GEOLOGY AND PETROLOGY OF PLUTONIC ROCK IN KUALA KRAI, KELANTAN

by

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DECLARATION

I declare that this thesis entitled "Geology and petrology of plutonic rock in Kuala Krai, 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.

Signature : 

Name : Siti Syarifah Binti Azri

Date : _____

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

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Geology and petrology of plutonic rock in Kuala Krai, Kelantan

ABSTRACT

The thesis is related to geology and petrology of plutonic rock in the study area of Kuala Krai, Kelantan. This study area is covered 25 Km^2. The objectives of this study is to generate detail geological map with the scale of 1:25000 and study the origin of the plutonic rocks in the study area based on petrography analyses. From the analysis using the secondary data, the study area consists of various types of rocks such as sedimentary rocks, igneous rocks and metamorphic rocks from 299 to 251 million years ago to date that is alluvial, microgranite, granite, metasediment and phylite. Comparison of plutonic rock between rock in Berangkat Pluton (Mohd Rozi Umor et al,2012) and Stong Complex in Kelantan (Ramdanshah & Mohd Rozi, 2001). Both are using the X-Ray Diffraction method to get data of major element and trace elements. XRF is non-destructive analytical tool used to test the fundamental structure of materialsThere are nine samples of different rock types taken in Berangkat Pluton (Mohd Rozi Umor et al,2012) while eight samples also from different rock types taken in Stong Complex (Ramdanshah & Mohd Rozi, 2001). Harker diagram is generated to an analysis, comparison between trace element and a major element in both places.

Geologi dan petrologi daripada batuan plutonik di Kuala Krai, Kelantan

ABSTRAK

Tesis ini berkaitan dengan geologi dan petrologi batu plutonik di kawasan kajian Kuala Krai, Kelantan. Kawasan kajian ini meliputi 25 Km^2. Objektif kajian ini adalah untuk menghasilkan peta geologi terperinci dengan skala 1: 25000 dan mengkaji asal-usul batuan plutonik di kawasan kajian berdasarkan analisis petrografi. Daripada analisis menggunakan data sekunder, kawasan kajian terdiri daripada pelbagai jenis batuan seperti batuan sedimen, batuan igneus dan batuan metamorf dari 299 hingga 251 juta tahun yang lalu hingga kini yang terdiri daripada aluvial, mikrogranit, granit, metasediment dan filit. Perbandingan batuan plutonik antara batu di Berangkat Pluton (Mohd Rozi Umor et al,2012) dan Kompleks Stong di Kelantan (Ramdanshah & Mohd Rozi, 2001). Kedua-duanya menggunakan kaedah X-Ray Diifactions untuk mendapatkan data elemen utama dan unsur surih. Alat analisis yang tidak merosakkan digunakan untuk menguji struktur asas bahan. Terdapat sembilan sampel jenis batuan yang berbeza diambil di Berangkat Pluton (Mohd Rozi Umor et al,2012) sementara lapan sampel juga dari jenis batuan yang berbeza diambil di Kompleks Stong (Ramdanshah & Mohd Rozi, 2001). Gambar rajah Harker dihasilkan untuk analisis, perbandingan antara unsur surih dan elemen utama di kedua tempat tersebut

TABLE OF CONTENTS

NO	LIST OF FIGURE	PAGES

NO	LIST OF TABLES	PAGES

LIST OF SYMBOL

^{o}	: Degree
µ	: Micro

LIST OF ABBREVATION

m	: meter
km^2	: Kilometer

CHAPTER 1

INTRODUCTION

1.1 General Background

Petrography analysis is an identification of rock types based on mineral composition using the Quartz, Alkali feldspar, Plagioclase, Feldspathoid (QAPF) diagram. This analysis must implement after finishing the geological mapping of the study area using the petrographic microscope that only available in laboratory not during field. Petrographic microscope known as a compound microscope whereby have ocular focusing on the virtual image of the subject produced in the microscope tube by the objective lens. Thin section are is used to reveals the optical properties of minerals in rocks. By thin section, rock samples thinned becoming 30 micrometer thick, observing using petrographic microscope.

Jeli are located in the center of the district of Kelantan in the eastward of Peninsular Malaysia. Kelantan is an agricultural state with fishing villages and paddy fields. This study area surrounds by two types of rivers which is Terang river and Pergau River. The study area is located at Kampung Bukit Berangan, Kampung Jerimbong, Kampung Bukit Tok Ali and Kampung Bukit Jering. This research focus on the petrography analysis of igneous rock in Dabong, Kelantan. Jeli area consist of Western Belt Granite that separated with a line which parallels with Bentong-Raub

suture with an age of between 200 years to 230 Ma (Ghani, 2005). In that, eastern belt granite includes Eastern and Central belt of Peninsular Malaysia

1.2 Study Area

1.2.1 Location

The study area located in Dabong, Kelantan which is close to the Kuala Krai and Jeli areas. Coordinate values in the study area are from N 5°29'56.835'', E 101°52'1.858" to N 5°29'57.688'', E 101°54'123'' and N 5°27'29.259'', E 1015°2'1.703" to N 5°27'29.626, E 101°54'47.445". The highest elevation of the study area is 211m and the lowest elevation is 40 m. The study area was covered of 25 km^2 and mostly outcrop located in the forest areas because three over four study area are covered by vegetation.

In order to reach Jeli town, it is taking approximately about 19.44 km length. The basemap of the study area is shown below (figure 1.2).

Figure 1.1: Map of Kelantan

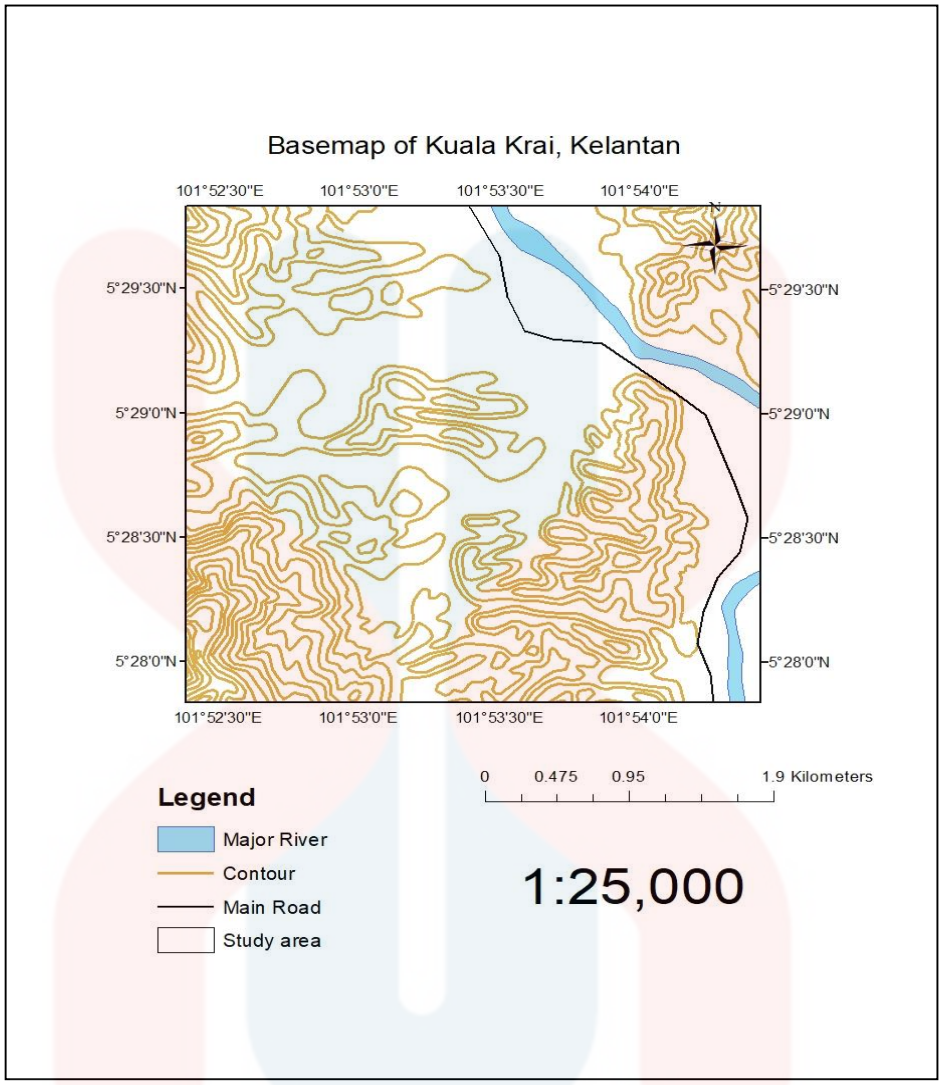

Figure 1.2: Geological map of Kelantan and and basemap of study area

Study area is surrounded by the presence of the hills with untapped with human. There are two main rivers and river in the study area, which the main river in study area are Pergau River and Terang River. River pattern has shown a very good drainage system for plantations. The population of Dabong districts are 121,98 people respectively. The majority is occupied by malay race while minorities are occupied by Chinese, Indian and few of another race.

1.2.2 Road connection/Accessibility

Length of the main road along the study area estimated is 6.9 Km. It is about 65 Km towards Kota Bharu while approximately 63 Km towards Dabong City. This road is located at the middle and right side. There is also small road that connected with main road associated with economic sector in the study area. This area is undeveloped area that is unpaved roads are more than paved roads, making this study area difficult to explore. Paved roads have connected village to village while unpaved roads are located at estate.

1.2.3 Demography

The Study area is covered mostly by lowland and low hills with Pergau river and Terang river are the only main river in this study area. Low hill areas are covered with estate plantations

a) People Distribution

This area dominantly covered by Malay people,which has the highest value of population about 37,836 as shown in Table 1.1. Indian race have 58 people , Chinese have 97 people and the other races are only 35 people. The total people distribution is 38,026 people. The employment of villagers such as car and motorcycle technician, teachers, and seller. There are also non-Malaysia Citizens usually work as oil palm plantation workers at Ladang Tapis.

Table 1.1: People distribution Jeli District (Department of Statistics Malaysia, 2017)

Races	Population
Malay	37, 836
Chinese	97
Indian	58
Other	35

1.2.4 Landuse

Landuse at the study area which is mostly covered by estate with 1,889 hectares of area. Oil palm production can empower the economic sector by reducing import service from other countries. Main estate in this study area is Ladang Tapis. Besides, it consists of two mosques which Masjid Mukim Bukit Tok Ali located at the south area while Masjid Mukim Jerimbong located at east area. The existence of a mosque can make it easier for Muslims to perform prayers. Homestay Kampung Bukit Jering located near the main road at the east part of the area, making it easier for travelers to find a place to stay. Ladang Tapis is located near main road covered 90 % study area. There is only one school in the area which is SK Bukit Jering near Maahad Nauzah Al Nazirin and Homestay Kak Za Tok Bidan.

1.2.5 Social Economic

The study area is covered with vegetation such as oil palm that later was was developed into an agricultural crop. It has social economic that give the source of income for villagers. For instance, SK Bukit Jerig practice academic skills and non-academic skills in between teachers and students.There also has small building that construsted along the main road such as restaurants, grocery shope, and burger stall.Few people make money by repairing cars and motorcycle and open homestay for traveler particulars.

1.3 Problem Statement

There is tremendous need for study of petrography of igneous rock because less detail petrography analysis for igneous rock especially in Jeli, Kelantan.

Besides that, the research problem is no latest geological map of this study area that can be referenced to others researchers.

1.4 Objective

I. To generate detail geological map, of the study area with the scale of 1:25000

II. To study the origin of the plutonic rocks in the study area based on petrography analyses

1.5 Scope of study

This research included laboratory works and geological mapping. Geological map is produced for study area using ArcGIS Software before begin the geological mapping Geological map can observe the geological feature roughly such as flat area, hills, drainage pattern. Meanwhile, geomorphology is covered from higher elevation by observing maximum up to 360 degrees of study area. Geomorphological study is function as to understanding the landform history and predict changes through a combination of field observation, physical experiment. This study also included a geological study that does the petrographic analysis in igneous rock. The types of igneous rock are recognizable using QAP diagram of percentage of mineral element collected. It can improve igneous rock data of the study area such as texture, classification and others. The geological map generated will enhance previous geological map of the study area.

1.6 Significance of study

This research gives a lot benefit to the researcher such as geologist, and students who want to know about igneous rock types. For example, it can be referenced for researcher who want to collect the data of petrography analysis of igneous rock especially in Dabong, Kelantan. This study will also give more information about the granite formation in the magma chamber based on the texture of granite. Moreover, this research can be used by other researchers. It also can generate an updated map that can assist in detecting potential mineral if any.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Literature review which discussing about the previous published information journal, data and the article which is the combination of summary and synthesis, in particular area and within a certain time period. The literature review was done before going to study area to gain estimation, planning about the research topic.

Petrology is the scientific study of rock composition, texture, and structure that is also derived from it in relation to geological processes and to physiochemical conditions and (Ostein, 2019). It is related with three major types of rocks which is igneous, metamorphic, and sedimentary. Petrology covers petrography and experimental petrology, which petrography are using petrographic microscope while experimental petrography perform the laboratory synthesis of rock. Without petrology which find it difficult to interpret our field data (Shaw, 2018). Texture characteristics greatly affect the condition where igneous rocks join from their parent magma. They are controlled by rate and sequence crystallization, which depends on the beginning temperature, gas magma content, composition, and viscosity and stress where it solidifies (Nwachukwu, 2011). Petrography analysis is crucial for all geologists in order to know characteristic and mineral composition in the rock. Besides that, geologists can classify, identify and describe the rock.

2.1.1 Regional Geology

Peninsular Malaysia categorized into two blocks which is Raub-Bentong suture while western part it belonging to East Malaya-block (Indochine Block) (Metcalfe, 2002). The Bentong-Raub zone is classically considered a deep water addition prism with a layer of ophiolite and volcanic molecules determined at the western boundary of the Central Belt (Jorien, 2014). However, similar incidents have also been reported from other locations (Jorien, 2014). Uncertainty about the geological history of the Bentong-Raub Zone is due to the lack of structure, metamorphic and kinematic data of the Bentong Raub Zone itself and the surrounding lithology unit (Jorien, 2014).

