GENERAL GEOLOGY AND TRACE ELEMENT GEOCHEMISTRY OF GEOLOGICAL SAMPLE AT DABONG, KUALA KRAI, KELANTAN.

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DECLARATION

I declare that this thesis entitled General Geology And Trace Element Geochemistry Of Topsoil At Dabong, Kuala Krai, Kelantan. is the result of my own research except as cited in the references. The thesis has not been accepted to any degree and is not concurrently submitted in candidature of any other degree

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In the name of Allah, Most Gracious, Most Merciful.

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General Geology And Trace Element Geochemistry Of Topsoil At Dabong, Kuala Krai, Kelantan.

ABSTRACT

The study area is located in Dabong. Dabong was in the small town at the area Kuala Krai, Kelantan. Dabong was situated at the north east of Malaysia and it the second largest district after the Gua Musang, Kelantan, Malaysia. The area covered by Dabong is 1,506.90 km2. The study area covered in Dabong approximately 25km2. The topography of Kuala Krai is a lowland type. This area is not fully discovered yet by the geologist. The Dabong area was famous by it geologic features because of metamorphic and igneous features that were occurred. The coordinate of the study area is from N 5º32'30'', E 101º52'00" to N5º 30'00'', E 101º 52'00'' and N5º 32'30'', E 101º34'35" to N5º30'00", E 101º54'35". The objective of this study are to update the geological map of the study area at 1:25000 scale to determine the trace elements and heavy metals in the study area. Such elements such as cadmium, copper, mangan, plumbum and zinc were identified to be present in the study area based on the previous researchers. The study area consist of three types of rocks based on the data observation. They are granite, granodiorite and shale.

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CHAPTER 1

GENERAL INTRODUCTION

1.1 General Background

In geology, soil also is a component of the terrestrial ecosystem and gives many benefits in food production, biochemical and recycling of elements. However, the rapid industrialization, urbanization and increasing reliance on agrochemicals, heavy metal contamination in soil has become severe during the last two decades (Pan & Wang, 2012). The soil also is an essential part the earth and gives a lot of benefit to the human.

The chemical element such as trace element is a crucial part of the soil. The knowledge of trace element content in soils and their spatial distribution is of interest because it contributes to a better understanding of the element dynamics at the Earth's surface and can provide the diagnosis of soil contamination by potentially toxic elements due to human activities (Yang et al., 2010). The trace element and heavy

can be found in soil and the rock and it can be affected by human activity. This change is due to anthropogenic activities comes from the human that make their life much more comfortable such as deforestation to build many big houses. Parent materials can determine the element distribution in soil migration and addition of elements into the soil profile (Yang et al 2010).

The research is focus on the geology and trace elements analysis in Dabong, Kuala Krai. Based on the previous study, the lithologies found in the area andesite, slate, sandstone and limestone (Fatin, 2016). Map also was produced where the data collected shows the distribution the different types of rocks.

1.2 Study Area

The study area this research was located at Dabong. Dabong was in the small town at the area Kuala Krai, Kelantan. Dabong was situated at the north east of Malaysia and it the second largest district after the Gua Musang, Kelantan, Malaysia. The area covered by Dabong is 1,506.90 km^2. The study area covered in Dabong approximately 25km^2. The topography of Kuala Krai is a lowland type. This area is not fully discovered yet by the geologist. The Dabong area was famous by it geologic features because of metamorphic and igneous features that were occurred. The coordinate of the study area is from N 5º32’30’’, E 101º52’00” to N5º 30’00’’, E 101º 52’00’’ and N5º 32’30’’, E 101º34’35” to N5º30’00”, E 101º54’35”. The study area was covered of 25 km^2 with one street as accessibility to enter and out of the base map. The base

map of the study area shown in Figure 1.1. The highest elevation in the study area is 762 m and the lowest elevation is 42 m based on the Figure 1.2.

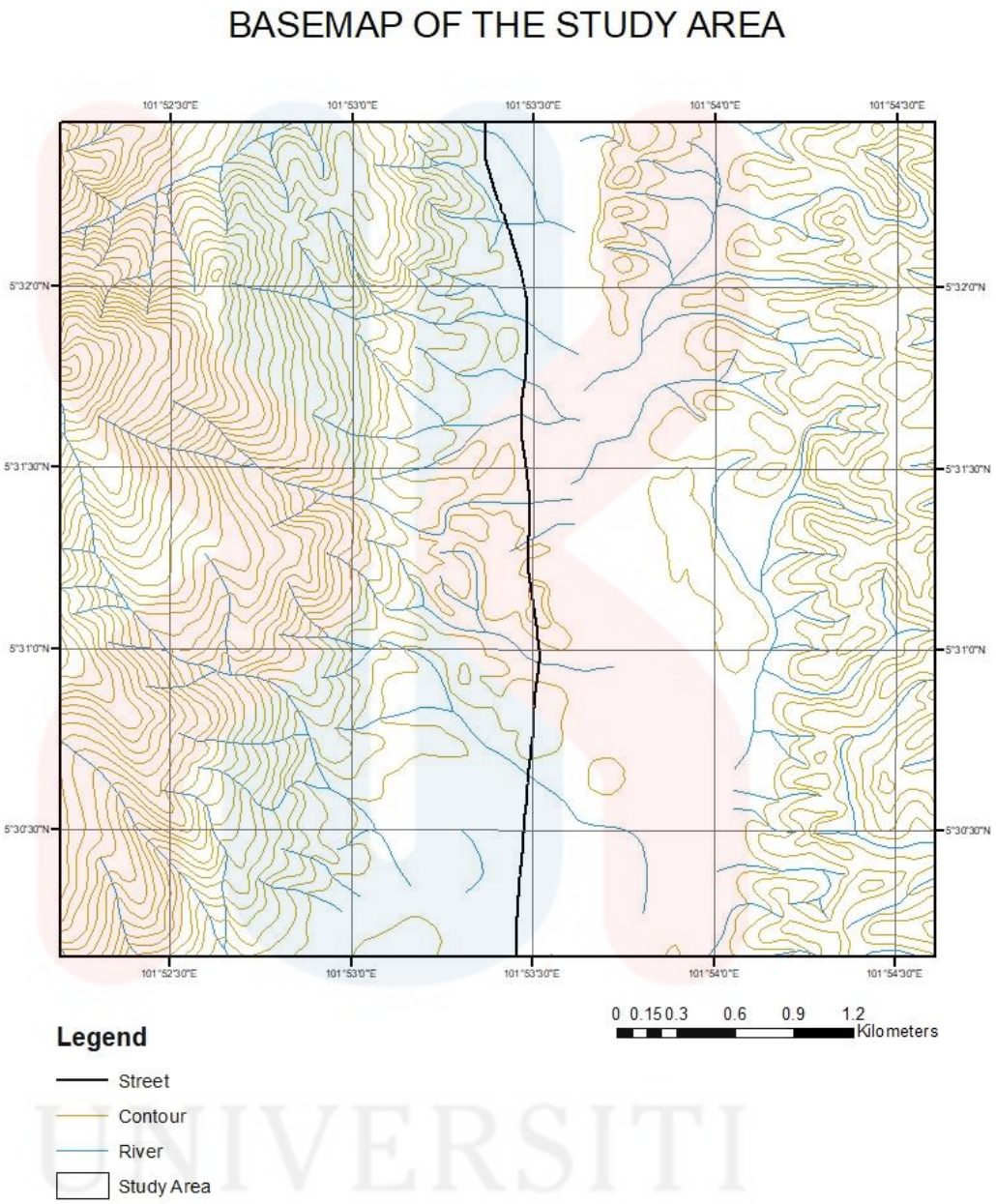


Figure 1.1: The map of Dabong, Kuala Krai, Kelantan.

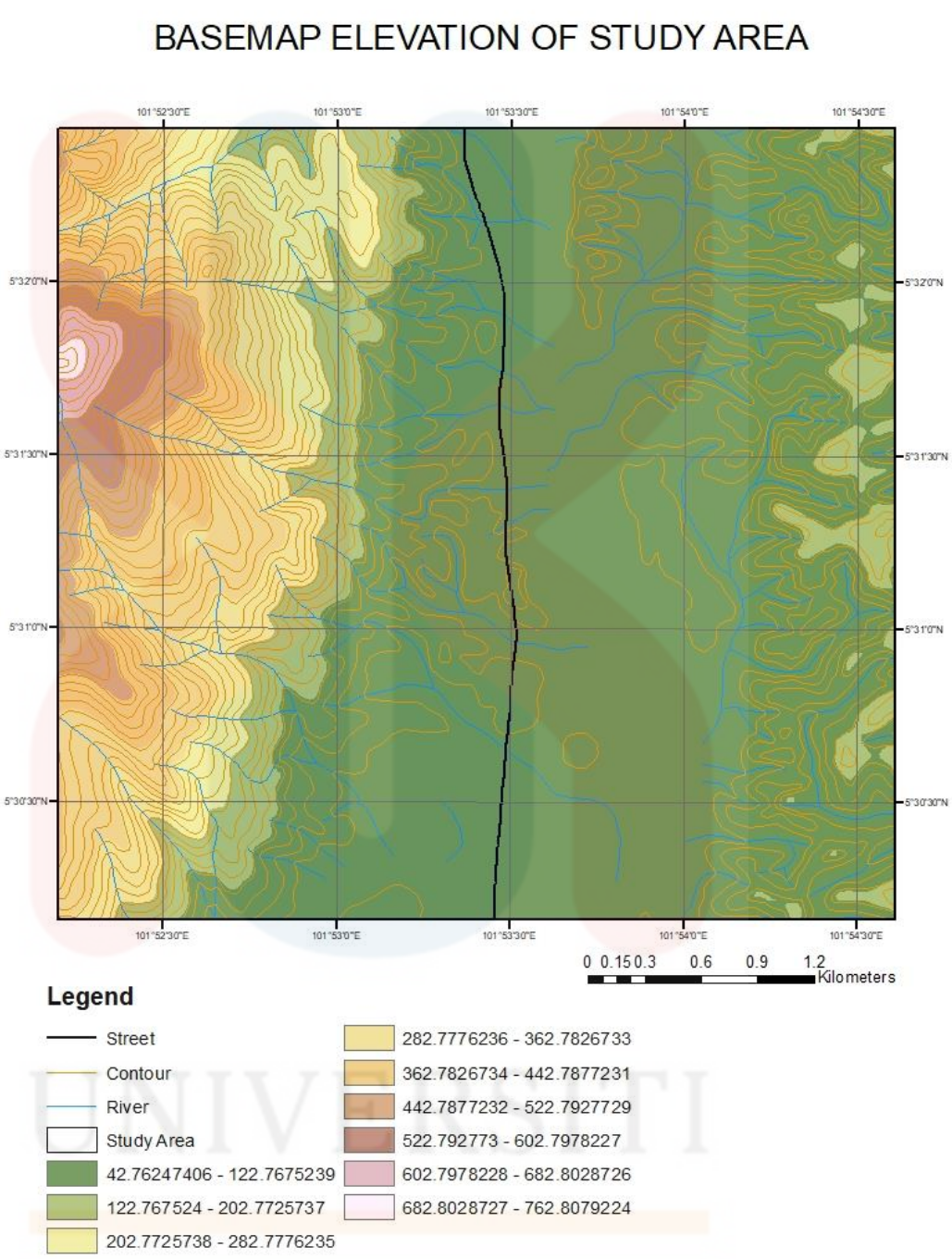


Figure 1.2: The base map of elevation Dabong, Kuala Krai, Kelantan.

