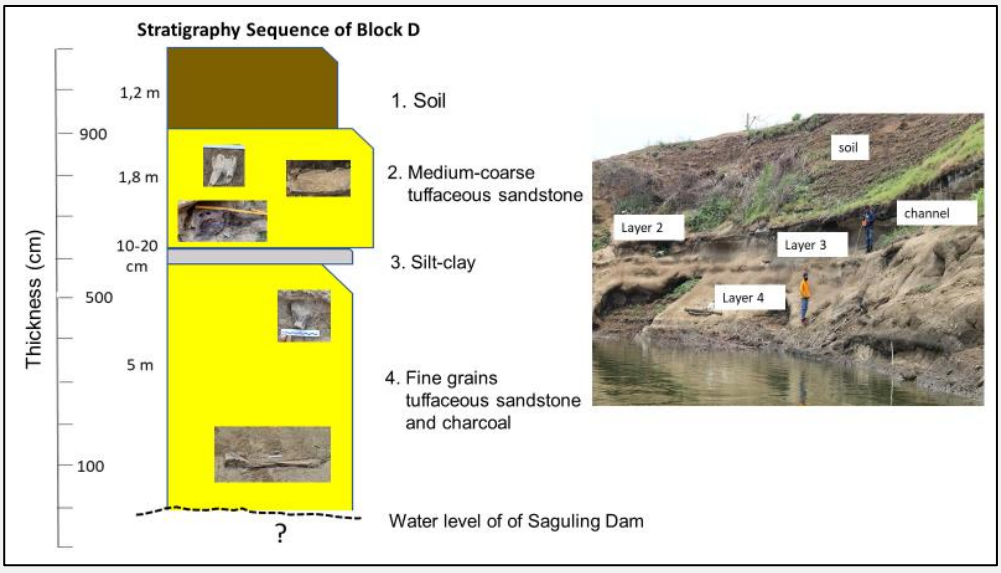


Figure 9. The stratigraphic sequence and outcrop at Block D

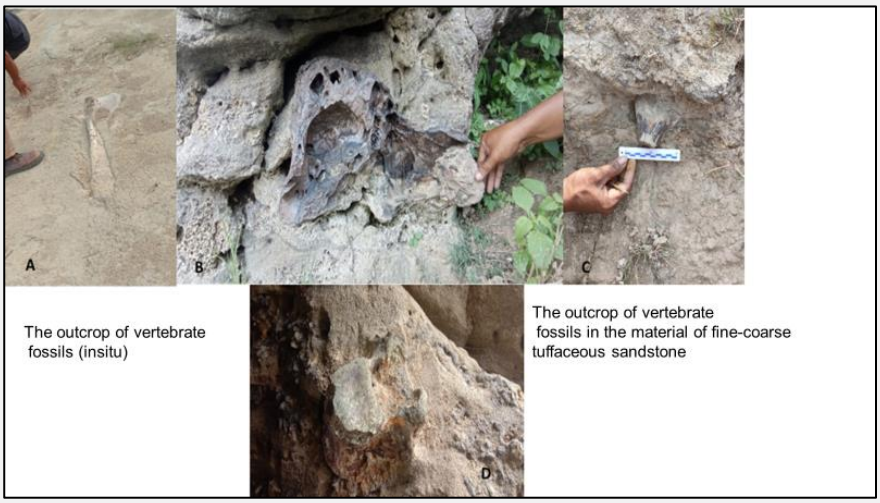


Figure 10. The outcrop of vertebrate fossils in sandstone layer at Block D

Table 1. The vertebrate fossils at Block D

| No. | Fossil Types | Lithology | Photo |
|---|---|---|---|
| 1. | *Humerus Probosidae* | Fine-medium sandstone, channel desposit |  |
| 2. | *cervidae* | Coarse-medium stanstone, channel deposit |  |
| 3. | *Bovidae* | Coarse-medium stanstone, channel deposit |  |
| 4. | *Bovidae Ribs* | Coarse-medium stanstone, channel deposit |  |
| 5. | Bone fragment unidentified | Surficial fossil on channel deposit |  |

| No. | Fossil Types | Lithology | Photo |
|---|---|---|---|
| 6. | *Pelvis* and Bone fragments unidentified | Surficial fossil on channel deposit |  |
| 7. | Teeth fragment of *Probosidae* | Surficial fossil on channel deposit |  |