Central Peninsular Malaysia surrounded by intrusion is believed to be a graben bounded by normal fault (Harbury, 1990). The Middle and East belts are marked with Lebir Fault Zone. It is marked by a straight line of NNW - SSE flow along Sungai Lebir near Manek Urai in Kelantan (Shuib, 2009). Increases and decreases in the fault zone are thought to result in the deposition of Jurassic Formation - Cretaceous Gagau and Koh. The Peninsula has an elongated NNW – SSE form in the south between Klang and Mersing, with a pronounced dog-leg arch.

The Peninsula backbone defines distribution of NNW – SSE Main Range Granite. The shape is influenced by the regional structures. The backbone of the Peninsula determines the distribution of the NNW – SSE general structural Main Range Granite. Central spine is separated betweem western and eastern parts pf peninsular that is extending from Malaysia–Thailand border to southern state of

Negeri Sembilan (Shuib, 2009) The Central Graben is characterized by gently folded sedimentary formations of Triassic and Mesozoic, underlined by stronger folded rocks of Permians. Pyroclastics is common in rock.While , the granites are usually less deposited in Central Graben, and and it is limited to complex belts that passing through Gunung Stong and Gunung Benom, uplift high grade of metamorphic rocks (Hutchison, 1977).

Peninsular Malaysia 's Main Range Granites are distinguished by a continuous mountain range that ranges from north to south along the western portion of the peninsula (Ghani 2009). To the west, Granite of the Main Range is exposed in many islands including Sembilan, Pangkor and Jarak.

Peninsular Malaysia consists of two tectonic terranes, both originating from the Gondwana Supercontinent and subsequently formed in Late Triassic times (Metcalfe, 2013). During the opening of the Meso-Tethys the Sibumasu Terrane, now comprising western Malaysia, split from Gondwana in Early Permian times. Sukhothai Arc, a volcanic arch system formed on the outskirts of the much larger Indochina Terrane, represents Central and Eastern Peninsular Malaysia. The Indochina block was separated from Gondwana in the Devonian period and Sibumasu was separated from Gondwana at the end of the Permian. Arc Sukhothai (island) volcano-plutonic formed during the northern subduction of the Paleo-Tethys Sea under the Indochina Block during the Late Paleozoic period.

Subduction of the Paleo-Tethys Ocean was followed by the collision of two tectonic terranes and the onset of subsequent orogenic deformation during the

Lower Triassic. In the Early Triassic-Early Jurassic Period, as a result of subduction of type A form the PaleoTethys Ocean under Indochina, post-orogenogenic Granite-Type-S granite was installed. These granites, representing the top topography of Peninsular Malaysia, are known as the Main Range granite. They separate the Bentong-Raub Zone augmented wedge deposit, from the Semanggol Formation foredeep deposit in NW Peninsular Malaysia formed at the depressed Sibumasu margin (Metcalfe, 2013).

2.2 Regional Geology and Tectonic Setting

The geology of Kelantan region consists of the central zone of sedimentary rocks and metasediments bordered on the west and east by the Main Granite Range Range and Limit. In between central zone, there is a granite interference window, which more prominent is UIu Lalat, batholith, Stong Igneous Complex and Kemahang pluton. The country's granite and rock belts have north-south direction and is basically north geological continuity of northern Pahang region. The belts continue northwards in western and central Kelantan in southern Thailand, but the boundaries in the east Granite is superimposed of Sungai Kelantan by coastal alluvial plain Kelantan.

The oldest rocks are from Lower Paleozoic Age, outcropping as a belt north direction bordering Main Range foothills and extending eastwards to Nenggiri River. It mainly consists of metapelites with small amount of and minor arenaceous, volcanic fragmental and calcareous intercalations. A large number of Permian volcanic sedimentary rocks occurs widely in the east, and too much inappropriate, Lower Paleozoic sequence in southwest Kelantan. Taku Schist, his age is still there hesitant

but definitely pre-Triassic, dominating central Kelantan. Triassic rocks are confined mainly in the center and South Kelantan. These rocks are mainly argillo-arenaceous sediments with alternating volcanoes and limestone. Several barrier of Permian rock emerge through Triassic sediment veneer (MacDonald, 1967).

The youngest rocks is the Jurassic-Cretaceous continental rocks that overlap the Boundary Range Granite and Triassic Sediments in the Gagau Mountain area on the ordinary state border between Kelantan, Pahang and Terengganu and on the west side of the and Mount Pemumpu and Mountain Perlis. The study area of Jeli, Kelantan have the distribution of rock that is igneous rock and metamorphic rock. From previous study, igneous rock types found in study area is western belt granite rock (Ghani, 2005).

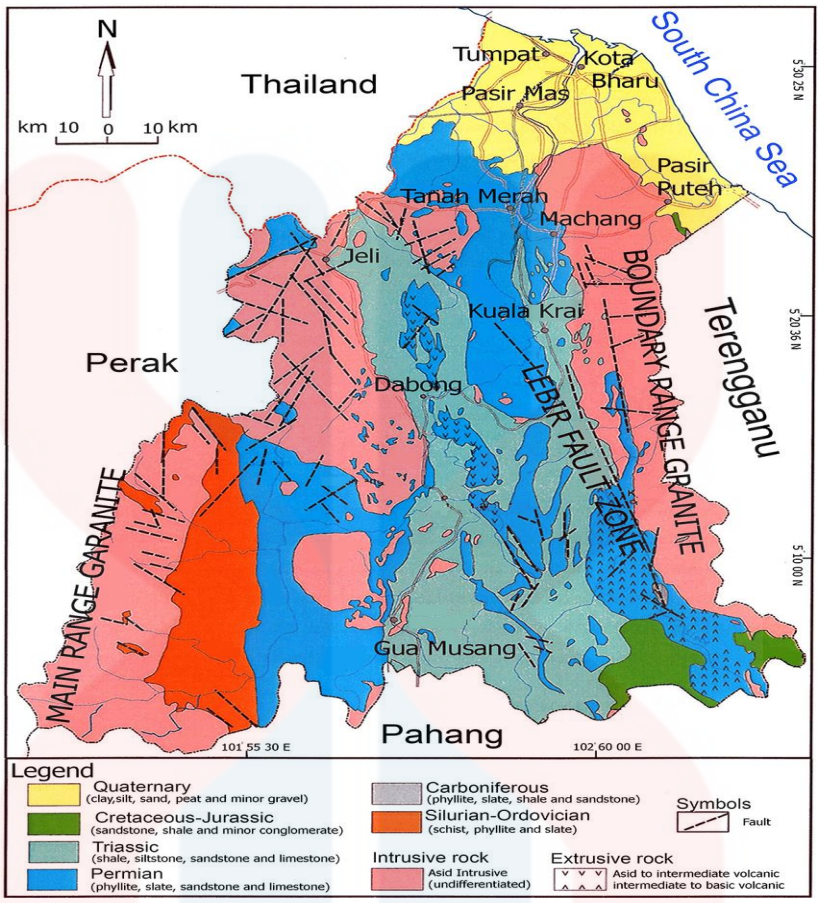

Figure 2.1: Geological map of Kelantan (modified from Department of Minerals and Geoscience Malaysia, 2003)

2.3 Stratigraphy

Lata Renyok is nearby geological site that exist in Jeli with famous natural waterfall. This place is a strong migmatite complex (Adriansyah, 2015) that has relation with migmatite of Poliktenik Jeli. Granite with well performed crsytals that is porphyritic granite are mostly found (Adriansyah, 2015). The presence of many hole structures of different sizes in large granite rock bodies (Adriansyah, 2015). Lata Renyok waterfall consist of leucogranite with the enclaves of metasedimentary rocks.Formation of geosite is influenced by endogenic and exogenic processes where

waterfall formed from uplifting , erosion and weathering processes that occuerd on fractured rocks have produced several geomorphological features in waterfall areas such as streams, rapids, cascade, ponds and river terrace (Adriansyah et al, 2015)

Generally, Gua Musang Group represented by Gua Musang formation, Aring Formation, Telong Formation, and Nilam Marble formation. Each formation from same group divides based on different lithologies unit. Dabong is also part of Gua Musang Group that consist of Gua Musang Formation and Telong Formation, ranges from Permian to Late Triassic.

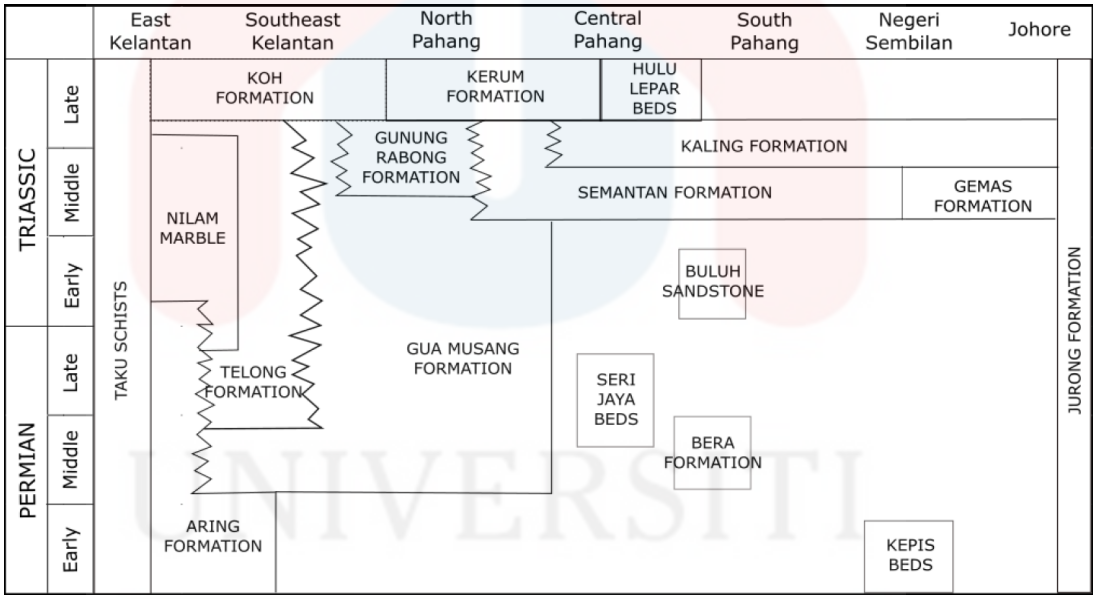

Figure 2.2: Permo-Triassic stratigraphic correlation chart of Central Belt Peninsular Malaysia. Modified from Metcalfe & Hussin (1995).

a) Gua Musang Formation

It origin name obtained from Gua Musang, South Kelantan that extended to south of Kelantan and Pahang. The ages of this formation is began from middle Permian to Late Triassic. Lithology unit of this formation consist of argillaceous and calcareous rocks interbedded with volcanic and minor presence of arenaceous rocks. Depositional environment is shallow marine shelf deposit with active volcanic activity. Upper part of Gua Musang Formation is connecter with Telong Formation, Semantan Formation and Gunung Rabong Formation. This formation separated into upper boundary and lower boundary. Lower boundary unidentified while upper boundary is overlapping with Koh Formation.

b) Telong Formation

It origin name obtained from Sungai Telong, South Kelantan, which the upper reaches of Sungai Aring in south Kelantan. The ages of this formation is began from Late Permian to Late Triassic. Lithology unit of this formation consist of sequence of predominantly argillaceous with some tuff and turbidites. Depositional environment is shallow marine environment with occasional. It is lateral equivalent to Gunug Rabung formation and Semantan formation. This formation separated into upper boundary and lower boundary. Lower boundary overlapping Gua Musang formation unidentified while upper boundary is overlapping with Koh Formation.

2.4 Structural Geology

Central Belt marginal areas is definitely a target. Faulting the major north-south trend. From Air photographs and Satellite, several large trend faults in the north-south were interpreted. In the marginal west areas. Few faults are extended into peninsular Thailand (Tija,1972). He also declares the presence in the western marginal area of a major north-south Karak-Kelau trend fault. A significant structural feature is the north-northwest trending Lepar fault zone near the eastern edge of the Belts. The north is further on Fault zone Lebir which follows the valley of Lebir. In the Triassic pre-late, with rejuvenating movement later. Without doubt, pre-continental rocks in the Central Belt were folding. Gobbett (1973) has often suggested that rocks were folded isoclinically based solely on the field observation of a thick and possibly repeated sequence of rocks dipping into a particular rock.

2.5 Historical Geology

Hutchinson (1977) has isoclinally folded metasediments in the country rock of the Main Range granite of the Western Belt and strongly folded Permian rock underlying gently folded Triassic and Mesozoic sequences in the Central Belt (Hutchinson, 1978) which show isoclinal folding and thrust along the western margin of the Central Belt. Lebir fault is interpreted from fault plane markings which indicate sinistral offset but no strong evidence to give an indication of magnitude of the horizontal displacement.

2.6 Comparison of petrology in Kelantan, Malaysia

The specification of this thesis is comparison of plutonic rocks in different places which is Stong Complex (Ramdanshah & Mohd Rozi, 2001) and Berangkat Pluton (Mohd Rozi Umor et al, 2012). Method used by the researchers is X-Ray Diffraction method analyses the data of trace elements and major elements for different plutonic rock. Nine samples found in Berangkat Pluton (Mohd Rozi Umor et al, 2012) while eight samples found in Stong Complex (Mohd Rozi Umor et al, 2012). Based on data obtained, harker diagram plotted with different element type. Using harker diagram, comparison data of major elements with different places and comparison data of trace elements with different places.

