GENERAL GEOLOGY AND RESISTIVITY SURVEY OF POLITEKNIK JELI AREA

by

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A thesis submitted in fulfillment of the requirements for the degree of Bachelor of Applied Science (Geoscience) with Honours

FACULTY OF EARTH SCIENCE

UNIVERSITI MALAYSIA KELANTAN

2017

DECLARATION

I declare that this thesis entitled "General Geology And Resistivity Survey of Politeknik Jeli Area"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: Fathul Hadi Zharfan Bin Adzmi

Date: 9th JANUARY 2017

ACKNOWLEDGEMENT

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

Alhamdulillah, all praise to Allah for strengths and His blessing in completing this proposal.

First and foremost, I would like to express my appreciation to my Final Year Project Supervisor, Miss Zakiyah binti Ainul Kamal for her guidance and support throughout my thesis completion. Thank you very much in helping me and she has been provided me advices and knowledge for this thesis accomplishment.

Next, I would like to take this good opportunity to thank my family who have been supported me since the day I started this research in March 2016. Thank you to my parents for always support me spiritually.

Thank you to Universiti Malaysia Kelantan (UMK) laboratory assistant and drivers who had help me a lot in the field. Thank you to my coursemates, especially Ahmad Mustaqim as he had thought and helped me a lot during the accomplishment of this thesis.

Moreover, thank you to my friends from other faculty, Hazwan, Khairul, and Che Amir who had helped me conducted my resistivity survey. They did not hesistate to help me from beginning to the final process in conducting the survey.

Last but not least, I would like to say thank you very much to all, who had been directly and indirectly involved in helping me to accomplish this thesis.

Sincerely, thank you to all of them.

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LIST OF ABBREVIATIONS

ERI	Electrical Resistivity Imaging
JUPEM	Jabatan Ukur dan Pemetaan Malaysia
JMG	Jabatan Mineral Dan Geosains

ABSTRACT

GENERAL GEOLOGY AND RESISTIVITY SURVEY OF POLITEKNIK JELI AREA

Electrical resistance survey and earth resistance are the other name for resistivity survey. Resistivity is generally used in geophysical survey method where electrical current is passed through the ground at regular points. In this research, Electrical Resistivity Imaging is used to measure the subsurface condition. The ERI result shows the subsurface condition. 3 survey line has been set in the study area for resistivity survey. Every line survey shows different result. The result is very useful as it can be refer by anyone in future.

ABSTRAK

GEOLOGI AM DAN KEBERINTANGAN RESISTIVITI DI KAWASAN POLITEKNIK JELI

Pemantauan rintangan elektrik dan rintangan bumi adalah nama lain bagi pemantauan resistiviti. Rintangan ini selalu digunakan didalam pemantauan geofizik dimana arus elektrik melalui tanah pada kadar yang tertentu. Didalam kajian ini, rintangan imej elektrik digunakan untuk mengukur keadaan bawah tanah. Keputusannya menunjukkan keadaan sebenar bawah tanah. 3 baris pemantauan telah dibuat didalam kawasan kajian. Setiap baris menunjukkan keputusan yang berbeza. Keputusannya sangat berguna kerana dapat dirujuk oleh sesiapa sahaja di masa akan datang.

CHAPTER 1

INTRODUCTION

1.1 GENERAL BACKGROUND

This study was conducted to know about the general geology and the subsurface condition of Politeknik Jeli area. Politeknik Jeli located in Jeli district, Kelantan. Kelantan consisted of 12 districts. District in Kelantan is called as Jajahan. Jajahan Pasir Putih, Jajahan Kota Bharu, Jajahan Tumpat, Jajahan Gua Musang, Jajahan Dabong, Jajahan Tanah Merah, Jajahan Bachok, Jajahan Kuala Krai, Jajahan Machang, Jajahan Jeli, Jajahan Pasir Mas and Jajahan Kota Mahligai. Lakota is the specific area study and the geomorphology consisted of hills.