1.3 Problem Statement

Based on the geology information, natural activities and human activities contribute to the accumulation of trace elements in topsoil. Health problems were caused by the excessive the input of trace elements to humans such as cancer especially for the people living in urban areas. Today, only some agencies know the rate of the accumulation of the trace elements such as SGS Malaysia Sdn. Bhd. and sometimes it does not even update annually. In Dabong, many geological hazard that happened here such as the flood risk in the nearest place to the study area. It could be easily identified and computed that Kuala Krai town was almost completely inundated (about 80%) with flood depths between 5 to 10 m whereas the Dabong town was almost completely inundated (Sathiamurthy et al., 2019). Since there is insufficient study of trace elements were collected in the study area, this study aims to provide the data for the trace element in topsoil and to record the distribution of the trace elements by using the secondary data such as the data from the previous research, the agencies and also from the software. This distribution of trace elements data may be useful in future use for the geologist in the future at the study area.

1.4 Objective

The objectives of this research are as follow:

i. To produce a geological map of Kuala Krai, Kelantan at the scale 1:25000.

ii. To investigate the distribution of trace elements in Dabong, Kuala Krai, Kelantan.

iii. To determine the potentially heavy metal in Dabong, Kuala Krai, Kelantan.

1.5 Scope of study

This study involves previous research works and using the Geographic Information System (GIS). Hence, this software is widely used to do the geological map. From the geological map, it can be observed the geological feature roughly such as flat area, hills and drainage pattern. This geological map is used because it represents the differences between rock and unconsolidated materials which can be shown in different colours in a geologic map. The Dabong area undergoes the urbanization process day by day and this research is conducted to gain the analysis of the trace element and also to update the geological map of Dabong in the study area (Shahani,2017). This study also included a geological study that does the analysis of trace elements and heavy metals. It is also relating their impact with the importance at the study area.

1.6 Significance of the study

This research can give the benefits to the researchers such as geologists and the other researchers who want to know about the trace element at the area. For example, this can be reference for any researcher who wants to collected the trace elements and also heavy metals that may be can be detected especially in Kuala Krai. At the end of the research in the study area, the data and the finding through the acquired method will be uploaded to the geological map. The finding also can be used to compare with the new data in the future. The data obtained also can give the analysis of the potential of the heavy metal in the study area.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A literature review is an absolute summary of research on a topic. Literature review gains the info by surveying from the articles, books and other relevant sources that related to the study and research. Every scientific researcher should begin the research by studying, reports of the studies related to the topics of interest (Copper,1998). The journals and articles are being published after getting the successful research. This publication is critical acts as a reference and ideas trigger for another to start a research. Literature review is essential to be done to get initial ideas before conducting any research. Literature review is important to get early overview of the study area and the field of interest.

. In this chapter, the research is related to the study area based on the previous study. The main tasks of this research are regional stratigraphy, rock, based on the theories and methods used by geology and research to gives the information of the evolution of general tectonic features and to explore the role of various geological for resource exploration minerals, analysis of chemistry, geological environmental assessment and relevant economic development to provide a comprehensive basis for geological data. Besides, it also includes the general geology of Kuala Krai and the place surrounding it.

2.2 Regional Geology and Tectonic Setting

The study area of Dabong has a distribution of rock which is an igneous, sedimentary and metamorphic rock. The sedimentary rock is interbedded sandstone, siltstone and shale while for igneous rock are phyllite and pyroclastic and metamorphic rocks are slate with the extrusive volcanic rock. Figure 2.1 shows the geology map of Kelantan.

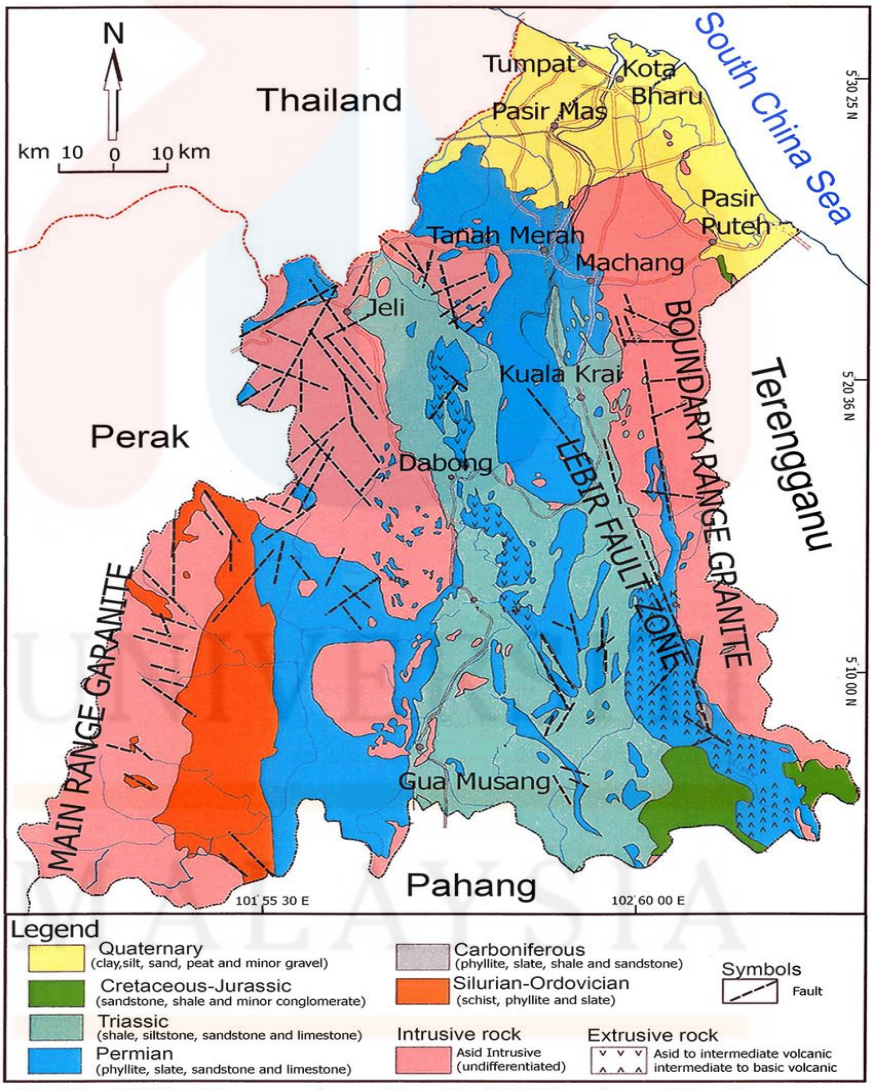


Figure 2.2.1: The figure above shows the geology map of Kelantan (Department of Minerals and Geoscience Malaysia, 2003).

Based on the existing geology map of Kuala Krai generated using Geographical Information System (GIS). The major rock distribution in Kuala Krai is a sedimentary rock with minor distribution in volcanic and metamorphic rock. Peninsular Malaysia has the most important information to study the deformation for the tectonic setting in Kelantan. The Middle of Peninsular Malaysia which is surrounded by the intrusion is believed a graben which is bounded by the normal fault (Harbury et al, 1990).

2.3 Stratigraphy

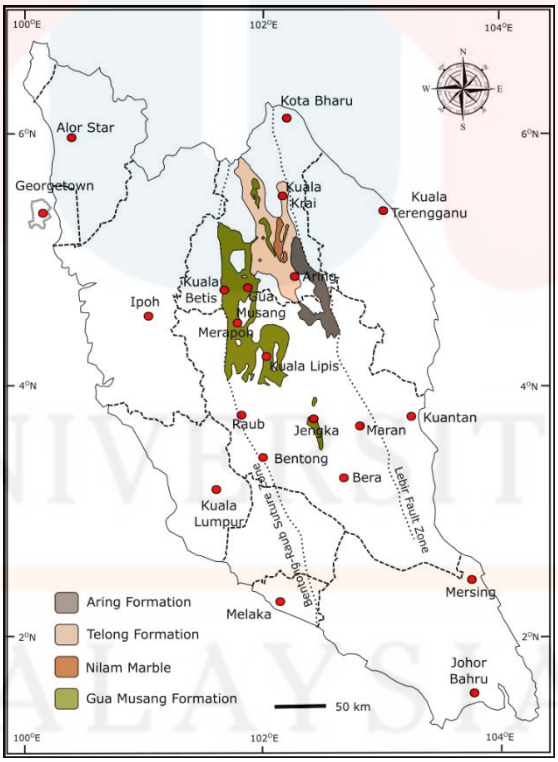


Figure 2.3: The distribution of the Gua Musang Group by Mohamed (1995).