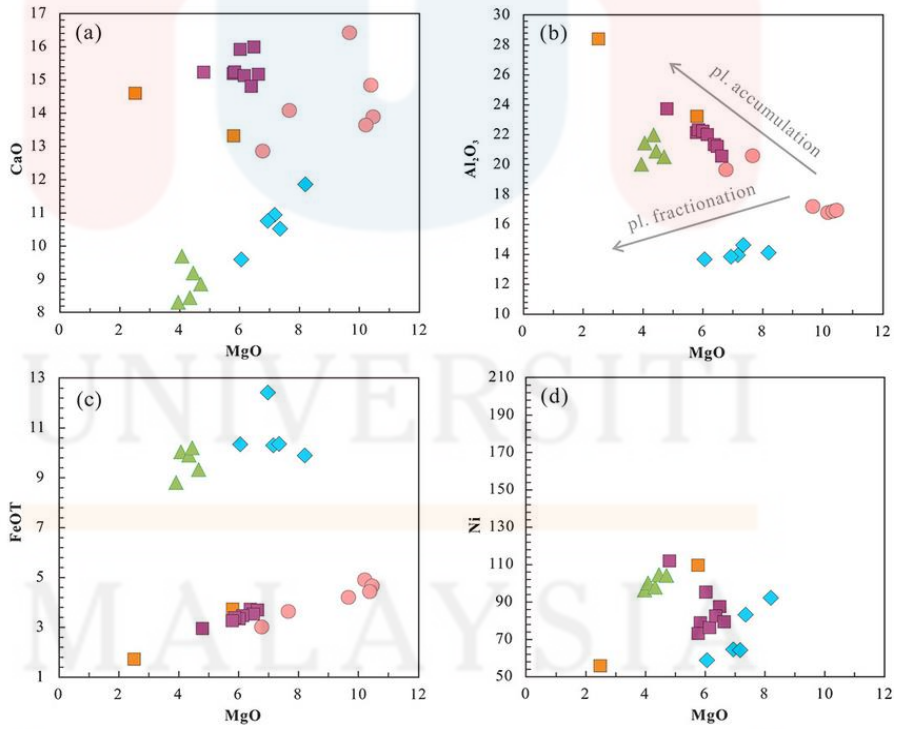

Figure 2.3: Example harker diagram (Carrasco, G.)

From correlation either trace elements or major elements, the type of correlation will be known either positive correlation or negative correlation.

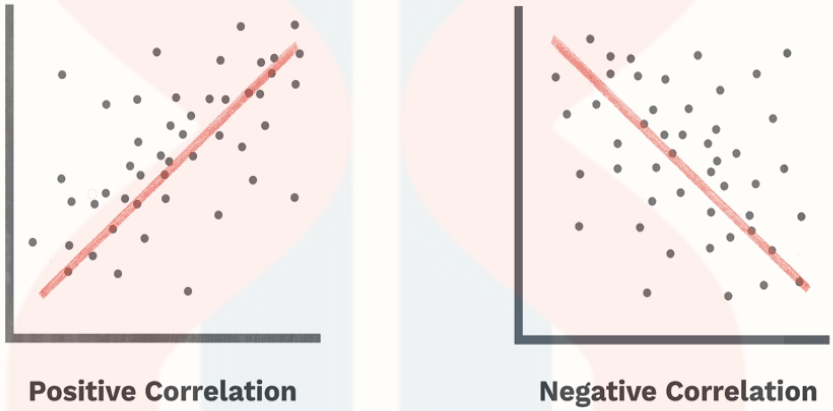

Figure 2.4: Correlation types for major element and trace element

CHAPTER 3

MATERIALS AND METHODOLOGIES

3.1 Introduction

This chapter is discussing about a method and material used. This is very important in doing a research study. The method and materials used are to classify and analyze the grade of the weathering of igneous rock based on the analysis on the field in the study area. Material and method use by referring, according to the previous study. Methodology is the important part in doing research. It will determine and describe all the method that been conducted of the research more detail and clear based on the flow that has been generated. Preliminary research required before doing the geological mapping. The data collection is obtained by doing the field study. The sample taken during the field survey. The data analysis also done.

3.2 Materials/Equipment

The geological study that is morphology, lithology, structural geology and stratigraphy of the study area. Source of material used for this research are article, internet, journal, maps, articles, photo, thesis, images and internet. In this thesis, no

3.3 Methodology

3.3.1 Preliminary Studies

During a preliminary study, methods used in data collection which is internet, journal, maps, articles, photo, thesis, images and bulletin. It was done before the geological mapping started to better understand the study area. The source information was gathered such as journal, books, thesis, article and internet. This preliminary study needs to be done first before going to the field.

3.3.2 Field Studies

The geological study is important because it is including all the studies about the lithology, morphology, stratigraphy and structural geology of the study area. Since pandemic covid- 19, students unable going to the field. Because of that, field data of study area get from many resource such as previous researcher, website and articles. Sample was taken during the second field survey at the study area (Noor Syafiqah, 2018). Data were collected from samples collected in the study area, the petrography and data analysis study need to be run (Noor Syafiqah, 2018). Traverse also need to be done during field study, which is more to structural geology of study (Noor Syafiqah, 2018). Mapping is done to collect data of geology study in the study area. Route tracking (traverse) using GPS was also carried out (Noor Syafiqah, 2018).

3.3.3 Laboratory work

a) Thin section

Thin section is the laboratory preparation of a mineral, soil and rock using polarizing petrographic microscope, electron microprobe and electron microscope and

electron microprobe. The first step is rock cutting which chip of rock sample prepared to cut by AbrasiMet 250 machine ("Rock thin Sections," n.d.). Besides that, Initial Face Grinding or lapping ("Rock thin Sections," n.d.). This step is to prepare a flat and release-free sample surface for bonding of samples to glass slides. Next, glue the glass slide must be flat so that the stone part can end with a fixed thickness ("Rock thin Sections," n.d.). It will produce glass slide. Label the slide and let it dry for about 1 day ("Rock thin Sections," n.d.). Slicing and grinding to final thickness 30μm using a PetroThin Thin Sectioning System ("Rock thin Sections," n.d.). Lastly, surface of the rock is thinning using silicon corbide powder with p2000 in order to get the exact thickness ("Rock thin Sections," n.d.).

b) Petrography analysis

Petrographic analysis of study areas by observed the thin section using the petrographic microscope where minerals can be distinguished by their specific optical properties. Meanwhile, igneous rock classification by plotting on QAP diagram. The specific igneous rock types are known based on their certain element percentage that ploted on QAP diagram. Those elements are quartz, alkali feldspar and plagioclase.

3.3.4 Data processing

Data analysis and interpretation of weathering grade of igneous rock are done by using ArcGIS version 10.3. This application is used to design, store, manage, display and analyze all the geographical and spatial data. Besides, rock analysis of rock samples identified and described the mineral content and their textural within the rock detail. All notes are recorded by hand, such as hand specimen and taken a photo. The data important because it is can be transfer into GIS and for the purpose of in case the data was missing and there still have a backup in notebook.

Digitizing map is done after completing the mapping. All data that from GPS and has been jotted down in field notebook was transferred into the computer for digitizing of the map. Geographic Information System (GIS) is a tool that used to analyze the spatial information from GPS and edit the data for the general geology aspect and a classification weathering grade of the study area. The data traverse also can be transferred into ArcGIS from GPS.

3.3.5 Data analysis and interpretation

Report writing is to involve a more in-depth description of the study. It is divided into five important topics that is introduction, literature review, material and method, general geology, specification and conclusion. Each part has correlation to each others. The specification is referring to the main topic of this research that is petrography analysis of granite rock. Thesis submission is separated in two phases, which first phases more to plan for the implementation and second phases is to perform improvements based on the evaluation and recommendations from the experts in this field.

CHAPTER 4

GENERAL GEOLOGY

4.1 Introduction

In general, general geology is related to geomorphology, stratigraphy, structural geology and historical geology of the study area. Most of the data obtained are from secondary data because of movement constraints due to pandemic COVID-19.

Gomorphology is the science of landforms, with an emphasis on their origin,form, evolution, and distribution across the physical landscape. Therefore, understanding geomorphology is very important to understand one of the most popular parts of geography. Because geomorphology interrelated with geography. The analysis of geomorphological processes offers valuable insight into the creation of different structures and characteristics in landscapes around the world, which can then be used to study many other aspects of physical geography as a context.

Stratigraphy is a branch of Geology and Earth Sciences that deals with the structure and succession of strata or layers, as well as the origin, structure and distribution of these geological strata. Stratigraphy included lithostratigraphy, biostratigraphy, chronostratigraphic, stratigraphy of sequences, seismic stratigraphy and magnetostratigraphic mapping. While there are several divisions in the portion of. In this article, stratigraphy only concerns lithostratigraphy.

Structural geology is carried out by studying the structure such as fault, joint, crack and fold which is revealed above the outcrop. In this part, GeoRose software which can plot structural geology rose diagram while Stereonet used to plot stereonet. The structural mechanism was also used to determine the primary forces that deformed the research area. The geologic map of Kuala Krai, Jeli with cross-section is constructed based on lithostratigraphy and structural analysis. Historical geology is the

study of changes in the Earth and its life forms over time. It concerns about the formation and history of the study area.

4.1.1 Accesbility

Accessibility in this study area is in relatively good condition compared to other areas since this area is a rural area. There is a road that connects the agricultural area with the village area. This can help employees to commute to work area easily. The estimated length of the main road in the study area is 6.9 km. It is about 65 km from Kota Bharu and about 63 km from Dabong City. It's on the middle and right side of this road. There are also small roads linked to main roads linked to the economic sector in the study area. This area is an undeveloped area that is more unpaved than paved roads, making it difficult to explore this study area.

4.1.2 Settlement

Settlement is an area that is the focus for residents to settle as well as areas where development areas are concentrated. Each settlement is near the river to make it easier for water resources to be obtained directly. Types of settlements in the study area are nucleated and dispersed. Nucleated settlement where the building is crowded, connected to the road, and the settlement itself may have an almost round or irregular shape. Such settlements can be cultural or urban, depending on the size and function they perform. While, dispersed settlement shows many buildings, scattered or distributed. One house is within one kilometer or more of the next. The name of the village consists Kampung Bukit Berangan, Kampung Jerimbong, Kampung Bukit Tok Ali and Kampung Bukit Jering.

4.1.3 Forestry/Vegetation

This study area is filled with forestry covering the western regions. It is an undeveloped rural area known as Gunung Stong Utara Forest Reserve. It is part of Gunung Stong State Forest Park (GSSP). These blocks of forests are extensions of the Titiwangsa Range, which straddles the Kelantan and Perak boundaries at this point.

They provide GSSP buffers and connectivity to the greater Main Range forest block. The Kelantan State Forestry Department manages the GSSP. While, eastern regions have a little vegetation or no vegetation. The residents who on average work as farmers cultivate the area into an area.

4.2 Geomorphology

Geomorphology is the landform and its mechanism correlated with its origin and its process evolution. The factors that govern landform formation are the atmosphere, which is temperature and precipitation, tectonic plate, and history. Geomorphological mechanisms are also known as these factors. There are three kinds of geomorphological systems that are exogenous, endogenous and extraterrestrial. The exogenic process concerns the weathering and erosion process, while the plate tectonic shifting that may cause uplifting, faulting or folding is included in the endogenous process. While, exogenic process refers to aggradation, degradation and action of the organism. In order to form a specific landform, both processes take a long period. Geomorphic classification is the categorization and description of the origin, nature also development of landforms. The basic framework of geomorphic classification can be divided into the origin and development (process), general structure and **s**hape (landform), dimensions and characteristics (morphometry), and presence and status of

process overprinting (geomorphic generation). Geomorphic processes are the external geologic force and dominant external interact with the existing geological structural framework to form Earth's surface.

4.2.1 Geomorphological classification

Based on the geomorphological unit map, there have variety rock types in this study area such as granite, metasediment, the intrusion of microgranite intruded granite, alluvial and phylite. The North West hill area is covered by forest and it caused the difficulty of traversing, but the river flowing from the western part of the hill showed that the type of rock is meta sediment, while biotite granite porphyry is on the hill in the southwest area. Hills may be created by geomorphic phenomena such as fault and erosion of broader landforms and accumulation of sediment by glaciers. The hilly area with an elevation of 420 meters showed high resistance. The elevated altitude was to the west of the map. While, an area with an elevation of 60 meter showed low resistance. Rainfall and runoff may cause the topography to be gradually reduced erosion. The elevated topography of flowing water has the ability to break down the earth material is then transported to the leftover material by hydraulic action. Area for deposition. In the area of low water flow, a deposition may occur. The rock in the upstream area has been usually angular, while the rock in the upstream area was angular. The downstream region was rounded off. This is because the distance from the rock has been transported. The flat area next to the river is called the floodplain. This floodplain area has a great chance of flooding. Pebble or sediment during flooding, It may be deposited on the surface of the region.

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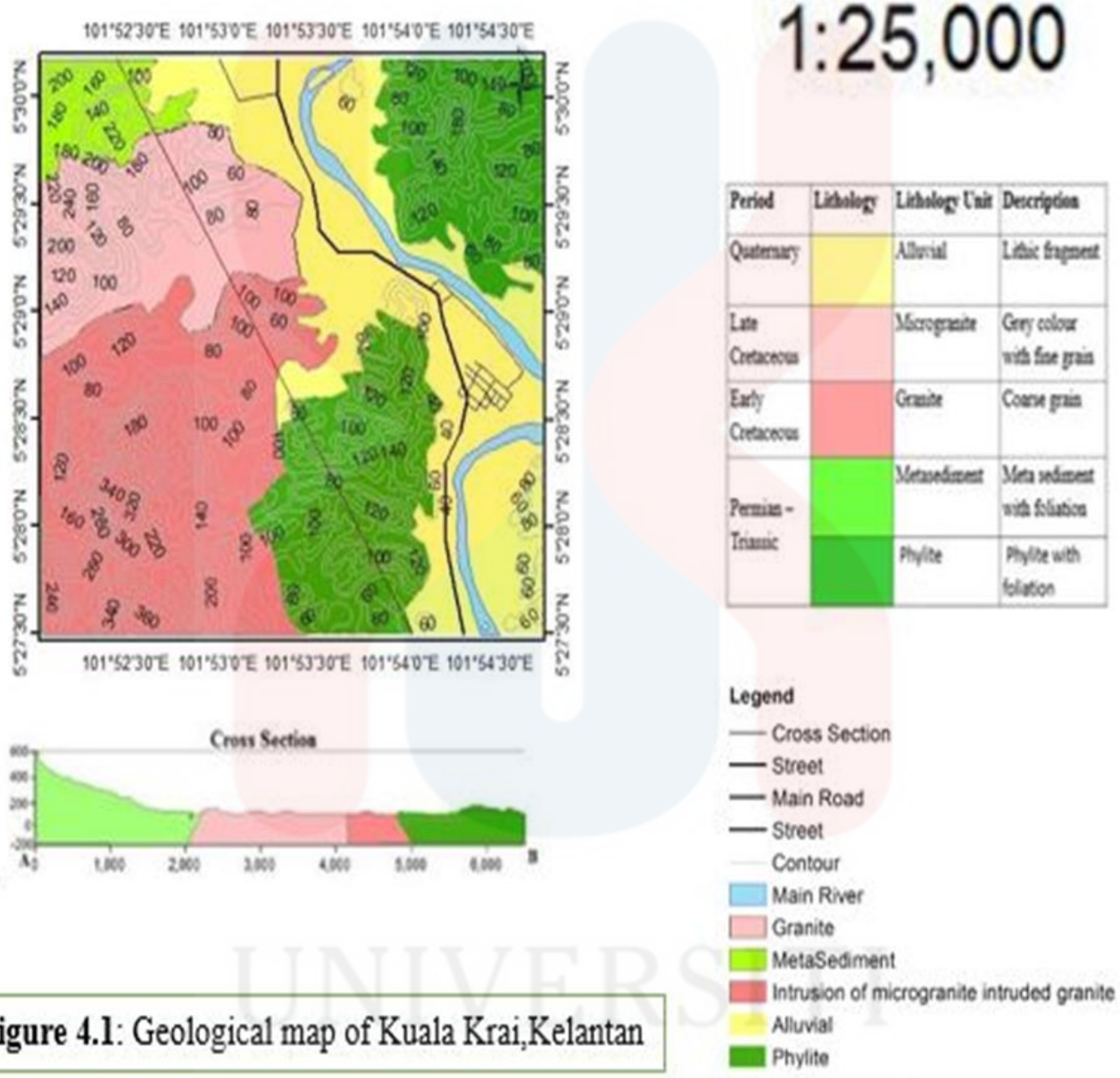