There is a broad division of geophysical surveying methods into those that make use of natural fields of the Earth and those that require the input into the ground. The natural held methods utilize the gravitational, magnetic, electrical, and electromagnetic fields of the Earth, searching for local perturbations in these naturally occurring fields that may be caused by concealed geological features of economic or other interest. Artificial source methods involve the generation of local electrical or electromagnetic fields that may be used analogously to natural fields, or, in the most important single group of geophysical surveying methods, the generation of seismic waves whose propagation velocities and transmission

paths through the subsurface are mapped to provide the information on the distribution of geological boundaries at depth. Generally, natural field methods can provide information on earth properties to significantly greater depths and are logistically more simple to carry out than artificial source methods. The latter, however, are capable producing a more detailed and better resolved picture of the subsurface geology.

Electrical resistance survey and earth resistance are the other name for resistivity survey. Resistivity is generally used in geophysical survey method where electrical current is passed through the ground at regular points. In general, geophysics involve the study of parts in the earth hidden from direct view (Wong, 1993). According to Groves p et al., (2011) the seismic reaction method measures the velocity of seismic body waves as they are reflected from different subsurface layers. Electrical resistance in the soil varies. They also can be affected by the existance of archaeological features. The patterns are recorded, plotted and interpreted.

After the patterns are plotted,we can know very clear where walls or ditches exist, even though we cannot see them from above ground. This result can be used to complement other geophysical data, such as from magnetometry, or to target the location of excavation trenches.

1.2 PROBLEM STATEMENT

There are a few problems arouse in this research because the lack of detail in geological mapping. It is also because lack of studies that has been done in this area. Jeli district included high institutions such as Politeknik Jeli, MRSM Jeli, UMK Jeli and Sekolah Menengah Sains Jeli. In order to make sure every development and contruction safety, they could use the subsurface data that we get from our study. As Jeli district consisted of hills, this research is important for future work such as building construction and housing area.

1.3 RESEARCH OBJECTIVES

I. To update the geological map of the study area to the scale of 1:25,000.
II. To identify the subsurface structure of Jeli area.
III. To investigate the subsurface condition of Jeli area for futurework.

1.4 STUDY AREA

Kelantan is one of fourteen states that comprises in Malaysia. Kota Bharu is the capital city of Kelantan. Total area that occupies Kelantan is about 14,922 km^2 and has a population of 1,635,000 people. Position of Kelantan in Malaysia is in the north-east of peninsular Malaysia. It is bordered by Narathiwat, Thailand. Kelantan includes 10 districts which are Kuala Krai, Machang, Jeli, Kota Bharu, Tumpat, Pasir Mas, Pasir putih, Tanah Merah, Gua Musang and Bachok.

Figure 1.1 shows the location of study area 5x5 km located in Politeknik Jeli in Jeli district, Kelantan, bounded by 5°42′N,101°50′E as seen in the figure, while figure 1.2 shows the map of Kelantan with study area. In order to get some basic detail, a geological mapping was conducted in this area with 25km^2. Figure 1.3 shows the geological map of the study area. This area can be accessed through the east highway and it was 94km away from Kota Bharu, the capital city of Kelantan.