The Gua Musang formation in South Kelantan to the North Pahang was mapped by Yin (1965). It was used to describe the Middle Permian period to Late Triassic. Kuala Krai was included in this central belt which involved the Telong Formation and correlated to the Gunung Rabung Formation and Semantan Formation (Lee, 2004).

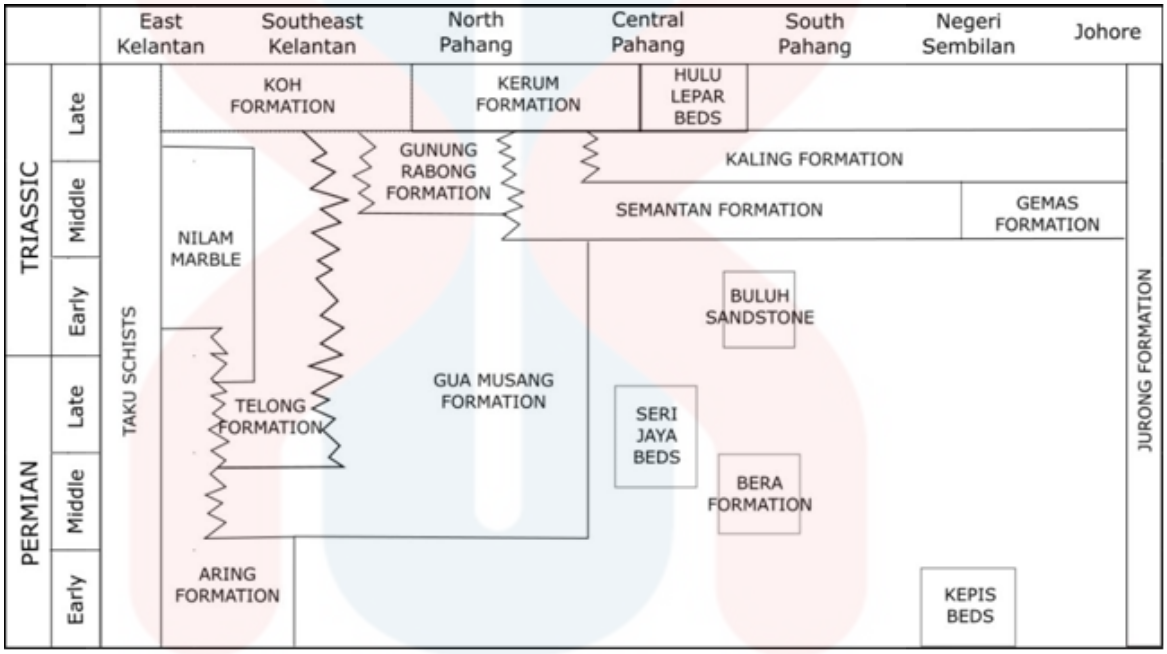


Figure 2.3: The Permian-Triassic stratigraphic correlation chart of Central Belt Peninsular Malaysia (Metcalfe & Hussin, 1995).

a) Telong Formation

Telong formation is dominant with argillite unit and Nilam marble dominant for the metamorphosed limestone. These argillaceous facies in Telong Formation is the most extensive facies in the study area (Mohamed et al., 2016). This stratigraphy distribution correlates to the Calcareous Formation in northwest Pahang and it is possible that these formations were deposited at the same Gua Musang platform.

b) Gunung Rabong Formation

Gunung Rabong Formation is dominant with shale, mudstone,sandstone and conglomerate. This formation also contain the volcanic fossil from Daonella which these was assumed to occur during the Middle to the late Triassic (Yin, 1965).

c) Semantan Formation

Semantan Formation along the Karak-Kuantan Highway are dominant with the conglomerate, pebbly sandstone, thick-bedded sandstone, interbedded sandstone-shale, contorted sandstone-shale, and shale-dominated heterolithics (Ismail et al., 2007). The sediments in Semantan Formation represent an image of sub environments from slope to outer fan. Both debris flow and turbidity of these current deposits are the main deposition processes in Semantan Formation.

2.4 Structural Geology

Along the axial belt there are differences in nomenclature for the same unit's connected extensions resulting from isolated work when it merges together. At the northern portion for example the Jelai Formation, Kerdau Formation,to Gua Musang Formation, Gunung Rabong Formation, Telong Formation and Aring Formation are overlapping and can be reduced essentially to the Aring and Telong Formations. Thai-Malay Peninsular is depositional formed by the major tectonic deformation during the Late-Triassic event. The formation of the Thai peninsular happened when the collision between Thai Shan Block moves to the west and the Indochina block moves to the East. It is occurred during the Middle Triassic to the Upper Triassic from the pre-collision rocks. From the chronostratigraphy, the Permo-Triassic Telong formation can be correlated with the Permo-Triassic Ai Ba Lo formation (PTrab) in Thailand because of the resulted movement from Batu Melintang to the Sungai Kolok along Malaysia-Thailand.

2.5 Historical Geology

Central Belt is not like the Western Belt which largely underlain by the Palaeozoic rocks. Kuala Krai is in the Central Belt which it is largely underlain by the rocks from the Mesozoic and Permian. The oldest rocks in the Central Belt are those bordering the eastern flank of the Main Range Granite (Khoo & Tan, 1983). The rocks here have been variously called such for example Foothills Formation and Bentong Group. They were consisted by schists, amphibolite, conglomerates and other clastics sedimentary rocks and small bodies of serpentinite that were associated with the schists deposit. To the east, the southern extension of Raub Group (Calcareous Series) is dominated by carbonaceous shale with rhyolitic tuff interbeds known as the "Semantan Formation", while the arenaceous band of the Lipis Group (Younger Arenaceous Series) is called the "Kaling Formation". The identification of ammonites and bivalves within both formations updated the age range to Middle-Upper Triassic (Mohamed et al., 2016).

2.6 Trace Elements analysis of soil

2.6.1 Trace Elements

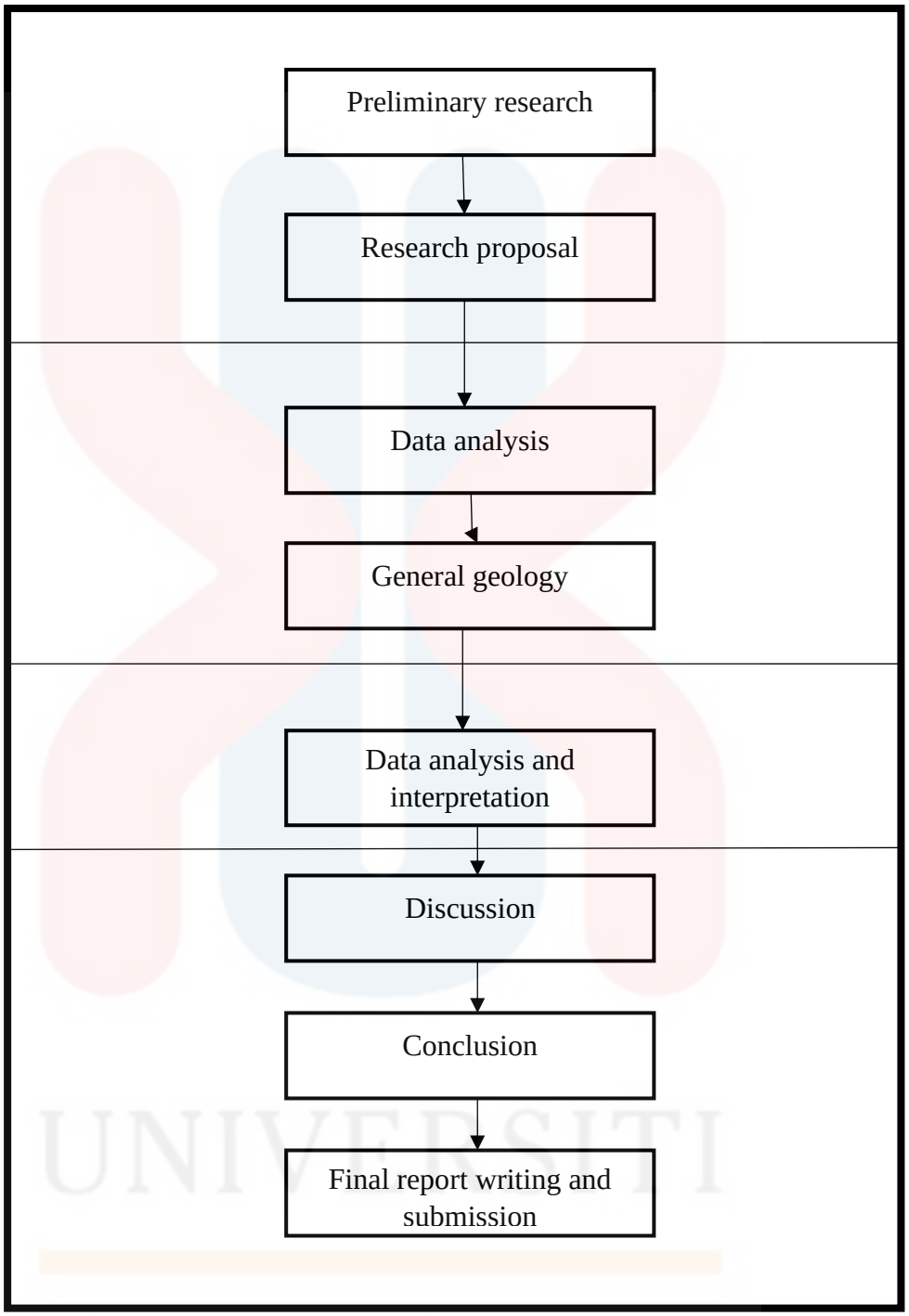
Trace elements is some elements that can be found in the soil with the less concentration below then the 1000 ppm (0.1%) in a sample such as rock and soil. The trace elements that may include are trace metals, heavy metals and micronutrients. This study only going to investigate the trace elements and heavy metals in the topsoil. Heavy metals are elements that have a density of more than 5.0 g/cm3 in the sample and some of the examples are Nickel (Ni), lead (Pb), Manganese (Mn), Mercury (Hg), Arsenic (As) and zinc (Zn). The main sources of trace elements is soil parent materials themselves, fertilizers, irrigation water, coal combustion residues, auto emissions and any metal industries. Even though some trace elements originate from rocks and it is essential for plant growth but when present in soils in high levels of those same elements it can become toxic. Trace elements that taken up by plants especially when they were grown on a contaminated soil. It could move into the food chain and accumulate in the fatty tissue of animals and humans (Carter & Gregorich, 2008).