Period	Lithology	Lithology Unit	Description
Quaternary		Alluvial	Lithic fragment
Late Cretaceous		Microgranite	Grey colour with fine grain
Early Cretaceous		Granite	Coarse grain
Permian – Triassic		Metasediment	Meta sediment with foliation
		Phylite	Phylite with foliation

Figure 4.1: Geological map of Kuala Krai,Kelantan

4.2.2 Drainage pattern

Drainage patterns provide information on topography and geological structure. Drainage density in the basin varies with the relative age of the various rock formations, different geologies, drainage areas and allows comparisons of basins and rivers. Based on figures, there are two types of drainage pattern based on river pattern which is dendritic and parallel. Dendritic drainage pattern covers around 95% while parallel drainage pattern covers around 5% only one of the drainage pattern map. The dendritic drainage pattern are most common types. An area that covered with those dendritic types shows rock which unconsolidated material below stream that can erode equally in all directions has no specific fabric or structure. Such as granite and sedimentary rock which does not fold. While, the parallel drainage pattern has a small percentage. Those patterns caused by steep slopes with slight relief. Because of the steep slopes, it flows fast and straight, with very few creeks, and all flow in the same direction. Parallel drainage patterns are formed where there is a clear slope to the surface. Parallel patterns also develop in areas of parallel and elongated terrain shape like outcrop-resistant rock straps.

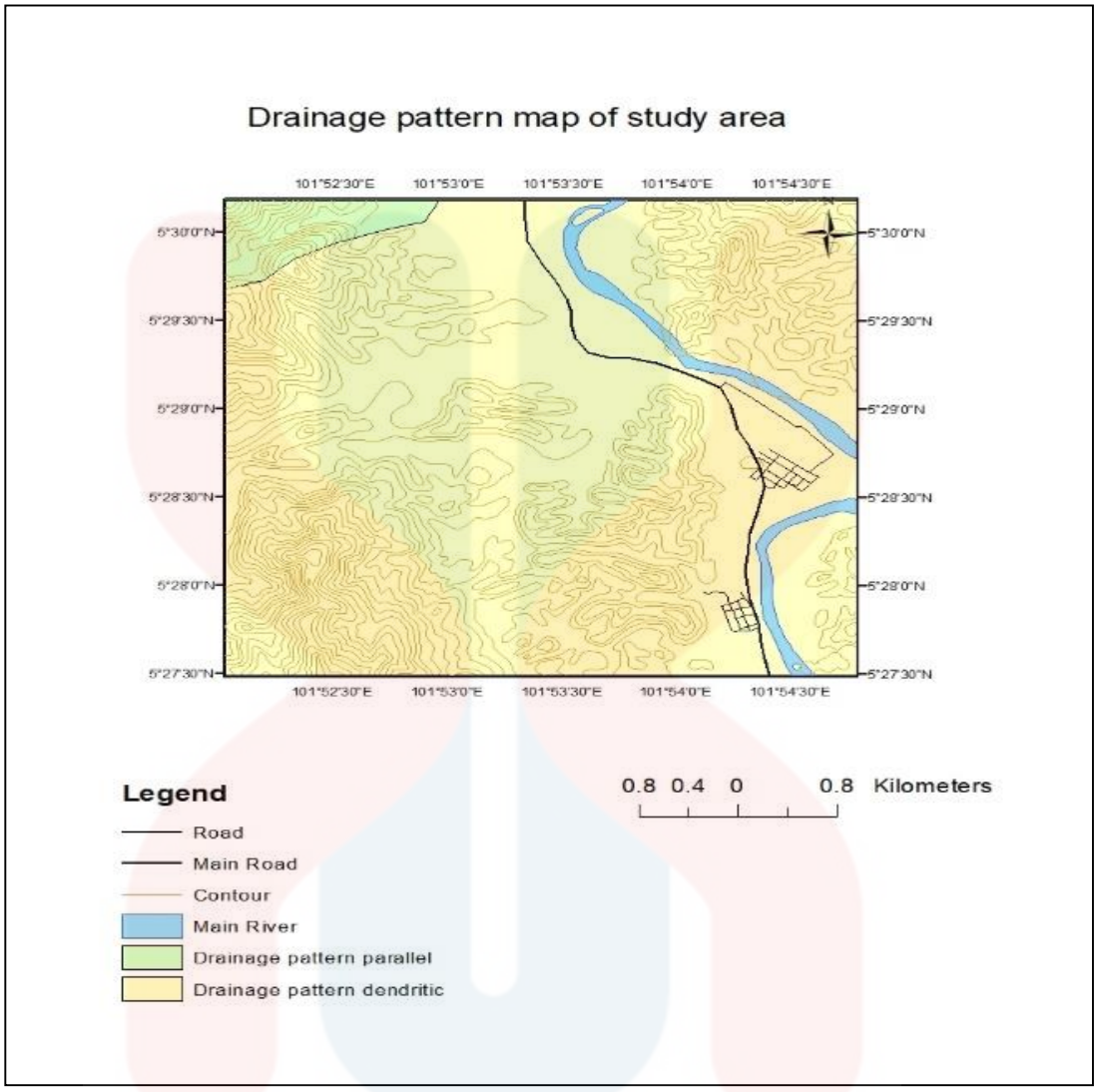


Figure 4.2: Drainage pattern map of study area

4.3 Lithostratigraphy

Lithostratigraphy is one of the branches of stratigraphy. It more concern on the physical properties of rock. Lithostratigraphy is the fundamental unit of the formation: a mappable rock unit with clear upper and lower boundaries. A single depositional environment will always be representing, and therefore a single type of rock or group of similar facies. Basically, each formation consists of different lower and upper limits. It also has a form section that is a specific location where it is well exposed and comparable to other locations. It has been continuous laterally during formation and

continuous from top to bottom, stratigraphically except for continued. Formations use a regular quadrangle-scale map to map. Lithostratigraphic units are bodies of rocks that are described and characterised on the basis of their lithological properties and stratigraphic relationships, whether bedded or unbedded. The basic units of geologic mapping are lithostratigraphic units. Stratigraphic correlation is the method of determining which sedimentary strata, through their stratigraphic relationship, are of the same age in distant geographical areas. By mapping and creating stratigraphic columns, geologists build geologic histories of areas that is a detailed overview of the strata from bottom to top.

4.3.1 Stratigraphic position

Period	Lithology	Lithology Unit	Description
Quaternary		Alluvial	Lithic fragment
Late Cretaceous		Microgranite	Grey colour with fine grain
Early Cretaceous		Granite	Coarse grain
Permian – Triassic		Metasediment	Meta sediment with foliation
		Phylite	Phylite with foliation

Figure 4.3: Diagram of lithostratigraphic unit of study area

Stratigraphic position also known as stratigraphic column. It represents period, lithology, lithology unit and description of physical properties of rock. The period of each rock type is determined based on a geologic time scale. There are types of rocks that are on same period. All rock types found in this study area are from Phanerozoic

era. Alluvial is the youngest lithology unit with quaternary period aged 2.6 million years until today. It contains of lithic fragment that usually source-specific textures and compositions that can be found in the thin section. The pieces of eroded or broken rock that cannot be quickly split into either the end-members of the quartz or feldspar classification are lithic fragments. The fragments that are not broken down into single minerals are these. They prefer to look fine-grained and very dirty, in brown and grey shades. Besides, microgranite and granite is from igneous rock types and same formation, but with different time scale. But, microgranite is grey colour intrusive igneous rock that is fine-grained includes crystals, smaller than rice grains, that are randomly oriented and interlocking while granite also an intrusive igneous rock that is coarse-grained. Microgranite are younger with late cretaceous period than granite with an early cretaceous period. In the meantime, metasediment and phylite are the metamorphic rock type with the same period from Permian-Triassic period. Both have foliation where has been split into thin sheets or laminates.

4.3.2 Unit explanation

a.Metasediment

i) Phylite

The type of foliated metamorphic rock formed from the slate is further metamorphosed such that a desired orientation is obtained by very fine grained white mica. It is composed mainly of quartz, mica sericite, and chlorite. Phyllite was found near the Terang River bridge which is at N 05°29’11.5”, E101°54’00.8’’ (Noor Shafiqah,2017). The colours of the rock were brown, black and green (Noor

Shafiqah,2017). Those colour represents the mineral composition of the rock. Phylite has fine grain with smooth texture. It has a low degree of metamorphism.

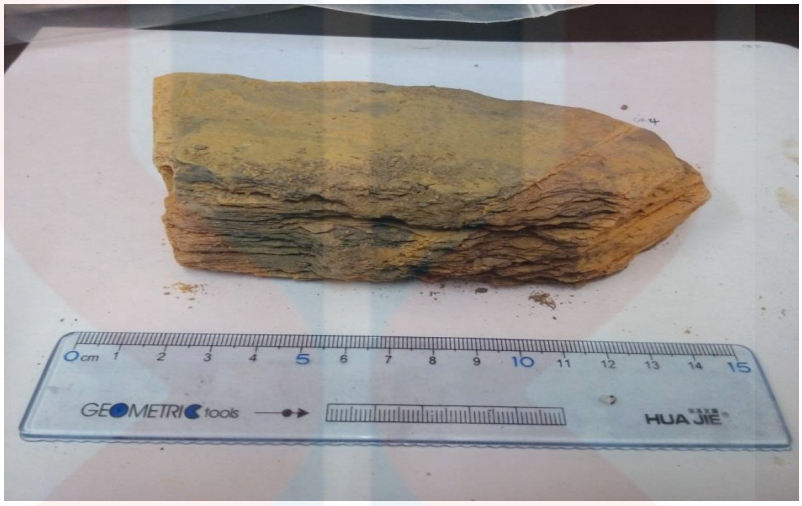


Figure 4.4: Phylite rock (Noor Shafiqah,2017)

ii) Metasediment

It is a sedimentary rock that becomes metamophic rock through metamorphism process. Meta sediment in the study area was located in the Suda River with coordinating N 05°30'19.0", E 101°53'03.2" (Noor Shafiqah,2017). Those rocks are highly weathered but foliation are clearly seen (Noor Shafiqah,2017). When the protolith is shale, first schist and then paragneiss are formed by metamorphism as temperature and pressure rise. The rock acquires first a foliation and then a banding as the grain size grows, and the mineral assemblage shifts to contain minerals such as mica, garnet, and aluminosilicates.

Figure 4.5: Metasediment with foliation (Noor Shafiqah,2017)

c. Granite

Granite, consisting mainly of quartz, alkali feldspar, and plagioclase, is course-grained igneous rock. With a high content of silica and alkali metal oxides, it forms from magma that slowly solidifies underground. An outcrop of biotite granite porphyry which is located at N 05°29’02.6”, E 101°52’05.3” (Noor Shafiqah,2017). It has It has a rough texture with rough detail measurements. Minerals that can be seen on these rock hand samples are quartz, biotite, plagioclase, and feldspar alkali. The name of this rock is porphyry granite biotite because it has a dominant biotite with porphyritic texture.

Figure 4.6: Granite rock (Noor Shafiqah,2017)

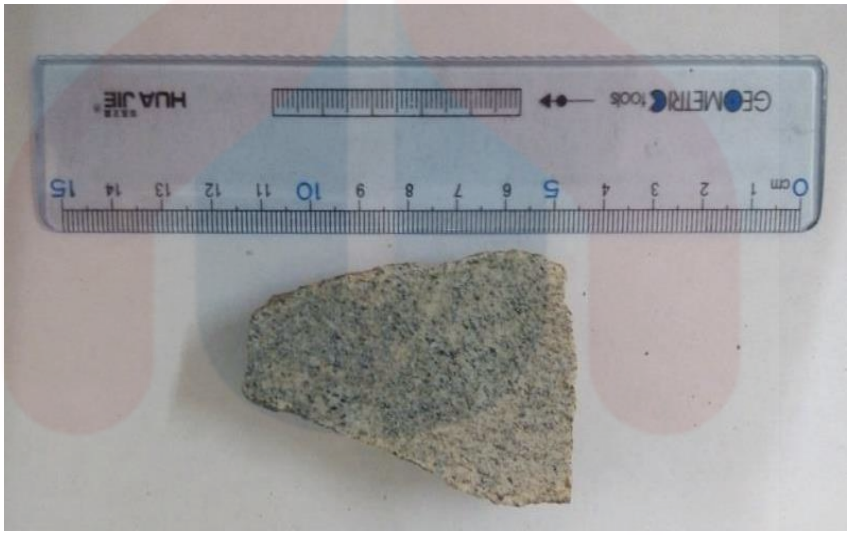


Figure 4.7: Hand sample of microgranite (Noor Shafiqah,2017)

d.Quartenary sediment

Quarternary sediment can be found in the Sungai Suda and Sungai Terang downstream (Noor Shafiqah,2017). This quarternary sediment is created by weathering and erosion of the Noring Granite at the Sungai Suda and Terang headwaters. Due to climate and temperature, which make shifts in minerals, physical and chemical weathering takes place. Physical weathering allows the rock to break

down into smaller parts because quartz has greater resilience than other rocks, such as lithic fragments, clay and quartz..

