GEOLOGY AND PETROLOGY OF GRANITE IN GUA MUSANG, KELANTAN

by

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a report submitted in fulfillment of the requirements for the degree of

Bachelor of Applied Science (Geoscience) with Honours

FACULTY OF EARTH SCIENCE

UNIVERSITI MALAYSIA KELANTAN

2021

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DECLARATION

I declare that this thesis entitled "Geology And Petrology Of Granite In Gua Musang, Kelantan" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Approved by,

Signature : 

Name : MARDHIAH BINTI MAT YUSOF

Date : 2/2/2020

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APPROVAL

I certify that the report of this final year project entitled "Geology And Petrology Of Granite In Gua Musang, Kelantan" by Mardhiah Binti Mat Yusof with matric number E17A0011 has been examined and all the correction recommended by examiners for the degree of Bachelor of Applied Science (Geoscience) with Honors, Faculty Earth Science, University Malaysia Kelantan.

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Date : _____

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ACKNOWLEDGMENT

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

First of all, First of all, Alhamdulillah praise to Allah SWT for giving me opportunity to finish this project successfully. With the gust and guide that He gives to me, I am able to finish up this project completely on the time given. Hence, with the strength He gave to me, it helps me to find the materials and information which are needed to finish up this project.

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Thank you.

Sincerely,
Mardhiah Binti Mat Yusof

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ABSTRACT

‘Geology and Petrology of Granite in Gua Musang, Kelantan’ was the title given for the FYP project and the main purpose was to update geological map on the study area in Bukit Senting, Gua Musang using application and software and another objective are to study the origin, history and mineral composition of granite in Gua Musang Kelantan by analyse the secondary data such as journals, books, and article.Petrology is one of the geoscience branches that studies the origin, composition, and structure of the rock. The specification study is focus on the granite rock which includes rock type of igneous rock. Igneous rock formation was the relate the cooling and solidification of magma or lava flow that was flows inside the earth’s crust (lithosphere). There is the time when the magma flows into the dyke and meets dome shape like batholith and laccolith which located at the lithosphere and solidifies through a long period inside it dome and formed the rock with large grain size before it is uplifting and expose to the earth surface. Usually, granite exposes to the earth’s surface has a light-colored igneous rock with a large grain size that can be seen by naked eyes. Its composition of the mineral is mainly quartz, feldspar with minor mica, amphiboles, and other minerals.

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ABSTRAK

'Geologi dan Petrologi Granit di Gua Musang, Kelantan' adalah tajuk yang diberikan untuk projek FYP dan tujuan utamanya adalah untuk mengemas kini peta geologi di kawasan kajian di Bukit Senting, Gua Musang menggunakan aplikasi dan perisian dan objektif lain adalah untuk mengkaji asal usul, sejarah dan komposisi mineral granit di Gua Musang Kelantan dengan menganalisis data sekunder seperti jurnal, buku, dan artikel. Petrologi adalah salah satu cabang geosains yang mengkaji asal usul, komposisi, dan struktur batuan. Kajian spesifikasi tertumpu pada batuan granit yang merangkumi batuan jenis batuan igneus. Pembentukan batuan beku adalah penyejukan dan pemejalan aliran magma atau lava yang mengalir di dalam kerak bumi (litosfer). Ada masanya magma mengalir ke tanggul dan memenuhi bentuk kubah seperti batholith dan laccolith yang terletak di litosfera dan menguatkan dalam jangka masa panjang di dalamnya kubah dan membentuk batu dengan ukuran butiran besar sebelum ia mengangkat dan mengekspos ke bumi permukaan. Biasanya, granit yang terkena ke permukaan bumi mempunyai batuan beku berwarna terang dengan ukuran butir besar yang dapat dilihat dengan mata kasar. Komposisi mineralnya terutamanya kuarza, feldspar dengan mika kecil, amfibol, dan mineral lain.

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LIST OF SYMBOL

°	Degree
km^2	Kilometer per square
%	Percentage
Ma	Mega-annum or a million years

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CHAPTER 1

GENERAL INTRODUCTION

1.1 General Background

Final Year Project or also known as FYP is a requirement to fulfill in for the students in the degree of Bachelor of Applied Science (Geoscience) with Honours from Universiti Malaysia Kelantan. Beside, due to the 2019 novel Coronavirus Disease or known as the COVID-19 outbreak, fieldwork mapping has been dismantled for the geoscience degree in the FYP project and changed into secondary data scientific knowledge and value study and analysis. Thus, secondary data is important in finding and study the specification of the research.

'Geology and Petrology of Granite in Gua Musang, Kelantan' was the title given for the FYP project and the main purpose was to update geological map on the study area in Bukit Senting, Gua Musang using application and software and another objective are to study the origin, history and mineral composition of granite in Gua Musang Kelantan by analyse the secondary data such as journals, books, and article.

Kelantan was consists of 10 district which was Kuala Krai, Gua Musang, Jeli, Tanah Merah, Machang, Pasir Putih, Bachok, Kota Bharu, Tumpat, and Pasir Mas. Gua Musang is the largest district in South Kelantan with approximately 7,979.77

km^2 (797,977 hectares) (Source: JPS Jajahan Gua Musang). Gua Musang has 3 subdivisions district which are Chiku, Bertam, and Galas.

The study area is located at Bukit Senting, Gua Musang, Kelantan which can be found near the border of subdistrict Gua Musang of Bertam and Galas with a diameter of 5km multiple by 5km box which total to $25km^2$. The map of the study area produce with scale 1:25000 and the data update in terms of geomorphology, demography, rainfall, land use, social-economic, road connection or accessibility, forestry and vegetation, and settlement. The method that use for geomorphology analysis map is using ArcGIS 10.3 software, GeoRose software and Google Earth Pro software to digitize and analyse the study area map.

Petrology is one of the geoscience branches that studies the origin, composition, and structure of the rock while petrography is involved the scientific studies to classify the rock and lastly mineralogy is the study that deals with minerals and it crystallography, properties, classification and the ways of distinguishing the rock. Igneous rock, sedimentary rock, and metamorphic rock was the three type of rocks in the rock cycle process. There also another type of rock which is pyroclastic rock.

The specification study is focus on the granite rock which includes rock type of igneous rock. Igneous rock formation was the relate the cooling and solidification of magma or lava flow that was flows inside the earth's crust (lithosphere). There is the time when the magma flows into the dyke and meets dome shape like batholith and laccolith which located at the lithosphere and solidifies through a long period inside it dome and formed the rock with large grain size before it is uplifting and expose to

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the earth surface. This is the general formation of granite that formed the large grain size granite rock. Usually, granite exposes to the earth's surface has a light-colored igneous rock with a large grain size that can be seen by naked eyes. Its composition of the mineral is mainly quartz, feldspar with minor mica, amphiboles, and other minerals.

1.2 Study Area

The selected basemap was located in Bukit Senting Gua musang to produce the geological map with scale 1:25000 and as for the the specific research study area or was selected in Gua Musang, Kelantan. The study area or also identify as basemap with the size of 5 km x 5 km with area 25 km per square as it enhance the knowledge and experience as Geoscience student using software and analyse data using ArcGIS or any software selected by student. The basemap data that was selected was process and analyse and update the geological map, growth of population, accessibility, landuse, vegetation and forestry and other related matter. The purpose of the analyse of the study area is to fulfill the main objective of the research study.

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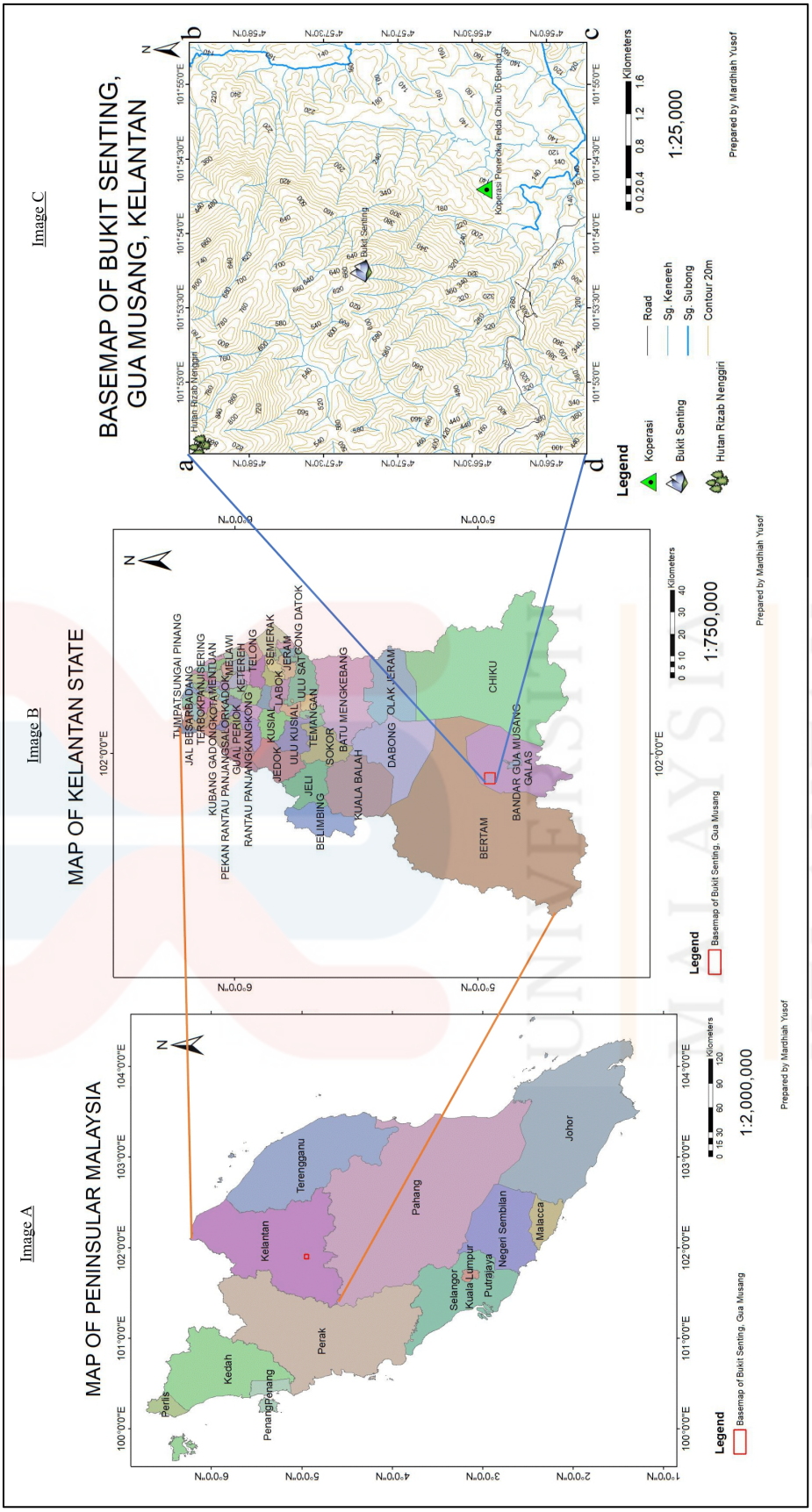

Figure 1.1 The correlation of the Map of Peninsular Malaysia (Image A) to Map of Kelantan State (Image B) to the Base map of Bukit Senting, Gua Musang, Kelantan (Image C)

1.2.1 Location

The location basemap for this research study was located at Bukit Senting, Gua Musang that near the boarder of Galas and Bertam Subdistrict. The coordinate of the basemap that was listed below,

a : 4° 58' 22.80" N, 101° 52' 31.84" E
b : 4° 58' 22.836" N, 101° 55' 17.292" E
c : 4° 55' 44.08" N, 101° 55' 17.148" E
d : 4° 55' 44.076" N, 101° 52' 32.52" E

As stated before the location was selected because of the second and third objective with to study the origin, history and the mineral composition of the granite in Gua Musang, Kelantan. While there is a lot granite area in Gua Musang, the basemap was spot on Bukit Senting is because it near to the accessibility of Gua Musang town that 20km away from the basemap. Thus, the area also famous with the Main Range Granite Formation as it batholith intruded the earth surface was urge to be study such as what the mineral composition that reside there, or what the before it intrude, is there other sediment layer reside onto it or what the environment and paleo-geography and many more.