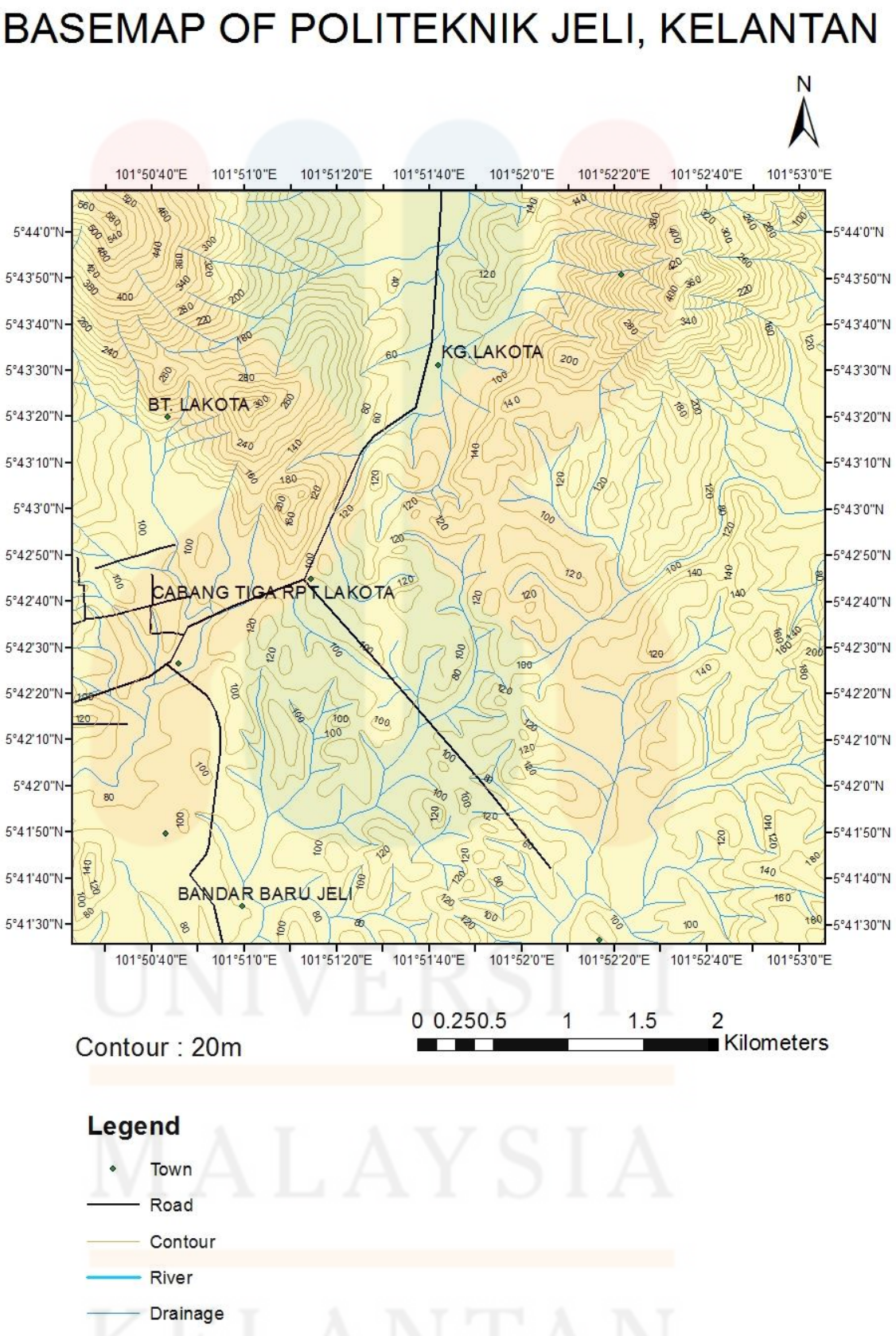

Figure 1.1: Basemap of Politeknik Jeli