CHAPTER 3

MATERIAL METHODOLOGIES

3.1 Introduction

This chapter will discuss about the flow when conducting this Final Year Project or known as FYP. The flow is important to makes this final year project works well. There is some methodology that were used in order to collect and gain the result. This method is used for achieving the objectives of this project. This material and method use by referring according to the previous study. The methodology also an important part of doing research. The methodology will determine and describe all the method that have been conduct in the research more detail and clear based on the flow that has been produced. Preliminary research is required before doing the geological mapping. The data analysis was also done by doing the geological map and gathering the data by using the secondary data.



3.2 Materials and Equipment

The material used are as usual for the research information study such as article, journal, book, magazine and the internet. The source is completely help to be done in order to make a reference and citation. After that is material for geological study.

The materials that were used for completing the result and to interpret the analysis is Geographic Information Data (GIS) software. The Geographic Information System (GIS) was used for getting the objective to display the map analysis. It is used to produce different a type of map, such as a base map, topography map and etc. besides it is also used to obtain data from the field and transfer it into the ArcGIS.

The second one is a base map. The base map is produced using software such as ArcGIS, GIS. It is important when we are doing the geological mapping. It is use as direction during mapping. The base map also give the information of the study area such as lithology, road, river, city and feature display at the study area.

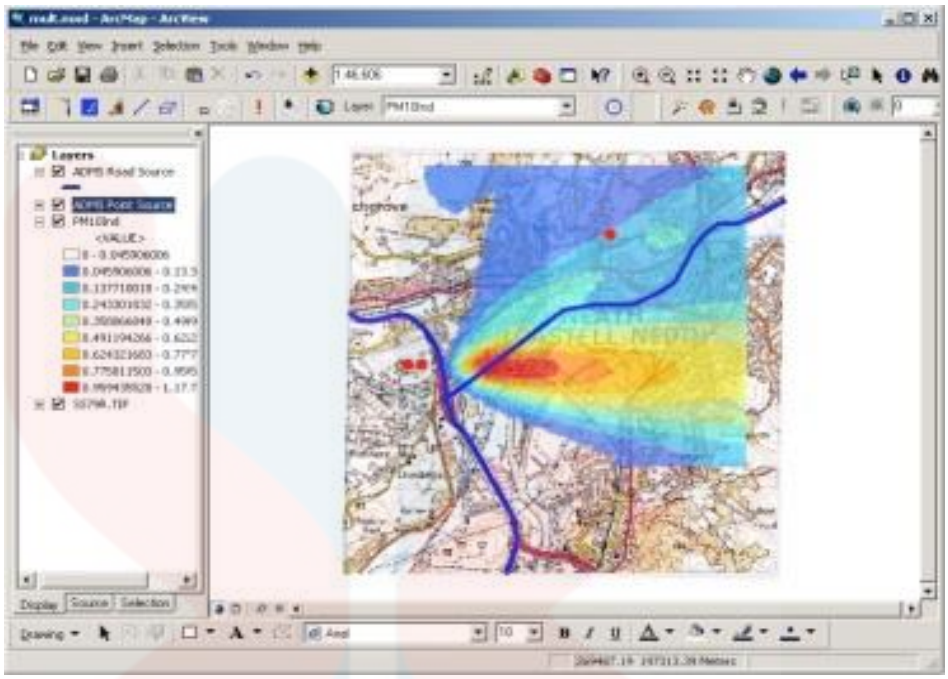


Figure 3.2.1: Figure above show the example of the base map.

The third one is the previous study and secondary that were collected by the previous researchers that were conducted when doing the research. It is useful to collect the data and to interpreting it into the study area.

3.3 Methodology

3.3.1 Preliminary study

In this final project research there are several methods in data collection for preliminary research such as sources from the internet, journal, articles, maps, photo, thesis, images and bulletin. The early study was done before starting the research in order to have a better understanding of the study area. Previous study has been conducted in Kuala Krai. The last study was conducted by using the Energy Dispersive X-Ray Fluorescence Spectrometry (ED-XRF) method and Inductively coupled plasma-optical emission spectrometry (ICP-OES). The source information was gathered such as journals, books, thesis, articles and the internet. This preliminary study needs to be done first before going to the field.

3.3.2 Data processing

Data analysis and interpretation of trace elements analysis and trace element are done by using ArcGIS version 10.3. This application is used to design, manage, store, display and analyze all the geographical and spatial data in the base map. Besides, rock analysis can be identified from the secondary data that can be processed by using GIS software. All notes are recorded by hand such as hand specimen and taken photo. The data important because it is can be transferred into GIS and for the purpose of in case the data was missing and there still have a backup in note book.

. Geographic Information System (GIS) is a tool that used for analyse the spatial information from any secondary data and previous research and edit the data for general geology specification and the classification of trace elements and heavy metal of the study area.

3.3.3 Data analysis and interpretation

Trace elements analysis

Atomic Absorption Spectrometry (AAS) is an instrument for estimating the ingestion of follow components introduce in soil tests by estimating the radiation consumed by the compound component of intrigue. This is finished by investigating the spectra created when the sample is energized by radiation (Maurya et al., 2018). The data obtained from the previous research also was used in interpreting. Total analysis of topsoil can also be used to assess the accumulation of toxic elements from atmospheric or man-made sources of pollution. Chemical elements in the soil are referred to as trace elements (TEs) because of their occurrence at concentrations less than 100 mg kg^{-1}. Trace elements have also been termed 'toxic metals', 'trace metals' or 'heavy metals'. Most of the trace elements of environmental and human/animal health significance are metals, for example cadmium, chromium, cobalt, copper, gold, lead, manganese, mercury, molybdenum, nickel, palladium, platinum, rhodium, silver, thallium, tin, vanadium and zinc. Other important TEs belong to the metalloid (for example boron, arsenic, and antimony), nonmetal (for example selenium), actinoid (for example uranium) and halogen (for example iodine and fluorine) groups of elements (Hooda, 2010). These elements are essential to the soil that required by the plants when it all generally below the average concentration.

CHAPTER 4

GENERAL GEOLOGY

4.1 Introduction

General geology includes the observation and analysis that were made based on types in the study area such as geomorphology, structural geology and lithostratigraphy. Geomorphology is the study of the landform and it's a process of the Earth's evolution. The geomorphology is important because it gives an explanation of its history. This chapter will cover the study of the topography and drainage pattern.

The stratigraphy involved the lithostratigraphy, stratigraphic position and unit explanation. The lithologies were done by observing it through the Geographical Information System (GIS) and the as research that were done before. This is used to identify and to confirm the type of lithologies as well as using it to updated the geological map of the study area.

Structural geology was carried out by the analysis of the structure that was found in the topography map and also from the formation that was occurred such as fault, joints and fold. The structural analysis done by plotting it using a rose diagram by using GeoRose software. The geological map of the Dabong, Kuala Krai, Kelantan with cross section were created based on the lithostratigraphy and journals analysis.

4.1.1 Accessibility

In geology the accessibility refer to the what, where, who, why and how we can accessed the study area. In the study area, there is the main road that is located near to the rural area and also the agricultural area that can be accessed by any types of vehicle such as motorcycles, cars and lorry. The main road that is connected to the study area is the Jalan Dabong-Jeli which this road was connected from the Kampung Jabir to Kampung Balah. The main road is also connected to the town area. In the study area, the road also connected to the residential area. Figure 4.1.1.1 shows the road connection of the study area.

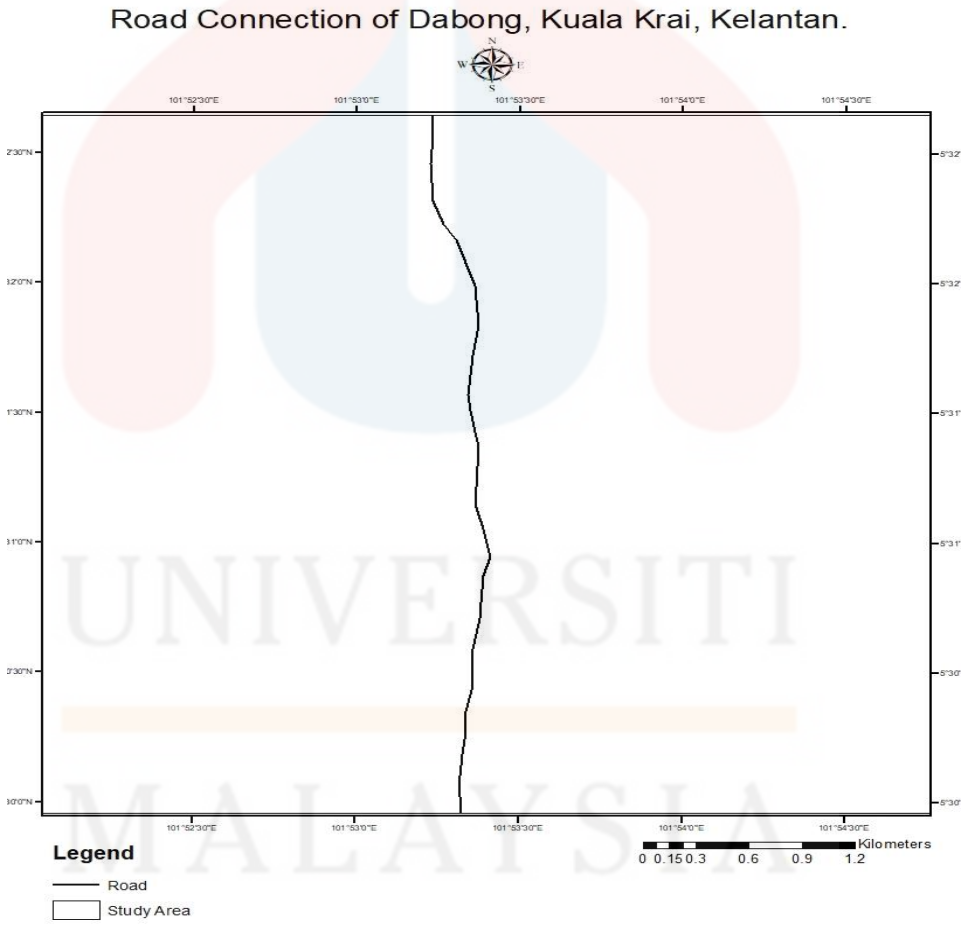


Figure 4.1: The road connection in Dabong, Kuala Krai, Kelantan.