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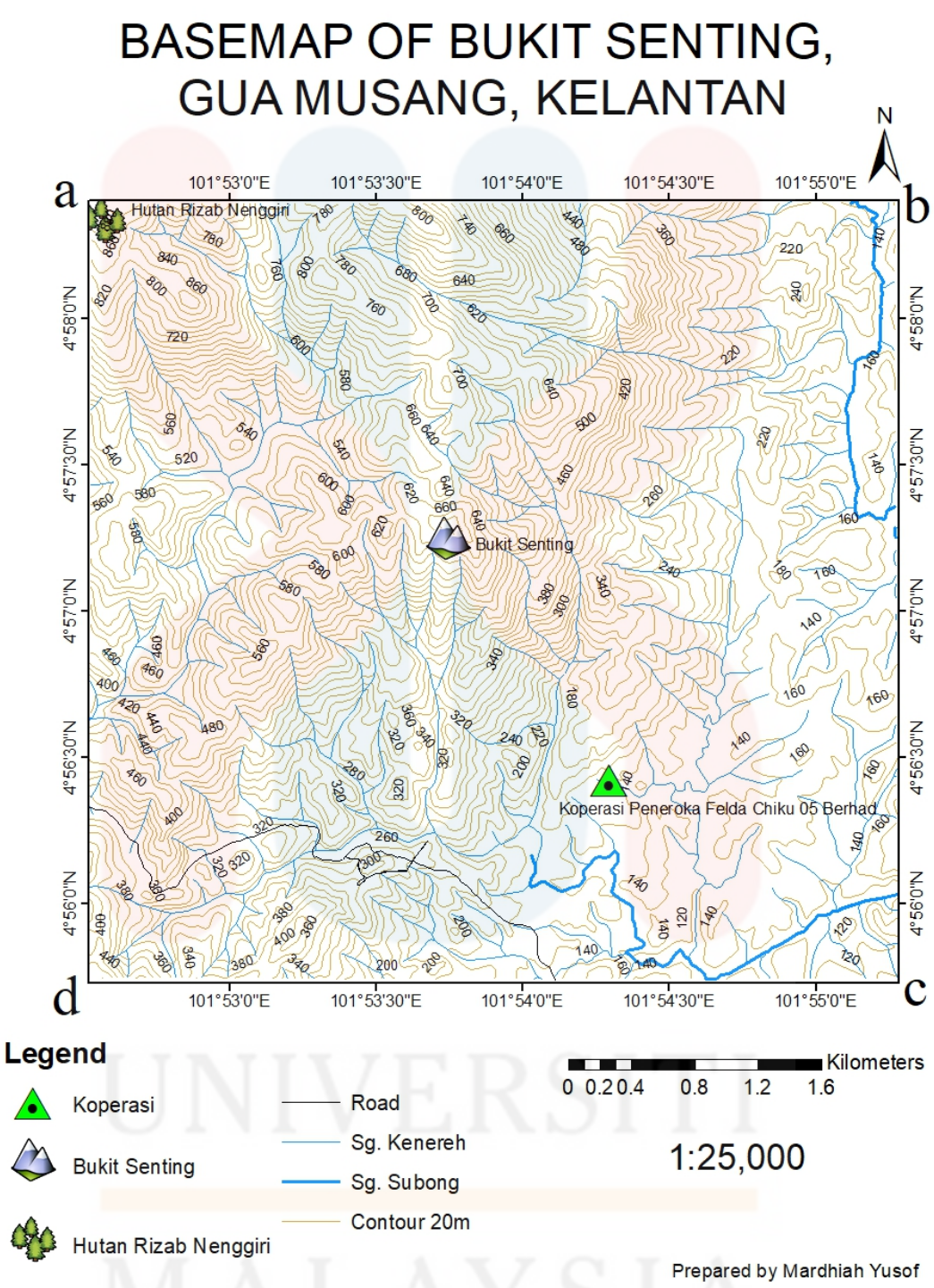

Figure 1.2 The basemap in Bukit Senting, Gua Musang, Kelantan

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1.2.2 Road Connection/Accessibility

Road connection or accessibility is refer to the society man-made construction such as road, building, facilities that was produce to support and help in for the society was also been analyse in this research study. The road connection analysis also can help the student of geoscience to receive or gain an accessibility and easy to move around inside and outside the basemap during fieldwork study. Even though the COVID-19 does the student also need to identify the road connectivity and accessibility to identify the private property area, government restricted area, the towns population. It really does effect the vegetation and weathering rate from surrounding population environment to the rocks areas.

As the road connection or accessibility in the basemap, the road inside the box was a collector or residential road for Felda estate use property to ease the burden in the movement to surrounding area and to collect the product of oil plantation (Refer **Figure 1.4**). As for outside of the basemap, the main road to the basemap was length around 5 km and the basemap to the Gua Musang town is about 20 km. It take around 20 to 25 minute to arrive to Gua Musang town to obtain the necessary thing or during emergency time. Gua Musang town was include so many facilities such as Hospital, Government Company, private company such as mall, store and even gas station and many more.(Refer **Figure 1.3**)

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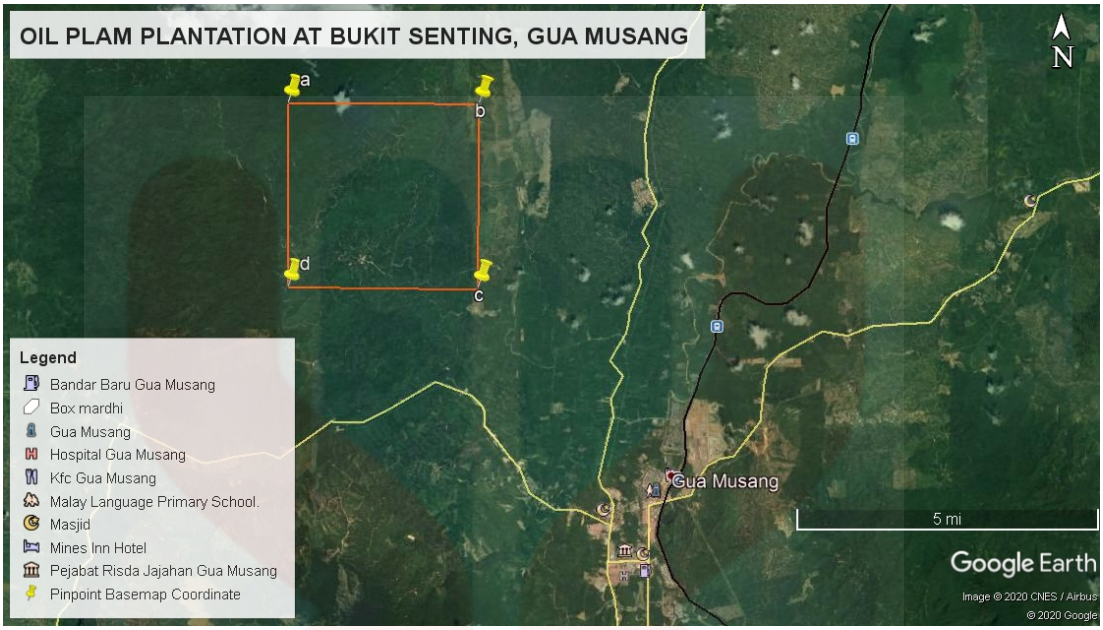

Figure 1.3 The road connection or accessibility from basemap to other facilities in Gua Musang town (Source: Google Earth Pro)

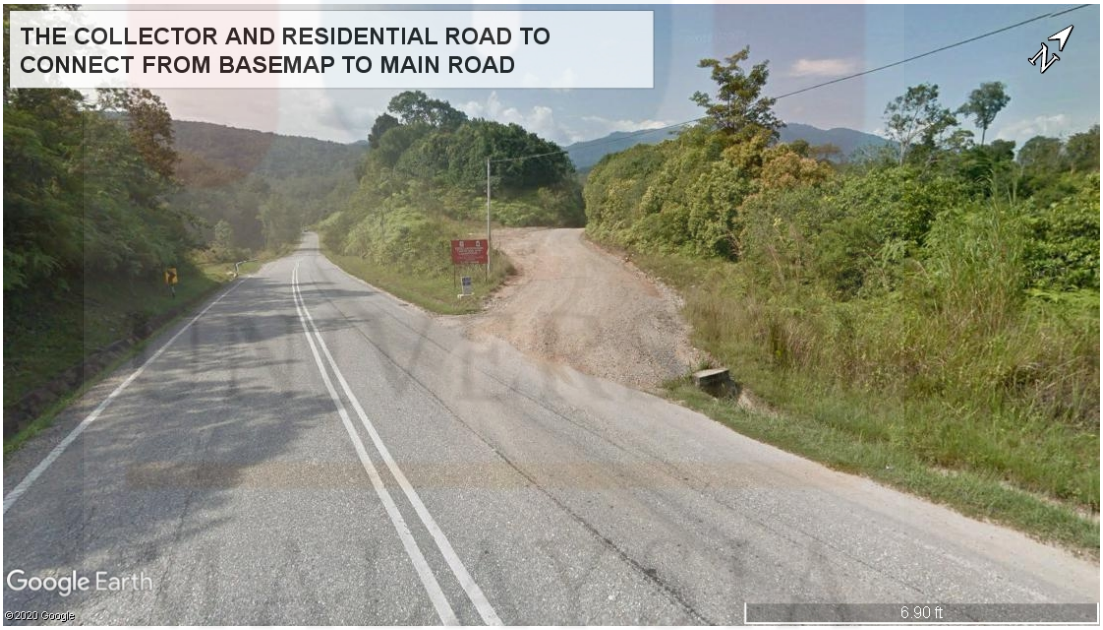

Figure 1.4 The road that connect from basemap (right road in figure) to the main road (left road in figure) (Source:Google Earth Pro)

1.2.3 Demography

Kelantan was located a the northern state of Peninsular Malaysia and was divided into 10 district which is Tumpat, Kota Bahru, Pasir Mas, Tanah Merah, Pasir Putih, Jeli, Machang, Kuala Kerai and lastly Gua Musang, Gua Musang District was divided into 3 subdistrict which is Galas on the South-Western side of Gua Musang, Bertam North-Western side of Gua Musang and Chiku was dominant area in Eastern side of Gua Musang (Refer **Figure 1.5**). Gua Musang was the largest district in southern Kelantan state with approximately 7,979.77 km^2 (797,977 hectares) (Source: JPS Jajahan Gua Musang).

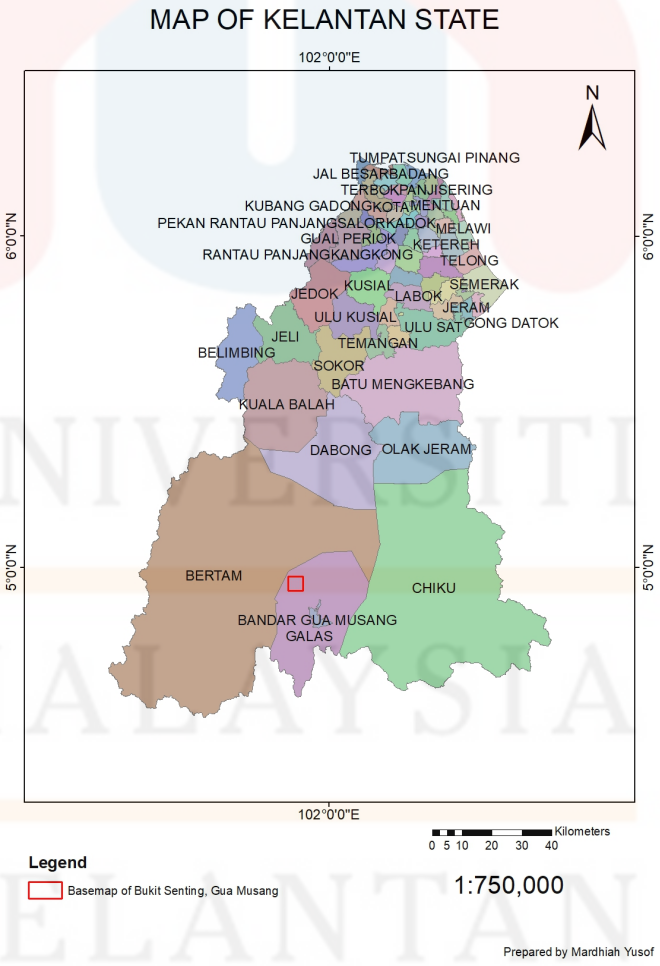

Figure 1.5 The Kelantan district and subdistrict and the basemap that was located.

Gua Musang district was located near the border of Pahang state to the south and Terengganu to the east, Perak to the west, and the Kelantan districts of Kuala Krai and Jeli to the north.. Gua Musang area compared to the State is as follows:

Table 1.1 States/ District and width of Kelantan and Gua Musang. Source: UPEN and JPS Jajahan Gua Musang

State / District	Width
Kelantan State	14,922km^2 / 1,492,200Hectare
Gua Musang	7,979.77 km^2 / 797,977Hectare

Analysis of people distribution in subdistrict in Gua Musang district. The most populated population in Gua Musang is Galas and followed by Paloh and Nenggiri sub district. **Table 1.2** shown the subdistrict ranking and its population.

Table 1.2 People distribution in three subdistrict at Gua Musang. Source: JPS Jajahan Gua Musang

Rank	Sub District	Population
1	Galas	51,297
2	Chiku	32,640
3	Bertam	9,109

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1.2.4 Landuse

Bukit Senting landuse was dominant by oil palm plantation and forestry. Oil palm plantation estate was managed by Felda and the worker was the residents that reside within the area (Refer **Figure 1.6**). The forestry area that near Bukit Senting Basemap was location near Hutan Rizab Nenggiri at the North-Western side of the map. There also other forestry such as the *Hutan Rizab Sungai Terah* in the Northern-Eastern side of basemap, the *Hutan Rizab Gunong Rabong* in South-Eastern side of the basemap, the *Hutan Rizab Batu Papan* in Southern part of basemap and *Hutan Rizab Sungai Perias* in Western side of basemap (Refer **Figure 1.7**)

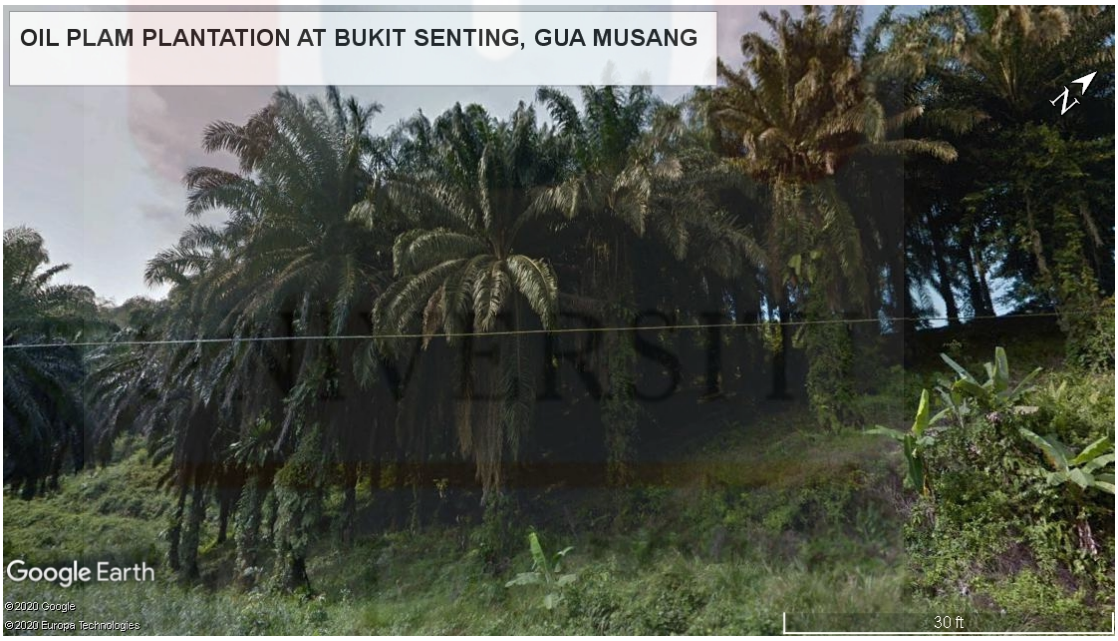

Figure 1.6 The oil palm plantation that was managed by Felda (Source: Google Earth Pro)