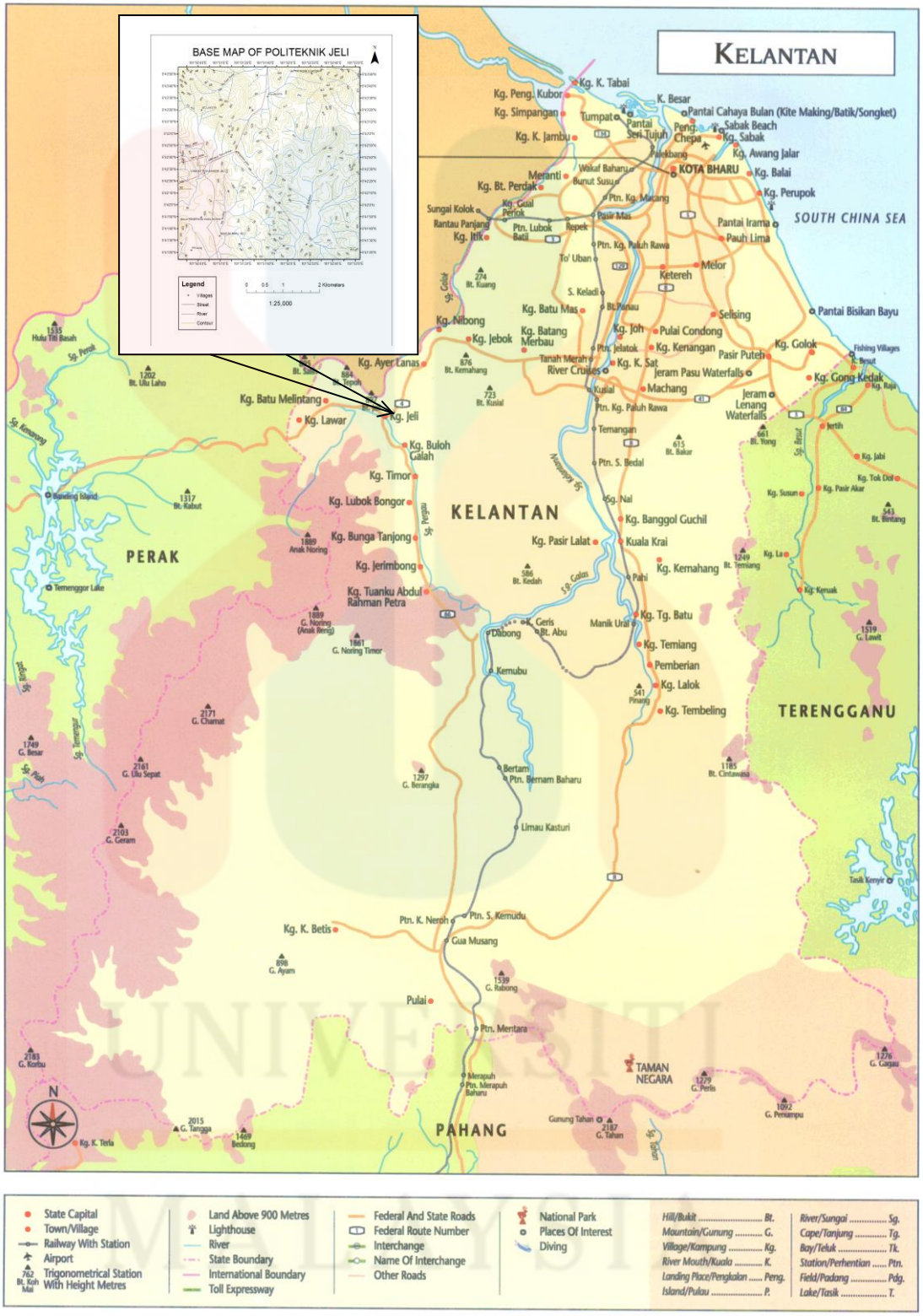

Figure 1.2: Map of Kelantan with study area.