From the imagery map, there is also an unpaved road that connects its way to the houses that a bit far away from the main road. This unpaved road may only be accessed by small vehicle types such as motorcycle and car.

4.1.2 Settlement

Kelantan is dominant by the forest reserve. This forest cover up to 55% and follow by the agricultural such as palm forestation. The location of the agricultural area that are within coordinate E 5º 30’33”, N 101º 53’30”. From the previous research and also the observation, this area was covered with shale and villagers used the area to build houses and it become a residential area. The factor this place was choosen as a residential area was because it has low elevation, near to the main road and also near to the river. This river channel also can gives the rural benefits and used by the people at this area.

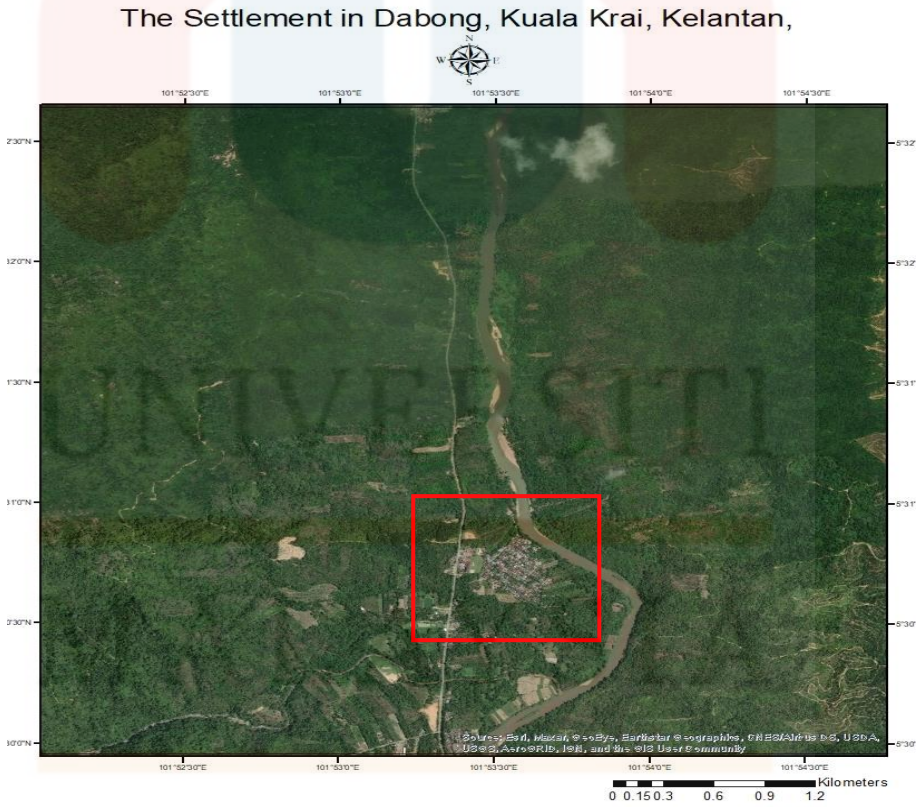


Figure 4.2: The settlement and land use from the imagery map.

4.1.3 Forestry

The Figure 4.3 shows that the landuse in the study area which is mostly covered by the forest. Then after that it was cover by the oil plantation. At the coordinate N 5º 31’ 30”, E 101º 54’ 0”, there is an oil palm plantation area were observed here. This plantation exists factor maybe because of the low elevation area and its type of rock that were suitable for the plantation. The area was mostly cover up by the forest because this area still in an urban process. This also was influenced by the contour of the forest that there is still nobody doing the forestation. There is also an agricultural area near at the Kampung Kuala Balah. This agricultural location is at a strategic location which is made more easier for farmers to use the water supply from directly from the river and the stream nearest.

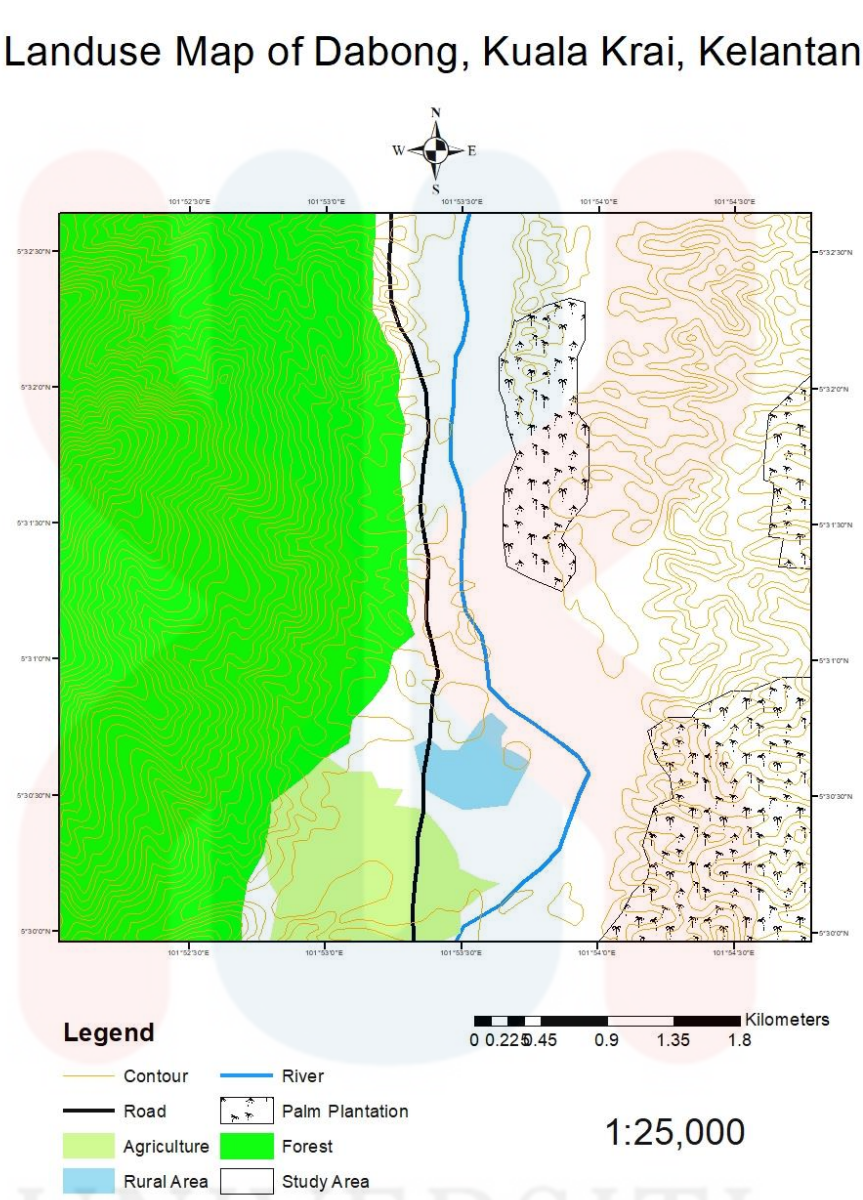


Figure 4.3: The landuse map in study area.

4.2 Geomorphology

Geomorphology was referred to as the study of the Earth's landform. The major type of landforms included the mountain, hill and plain. The geomorphology of the earth can be resulted from the exogenic and endogenic processes. The exogenic process consists of the weathering, mass wasting, erosion and depositional processes while the endogenic process can be created by the volcanism and earthquake. Both of these process were occurred in a long period to form a particular landform. The differences of the mountain and hill can be distinguishing from its physical form such as it has a peak form that high than its surrounding area and mountain usually have the minimum height from 600 m.

Fluvial is a morphology formed by the deposits and landform. Its always associated with the streams and rivers. From the Figure 4.3 it showed the fluvial morphology in the study area based on the topography map.

Figure 4.3: Fluvial morphology based on the topographic map.