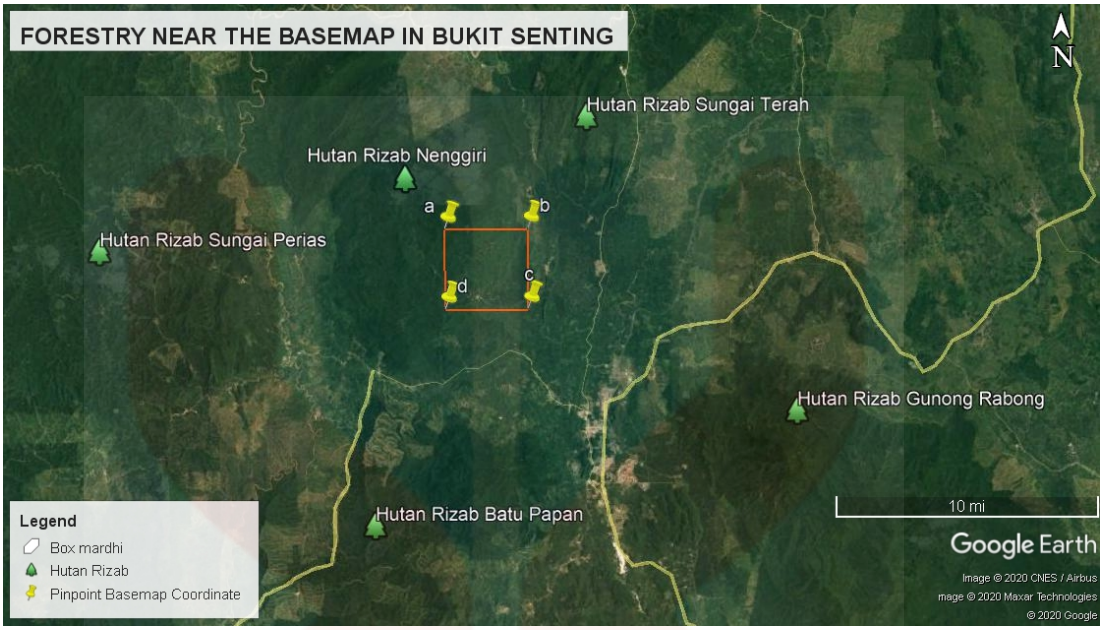

Figure 1.7 The forestry that was located near the basemap (Source: Google Earth Pro)

1.2.5 Social Economic

Bukit Senting district was residents by the community of Felda and the landuse there was agriculture of oil palm plantation (Refer **Figure 1.6**). Gua Musang residents which is the outside of the basemap also has another agriculture such as rubber tree plantation. Most of the social economic that was done in the area is dominantly Malays.

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1.3 Problem Statement

The geological map that used for this research study is a geological map that already in a long period ago, meaning that no update in term of geomorphology, demography, rainfall, land use, social economic, road connection or accessibility, forestry and vegetation, and settlement. For example, rainfall is one of the weathering and erosion factors that can change the original features of the study area. Hence, the new updated geological map is important to provide the latest formation change on geomorphology, land cover, land use, demography, and especially the specification of granite in the study area.

Beside, due to the 2019 novel Coronavirus Disease or known as the COVID-19 outbreak, fieldwork mapping has been dismantled for the geoscience degree in the FYP project and changed into secondary data scientific knowledge and value study and analysis. Thus, secondary data is important in finding and study the specification of the research study. However, most of the data like journals and books are old and long last updated that need to research and re-update back by other researchers.

Besides, granite formation is useful in an industrial building, engineering and mining exploration and help this sector to analyse the location before the field exploration to reduce the financial on exploration and unnecessary land mining. Besides granite produce a mineral such as quartz that can lead to many discoveries such as fault line, gold belt, ore mineral, rare earth element (REE) that yet to be explore and discover in many locations.

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1.4 Objective

The objectives of the research study are:

a) To update the geological map in scale 1:25000 of the study area.

b) To analyse the mineral compositions of the granite in Gua Musang, Kelantan.

c) To study the origin and history of granite in Gua Musang, Kelantan.

1.5 Scope of Study

The scope of the study update the geological mapping of the study area box of 25km^2 in the scale of 1:25000 using ArcGIS 10.3 software and Google Earth Pro software to analyse the lithology study, geomorphology study, drainage system analysis, topography analysis, slope and landslide and the different type of rocks and it deposits, as well as location of geologic structures such as faults and folds, granite landform and pattern. Another scope of the study is to analyse the granite petrography and formation in the Gua Musang by study and analyse secondary data such as journals, books, and others.

1.6 Significant of Study

The granite formation and landform are important to engineering, plantation, industrial, and other as it will affect the soil environment and erosion in the area as well as the magma formation and contact in the area.

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The granite formation and landform is an important structure that needs to be analyse before the research project can be conducted in the area. It is useful to other researchers who want to discover and research more on other site and engineer who need to be careful when the project was conducted so that the area that will be drilling is not hard rock like granite and need to be avoided. By learning the origin and formation of the granite, it also includes the mineralogy of granite which consists of the quartz mineral that important in ore mineral exploration and magma contact to the lithosphere.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Literature review is to analyse the research previous from other researcher that related to the specific research study or even main objective of the research study. By conduct the literature review, student can add knowledge and widening the view of the research study specification and knowledge. Beside by analyse the literature review, student can view from difference researcher perspective and analysis.

The literature review that was obtain in this research study was about the topic on granite, petrology, landform, rock distribution, formation, belt, structure and many more. Hence, the literature review was cited from the other researcher journal, article, books and can be obtain in the Google Scholar search engine.

2.2 Regional Geology and Tectonic Setting

Tectonic setting was a plate of the Earth's crust was move in a large scale of plate tectonic and outcome for the plate tectonic movement are rift zones, subduction zones, transtensional or strike-slip zones, and extensional regimes.

Peninsular Malaysia has subdivided belt into Northern to North-Western and Southern to South-Eastern belt based on the stratigraphy, mineralisation, geological structure, geological structure, geological history and tectonic evolution. However, there are different viewpoint or perspective from different researcher identify the belt. According Scrivenor (1928), Peninsular was subdivided belt into three elongated belts which is a western tin belt, a central gold belt and an eastern tin belt based on the mineralisation. However, Hutchison (1977) subdivided belts into four major tectonic which is Western Stable Shelf, The Main Range Granite, The Central graben and the Eastern Belt based on the different tectonic histories. As for Khoo and Tan (1983), the belt was subdivided into 3 belt which are Western belt, Central belt, and the an Eastern belt based on the difference in stratigraphy and geological history within Peninsular Malaysia (Refer **Figure 2.1**).

For this research study, the belt that was focus was from Main Range Granite by Hutchison (1977) and Western belt by Khoo and Tan (1983). The boundary between the eastern and central belts which was the subdivision belt was subdivided it by the Lebir Fault zone, and the boundary between the central and western belts is the Bentong-Raub line by Hutchison (1975). The are also another name of Bentong-Raub line which is Bentong Raub Suture Zone by Metcalfe (2000) (Refer **Figure 2.2**).

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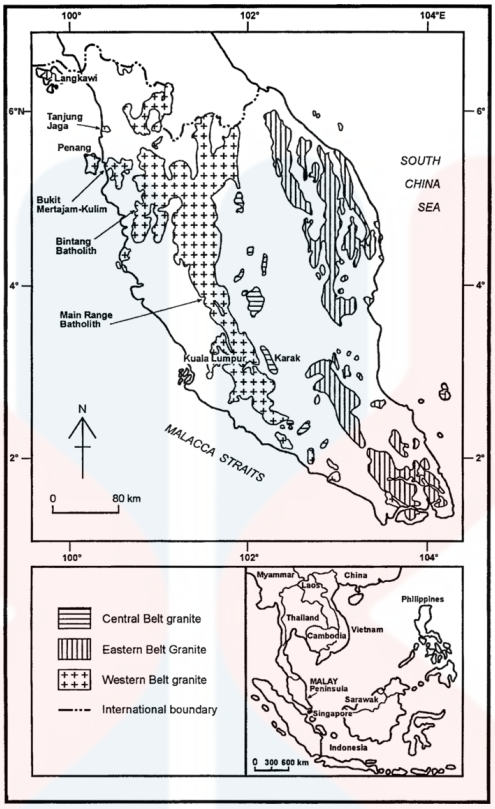

Figure 2.1 The map of Peninsular Malaysia which shows the divided granites batholith according to belt (Ghani, 2005)

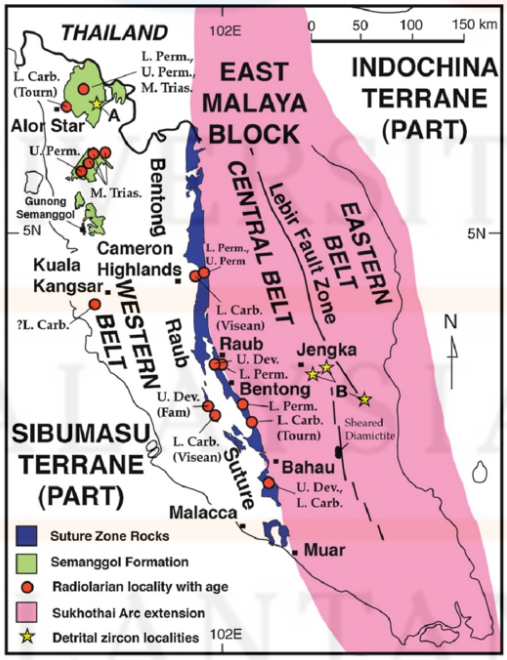

Figure 2.2 The Bentong–Raub Suture Zone of the Peninsular Malaysia (Metcalfe, 1995).

2.3 Stratigraphy

Stratigraphy was a classification, correlation and interpretation from older to younger bed in the area of the rocks. The study of the rock layers strata and layering (stratification) was the also the stratigraphy meaning.

According to Hutchison (1989), protozoic basement was not exposed in Peninsular Malaysia. This age was underlying and still unexpose was indicated as Proterozoic crust and it mineral composition is Nd, Sr, zircon U-Pb isotopic data which is from granitoics of the Sibumasu Terrane. According to the Khoo and Tan (1983), the are 2 divided of Western belt which is the northwest side of the Western belt included the area of the states of Kedah, Langkawi-Perlis and north Perlis and another one is Kinta Malacca sector of the Western Belt that include Kinta Valley, and Paleozoic rocks south to Malacca.

As for the Main Range Granite, according from Ghani (2005), the three parallel belt which are Western belt, Central belt and Eastern belts was consist of granites and was grouped into two granite provinces which is Western province (western belt) that consisting of granites that age range from 200 to 230 Ma and while another one which is the Eastern province (eastern belt and central belt) age from 200 to 264 Ma. Also the western belt granite was composited of S-type granites more than Eastern Belt granited which is dominated by I-type that and subordinate with S-type granites (Ghani, 2005). According to Hutchison (1977), the Main Range Granite which also known as granitoid belt was located along the western margin of the Bentong-Raub Suture Zone.

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2.4 Structural Geology

Structural geology was the study of structure that formed on the rock and study the distribution of the rock that make up the crust of the earth. Structuraly in the west of Kelantan state, there are boundared by olistostrom and as at the east was influence by Lebir Fault Zone (Sources: Geology Society of Malaysia, 2010). Refer **Figure 2.3**, Lebir Fault Zone was elongated forms of fault that forms a boundary between Central belt and Eastern belt of the Peninsular Malaysia. At the north area, the fault zone was elongated from southern-southeastern in and along the Lebir valley. In the Central basin was found diamicite that from eastern margin and the clasts sedimentary rock composition was compose of mineral sandstone, tuffacceous sandstone, carbonaceous tuff and mudstone which found in muddy matric that was sheared and foliated (Metcalfe and Chakraborty, 1988). The age of the rock that of granitoid that obtain from Lebir Fault Zone based on the isotope geochemistry analysis is 222 ±5Ma or Late Trassic.