4.4 Structural geology

Structural geology, a scientific discipline that, with a large and a small scale, is concerned with rock deformation. Its field of research is broad, ranging from submicroscopic crystal lattice defects to fault structures and crust folding systems of the Earth. Structural geology techniques are almost as diverse as those of the geological sciences as a whole. Using the same general techniques used in petrology, small-scale structural characteristics may be studied, in which parts of rock placed on glass slides are very thin on the ground and then analysed with polarising microscopes. The methods of field geology are used on a broader scale. This involves the orientation of such structural characteristics as faults, joints, cleavage, and small folds being plotted. In most situations, the aim is to use the knowledge available on the surface to interpret the structure underneath the surface. The methods employed are primarily those of geophysics which include the use of seismological, magnetic, and gravitational techniques where mountains, continents, ocean basins, and other large-scale features are involved. In addition, since it is rarely possible to directly observe the processes that cause rocks to deform, it is important to research them using computer models in which they are mathematically represented.

4.4.1 Lineament analysis

Lineaments are linear features that offer details about the geological system underlying them. Lineament is one of the most significant characteristics indicating

elements of the subsurface or structural failure such as faults and is typically derived by visual inspection of enhanced image images. The lineament map indicates the existence in the study area. Using the protector to assess the principal force of lineament that form the bearing of the lineament was taken. 60 readings were taken from google earth.

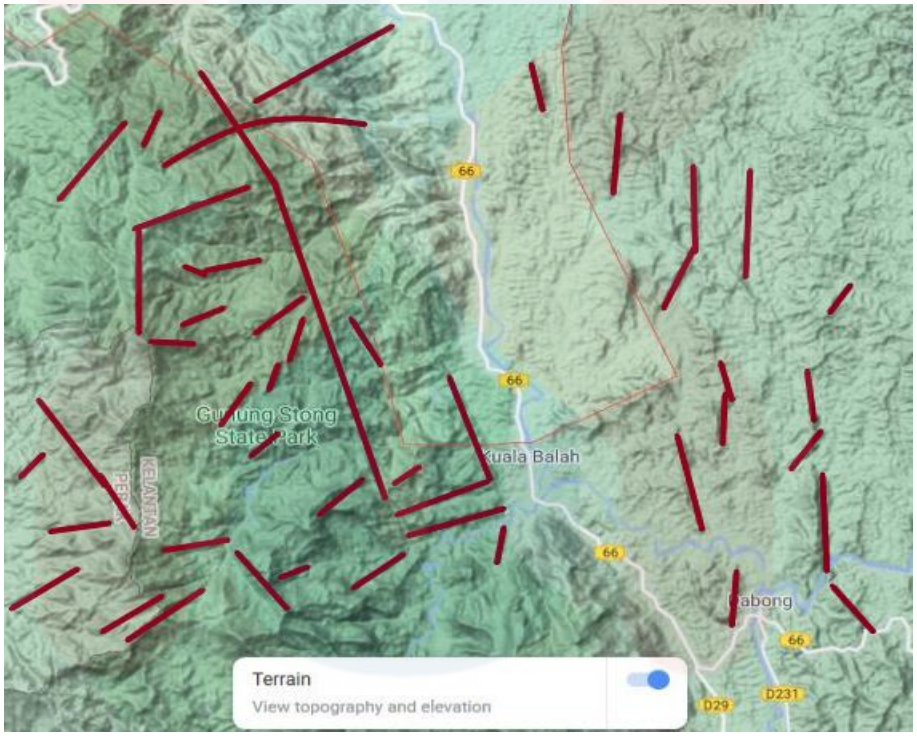


Figure 4.8 : Lineament map of Jeli area

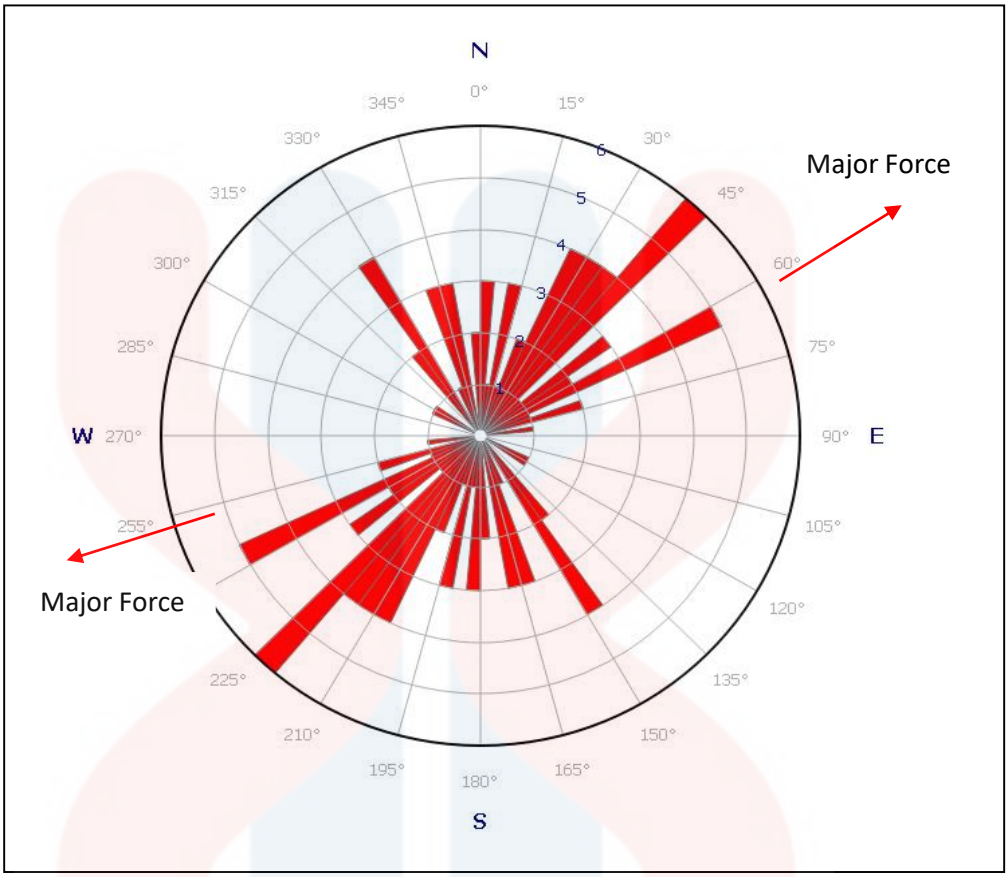


Figure 4.9: Orientation of lineament

Table 4.1: 60 readings of lineament

19	22	336	347	38	61	325	20	322	52
34	342	6	11	123	343	62	44	40	37
340	27	348	4	66	327	208	40	240	11
34	355	2	37	44	61	73	58	50	57
206	10	3	33	37	53	61	44	345	46
32	325	27	323	74	328	177	80	117	41

From lineament line plotted, there are 60 values of angle obtained. The major orientation of lineament is N 20°W and S 20°E which indicated the main force that deformed this area is from the particular direction.

4.5 Historical Geology

The oldest rock in the study area was meta sediment. This metasediment was originated Gua Musang Formation based on Tulot and Umor (2001). The age of meta sediment was Permian to Triassic. Nearing Granite has three types of granite that can be found in the study area which is better granite porphyry, coarse grained foliated granite and micro granite. Quaternary sediment was the youngest lithology that had in the study area in the era of the Cenozoic. Quaternary sediment was the alluvium such as lithic fragment, pebbles, sand and quartz that transported by flowing water and deposited in the area of the floodplain.

CHAPTER 5

COMPARISON OF PETROLOGY IN KELANTAN, MALAYSIA

5.1 Introduction

Chapter 5 is about the comparison of petrography analysis in Kelantan, Malaysia. Data obtained from many researchers will be used as data to be analysed and compared. Petrographic analysis is an in-depth examination of a single rock sample's chemical and physical characteristics. Macroscopic to microscopic studies of the rock sample should provide a complete analysis. Petrographic research focuses on the features of mineralogy and the micro structure or texture of rock, on the basis of the field of pathological geology. X-ray fluorescence (XRF) is a non-destructive analytical method used to determine the material's chemical composition. By measuring the fluorescent (or secondary) X-ray released from a sample when it is excited by a primary X-ray source, XRF analyzers determine a sample's chemistry. Any of the elements contained in a sample creates a specific collection of characteristic fluorescent X-rays that particular element, which is why XRF spectroscopy is an outstanding technology for qualitative and quantitative material composition research. While, X-ray diffraction is an effective non-destructive method for characterizing crystalline materials is X-ray diffraction. It offers data on structures, phases, desired orientations of crystals (texture), and other structural parameters, such as mean size of grain, crystallinity, strain, and defects of crystals. XRD peaks are created by constructive interference in a sample by a monochromatic beam of X-rays dispersed

from each group of lattice planes at particular angles. The atomic locations within the lattice planes decide the peak intensities. Consequently, the XRD pattern of a given substance is the fingerprint of periodic atomic arrangements.

5.2 Results and discussion

1) Major element

Major elements of Berangkat Pluton (Mohd Rozi Umor et al,2012) and Stong Complex, Kelantan (Ramdanshah & Mohd Rozi, 2001) obtained using X-Ray Diffraction (XRD).

Figure 5.1: Major element of three rock unit inside Berangkat Pluton (Mohd Rozi Umor et al,2012)

Granite Unit	Granodiorite			Monzodiorite			Microdiorite		
No. sample / Rock Name	A1	A2	A3	B1	B2	B3	B4	C1	C2
SiO^2	8.83	65.76	66.48	59.1	60.3	61.45	61.53	64.19	63.27
TiO^2	0.46	0.44	0.47	0.8	0.69	0.7	0.78	0.63	0.68
Al_2O^3	15.67	14.88	15.21	14.87	15.08	15.75	14.84	14.44	14.37
Fe_2O^3	3.5	3.41	3.54	5.74	4.72	4.76	5.1	4.48	4.93
MnO	0.04	0.06	0.06	0.07	0.06	0.07	0.06	0.06	0.07
MgO	2.07	1.96	1.9	4.28	3.48	3.79	3.29	2.09	2.3
CaO	3.02	3.08	2.81	4.15	3.76	3.9	3.5	2.99	3.05
Na_2O	3.12	3.12	3.79	2.95	3.73	2.29	2.76	2.85	2.69
K_20	4.75	4.79	5.14	4.59	5.34	4.63	4.93	4.81	4.69
P_2O_5	0.19	0.23	0.22	0.42	0.36	0.3	0.39	0.27	0.38
Total	102.6	98.57	100.5	97.74	98.43	98.3	97.96	97.65	97.08

Figure 5.2: Major element of two rock unit in Stong Complex, Kelantan (Ramdanshah & Mohd Rozi, 2001)

	Leukogranite					Tonalite		
No. sample / Rock Name	D1	D2	D3	D4	D5	E1	E2	E3
SiO^2	72.99	73.97	72.08	72.64	71.46	70.03	65.33	68.37
TiO^2	0.21	0.18	0.24	0.17	0.28	0.30	0.73	0.51
Al_2O^3	15.37	14.11	15.47	15.38	15.95	14.96	14.95	14.85
Fe_2O^3	1.39	1.49	1.56	1.21	1.85	2.17	4.60	4.03
MnO	0.04	0.03	0.03	0.03	0.03	0.04	0.07	0.07
MgO	0.19	0.04	0.26	0.02	0.36	1.04	2.57	1.74
CaO	2.16	1.08	2.28	1.66	2.29	1.93	3.20	3.11
Na_2O	3.96	3.21	3.95	4.10	4.09	3.01	2.65	2.63
K_20	3.18	5.45	3.60	4.26	3.13	5.87	4.66	3.88
P_2O_5	0.04	0.04	0.06	0.03	0.08	0.15	0.30	0.19
Total	100	100	99.99	99.97	99.97	100.04	99.84	99.96

2) Trace element data of Kelantan

Trace elements of Berangkat Pluton (Mohd Rozi Umor et al,2012) and Stong Complex, Kelantan (Ramdanshah & Mohd Rozi, 2001) obtained using X-Ray Diffraction (XRD).