4.2.1 Geomorphologic Classification

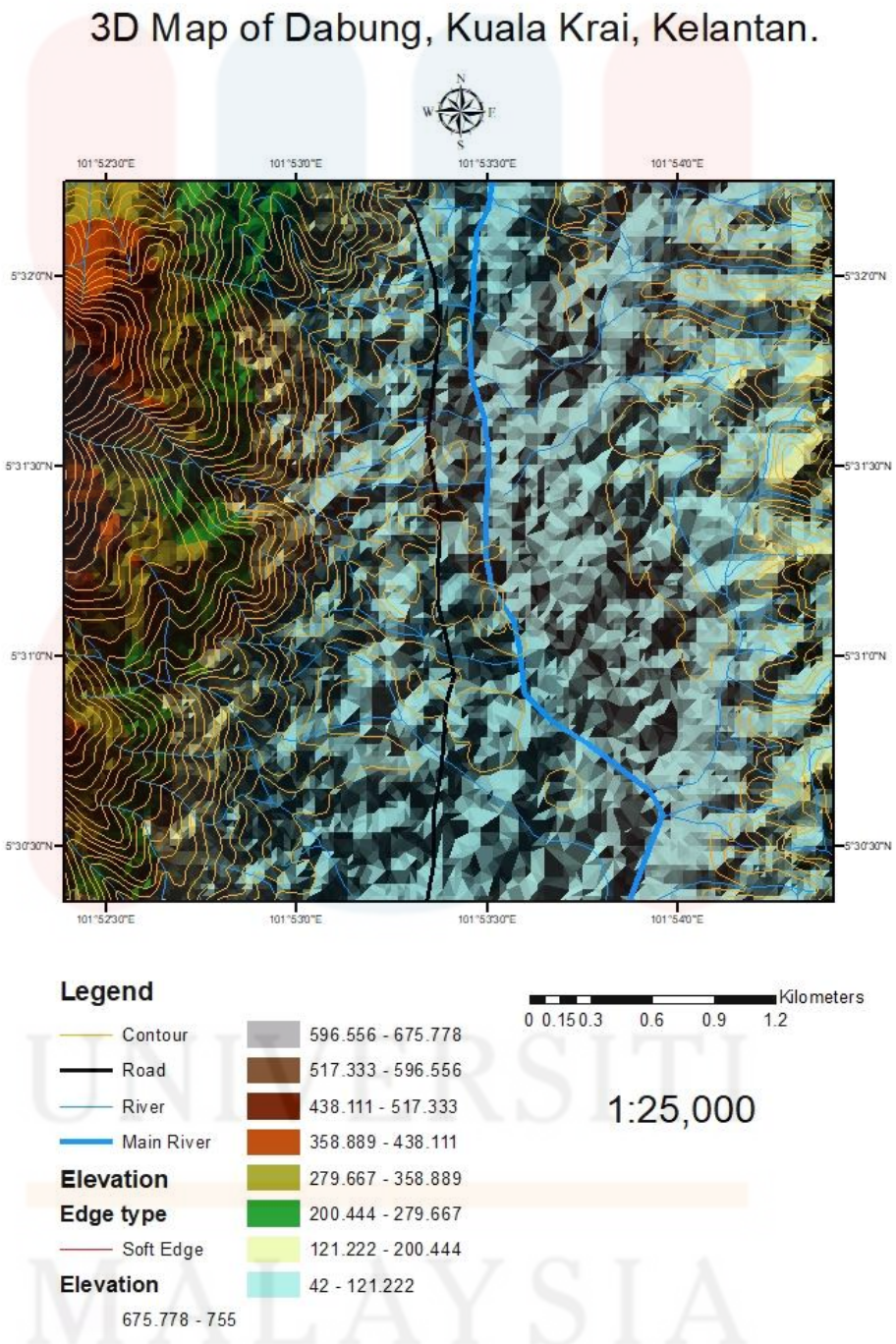


Figure 4.4: Geomorphologic 3D unit map.

4.2.2 Drainage pattern

Drainage pattern is the arrangement of the streams on the Earth's surface by drainage system. The geomorphology and the topographic is the factor for the drainage system. Moreover, the pattern of the drainage system was also reflected by the types of rock. The drainage types included the dendritic, parallel rectangular, radial and deranged pattern. Dendritic drainage pattern is the common drainage pattern that can be found on the Earth's surface. The Figure 4.5 shows the types of dendritic and rectangular drainage pattern.

In the study area, the pattern that can be observed were dendritic and rectangular pattern types. The pattern of the dendritic drainage pattern shape is like a tree roots meanwhile the rectangular pattern close to 90º degree. The dendritic drainage pattern develops in an area underlain by the homogenous material (Ritter, 2006). From the observation, the dendritic drainage pattern were mostly found at the sedimentary rock located. In the study area, the dendritic drainage pattern most likely to be in areas that were covered by shale rock.

The rectangular pattern also can be called angular dendritic because it close to 90º degree. The rectangular can occur when the stream direction changes and causes the acute angles of the stream. The rectangular pattern is usually caused by jointing or faulting by the bedrock. The rectangular pattern is associated with the massive intrusive igneous rock and also metamorphic rock.

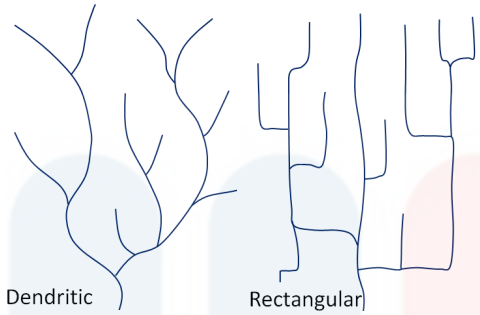


Figure 4.5: The dendritic pattern and rectangular pattern. Source : Physical Geology, 2015.

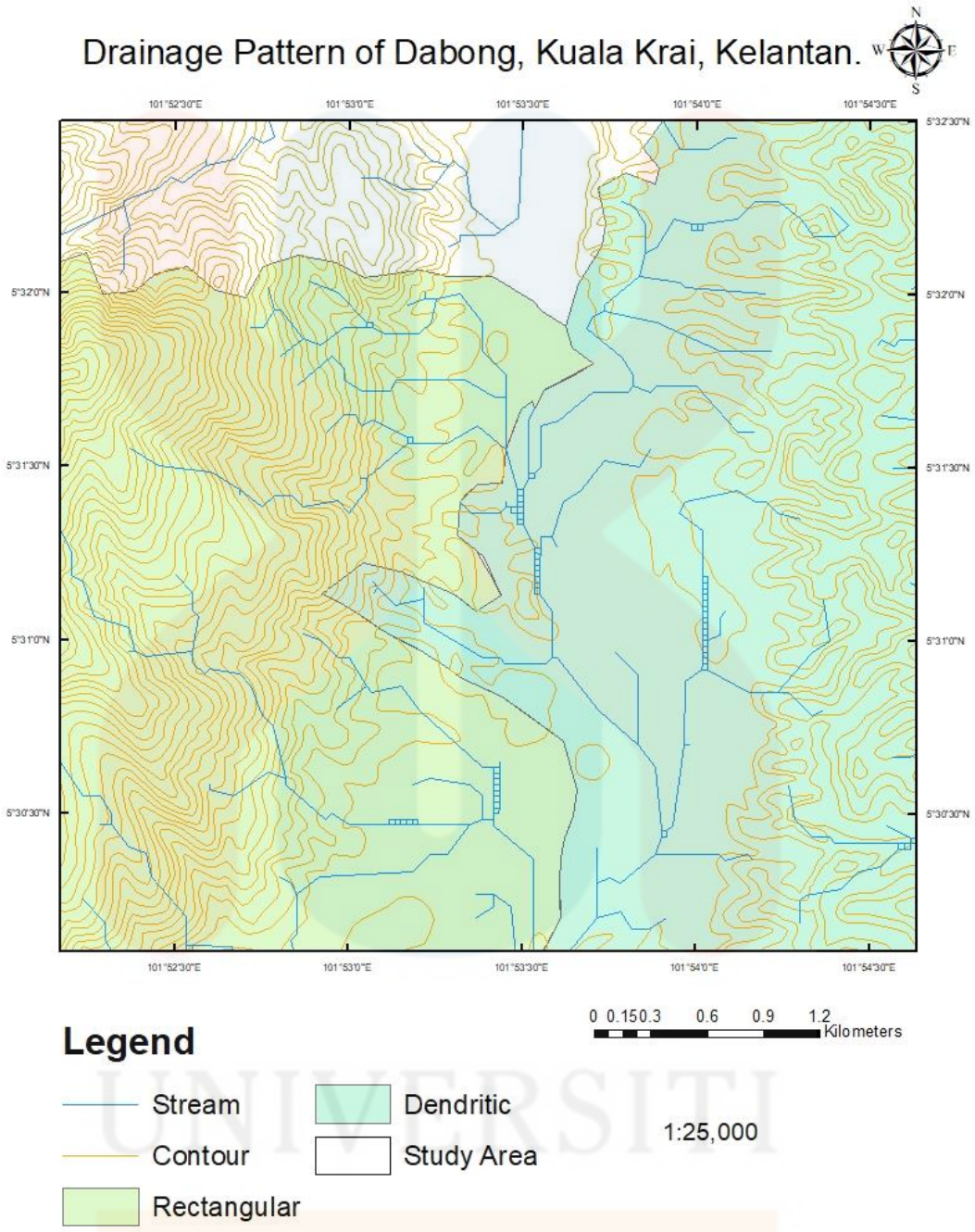


Figure 4.6: Drainage pattern of Dabong, Kuala Krai, Kelantan.

4.3 Lithostratigraphy

The boundary of the igneous and sedimentary rock were determined by the contour pattern and also from the result based on the previous research. For the igneous rock, the common type that may can be found in the study area was granite and minorly granodiorite. Then, the sedimentary rock that may be found also are shale. Based from the data and also the research, sandstone and mudstone also may can be found but in a minor scale that cannot be map able. Besides. The alluvium also was categorized due to its cover along the Pergau River.

The sedimentary rock possibly is older than igneous rock because the granite and granodiorite also one part of the Kanerong Leucogranite (Afalatun, 2013). The sedimentary rocks are believed to have an aged from Triassic. The granite and granodiorite also believe to have an age of Early Tertiary. The granite is a granite intrusion to the sedimentary rocks in the study area. Alluvium is the younger part that may deposited around Quaternary. The sedimentary rock which is shale may have deposited around the deep water.

4.3.1 Stratigraphic Position

Table 4.3.1: Stratigraphic column

Stratigraphic Column			
Age	Period	Explanation	Rock Unit
Cenozoic	Quaternary	Mainly deposited along the river. Maybe interbedded with sand, silt and clay	
	Early Tertiary	May contain the silica and quartz.	
Mesozoic	Triassic	A fine grained rock composed with the mud, clay and quartz	

4.3.2 Unit Explanation

a) Alluvium

Based on the table 4.3.1, the age of the alluvium is younger than the other lithologies. Other than that, the age of the alluvium also may be deposited around the Quaternary. From the geological map also, the lithology that has alluvium always in line with a river where it main deposition occurs after the accumulation of the debris materials. Lateral migration tends to eliminate older units as it creates new alluvial deposits, whereas incision may lead to the preferential preservation of older units beyond the incision slot. Aggradational environments are likely to preserve more

complete records, although simultaneous lateral migration may eliminate, possibly repeatedly, the upper parts of alluvial units (Lewin & Macklin,2003).

b) Acid Intrusive Rock

The acid intrusive rock that found in the study area is granite and granodiorite according to the geological map. The acidic igneous rocks (commonly referred to as "acid" rocks and rarely as acidities) comprise those rocks, whatever their origin and whatever level of the crust in which they crystallize, that are sufficiently silica-rich to contain modal (actual) or normative (theoretical) quartz in quantities of about 10% or more (Ward,1989). Among the deep-seated rocks in acid intrusive rocks, granite and granodiorite are the most commonly deposited.

c) Shale

Shale is made out from the clay and the silt sized-particles. The shale also is very soft. It is can always be found at the low hill types and mostly be found around the oil palm plantation.