Extended from Malacca in the south to the Thailand in the north, the mountain range was interbedded with the large characteristic of batholith or complex plutons at the Western belt granites with the restricted composition range of tin bearing S-type granite.The huge mountain range extended and cover over 15000 km^2. Two main batholith masses can be distinguished in the Western Belt Granite (Ghani, 2005)

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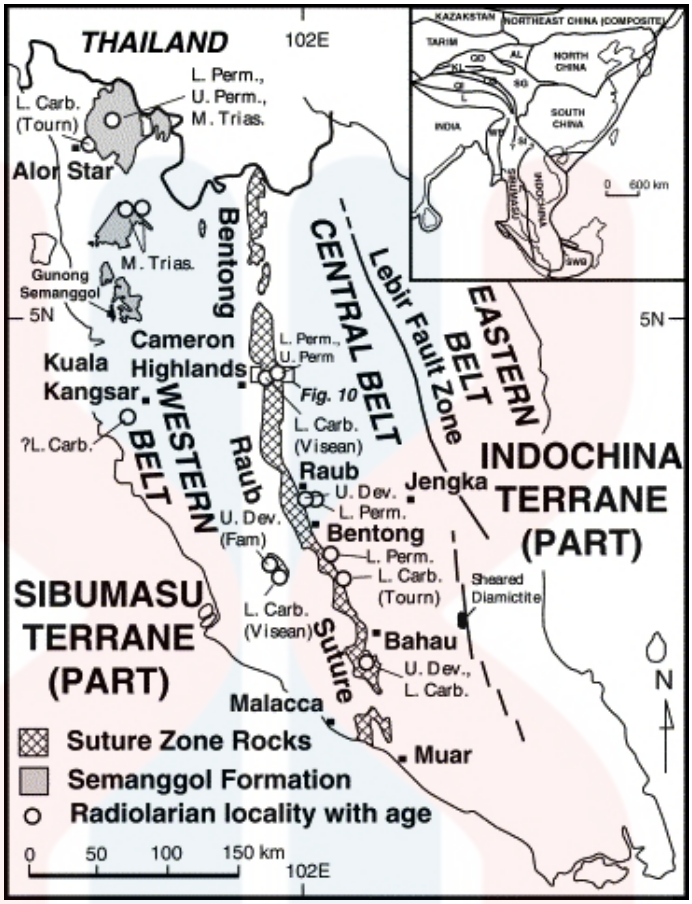

Figure 2.3 The Lebir Fault Zone was formed and can be seen on the Northern (Metcalfe, 2000).

Gua Musang Formation main fold structure can be found surround the belt that intruded from the northern to southern of Peninsular Malaysia. The main fold in northern part was part of the granite intrusion and diorite porphire towards northeastern-southwestern that effect during uplifting (Sources: Geology Society of Malaysia, 2010). Because of the granite intrusion, the sedimentary rock layer or other rock layer on the upper surface during that time was form a folding structure on the area.

2.5 Historical Geology

Volcanism was occured in Western belt, Central belt and Eastern belt and identify as plutonic acid magmatism that intrude during the early Permian, late Permian/early Triassic and the late Triassic at the Western Belt, late Triassic and late Cretaceous in the Central Belt and late Permian/early Triassic and late Triassic in the Eastern Belt. (Khoo and Tan, 1983). The Permian-Triassic Mass Extinction was a largest and one of the Mass Extinction Event that occurred during Late Permian and Early Triassic period (Joeharry et al., 2018).

According to Joeharry et al (2018), Merapoh Limestone was one of the Gua Musang Group and was overlain with older Middle to Late Permian brachiopod bearing tuffaceous shale regarded as Leptodus Shale. Joeharry et al (2018) also restated that the there a bands of a fossil-rich shale layer(s) extending across Sungai Yu - Sungai Toh area and the sediments deposited and fossils was found and was record as younger age at the Northward of Gua Panjang towards south Kelantan (Refer **Figure 2.4**).

Western belt, Eastern belt and Central belt was formed and intrude as 3 parallel structure at the Peninsular Malaysia and was grouped into 2 granite province which Western province and the Eastern province granites that age from 200 to 230 Ma (Western Belt) and 200 to 264 Ma (Central Belt and Eastern Belt) (Ghani, 2005).

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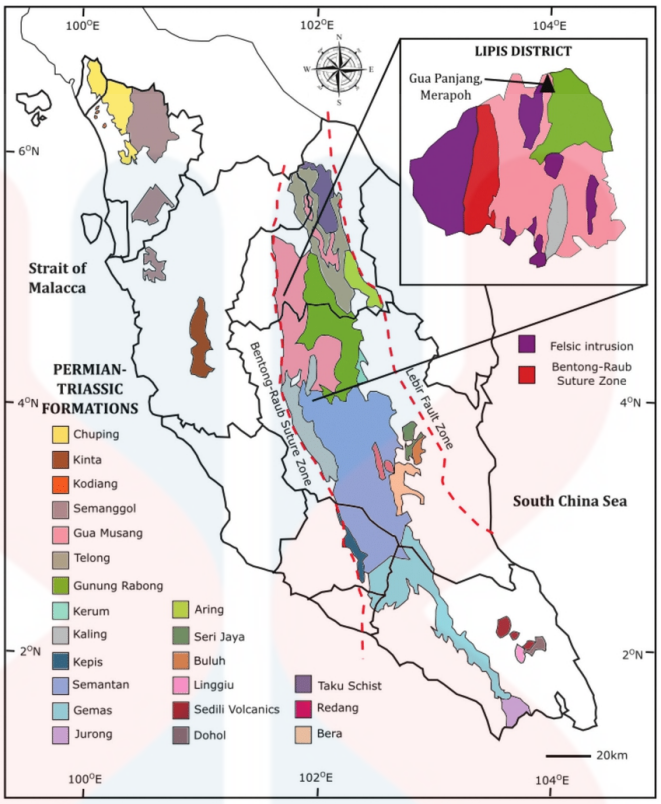

Figure 2.4 Permian-Triassic formations in Peninsular Malaysia are largely distributed across the Bentong Raub Suture Zone (Joeharry et al, 2018).

Refer **Figure 2.4**, the Bentong Raub Suture Zone was affected the Lipis district environment because before the Permian to Triassic period, the paleo-environment of the area was the sea level that shallowing in Lipis area. This can be identified because of the underlying Late Permian foraminifera bearing limestone at Gua Panjang and the mineral composition of rock is tuffaceous in nature, with increasingly richer tuff in the underlying sequence of massive brachiopod rich tuffaceous shale. According to Joeharry et al., (2018), the granite intrusion (volcanic activities) was causing the extinction of marine benthonic fauna, which happened gradually from as early as late Middle Permian to Late Permian.

2.6 Research Specification

The research specification is the research study that focus on the understanding, collected data, and analysis to fulfill the objective and the scope of study. Research specification also can be assume as the aim of the research study and focus on the objective topic related to the research study and to analyse the data so the objective can be achieve.

2.6.1 Granite in Kelantan

There is 3 parallel belt that form on Peninsular Malaysian granites which is Western belt, Central belt and Eastern belt. And this belt was group into 2 province which is Western province which is from Western belt and another one is Eastern province which are the pair of Eastern belt and Central belt. According from Ghani (2005), the age of Western province was age range from 200 to 230 Ma while Eastern province was age from 200 to 264 Ma which means the Eastern province granite formation take more time rather than Western province granite.

The Western belt granite (Western province) was a huge mountain range cover was exceeded 1500km^2 that was extended from southern of Malacca to the northern of Thailand]. There was two batholith masses in Western belt granite that can be classified as the Main Range batholith on the eastern flank and the adjacent Bintang batholith immediately to the west with a small intrusive at the centre. The small intrusive at the centre was called Bukit Mertajam-Kulim, Penang, and Langkawi

complexes. The granitic batholith on each batholith masses was form and embodies with its own individual plutons (Refer **Figure 2.5**).

The Western Belt granite which known as Bentong-Raub line was contained with the ophiolite-melange association that occurs at the west of a belt (Hutchison,1977). According from Ghani (2005), the ophiolite line is a marked of the Triassic collision suture that split an eastern Peninsular Malaysia crustal block and western Peninsular Malaysia crustal block. Later then, Ghani (2005) also stated that Mitchell (1977) propose the Western belt granite can be divided into three distinct groups according to the the different tectonic reconstruction because the Western Belt granites were formed in a continent collision setting broadly analogous to that of the Tertiary Himalayan leucogranites..

Ghani (2005) stated that the total granite cover in the first group, Western Belt granite was 90% volume and the type if rock was a coarse to very coarse grained megacrystic biotite muscovite granite. Commonly mineral composition for individual granitic body was aplopegmatite and mesogranites associated and it was a frequent comples that develop in mineral layering. The second group which was located at north part of the Western belt granite and the granitic bodies was associated with to the amphibole. For an example is the Bintang granite complexes. The common mineralogical assemblages of this complex is low Al-biotite+sphene+actinolitic hornblende (Liew, 1983). Ghani (2005) stated that Khoo and Lee (1994) was describe that the Western belt granite at the northeast is plutonic rocks that was contained of hornblende-biotite quartz monzonite, tonatite, granodiorite and adamellite from northeastern most Western Belt granite. For the third group, the

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Western belt was identify as the felsic volcanic rocks that also known as a volcanic complex, which is temporally and spatially to the granite.

According to Ghani (2000), Alexander (1968) stated that the Bentong Group period age for complex intruded for Selut Schist was from Pre-Devonian, Gombak Chert from Late Devonian to Early Carboniferous period and Sempah Conglomerate from Permian period. This complex was consist units of tuff lavas, lavas and a characterize as porphyry subvolcanic unit which contains pyroxene and phenocrysts (Liew, 1983). As for the two main rock types of the complex were orthopyroxene bearing rhyodacite and rhyodacite (Ghani, 2000).

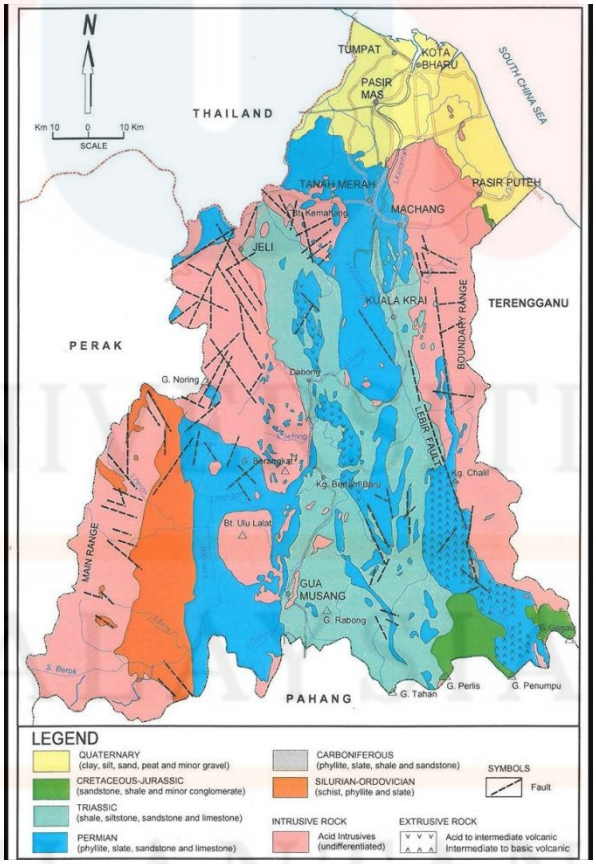

Figure 2.5 General Geology of rock distribution at Kelantan (Elhaj, 2016)

According from Hutchison (1977), the Main Range Belt was bee uplifted uplifted by several kilometre since the Triassic. The margin of the Main Range granite,just west of the Bentong-Raub SW are near Bentong is characterised by strongly gneiss granite and augen structures.

2.6.2 Petrography of Granite

Igneous rock was formed when the magma which is molten rock material freezes and solidifies. Intrusive igneous rock (or also known as plutonic) and extrusive Igneous rock (o also known as volcanic) were two type of igneous rock. This igneous rocks was different under diverse conditions from texture, mineral composition, and appearance. Intrusive igneous rock or plutonic was formed when magma was solidifies inside the Earth and after that the rock was uplifted to the surface. The process was long term period that take over many thousands or millions of years that effect the mineral grain size that form the large size and visible mineral to the naked eyes. The texture was a coarse grain.

Another one was extrusive igneous rock or volcanic was formed after the magma (in molten material) rise up to the earth crust and solidifies above or near the Earth's surface. These are the rocks that form at erupting volcanoes and oozing fissures. Because the volcanic igneous rock was solidifies too quickly, the mineral grain size cannot formed or less visible to naked eyes and this small grain size were consists of the very fine-grained or even glassy texture. However, the characteristic or volcanic igneous rock has a formed of bubbly and vesicular texture because of the hot gas bubbles that trapped during the quick solidification.

Igneous petrology was a study of the occurence, origin, evolution, composition and classification of the rocks that formed from magma. According from Frost and Frost (2019), igneous petrology was subdivided into 2 component which are igneous petrography and igneous petrogenesis. Igneous petrography was the study of the description and classification of igneous rock while igneous petrogenesis was a the study of the origin and evolution of igneous rocks. As for the research focus study was more focus on igneous petrogenesis because of the objective and the scope of study was to study the origin and history of granite in Gua Musang itself.

Ghani (2005) stated that Western Belt granite mineral was influence by mineral abundance, of a K-feldspar, quartz, plagioclase, biotite, muscovite, allanite, zircon, sphene, apatite, secondary epidote, tourmaline, ilmenite, amphibole, andalusite and garnet. Amphibole found in the northern part of the Western Belt granite is mainly actinolitic hornblende in composition with an atomic Mg/(Mg+Fe) range from 0.5 to 0.6 (Liew, 1983). Liew (1983) suggested that the geochemical difference between the granitiods of both provinces largely reflects the S type nature of the West Coast and the predominantly I type nature of the East Coast granitoids. Among the geochemical difference between these two granitoids provinces are:

i. The expanded range of compositions of the Eastern Belt Granite ($Si0_2$: 50 to 78% Si02) compared to that of the Western Belt granites ($Si0_2$ > 65%).
ii. The Western Belt Granites have lower Na_20 contents and high Th, U, Sn, Pb and Cs contents compared to the Eastern Belt Granite
iii. Magmatic evolution of the Western Belt Granites were controlled by K-feldspar, plagioclase and biotite whereas in the Eastern Belt granite, hornblende,

Kfeldspar, plagioclase and biotite was the important mineral assemblage in the magmatic evolution.

According Yao et al (2017), the Permian Formation was consist of the volcanic igneous rock and carbonate sedimentary rocks that was poor with mineral quartz. As for Triassic sedimentary rock made up of organic particles and sandstone is quartz-rich. Hence, the metamorphic rock consist of quartz mineral that was richer than the igneous rock and carbonate rocks that varies across the area.