Figure 5.3: Trace element of three rock unit inside Berangkat Pluton (Mohd Rozi Umor et al,2012)

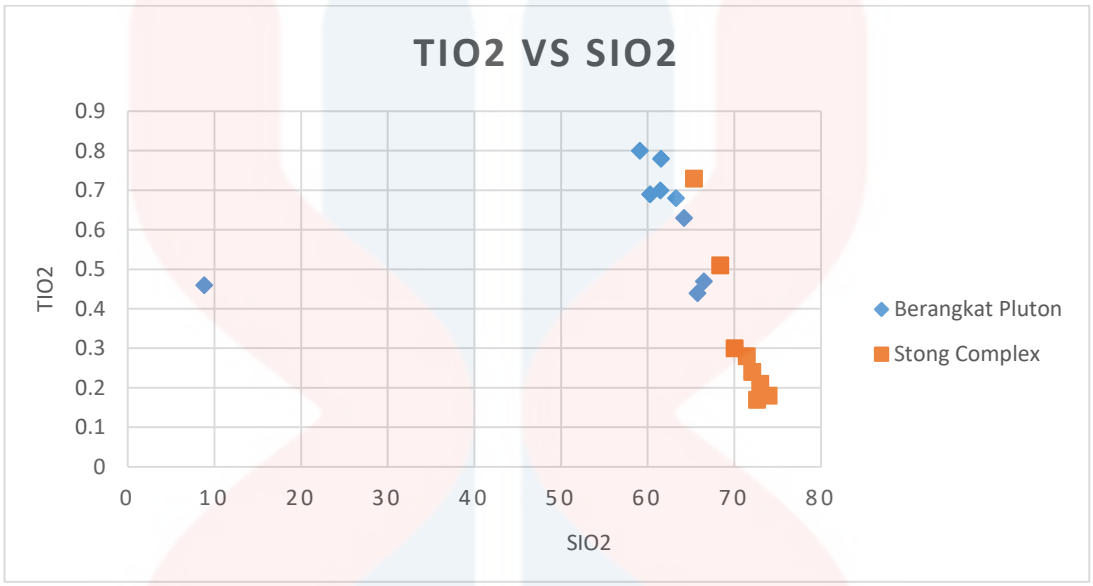
Granite Unit	Granodiorite			Monzodiorite			Microdiorite		
No. sample / Rock Name	A1	A2	A3	B1	B2	B3	B4	C1	C2
Sr	394	385	371	434	415	406	398	468	457
Rb	694	670	695	652	662	670	678	637	625
Ba	1185	1230	1158	1559	1494	1439	1398	1735	1723
Zn	83	87	104	96	84	80	75	89	91
Cu	17	29	43	63	32	40	36	48	33
Co	42	18	dhp	40	35	38	43	24	42
Ni	5	4	17	168	113	110	98	33	43
Cr	72	72	83	213	125	130	85	94	76
V	64	61	69	100	98	90	85	74	98

Figure 5.4: Trace element of two rock unit in Stong Complex, Kelantan (Ramdanshah & Mohd Rozi, 2001)

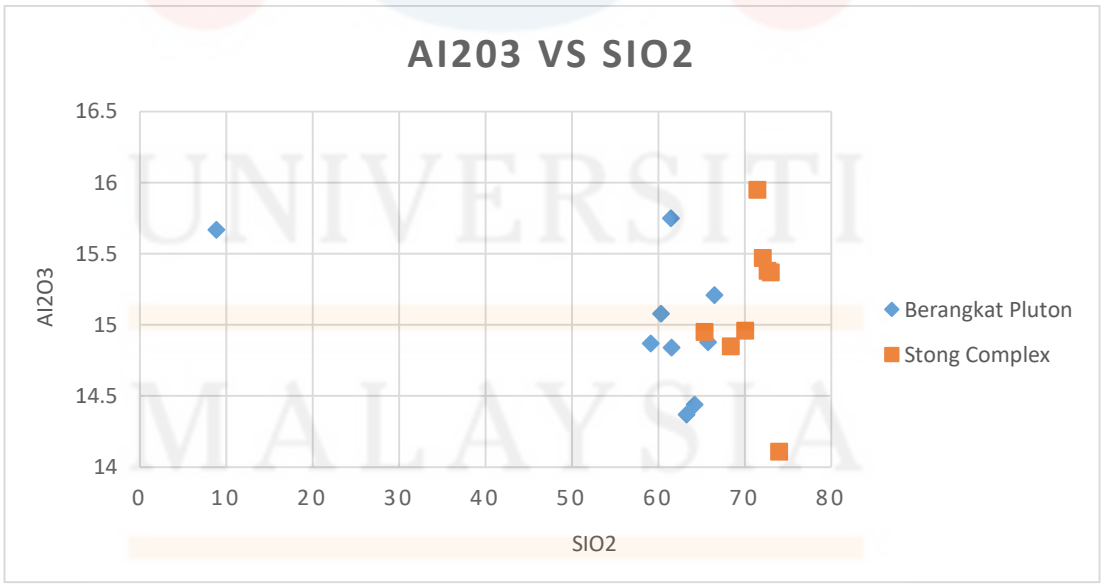
	Leukogranite					Tonalite		
No. sample / Rock Name	D1	D2	D3	D4	D5	E1	E2	E3
Sr	1012	290	1267	1282	1063	271	373	318
Rb	153	249	189	173	134	334	281	246
Ba	1994	1365	1929	2080	2038	1096	1604	1267
Zn	43	43	56	27	49	26	66	60
Cu	15	16	14	16	14	16	40	16
Co	1	18	36	1	23	25	53	46
Ni	6	2	8	1	4	31	49	26
Cr	4	7	4	4	4	1	94	40
V	20	15	30	16	33	39	85	74