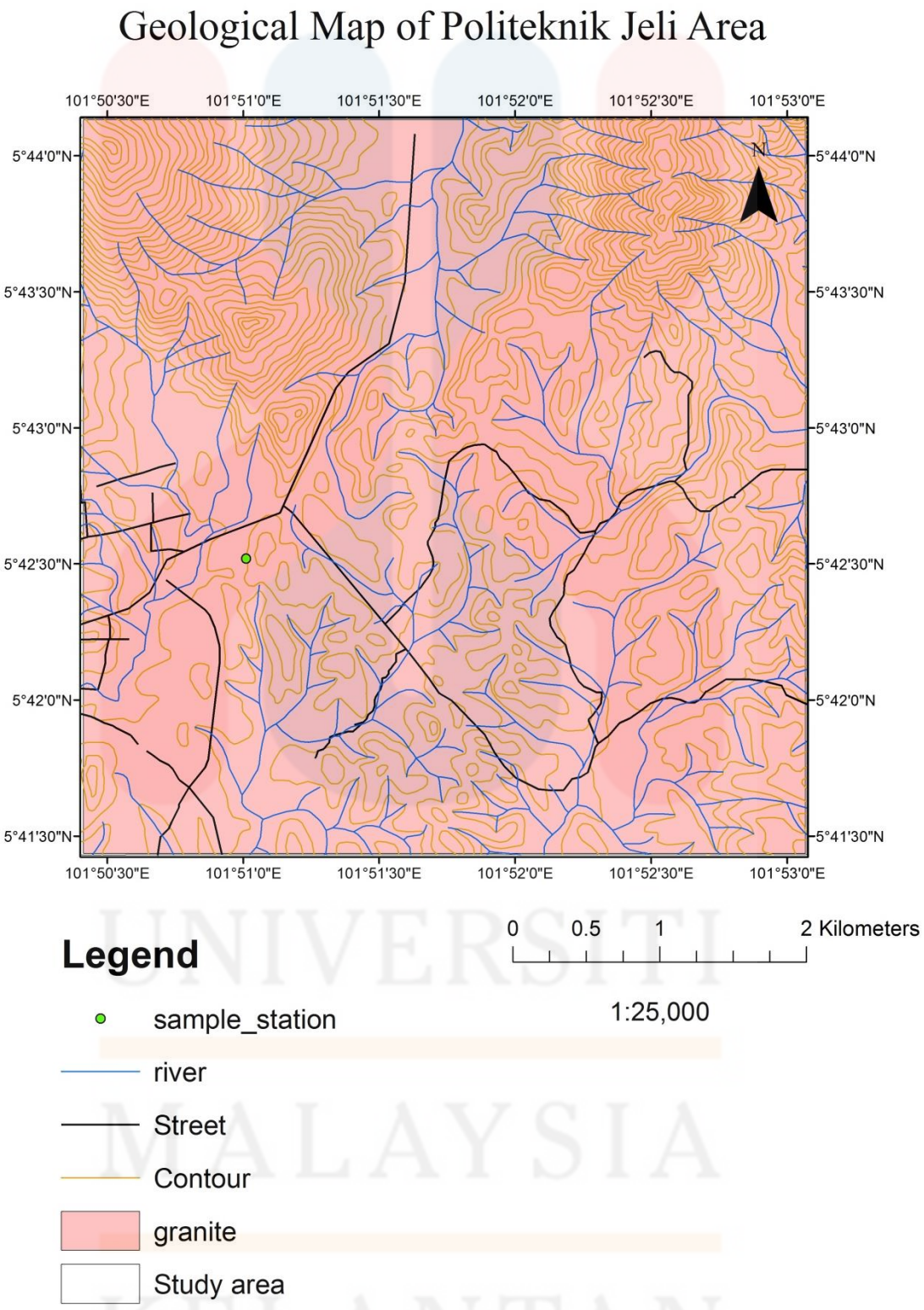

Figure 1.3 Geological map of the study area

1.4.1 GEOGRAPHY

Politeknik Jeli located in Lakota area. The geography of Lakota was dominantly by hills. The hills circumvented the study area that commonly filled with laterite. There were some hills that already been exploited by denizens and developers for business sites, house, and high inculcation places. There were additionally hills that denizens exploited and became as rubber estates. In Lakota, main river was wide and number of minuscule river were high. The diminutive rivers were needed to be map exhaustively. Generally, metamorphic rock in this extent area shows region border which inclined to have North-South parallel with Peninsular Malaysia region border. Simultaneous tectonic kineticism had constructed regional and local structure in the series of anticline and syncline including local folds. This state resulted the bedding to be inclined towards west and recurrently interfered by local shear and fault. Kemahang granite showed the charactheristic that it was exposed to shear. Shear zones in metamorphic rock commonly correlated with permineralisation.