2.6.3 Origin and History of Igneous Rock

According to the Frost and Frost (2019), Igneous rock formed in a variety shape. Mafic volcanic rock was occurred mostly as flows, felsic volcanic that also form flows, but also commonly form pyroclasticrocks , or rocks fragmented while still hot. Hypabyssal rocks may form as lava domes , dikes , or sills , and plutonic rocks occur as plutons and batholiths , as well as dikes and sills.This lava flows thickness was range from less than a meter to more than ten meter. Mafic lava flows was subdivided into two type of which is blocky lava and massive lava with a ropey surface is called pahoehoe.

In cross-section, many flows, particularly those that ponded before completely crystallizing, show columnar jointing. Columnar jointing forms by contraction that cracks the rock as heat from the flow dissipates to the ground surface. The vertically oriented columns, which are typically hexagonal in cross section, are commonly relatively wide at the base of the flow and more narrow at the top. Where basalts

erupt or flow into water, and formed pillows. The magma that contacts water is chilled and quenches, forming a distinctive lobate, or the top of a flow, something that may be difficult to recognize in complexly deformed volcanic rocks

2.6.4 Characteristic and Mineral Composition of Igneous Rock

Igneous petrology based the texture and structure to observed and analysis igneous rock crystalised. Texture and structure had a same meaning even though the texture of a rock refers to the small-scale appearance of the rock such as the size, shape, and arrangement of its constituent phases,including minerals, glass, and cavities while the structure of a rock refers to larger-scale features recognizable in the fieldwork such as banding, variations in mineral abundances, or jointing. The texture can figure about the cooling and crystallization rated and phase relations between minerals and magma at the time of crystallization. As for structure, it can provide information of the process that happen during the formation of rocks and the mechanisms of differentiation (Frost and Frost, 2019).

Further explain by Frost and Frost (2019), an igneous rock crystallization was a variable control by the cooling rate. When the magma was cooled down and has a very slow cooled down rate, it will form the plutonic rock and also the nucleation will be slow and nutrients will have ample time to migrate through the melt to grow large (up to centimeter-sized) crystals. Such a coarse-grained rock is said to be phaneritic . If a magma cools quickly, as in a hyperbyssal or a volcanic rock, then nucleation will be rapid and many nuclei will compete for resources, producing an

aphanitic , or fine-grained rock. In some volcanic rocks, the magma cooled so rapidly that no nuclei at all could form and the resulting texture is glassy .

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CHAPTER 3

MATERIALS AND METHODOLOGIES

3.1 Introduction

Material was the material or an equipment that was use to conduct the research study session while the method is the step of procedure that was conduct while using the material or an equipment. The material and method section was really important part where it can customized the research study and help the student to know the procedure that need to conduct step by step.

The Geoscience students need to perform fieldwork and lab experiment to conduct the FYP research. But because of the COVID-19 outbreak, the procedure of the method was change into secondary data collection and analysis. The secondary data can be obtain either in Google scholar engine or by survey and data record form the government or private sector. But as for the Chapter 4, software and other application will be use to analyse the geological map such as ArcGIS.

The method phase for this research study was consists of 5 phase which is preliminary study, secondary data collection, data processing, data analysis and interpretation and lastly is report writing and thesis writing.

3.2 Materials/Equipment

The material and equipment that was use for this research was secondary data that can in online (Google Scholar engine) or offline (survey or books) and also the Chapter 4 where there a software or application that was use to process and analyse the data of geological map, drainage pattern and other.

Table 3.1 Method, and software that used and its description

Secondary Data	• Google Scholar is the search engine that use to search journals, books, and anything related to the research study in the area that was collected and analyse.
ArcGIS 10.3 Software	• ArcGIS software is necessary for digitizing geological mapping. • ArcGIS software also will be used to analyse the geomorphology, drainage pattern, slope, and other analysis.
Google Earth Pro	• To view the Earth from satellite imagery, map, terrain, 3D building, and to outer space. For this research study, the Google Earth Pro was serve as to view the street, landuse, forestry, facilities and other because the fieldwork study was removed.
GeoRose	• GeoRose was to plot and rose diagram and stereonet plotting program by using the lineament, strike and dip data. However, for this research study, it was use to analyse the negative lineament.

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Bowen Reaction Series Diagram	• To determine mineral that formed at specific temperature during the as magma cooling and solidifies. • By analyse the literature review under petrography study, Bowen Reaction Series Diagram can be used to have a better understanding of the origin and history of the granite rock formation.

3.3 Methodology

Methodology was a procedure that help student to analyse and gather a data in more accordingly and strategic step. As it also was help to manage the time spend and research discovery. There a 5 phase that was conduct which is preliminary study, secondary data collection, data processing, data analysis and interpretation and lastly is report writing and thesis writing.

3.3.1 Phase 1 : Preliminary Studies

The preliminary study was the first phase to understanding the purpose of the study and what benefit of it before further study research was done. It is like proposed a quality review or evaluation related to the issues in the study area. Data collected form the Google maps, previous thesis, and report for more information. From Google maps, the base map can be analyse because the limited studies for fieldwork study because of the COVID-19 outbreak . Besides, a preliminary study needs to be confirmed before the objective, summary, and study area was decided.

3.3.2 Phase 2 : Secondary Data Collection

In the secondary data collection, the data that was related to the main objective and specific research study was collected. Most of the data was in the journals, books, and website that search is related to the petrography, petrology, mineralogy of granite in the Bukit Senting and Gua Musang area. Besides, the research study also includes the research of the geomorphology and landform of rock, drainage pattern and system, stratigraphy, history, and many more. All this data was collected by using the Google Scholar search engine to help in secondary data collection.

3.3.4 Phase 3 : Data Processing

Data processing phase was the data that was process using the ArcGIS 10.3 software and GeoRose software. The data that was analysis was the geological map, drainage pattern, structure and geomorphology. This phase was to fulfill the main objective of the research study in the chapter 4. There also data that was process from the Google Earth Pro and it help from the forestry, landuse, vegetation, society or community analysis and the accessibility that was surrounding the basemap.

3.3.5 Phase 4 : Data Analysis and Interpretation

After the data was collected, the data will be analyse and interpret to understand more the granite distribution and the mineral composition of the granite in the research area. The method that was used to analyse the geological map in ArcGIS 10.3 software and Google Earth Pro software. This software helps to analyse the

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geomorphology, stratigraphy, fault line, lineament line, drainage pattern that later was used to better understand the granite landform and formation. Another method is using Bowen Reaction Series Diagram after the mineral composition data were collected throughout the secondary data collection. This is another method to analyse the origin and formation of granite in the research area. If the granite is more in quartz, means it felsic rock, and the temperature during solidification is low to 800°C and other more.

3.3.6 Phase 5 : Report Writing and Thesis Writing

The last part of the research methodology is report writing which documentation part of all data gathered according to the format of FYP writing provided by Faculty Earth sciences, University Malaysia Kelantan, for academic documentation purposes.

3.4 Flowchart of Methodology

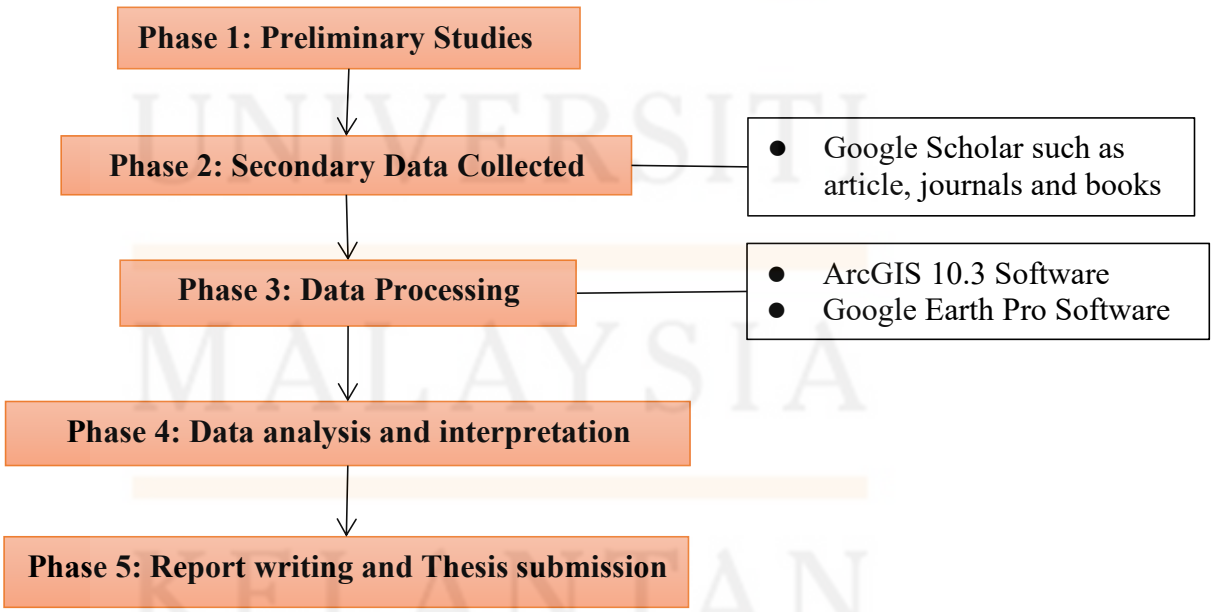

Figure 3.1 Flowchart of method research

CHAPTER 4

GENERAL GEOLOGY

4.1 Introduction

Chapter 4, general geology was a chapter that fulfill the main objective which is to update the geological map in scale of 1:25,000 of the study area. The study area basemap was located at Bukit Senting, Gua Musang, Kelantan. The location was selected because the specific research was to analyse the petrology of granite and the area was famous for it Main Range Granite Formation.

4.1.1 Brief Content

The base map produce with scale of the map is 1:25000 and the study area located at Bukit Senting, Gua Musang, Kelantan, which near the border of sub-district Gua Musang of Galas and Nenggeri. The edge of the coordinate is,

a : 4° 58' 22.80" N, 101° 52' 31.84" E

b : 4° 58' 22.836" N, 101° 55' 17.292" E

c : 4° 55' 44.08" N, 101° 55' 17.148" E

d : 4° 55' 44.076" N, 101° 52' 32.52" E

The landuse and forestry in the basemap was oil palm plantation and Hutan Rizab Nenggiri. As for the road connectivity, the community use the collector or

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residential road that no tar to move around in the estate. The facility and accessibility that near the basemap was Gua Musang town and the it took nearly 20 to 25 minute to go from basemap tu Gua Musang town to gain the tools or needs. The distance from basemap to Gua Musang town was 20km length. The rock that can be found in study area is intrusive rock which is granite (with minor granodiorite) and sandstone and shale (shale undergoing meta-sediment to form into a phylite, schist and slate).

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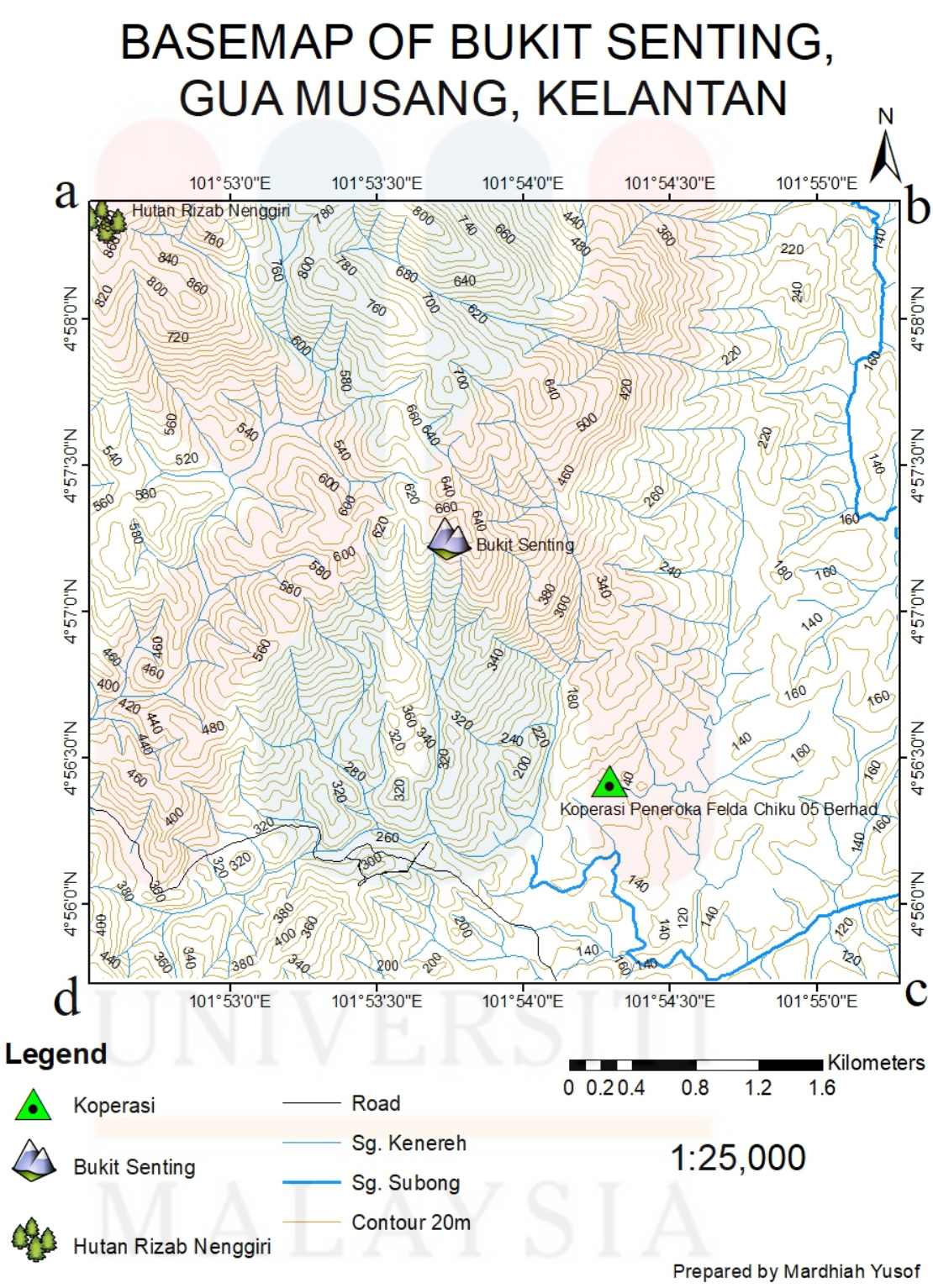

Figure 4.1 The basemap of Bukit Senting, Gua Musang, Kelantan

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4.1.2 Accessibility

The accessibility was really important for community to get the item and and needs from the facilities area. And because the Gua Musang town was located at the center or the Gua Musang district, the population at the area were more than the other place. The Gua Musang town also was located near the boarder of it subdistrict, Galas, Bertam and Chiku. Surrounding the Gua Musang town was mostly plantation or forestry area. Thus, the road connectivity was limited and the population that live near the plantation society was limited to the society.