2) Hacker diagram major element of Berangkat Pluton and Stong Complex

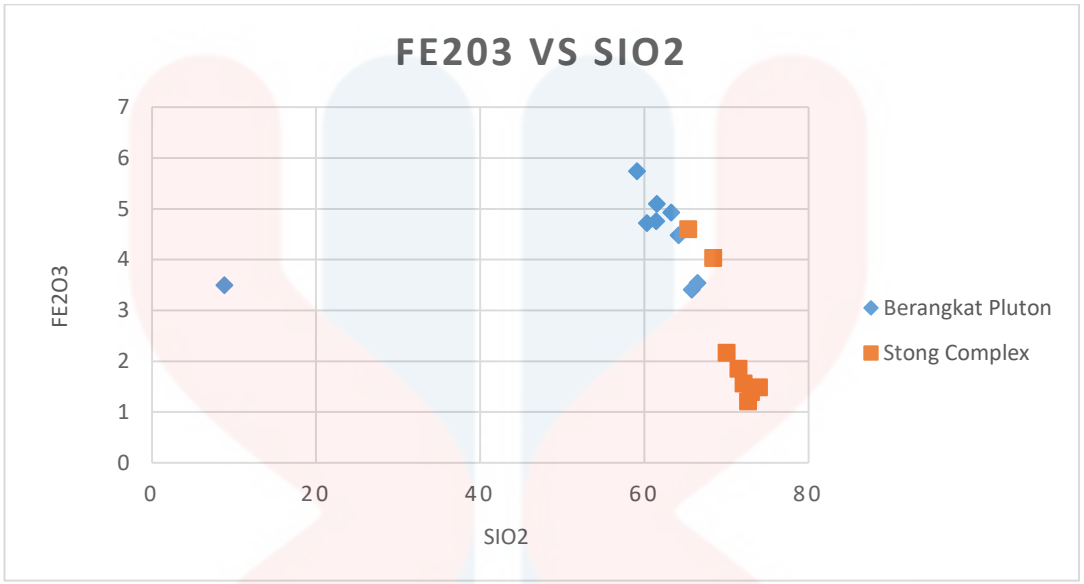
i) TiO^2 vs SiO^2



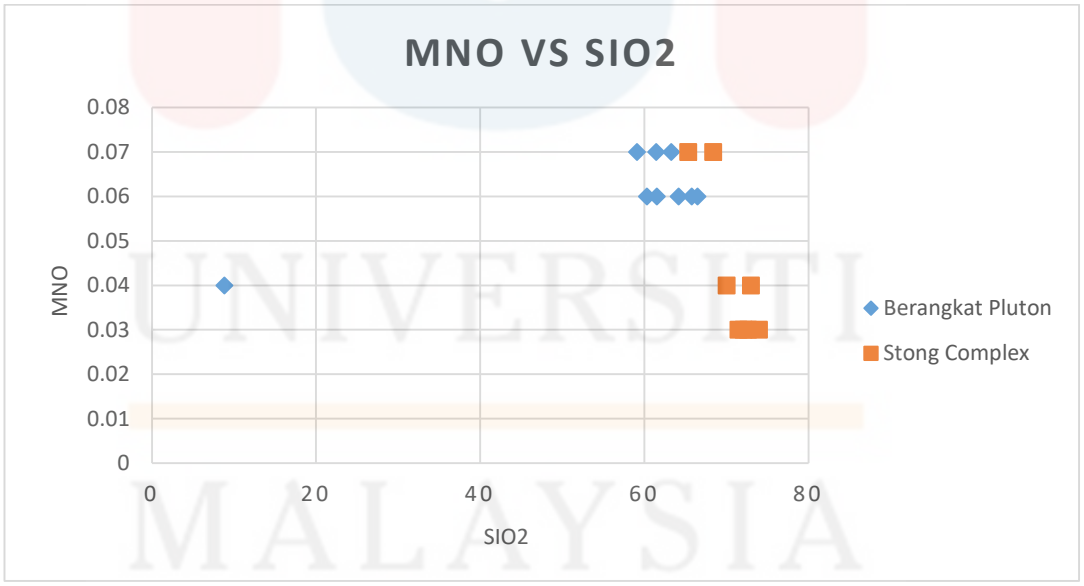
2) Al_2O^3 vs SiO^2



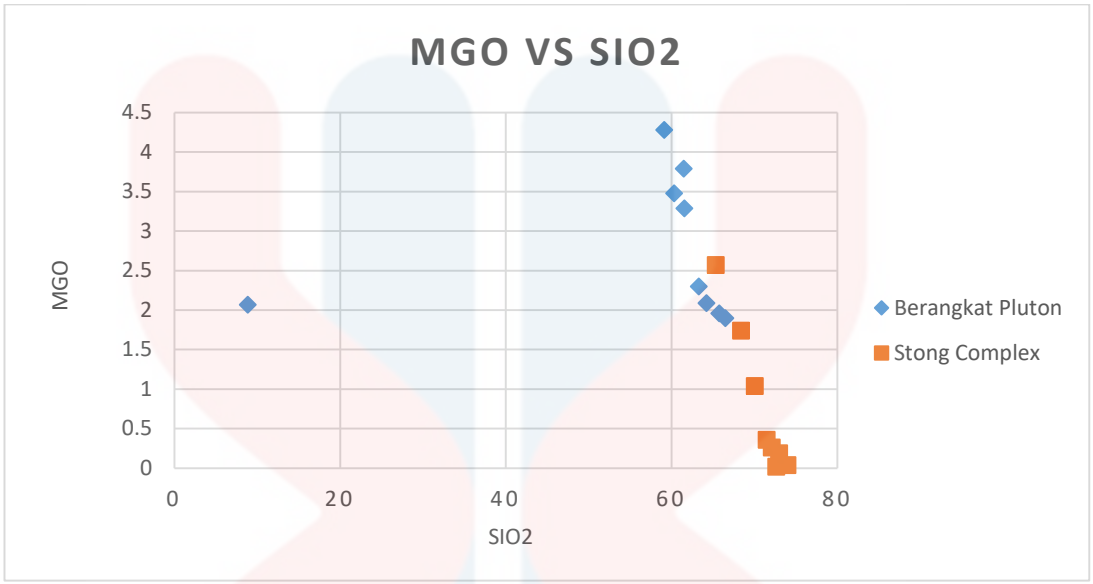
3) Fe_2O^3 vs SiO^2



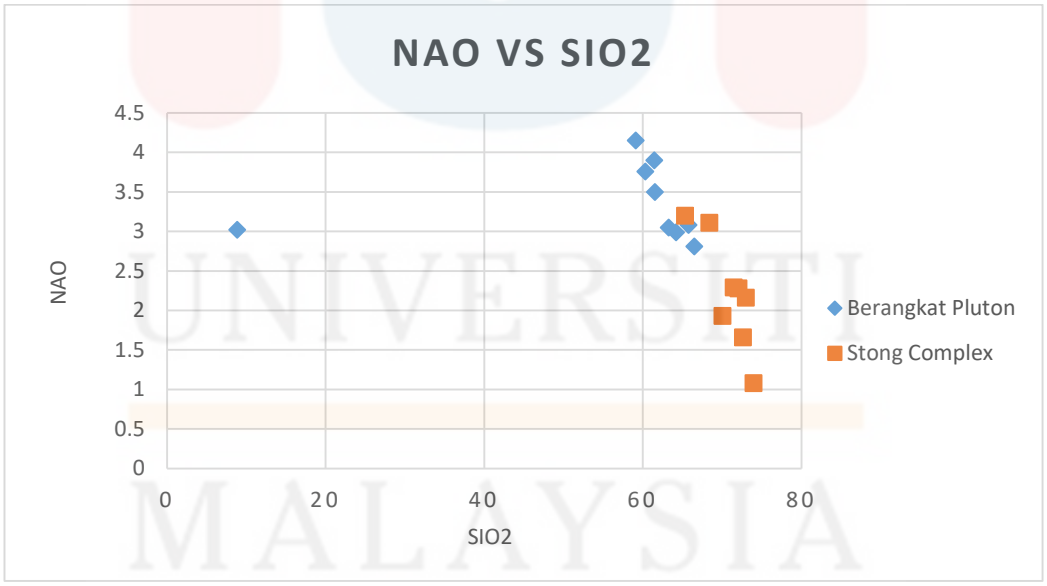
4) MnO vs SiO^2



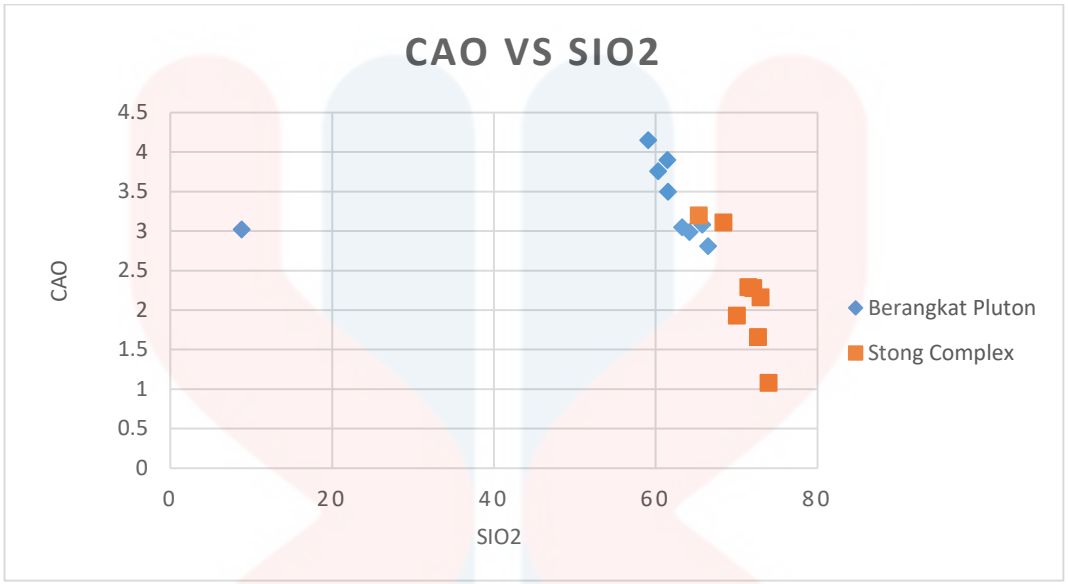
5) MgO vs SiO^2



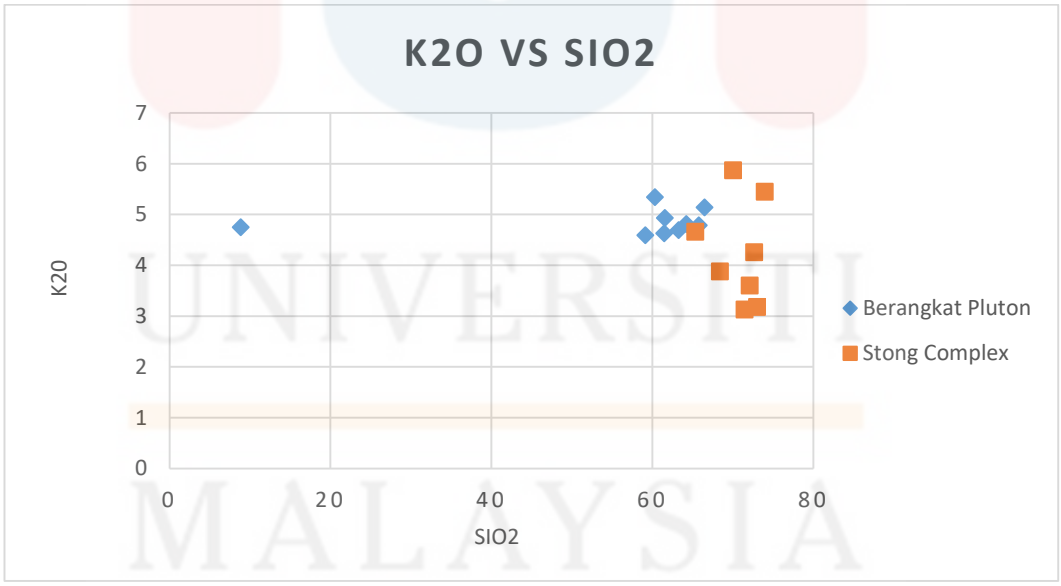
6) Na0 vs SiO^2



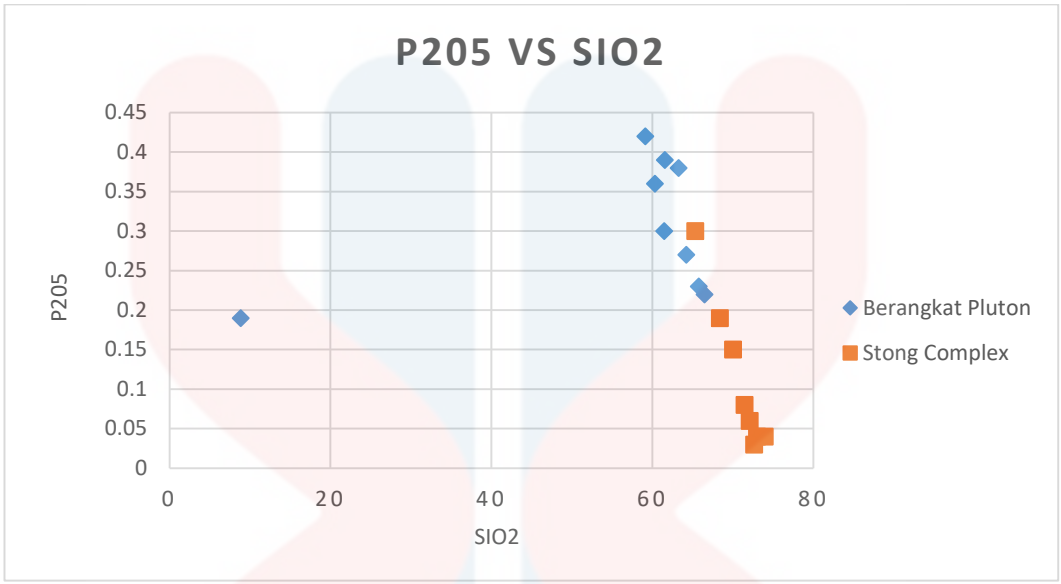
7) CaO vs SiO^2



8) K_2O vs SiO^2

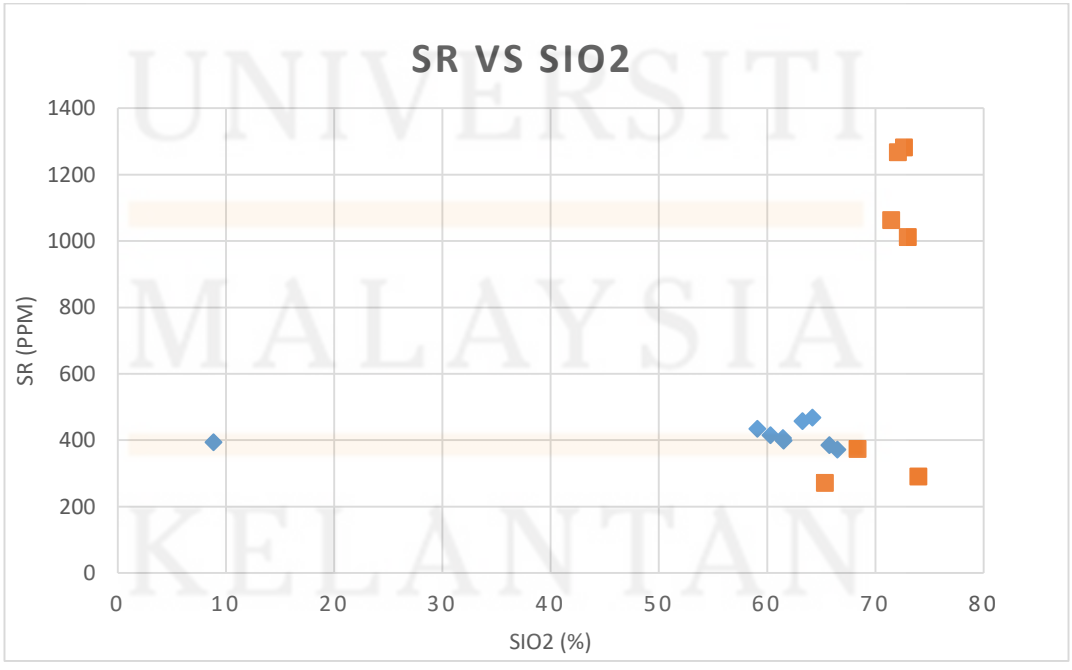


9) P_2O_5 vs SiO^2

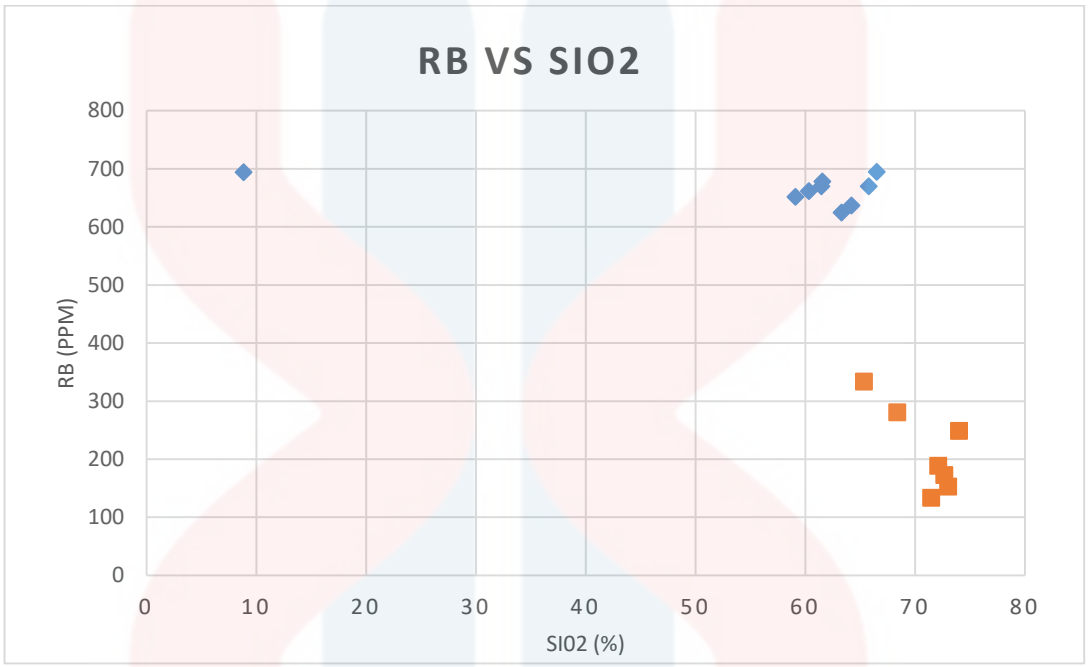


2) Hacker diagram trace element of Berangkat Pluton and Stong Complex

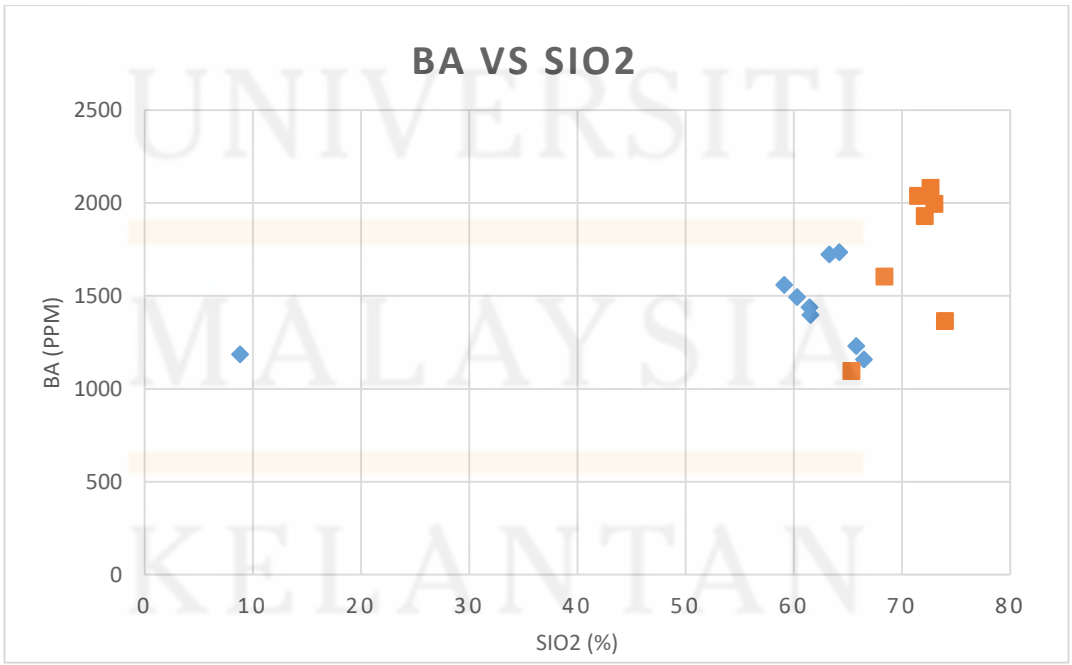
1) Sr vs SiO^2



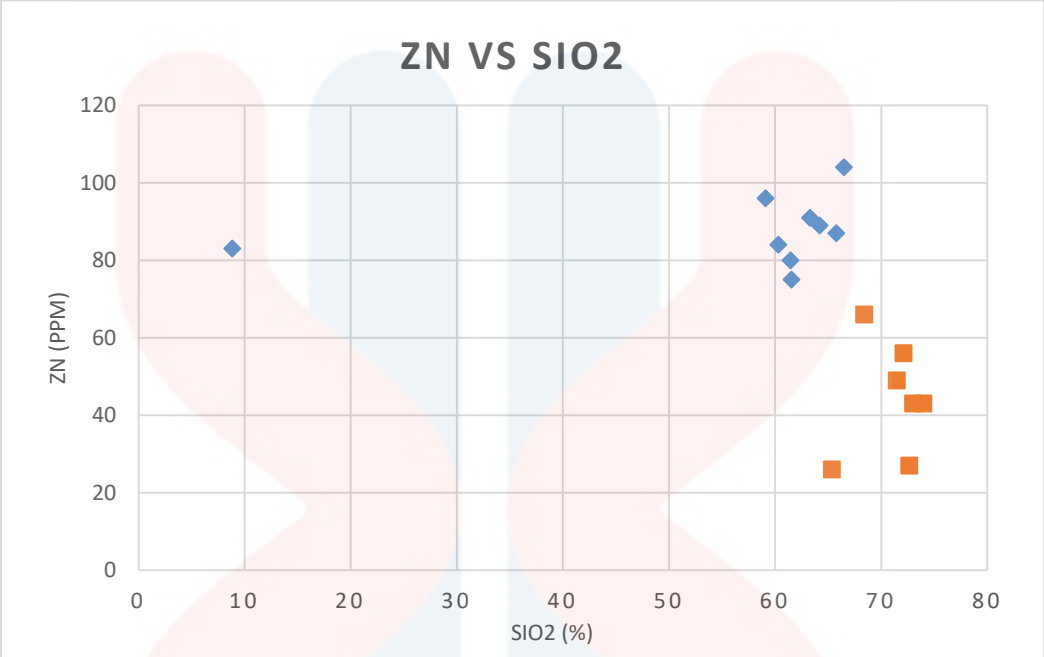
2) Rb vs SiO^2



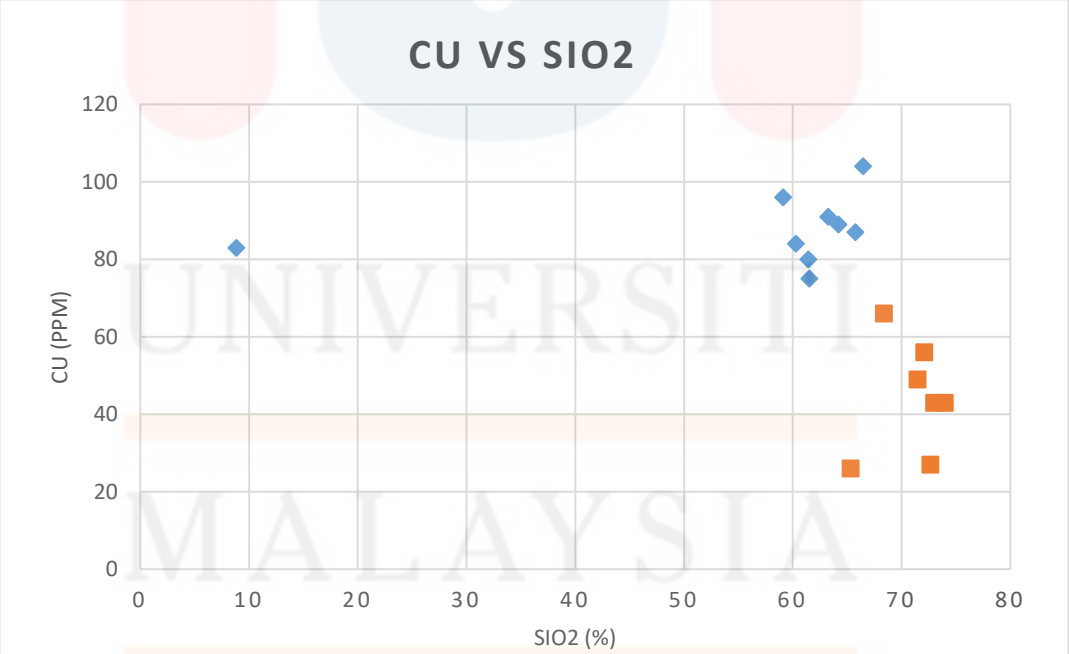
3) Ba $_{vs}$ SiO^2



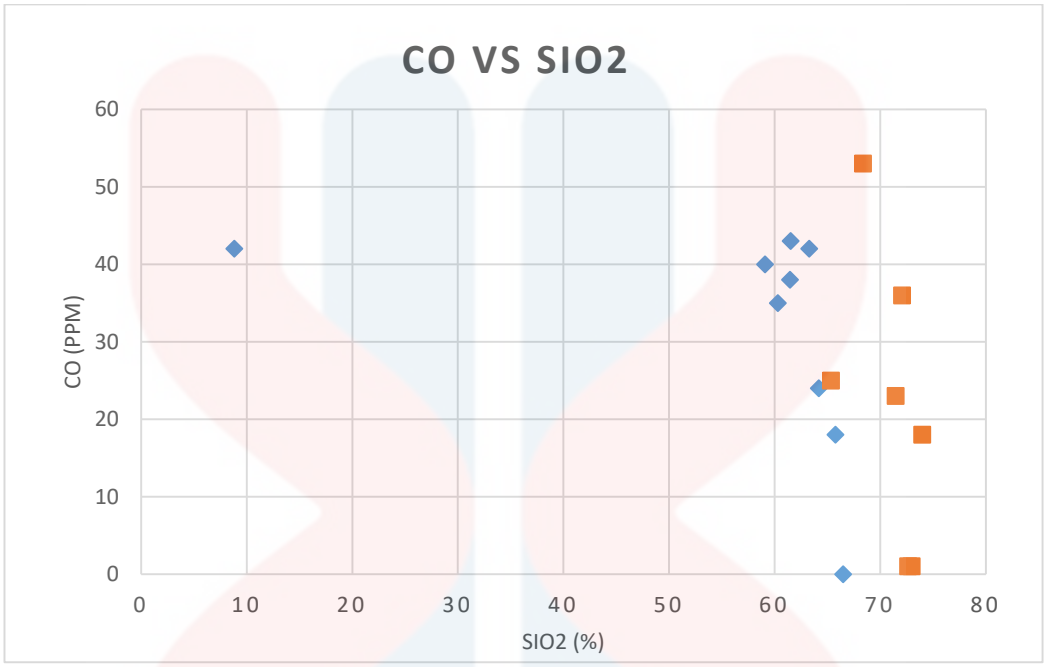
4) Zn vs SiO^2



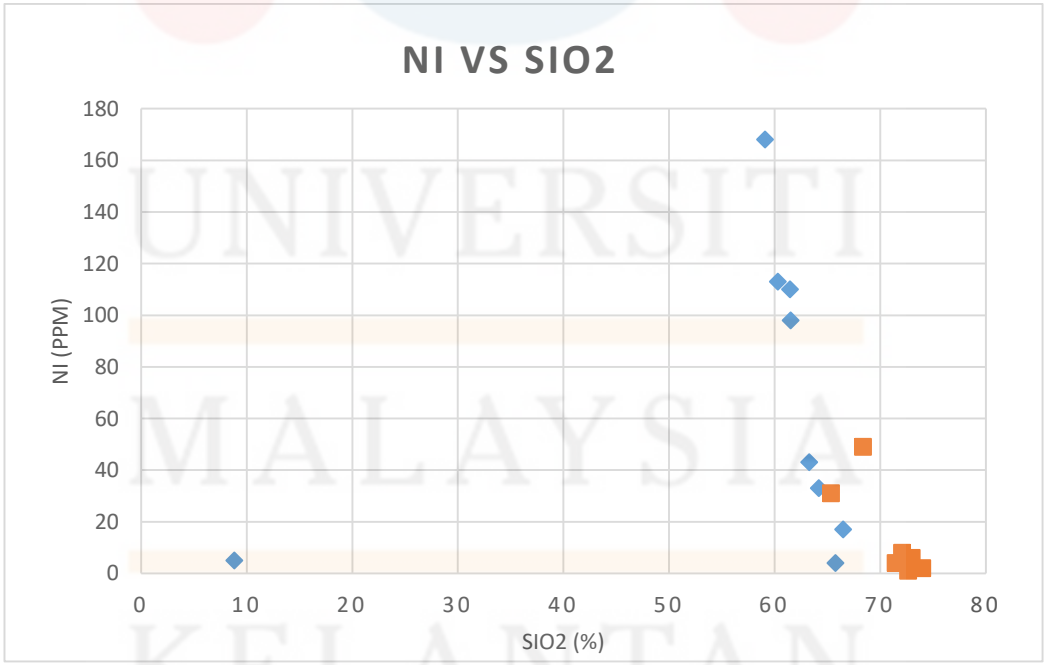
5) Cu vs SiO^2



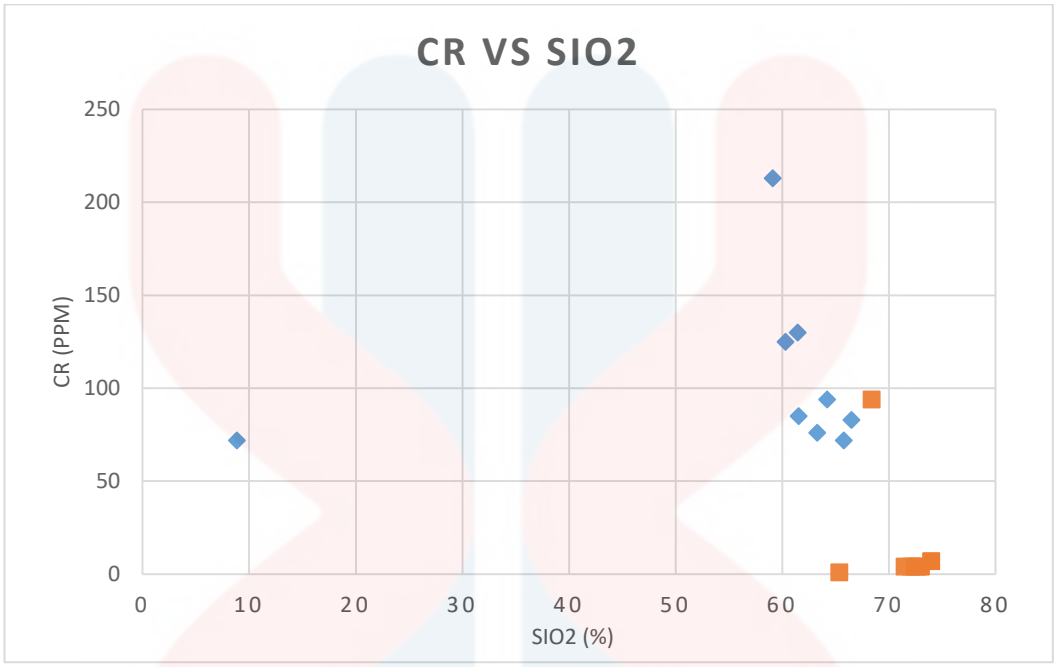
6) CO vs SiO^2



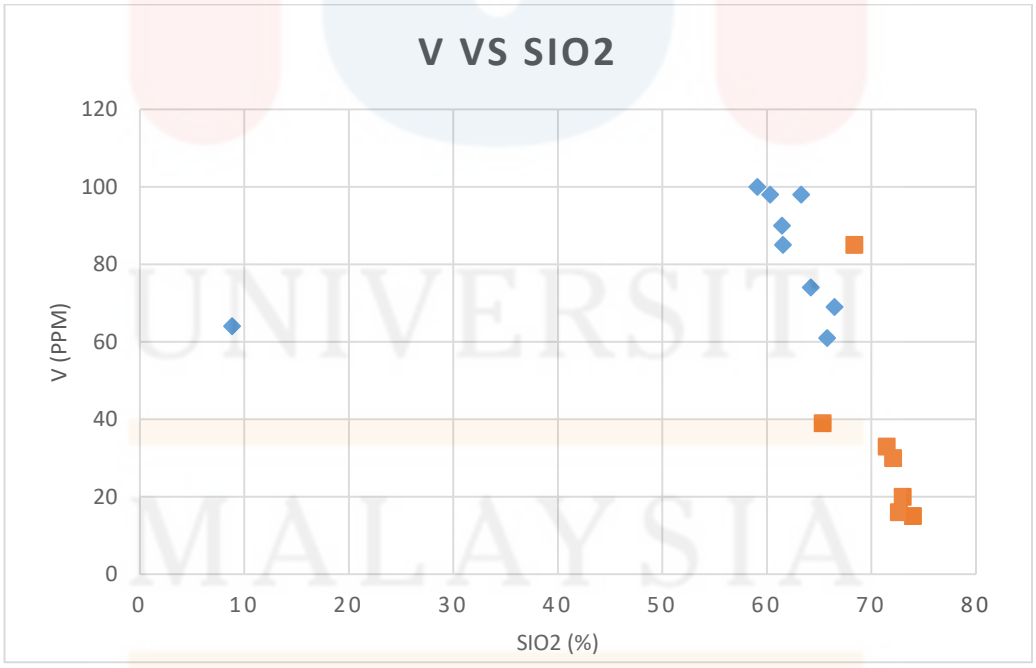
7) Ni vs SiO^2



8) Cr $_{vs}$ SiO^2



9) P_2O_5 vs SiO^2



This part discusses about the comparison of major element from different places which is Berangkat Pluton and Stong Complex using X-Ray Fluorescence. There have 9 samples taken in Berangkat Pluton (Mohd Rozi Umor et al,2012) with variety rock types. Those rocks are granodiorite, microdiorite, monzodiorite (Mohd Rozi Umor et al,2012). Based on mineral content and geochemical trends, major elements, all three units these rocks have a genetic relationship and derived from a common source of magma (Umor, 2012). Though the direction of rock differentiation based on the abundance of quartz shows the rocks evolved from Monzodiorite Sg. Lah to microdiorite enclave and Granodiorit Bertam. All units' rocks crystallize at about the same time, however at varying positions in one intrusive body. This is because all the rock units are found to be classified inside the same rock series and magma series.

There have 8 samples taken in Stong Complex, Kelantan (Ramdanshah & Mohd Rozi, 2001). Five samples taken from leukogranite while three samples taken from tonalite sample (Ramdanshah & Mohd Rozi, 2001). Trace element consist of V, Cr,Ni, Cu, Zn and Co (Ramdanshah & Mohd Rozi, 2001). Figure Harker plotted between trace elements against Si02 concentrations as in Figure 4. Two correlation trends can be observed namely correlation positive and negative correlation. Positive correlation trends indicated by the element Sr also Ba for Stong Complex while Pluton Berangkat indicated by the elements of Rb, Zn and Cu. Positive correlation which is where the trend of Cr element distribution is increasing against increasing Si02 concentrations Negative correlation trends indicated by the elements Rb, Zn, Cu, Co, Ni and Cr for Stong Complex and by the elements Sr, Ba, Co, Ni, and Cr for Berangkat Pluton where the trend the distribution of these metal elements is reduced against increased concentration of Si02 This indicates a relationship negative which is increasingly increasing differentiation then decreases the concentration of these