*Geosite Block E*

This area is known as Pulau Pasir Benteng and also is Pulau Monumen Sirtwo for tourism. The result of Block D area composed of three layers of volcanic rock. The outcrop is consisting pyroclastic fall at the top layer, pyroclastic flow at the middle and volcanic breccia at the bottom as shown in Figure 11. The vertebrate fossils were found in pyroclastic flow layer which is in the erosion marks. We are predicting many fossils have lost due erosion and is transported by stream river. The description of volcanic fall is as follow: color is grey and brown, graded bedding and scoria structures, thickness of outcrop is about 5 meters. There are volcanic ash layers which thickness is 1-2 cm and lapilli layers is 2-3 cm. While, the pyroclastic flow layers consist contain coarse fragments, ash, pumice and charcoal deposits. While, the pyroclastic flow layers consist coarse fragments, ash, pumice and charcoal deposits. This layer contains vertebrate fossils at the top layer (Fig. 11). Pyroclastic flows generally follow valleys or other low-lying areas and depending on the volume of rock debris carried which can carry fossils or others material by the flow. The third layer is volcanic breccia and have physical characteristic as same as in Block B area. The layer deposits covered by pyroclastic flow with clear layer boundaries.

The final result is shown in Figure 12 which show the correlation of stratigraphic sequence and sedimentary facies with thickness is ± 38 meters. The correlation was started by grouping of the physical, chemical and biological properties of each block and sorted according to the lithological characteristic and fossils contain. The sedimentary facies of ancient lake distinguished into three sub-facies, i.e.: A) volcanic deposit with vertebrate fossils, B) tuffaceous sandstone without vertebrate fossil, and C) tuffaceous sandstone with vertebrate fossil. However, it is believed that there are other facies, this is due to covering the outcrops by the puddle of dam. Its accordance as well as to the report of study of rock collection of Museum Geology in Bandung Basin by Winarto et al., (2020), which is exposed the conglomerate deposits, clay-silt deposits, sandstone, tuffaceous sandstone and volcanic deposits with paleosol insertions, and at the top are tuffaceous breccia deposits. Furthermore, the interpretation of depositional environments is show in Figure 13, which is divided into three parts of environments, i.e.: shore zone, slope zone and bottom zone. The depositional environment is determined based on the facies analysis (Nichols, 2009). In general, sub-facies A, sub-facies B, and sub-facies C occurred systematically on the lake environment. The source of sedimentation material precipitated into the lake with certain direction. We are interpreting that all material is sourced from the highlands in the western part of research area. In this preliminary survey study, we have not carried out detailed analysis, using petrographic, geochemical or other methods for lithology and fossils analysis.