Refer to **Figure 4.2**, road for the collector and residential was limited to the community of estate while the Gua Musang town was full of other accessibility and facility of private sector and government sector.

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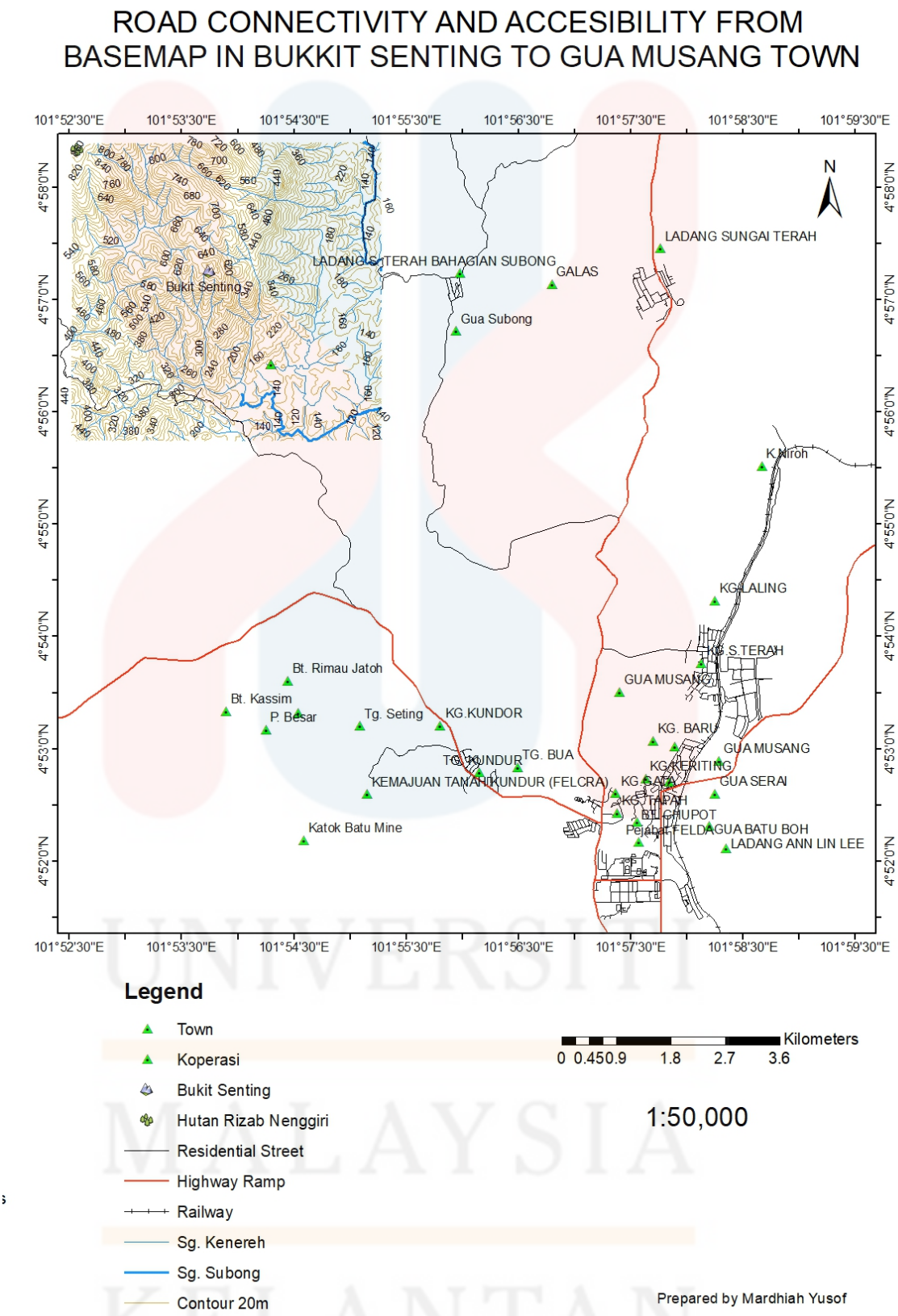

Figure 4.2 The road connection and accessibility from basemap to the Gua Musang town

4.1.3 Forestry (or Vegetation)

The forestry on the basemap was reserved forestry which is Hutan Rizab Nenggiri located at the North-Western side of the basemap. Refer to **Figure 4.4**, the forestry was dominant by trees and bush. The land use in Gua Musang is used for plantation and forestry. Most of the landuse used for oil palm plantation, rubber tree that manage by Felda or private sector while reserve forestry was manage by government sector (Refer **Figure 4.3**). Reserve forestry in Gua Musang was reserve as the government property and will be used if the government have an forestry project in future. It also forbidden to enter the reserve forestry without any permit and take the forest product in there.

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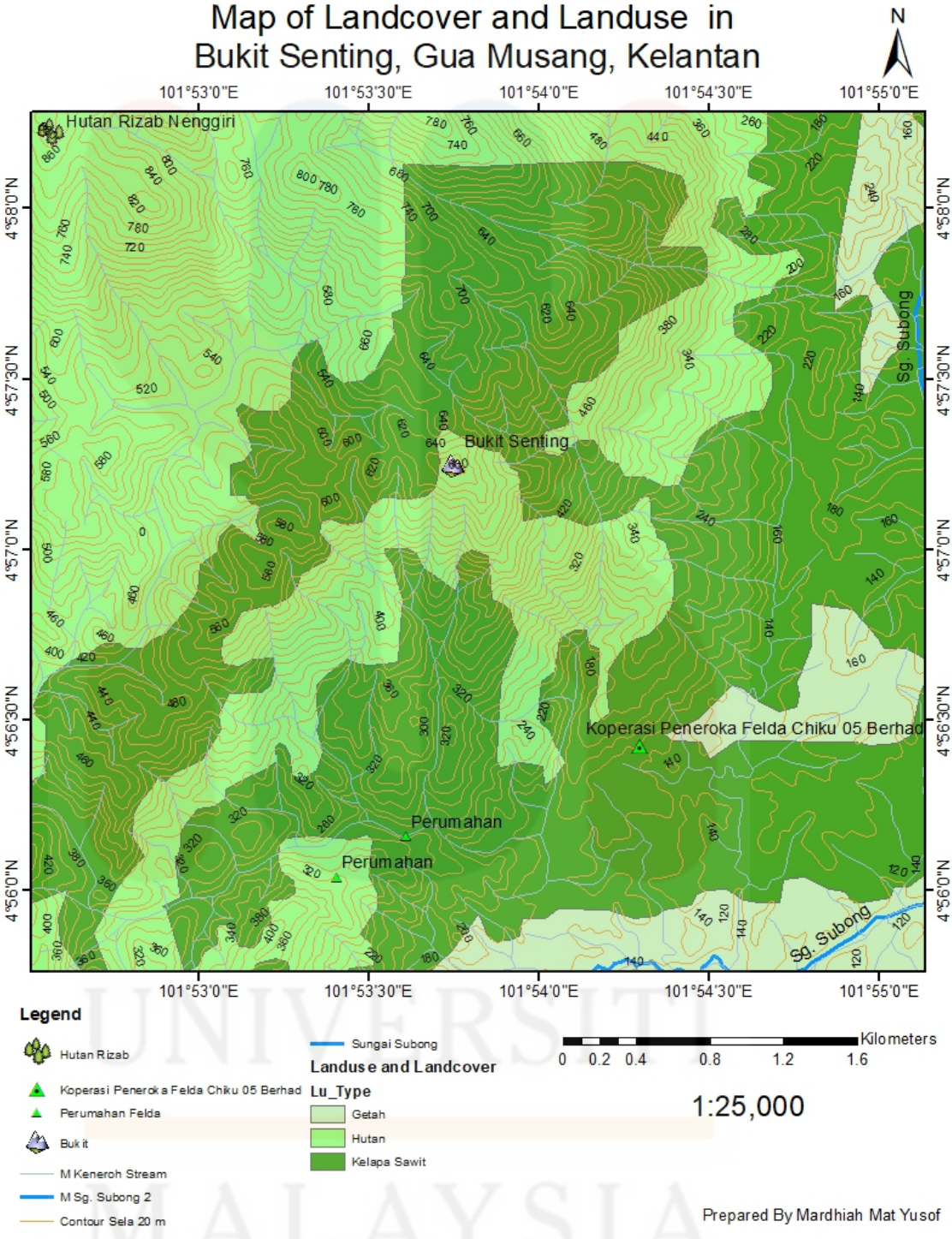

Figure 4.3 The land use in the study area that covers by forestry, palm oil, and rubber farm

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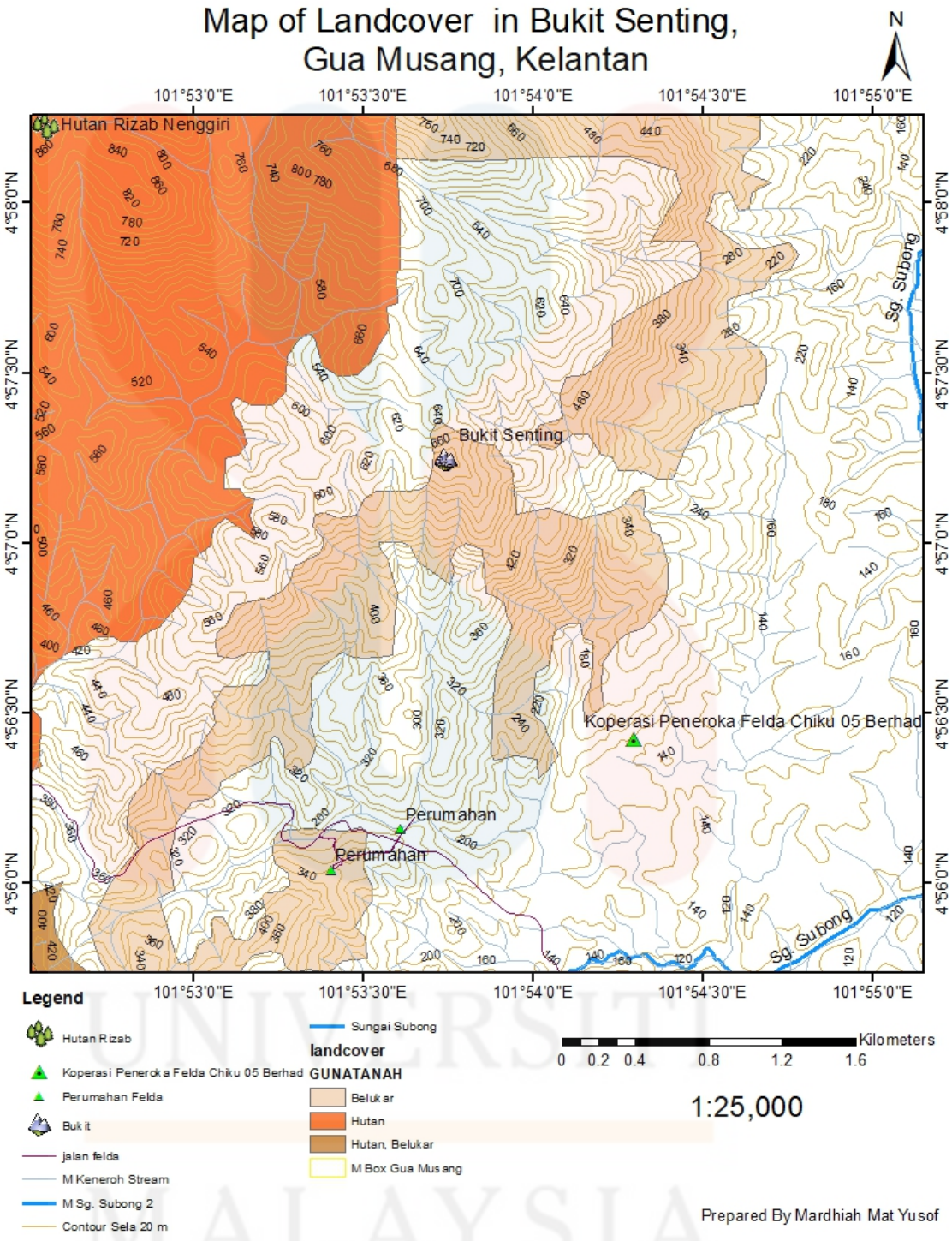

Figure 4.4 The land cover map in Bukit Senting, Gua Musang, Kelantan

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4.2 Geomorphology

Geomorphology was the study of the landforms, topography, sediment deposit and drainage pattern that effect the area. By study the landform and landscape of the area, the rock type can be analyse. Beside drainage pattern also can be analyse how the type of rock, porosity of material and the pattern that influence the area.