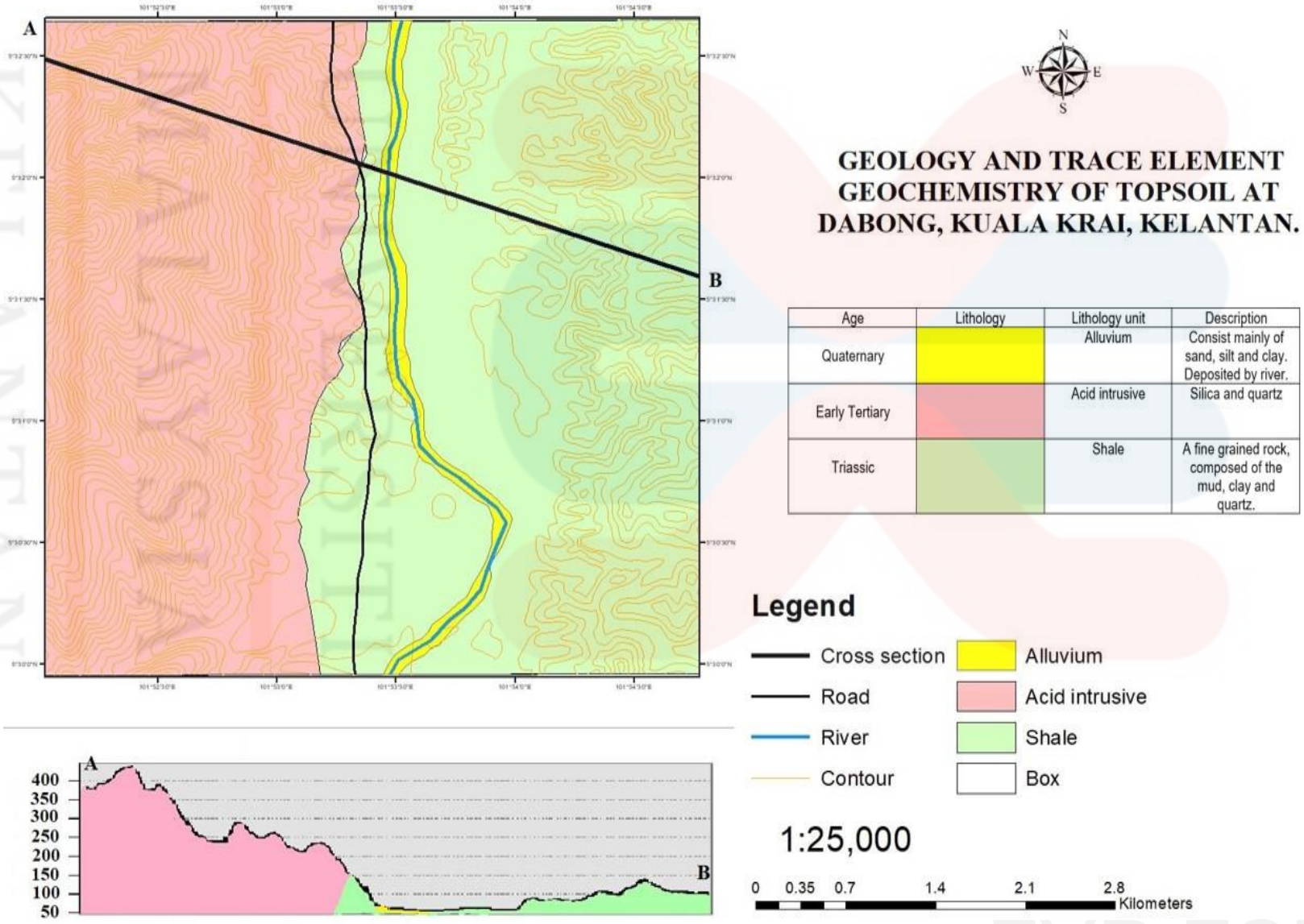


Figure 4.7: The Geological Map of Dabong, Kuala Krai, Kelantan.

4.4 Structural Geology

4.4.1 Fold

Fold also one of the geologic structures that were formed by the deformation. It occurs when the two plate tectonic collide and become a fold with the forces. The types of fold that can be included are an anticline, syncline, chevron and recumbent. This folding occurs when the Earth's crust more ductile than the surface and causes an imbalance.

The one type of fold that observe from the topography map is anticline since this fold can be seen through the lineament line. This folding also creates the mountain because the folding occurred in that area.

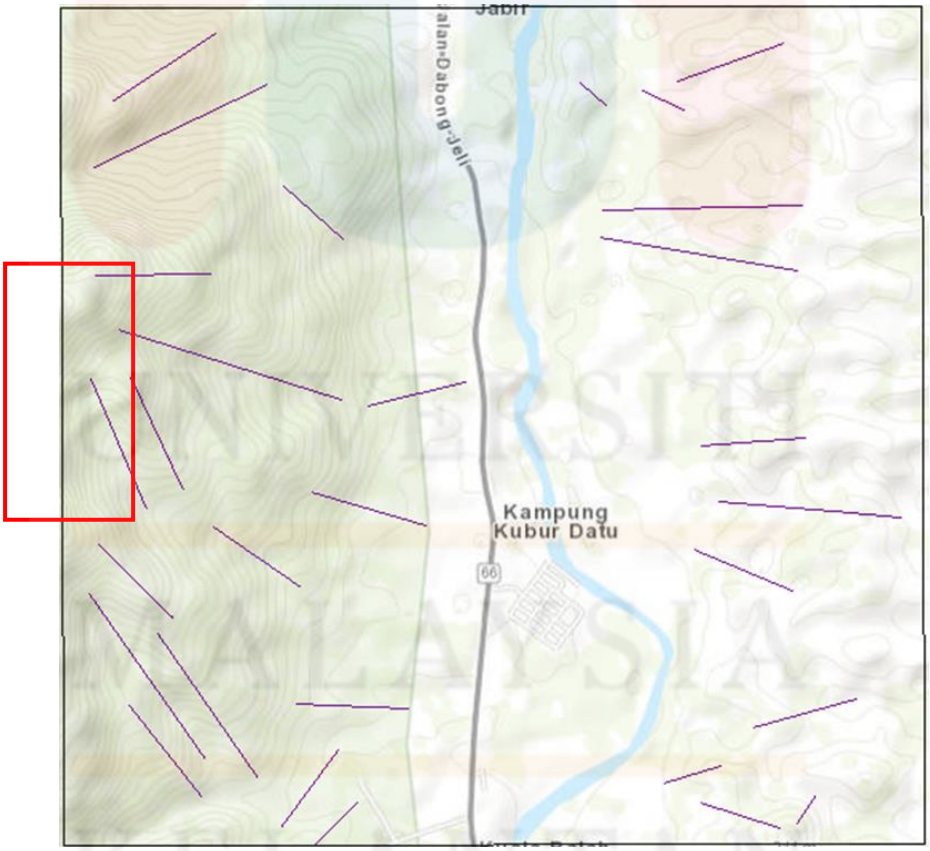


Figure 4.8: The figure shows the fold in the box.

4.4.2 Mechanism of Structure

The lineament analysis was used to identify the structure. Lineament analysis is a straight line on the landscape to reveal the hidden shape of the study area. Figure 4.9 showed the analysis of the lineament in the terrain map and followed by the figure 4.10 that was processed by using GeoRose software. The determination of the lineament analysis was taken from the terrain features in base map in GIS. The analysis is doing by the observation of the hills and river from in a linear line.

Figure4.9 (a): Analysis of lineament in Dabong, Kuala Krai, Kelantan.

Table 4.4.2 Degree in a different angle of the lineament

Angle (º)			
60	129	143	110
68	112	140	96
91	107	30	20
131	150	40	60
109	151	93	115
100	89	70	130

4.5 Historical Geology

Historical geology was included in the origin and also the formation of geological features on the earth. For the study area, the sedimentary rocks are formed due to the deposition. Then it was intruded by the igneous volcanic rock consisting of the acid intrusive rocks from the granite and granodiorite. And this formed the mountain after a long period for the intrusion. After the intrusion occurred, the igneous rock went through another deformation process which it formed another geological structures such as folds and joints. From the differences of the contour and after a long time, the alluvium area was occurred because of the weathered rock. This weathered rock became sediment and formed as alluvium along the river area.

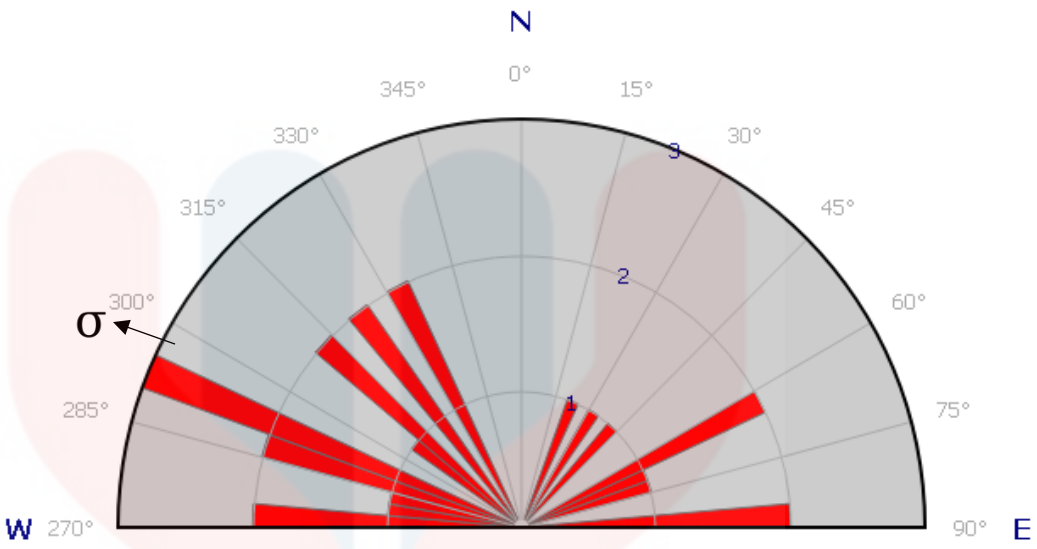


Figure 4.10: The force of structural deformation of Dabong, Kuala Krai, Kelantan.