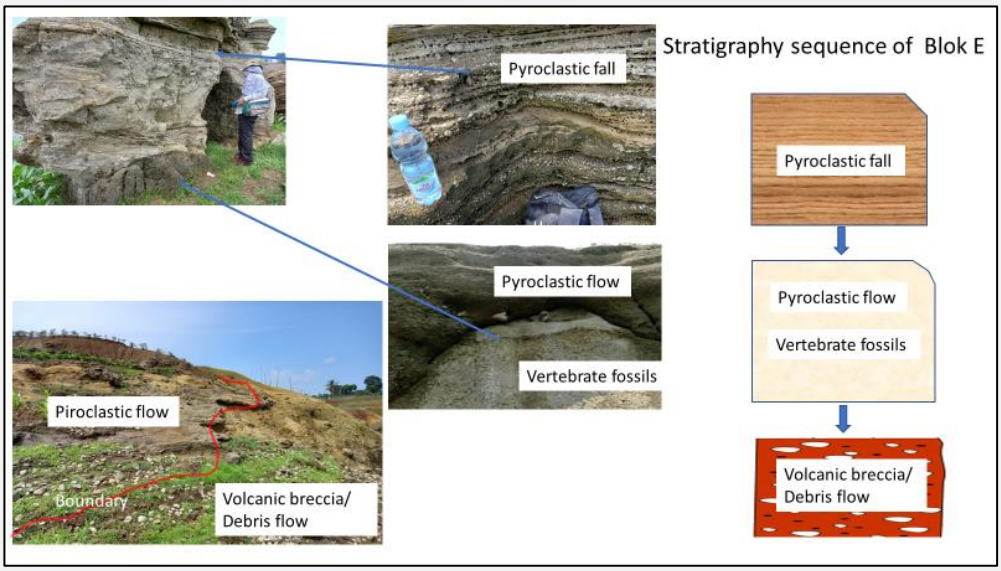


Figure 11. The outcrop and vertebrate fossil in sediment layer at Blok E

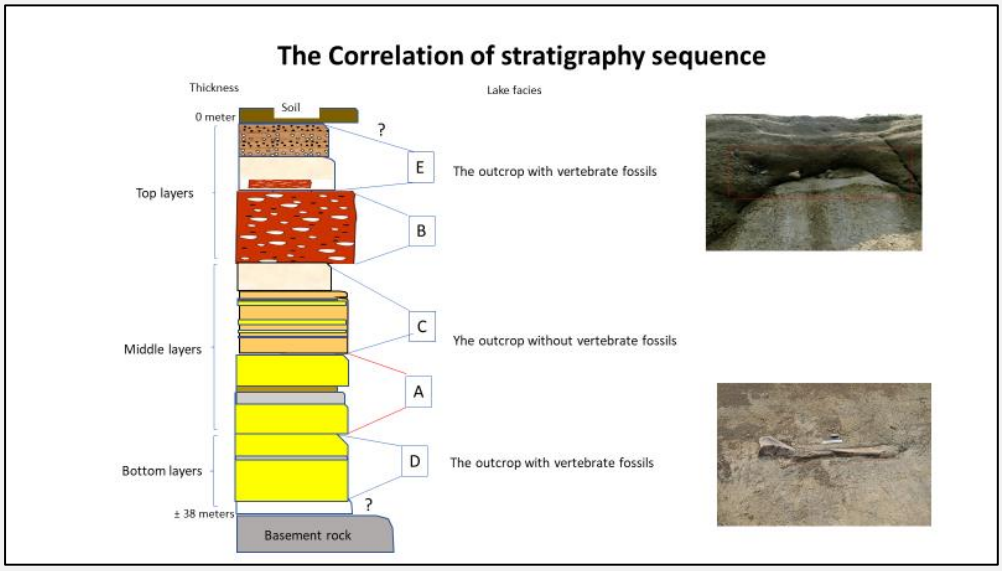


Figure 12. The correlation of stratigraphy sequence and sedimentary facies

## Paleontology ang Biostratigraphy

Currently, the fossils have been collected (Table 1) by local government (KBB). The paleontology study refers to vertebrate fossils at Citarum River areas where included research area. And is expected to add vertebrate fossil data in West Java. Siswanto & Noerwidi (2015) have been arranged biostratigraphy in West Java but is not include Citarum River zone. Based on the study of biostratigraphy and geochronology in Quaternary period of Java, it has been arranged by Sondaar (1984), van den Brink (1982), Dam (1994), Aziz & de Vos (1999), we are trying to relate the result of vertebrate fossil as shown in Figure 14, though is not detail in geological time. The geochronology is adopted from international chronostratigraphic chart by Cohen et al. (2018). It concerned the limitation of research and hope to continue the study of age and lithofacies correlation. We are interpreted the ancient fauna which is part of young fauna with age range 16-

135 ka at Citarum River zona. The older fossil is not found which is predicted into bed layer of lake sediment with age is more 135 ka. And it is representing as a part of the ancient fauna of West Java.