4.2.1 Geomorphologic

Geomorphology was a study of landform and topography that can be analyse using the elevation data of the area. For the basemap elevation, the highest elevation was 937m from the sea level located at the North-Western side of basemap while the lowest was 101m from the sea level located at the South-Eastern side of map (Refer **Figure 4.5**). The hill on the study area consist of high hill with the high slope (Refer **Table 4.1**).

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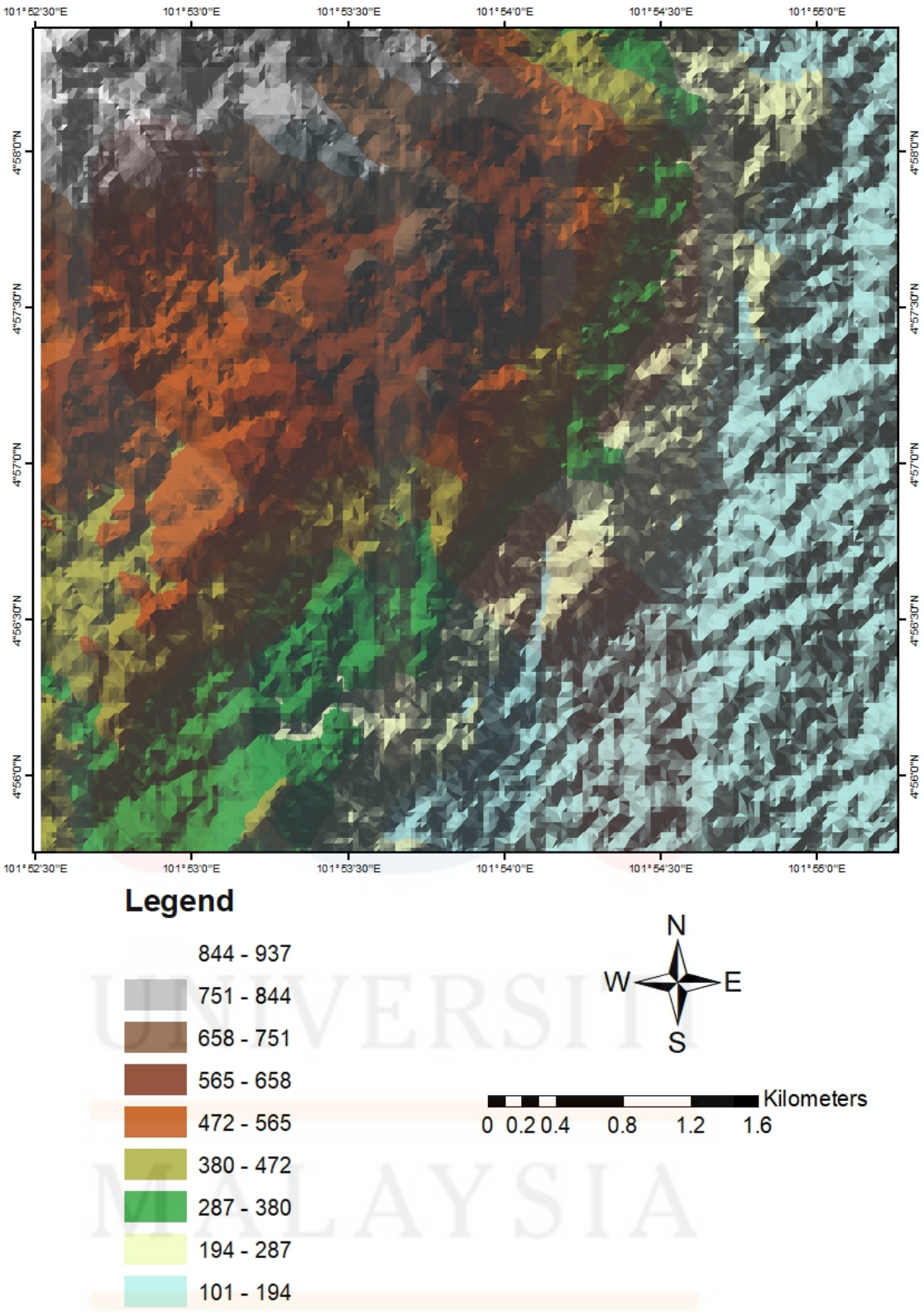

Figure 4.5 The landform with elevation of the basemap in Bukit Senting Gua Musang.

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Table 4.1 The number of sites having different elevation, slope, aspect, and land surface types (Wood, et al 2018)

Elevation (m)		Slope (°)		Aspect		Land surface	
800–999	21	flat	66	E	55	forest	66
1000–1199	56	1–5	71	N	33	grass–shrub–crops	127
1200–1399	45	5–10	38	NE	44	rock–rubble	22
1400–1599	28	10–15	22	NW	9	urban	9
1600–1799	26	15–20	21	S	19	wetland	8
1800–1999	22	20–25	6	SE	31		
2000–2199	18	25–30	6	SW	24		
2200–2399	10	> 30	2	W	17		
2400–2599	4						
> 2800	2						

4.2.2 Drainage Pattern

There are 2 drainage pattern that can be observe which is dendritic patterns and parallel pattern (Refer **Figure 4.6**). Dendritic patterns can be seen at location where the rock or unconsolidated material was beneath the stream and has no particular fabric or structure and can be eroded equally easily in all directions. Another was parallel drainage pattern that formed because of the steep slopes with some relief. And because of the steep slopes, the streams are swift and straight, with very few tributaries, and all flow in the same direction (Earle, 2015).

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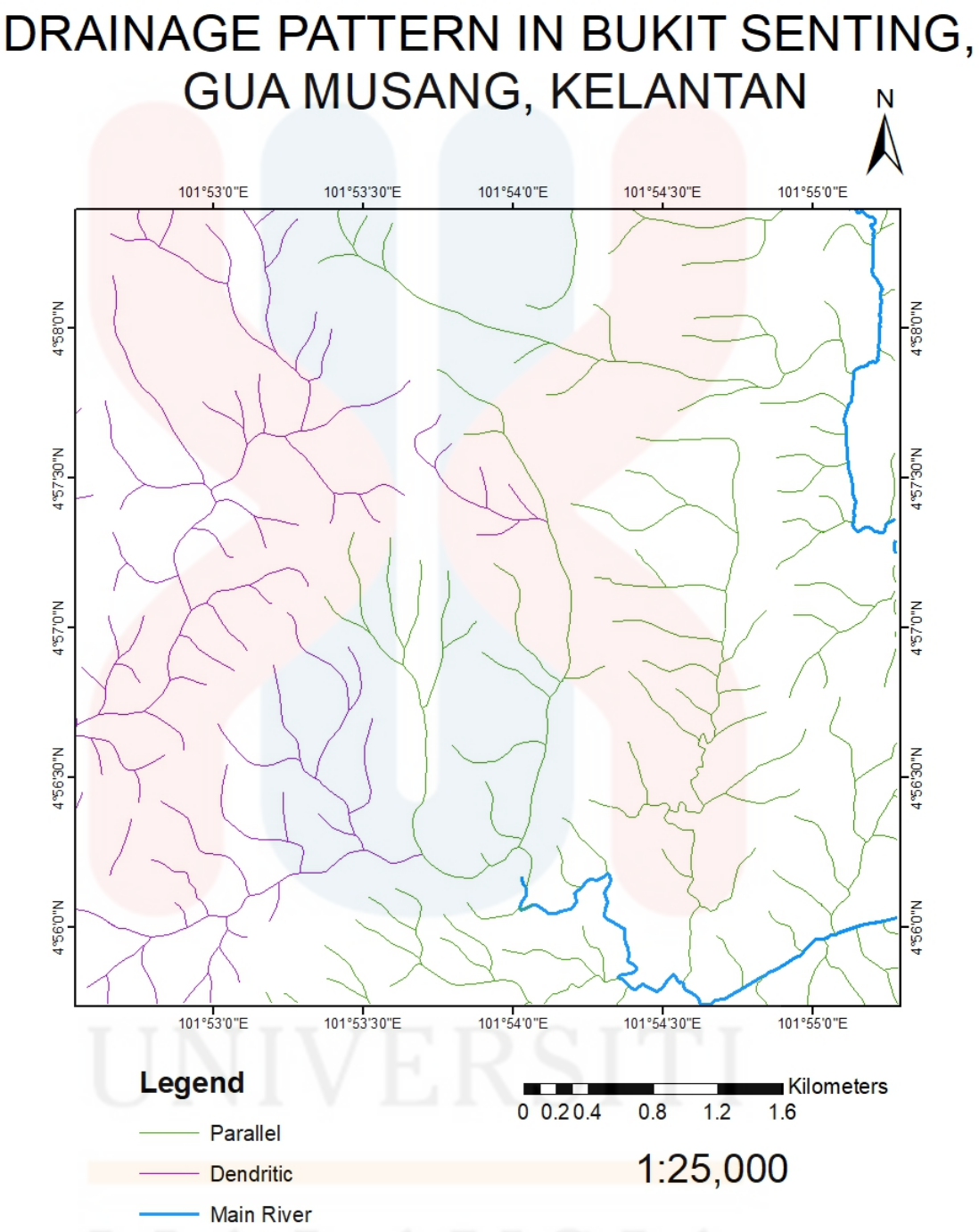

Figure 4.6 The drainage pattern in Bukit Senting, Gua Musang, Kelantan

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4.3 Lithostratigraphy

Lithostratigraphy was a lithological characteristic of the strata and the relative stratigraphic position. The relative stratigraphic position is to determine the beds age from older to youngest. By using the hierarchical system to classified the unit bedding rock along with the formations and classification that describe the rocks.

4.3.1 Stratigraphy Position

Stratigraphic position can be analyse with cross section on the rock to identify the oldest to youngest rock. In the basemap in **Figure 4.7**, the cross section from A to A' can be seen to cut from the North-Western side of map to the South-Eastern of the map and all rock boundary was included in the cross section. From the A to A', the rock boundary that was include are granite, shale and sandstone and lastly alluvium.

The older rock which is shale and sandstone was aged from a Permian period. According to the Yao et al (2017), the test result from the ASTER imagery stated that the carbonate sedimentary rocks from the period of Permian consist of poor quartz while Triassic sedimentary rock made up of organic particles and sandstone and was rich with quartz mineral.

By refer to the **Figure 4.7**, the stratigraphy unit from oldest to the youngest bed rock was shale and sandstone, granite and recent age was alluvium. The rock unit age was identify by using the previous research data and literature review. According to Jamil et al (2016), the granite was aged on the Triassic period from age 200 to 225

Ma ago and the rock was influence by granitoids coarse grain was widespread at Western belt of Peninsular Malaysia. Also according to Jamil et al (2016), the biggest batholith in the Western belt was the Main Range granite which characteristic of peraluminous to metaluminous granite and granodiorite and displays typical ilmenite-series characteristics.

As for alluvium, alluvium was created by weathering of sediment and deposition of sediment form high ground to the lower ground. It also can be transport using drainage from high elevation to the low elevation. That why, most of the alluvium that can be identify was located at main river which is Sungai Subong.

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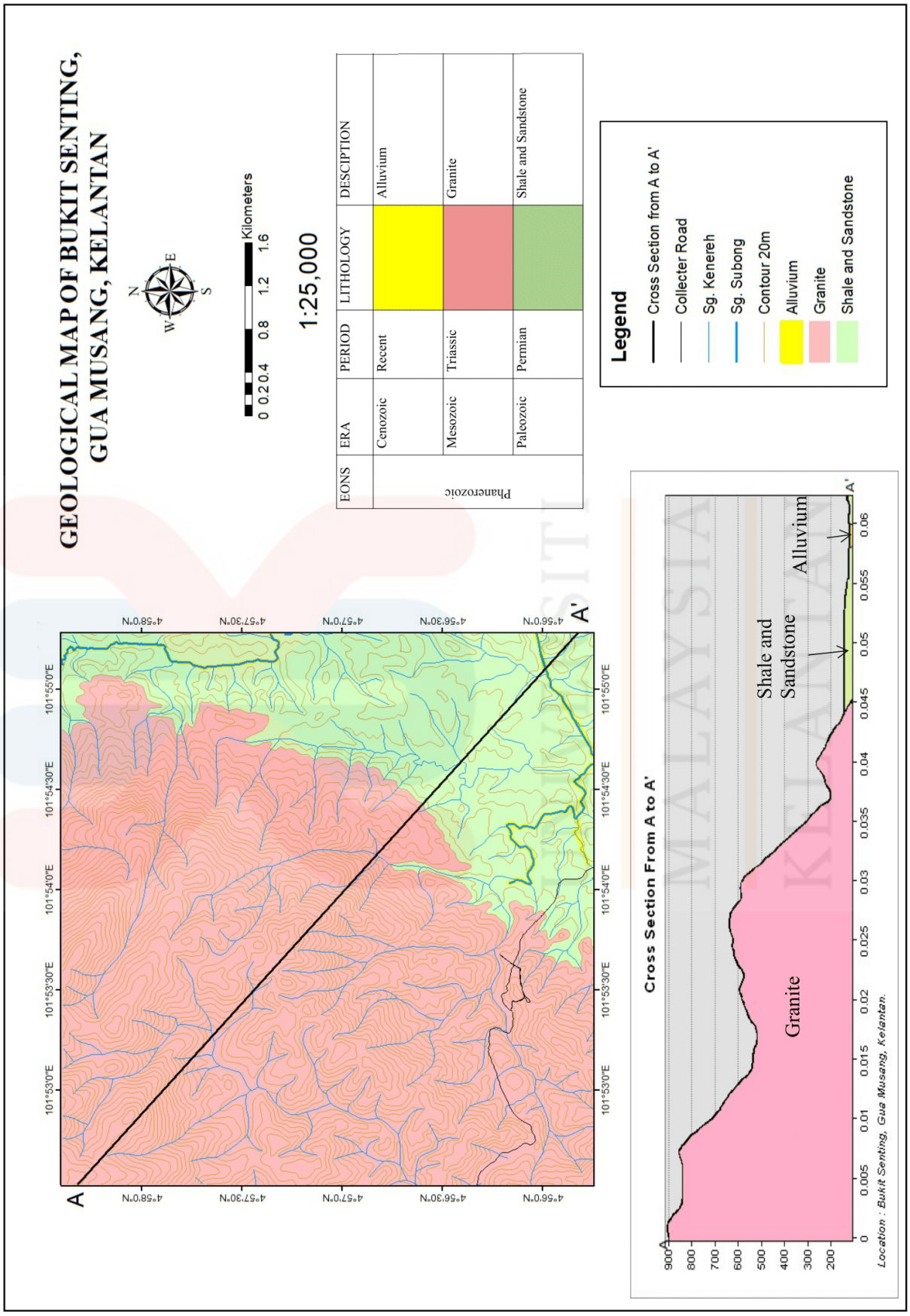

Figure 4.7 The geological map of Bukit Senting Gua Musang,

4.3.2 Unit Explanation

4.3.2.1 Shale and sandstone unit

Composition of shale and sandstone unit: The rock of shale and sandstone was undergoing meta-sediment process as it change from parent rock into metamorphic rock. This unit of rock was sedimentary rock so the landform was a bit flat than the granite landform. Because it was a sedimentary rock, the weathering rate was higher than other rock formation (Yao et al, 2017) .