elements. The transition metal element is high in mafic rocks and less in felsic odors. Element V is found to represent rich minerals Fe in feromagnesium minerals such as biotite (Brian and Carleton, 1989) in which these minerals are increasingly decreases with increasing current Si02 concentration gradual differentiation.

CHAPTER 6

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

As a conclusion, geology including geomorphology, has been described in the study field. Stratigraphy, lithology, geology of structures and historic geology. The lithology found in the study area was meta sediment, phyllite, biotite granite porphyry, coarse grained foliated granite and microgranite, based on data collected in the study area. Meta sediment and phyllite, from Permian to Triassic, are of the same age. Meta sediment and phyllite, from Permian to Triassic, are of the same age. Though early Cretaceous and microgranite were for biotite granite porphyry and coarse grained foliated granite, there was late Cretaceous intruding coarse grained foliated granite.

Nine samples obtained from three different rock types which is microdiorite, monzodiorite and granodiorite in Berangkat Pluton. It has different mineral and geochemical content. However, it is classified in a series of rocks and magma the same indicates the origin of the same magma origin. The process of petrogenesis for the crystallization of each rock unit is by differentiation of rocks such as mineral fractionation and slight assimilation of surrounding rocks.

Eight samples obtained from two different rock types which is leukogranite and tonalite rock in Stong Complex, Kelantan. Based on the magma correlation and differentiation trends shown by Hacker Diagram, tonalite is more relatively old compared to Leukogranite because it is formed first in a series of magma

differentiation though no boundary was found between these two units at the field. Direction of differentiation is from Tonalite depart to Leukogranite. This clearly shows that the process of formation of the Stong Complex originated from the same source of magma suffered gradual differentiation and it is a granite body type I is part of the Eastern Granite.

6.2 Recommendation

Proposal for the improvement of the final year project report, which is to use primary data so that the data obtained is the most up-to-date. In addition, students are able to hone their talents in interpreting the geology of strutting and rock types in the field using existing knowledge learned in class. In addition, data collection must be done in advance so that writing can be done carefully. In the meantime, mapping should be carried out to find out the relationship between metamorphic rocks that is metasediment with igneous rocks that is granite. Recommendation of Stong Complex, Kelantan which is further explanation aspect of petrogenesis.

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