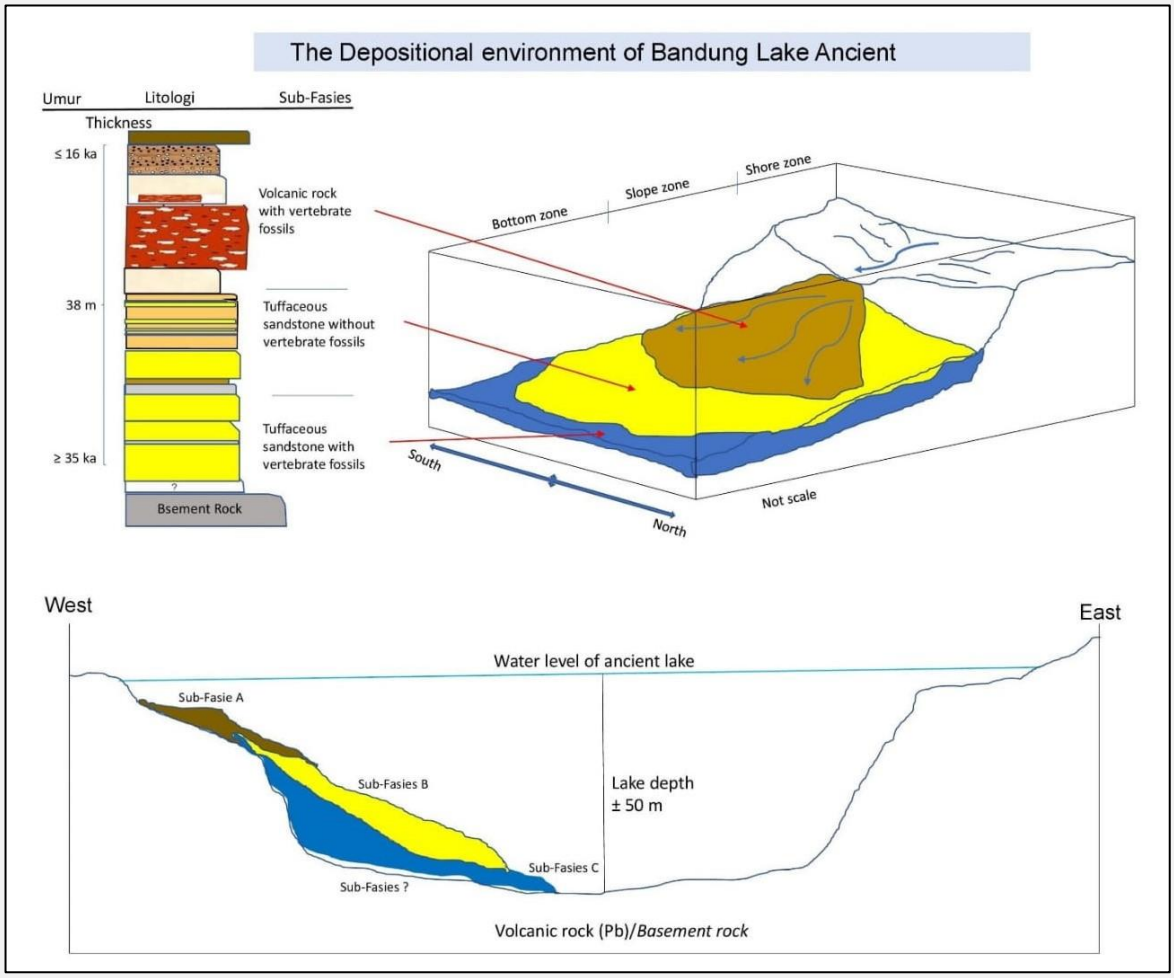


Figure 13. The illustration of the depositional environment of the Bandung Lake ancient and cross section of sedimentary facies

| | Cohen, 2018 | | SONDAAR, 1984 | | Van Den Brink, 1982 | | Aziz and De Vos, 1999 | | Study, 2021 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Epoch | Age | Biostratigraphy | Age | Biostratigraphy | Age | Biostratigraphy | Age | Biostratigraphy | Age |
| Quaternary | Holocene | 10-0 ka | | | Wajak | 11.7 - 0 ka | | | | |
| | Late Pleistocene | 129-10 ka | | | | | Citarum | 29.600-42.360 Ya | Citarum | 16-136 ka/Young |
| | | | Punung | 125-60 ka | | | | | | > 136 ka/Old |
| | Middle Pleistocene | 129-774 ka | Ngandong | 0.3-0.8 ma | | | ? | ? | ? | ? |
| | | | Kedung Brubus | 0.8 ma | | | | | | |
| | Early Pleistocene | 0.774-2.58 ma | Trinil H.K | 1.0 ma | | | | | | |
| | | | Cisaat | 1.2 ma | | | | | | |
| | | | Satir | >1.5 ma | | | | | | |

Figure 14. The correlation of geochronology and biostratigraphy

The results of morphometric analysis are interpreted the vertebrate fossils where is sourced not far to the Citarum river tributaries (Cijambu River and Cilanang River) as well as middlestream of the Citarum river. Furthermore, it is interpreted the ancient fauna colonies that they were lived close at the water resources with relatively flat-wavy morphology. And the distance is approximate 2-5 km.

## CONCLUSION

The Sirtwo Island and surrounding is delineated as a vertebrate fossil zone which is included young fauna with the age is range 10-135 ka. The fossils are the batch of vertebrate fossils which is original and in situ. It consists *Rusa sp.*, *Bovid sp.*, *Elephas maximus* and unidentified bone fragments. The vertebrate fossils are found in the outcrop of sediment at Block D and Block E. The stratigraphy sequence is interpreted from the bottom to top that is Blok D, Block A, Block C, Block B and Block E. The sedimentary facies of ancient lake are distinguished into three sub-facies, i.e.: volcanic deposit with vertebrate fossil, tuffaceous sandstone without vertebrate fossil and tuffaceous sandstone with vertebrate fossil. And the deposition environment of ancient lake is shore zone, slope zone and bottom zone. This study is providing the update data of geological and paleontological of Museum Geology. We are also offer the collaboration research of vertebrate fossil.

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