4.3.2.2 Granite unit

Composition of granite: The rock that was dominant at here was granite mainly granodiorite The granite colour can't be view from Google earth imagery but it can be analyse using it landform and previous research studies. Granite usually consist of low weathering mineral that and thus uplifting in high slope and high landform (Ghani, 2005; Ghani et al, 2013).

4.3.2.3 Alluvium unit

Composition of alluvium: Alluvium was dominant by sediment deposit that was erode and transport to during weathering process form higher ground to the lower ground and also can be transfer during rainfall and drainage. The colour of sediment on the Earth view was a slightly orange and was deposited near the side river bank.

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4.4 Structural Geology

Structural geology was a formation that was happen because of the plate tectonic movement between and form a fold, fault and lineament line.

4.4.1 Lineament

Lineament was a feature which indicate the linear feature in landscape that can determine the underlying geological structure such as fault, fracture or joint. Lineament also divided into two type which was positive lineament and another was negative lineament.

This data lineament is negative lineament because it was collected near the valley and stream area (Refer **Figure 4.8**).There are 115 data lineament were collected and interpreted into rose diagram. The forces on rose diagram is between angle 25° to 30° (Refer **Figure 4.9**). Using **Figure 4.8**, there was minor positive lineament structure, thus the positive lineament was not plot in the research chapter.

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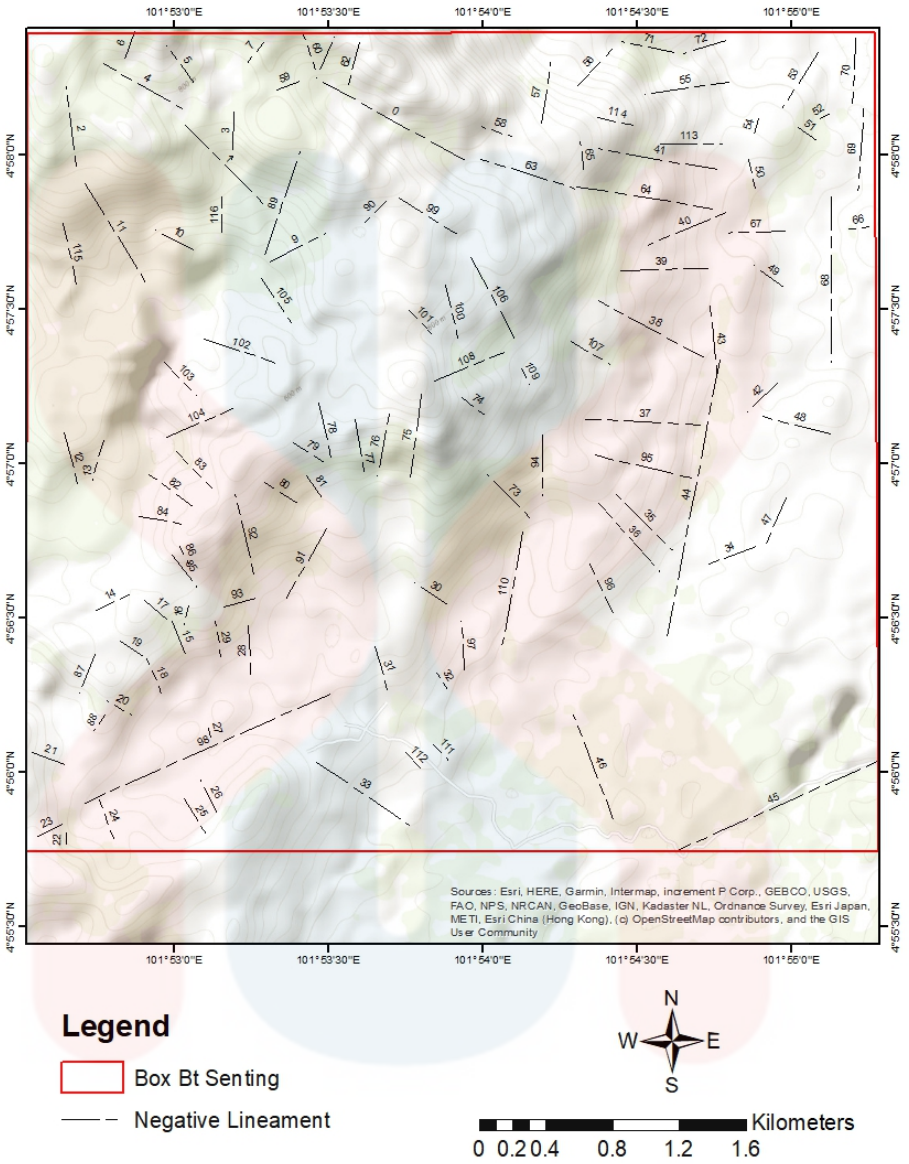

Figure 4.8 The lineament line that was mark on topography map.

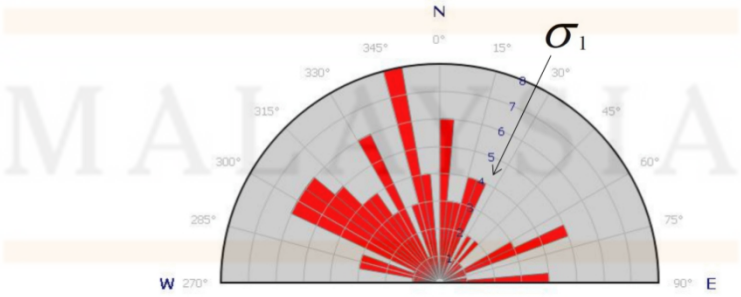

Figure 4.9 The rose diagram of the lineament and the δ_1 was indicated the dominant forces on the basemap area.

CHAPTER 5

PETROLOGY OF GRANITE

5.1 Introduction

Research specification was focus on the petrology of granite in Gua Musang Kelantan and its objective was to study the origin, and granite mineral composition. Also a bit of compared the Western Belt granite and Eastern Belt granite because Gua Musang granite was province by the Western Belt granite and Eastern Belt granite.

5.2 History and Origin of Granite

During the plate tectonic movement which is plate move away from one another, a hot, buoyant peridotite from the mantle rises and, because of its ultramafic composition, partially melts to form a mafic magma that is chemically similar to basalt or gabbro. The magma rises and intrudes into the surrounding lithosphere or is extruded onto the seafloor. This plate tectonic movement was called divergent plate boundary. Peninsular Malaysia was also affected by the granite intruded in to earth crust thus creating 3 elongated paralel belts which is Western belt, Eastern belt and Central belt. This 3 belt then was grouped into 2 province granite which is Western province which is from Western belt and another was a collaborate between Central belt and Eastern belt and was named Eastern province. The age of Western province

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was from age range 200 to 230 Ma while Eastern province was aged from 200 to 264 Ma (Ghani, 2005). The Western belt has many name by other researcher which is Western belt (Khoo and Tan, 1983), Main Range Granite or Bentong- Raub Line (Hutchison, 1977) and Bentong Raub Suture Zone (Metcalfe, 2000). Gua musang granite was effected by these 2 province belt which is Western province and Eastern province. Hutchinson (1977) stated that during the granite intrusion, the Main Range Granite has been uplifted by the several kilometers since Triassic period and the margin of the Main Range Granite, in the west of the Bentong Raub Line SW (near Bentong area) are dominantly composed by gneiss, granite and augen.

Gua Musang Formation was also affected by granite intrusion where the main fault that formed is Lebir Fault Zone. During intrusion,there also strong and compact folding that was occur on the older rock at the area. According from Geologi Society of Malaysia (2010), the folding and faulting direction that occur was between westnorthwestern to the eastsoutheastern and up to eastnortheatern to the westsouthwestern and the intrusion was of diorite porphire towards northeastern to southwestern.

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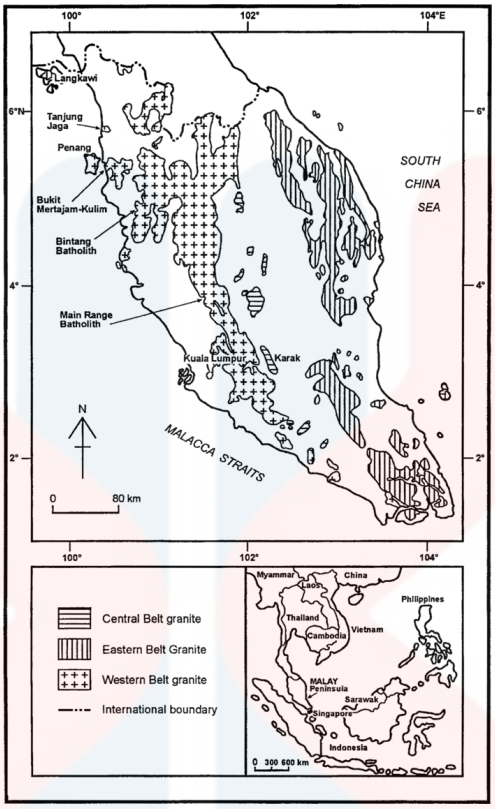

Figure 5.1 The map of Peninsular Malaysia which shows the divided granites batholith according to belt (Ghani, 2005)

After the granite intrusion and uplifting, the weathering was undergoing on the rock. Weathering which is the fragment deposited from parent rock at the Earth's surface. This weathering process was divided into 3 type which is chemical weathering, physical weathering and lastly biological weathering. According to Campbell (1997), the type and rate of weathering rocks depend on the rock characteristic, the physical, chemical and biotic characteristic of the weathering fluids, the nature of reactions at the mineral surface and environmental factors.

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5.3 Petrology of Granite

Ghani (2008) stated that Peninsular Malaysia belt which is Western belt and Eastern belt granite had a characteristic of S type of granite. The Eastern belt mineral composition of silica dioxide, SiO_2 was range from 50% to 78% while the Western belt silica dioxide, SiO_2 is more than 65%. The Western belt granite has high SiO_2 because of the magmatic evolution by mineral of K-feldspar, plagioclase and biotite. The magmatic evolution in the Eastern belt was controlled by granite, hornblende, K-feldspar, plagioclase and biotite. By using the zircon mineral on the belt to analysis the age, the Western belt granite was older than the Eastern belt granite. The dated for Western belt granite was from 900 to 1400 Ma while Eastern belt granite aged between 1500 to 1700 Ma. Thus, the Western belt granite was consists of monzogranite and syenogranite while Eastern belt granitoids have more expanded composition from granite to diorite.

The Western belt granite mineral was consists of the K-feldspar, quartz, plagioclase, biotite, muscovite, allanite, zircon, sphene, apatite, secondary epidote, tourmaline, ilmenite, amphibole, andalusite and garnet. At the Western belt granite of the north, the amphibole mineral was founded and mostly was actinolitic hornblende in composition with an atomic Magnesium, Mg/(Magnesium, Mg and Iron, Fe) range from 0.5 to 0.6 (Liew, 1983).

According to Campbell (1997), the mineral that crystallised during the temperature was high which was biotite and plagioclase feldspar was unstable at the Earth surface stated that minerals that crystallise at the highest temperatures,

especially biotite and plagioclase feldspar, are unstable at the Earth's surface and exposed more during alteration. The biotite and plagioclase feldspars are chemically altered, leaving the quartz and potassium feldspars in relief. As the surface is rapidly reduced by flaking, such pitted surfaces are an indicator of recent exposure from beneath the regolith.

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CHAPTER 6

CONCLUSION

6.1 Conclusion

Peninsular Malaysia belt was divided to three parallel belt and one of the belt which was Western belt or also known as West province was the effect of the Main Range Granite and was aged from 200 to 230 Ma (Ghani, 2005). According to Hutchison (1977), the Western belt granite consist of the ophiolite-melange association and was identify as Bentong-Raub line and was affected by Lebir Fault Zone in the east. Igneous rock in Gua Musang are granite, diorite porphire, andesite, ignimbrite dan dolerite and near the boundared area of granite intrusion and most of the sedimentary rock that near the boundary area of granite and sediment was formed in compact and mainly folding. According to Jamil, et al (2016), the granite intrusion was ages from Triassic period (200 to 225 Ma) and was granitoids characteristic grain. The granite formation was the biggest batholith in the Western Belt and consists of peraluminous to metaluminous granite and granodiorite and displays typical ilmenite-series characteristics. This granite formation was called the Main Range Granite was widespread in Western Belt of Peninsular Malaysia.According to Ghani, et al (2013), this Triassic Main Range Granite formed during Paleo-Tethyan Bentong–Raub suture zone was regarded exclusively as an S-type granite. However, Ghani, et al (2013) said that the Main Range Granite was dominantly biotite granites of batholithic proportion and host one of the world's largest tin provinces.

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