CHAPTER 5

RESULTS AND DISCUSSION

5.1 Introduction

This chapter focusing about the specification of the research which is the concentration of the trace elements in top soil. The trace elements is a minor element that can be detected in the topsoil. Since the observation were made up from the existing secondary data, the data collected from the research at the Sungai Pergau since Sungai Pergau was also a main river in the study area.

5.2 Trace Elements of Top Soil In Dabong

The trace elements that may include are trace metals, heavy metals and micronutrients. This study only going to investigate the trace elements and heavy metals in the topsoil. Heavy metals are elements that have a density of more than 5.0 g/cm3 in the sample. The main sources of trace elements is soil parent materials themselves, fertilizers, irrigation water, coal combustion residues, auto emissions and any metal industries. Figure 5.1 shows the mean range of the trace elements such as Chromium (Ch), Gallium (Ga), Manganese (Mn) and Vanadium(V) sediment sample at Sungai Pergau that were analysed by X-ray Fluorescence (Sugumaran et al., 2019). Since the Sungai Pergau was located in the study area, these concentration shows that Ch within the range of 60 - 100 ppm. For concentration of Ga, it mean concentration

around 30-50 ppm. The concentration of Mn range in between 200-400 ppm. The V concentration fall in the range between 190- 260 ppm. There are some element Zn, Pb, Ca, Mn, Cr and V have also been inferred as fertilizer binding agents and related to agricultural land uses (Nicholson et al, 2003). This land agriculture may cause the high concentration in some elements such as oil palm plantation that also were presented in the study area in Figure 4.3 the landuse map.

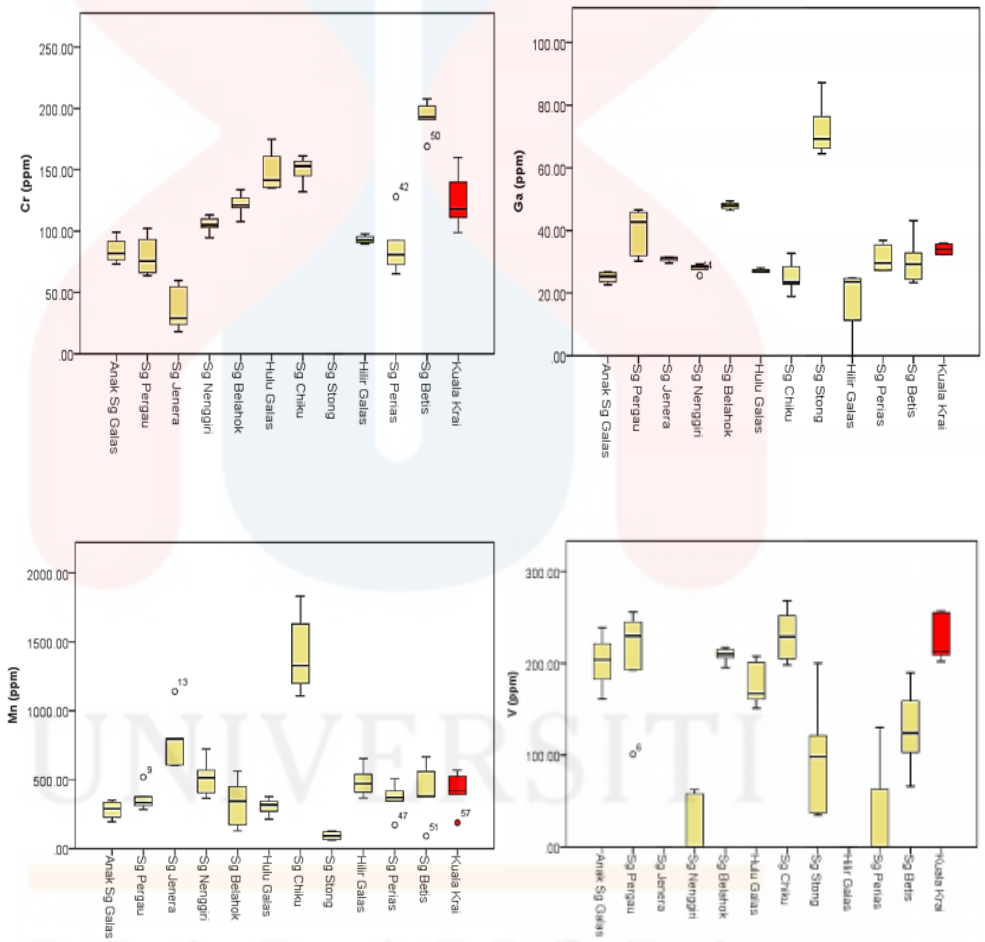


Figure 5.1: The range concentration of trace elements such as Chromium (Cr), Gallium (Ga), Manganese (Mn) and Vanadium (V) on different places in Kelantan (Sugumaran et al., 2019).

Based on the trace elements present such as Cr, Cu, V, Ga, Zn and Pb that were also analysed at Stong Complex which is also the same complex unit namely as Bertam Granodiorite and Dabong Tonalite. The concentration of these elements are shown in Table 5.1.

Table 5.1 The value of trace elements that presented in Berangkat Pluton (Umor et al., 2012).

Trace Elements (ppm)	Dabong Tonalite	Bertam Granodiorite
Cr	92	72
Cu	41	17
V	68	64
Ga	24	15
Zn	82	83
Pb	58	47

These concentration are slighly lower than the result in Figure 5.1 because of the agriculture contribution such as palm plantantion in the study area that lead to the high concentration for trace elements in study area but still under 100 ppm.

5.3 Concentration of Heavy Metals

In December 2014, the biggest flood event already occurred in the east of Peninsular Malaysia which situated in Kelantan. As a resulted of the flood disaster, the heavy metals concentration in soil may changes because of the flood event. This wil become harmful to the environment due to the pollution deposited in soil. This research was carried out in 2015 to determine the heavy metal concentration from flood in Dabong area. Shale sample have been collected and were analysed by using Atomic Absorption Spectroscopy (AAS). From the sample collcetion, the heavy metals that present here were Lead (Pb), Cadmium (Cd), Mercury (Hg), and Arsenic (As). This elements was choosed for heavy metal concentration. The result indicated that the heavy metal concentration did not exceed the limit (Sukri et al., 2015). The results from this study can be used as a data to improve the soil quality and for consideration of future land use activities. The geochemistry analysis have been done to determine heavy metals content in the top soil. Heavy metals that have been analyzed are zinc (Zn), lead (Pb), iron (Fe), chromium (Cr), magnesium (Mg), copper (Cu), potassium (K) and calcium (Ca) that also present in Dabong, Kelantan (Bakar, 2016).

Mean concentrations of lead, zinc, copper, cadmium and ferum in sediment sample are shown in Table 5.2. Total metal concentrations in sediment were lower as compared to the concentration in earth crust for baseline concentration for heavy metals as described by (Merian 1991). The heavy metal concentrations in the sediment were used to compare the concentration with the other previous studies. These values could be used to evaluate the load of anthropogenic metals from its surrounding (Merian, 1991). From the results in Table 5.2, the mean concentration indicates no serious anthropogenic activities occurs. This trace elements in sediment were analysed

by atomic absorption spectrophotometry, AAS. Table 5.3 show the sediment criteria proposed by EPA to indicate the pollution in sediment.

Table 5.2 : Heavy metal concentration in sediment (Ahmad et al., 2009)

Heavy metal	Metal Fraction (mg/kg)	Mean Value (mg/kg)
Pb	0.028	20.82
Zn	0.56	18.67
Cu	0.42	6.74
Cd	0.01	1.82

Table 5.3 : Sediment criteria in mg/kg dry weight (Engler, 1980).

Heavy metal	Not polluted	Slightly polluted	Severely polluted
Pb	<40	40-60	>60
Zn	<90	90-200	>200
Cu	<25	25-50	>50
Cd			>6

Result from the study shows that sediments in Sungai Kelantan received minimun anthropogenic metal load. This low heavy metal accumulation due to homogenous pH (Ahmad et al., 2009).

From the observation based on the previous studies, the common heavy metals that were presented here are Zn, Pb, Cu and Mg.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

As a conclusion, the geological map of Dabong, Kuala Krai, Kelantan with the scale of 1:25 000 was produced to complete the objective 1. The type of map that has been produced is a geological map, geomorphology map, landuse map, road connection and 3D map. Besides, the lithology that can be observed is granite, granodiorite, alluvium and shale. All of these lithology is categorized into three groups that can be mapped into a geological map. These group are acid intrusive which include the granite and minor granodiorite, shale and alluvium.

The drainage pattern in the study area was observed as dendritic and rectangular pattern. These patterns can be seen by the stream flow that were processed using DEM data on GIS. For the rectangular pattern, it only can occur at the igneous rock and metamorphic rock. Since the rock that can be observed there was only igneous, then the result is highly granite and granodiorite that can be at that area.

The trace elements that were presented here are Cr, Cu, V, Ga, Mn, Zn and Pb. There are some elements are slightly higher such as Mn and V. This high concentration may be caused by the agricultural and also the flood that have been occured in study area.

6.2 Recommendation

From the observation and after handling this project, there are several suggestions to improve the thesis. It is included the geological mapping for the present and in the future. The suggestion is the society and the government should working

together to maintain the geological value. The main purpose is to make the study area to be preserved for the young generation since this place is not completely explored yet.

Based on the observation from the trace elements and heavy metals concentration. The villagers should control the agricultural to avoid the high concentration in topsoil to avoid the contamination in future. There are some element that were present that related to agricultural land uses. This land agriculture may cause the high concentration in some elements such as oil palm plantation.

Next, the field and laboratory work is highly needed to analysis the most recent result. This is because the main objective is to updated the geological mapping thus these two important things need to be carried out to obtain the newer results. The secondary data is sometimes limited and not every required data needed has its own secondary data.

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