a) People distribution

Numbers of people that live in Lakota in 2010 are 608 people. There were 297 of male and 311 were female. There were 127 households in Lakota and 134 were number of living quarters.In Lakota, the number of Bumiputera was dominant and predominant by non-malaysia citizen. Refer Table 1.1 below for the exact amount of people lives in Lakota Jeli.

Table 1.1: People distribution in Lakota Jeli.

AGE	TOTAL
0-4	43
5-9	75
10-14	93
15-19	73
20-24	40
25-29	32
30-35	35
40-44	40
45-49	33
50-55	33
56-59	15
60-64	21
65-69	13
70-74	13
>75	13

b) Rain distribution

The Jeli district result the highest total rainfall annually in state of Kelantan. Batu 13 Jeli known as the wettest place and the heaviest rainfall in Malaysia in 2011. The precipitation for Batu 13 Jeli is 1623.5 mm and for rainfall is 6468.9 mm for mean rainfall of 2010 until 2012 (Wikipedia,2012).

c) Land use

In the study area, villagers used the land for agriculture purpose. The villagers choose to plant rubber tree due its commercial value of latex as their main income. Building construction, housing area, and educational building was minor in this area.

d) Social economic

Most people in Jeli worked as rubber tapper whileothers worked in government sector or independently opens up small business example as grocery shop, food stall, and service shop. The rubber plantations which belong to the local people also attracted people from outside to invest and work. The development of Jeli was started when the government encouraged and initiated the people around Kelantan to start open new area for agriculture. This process begin with a period of land clearing or logging.

e) Road connection

The study area can be accessed by Grik- Pasir Putih road that connected with East-West Highway. This road becomes the major connection between Perak and Kelantan state. All the raw materials and products from the east and west of Malaysia transported using this road. Figure 1.4below shows the Highway Jeli-Grik route.

Figure 1.4 : Highway Jeli-Grik Road 4 (Source: Google Map)

1.5 SCOPE OF THE STUDY

This study included two scope which are the resistivity survey and geological mapping. Resistivity survey was conducted to get the subsurface information and the data can be used for future work. Geological mapping was conducted to enhance existing map, while resistivity method used to investigate the subsurface condition of the study area.

1.6 RESEARCH IMPORTANCES

The importance of this research is to expose the people nearby about the information on the structure of the subsurface. Furthermore, building strength and a foundation of construction depends on the subsurface condition of the area. By doing this research, we can get the latest subsurface data for future usage such as for mining project by government or non-government agencies. During this research, the application of geophysical method also enhanced the understanding of the area with addition of information by the geological mapping. On top of that, this research can contribute the data for other future work.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will tell us briefly about the past research that have been conducted relating to this topic. Area's regional geology and tectonic setting, stratigraphy, structural geology and regional structure were included. This study will be carried out by using resistivity survey. Resistivity survey method was used in this study to know more about the study area's subsurface. The data we get can be very helpful for future work. Resistivity survey also can be use for groundwater investigation. One of them is Brousse (1963) which cited the effectiveness of the electrical resistivity method n the investigation of the groundwater in complex granite areas. Besides that, Olorunfemi and Oloruniwo (1987) used the electrical resistivity method for groundwater investigation in parts of the basement terrain in Southwest Nigeria.

2.2 REGIONAL GEOLOGY AND TECTONICS SETTING

There is one belt in Kelantan state. It was central belt and they were called Gua Musang formation, Telong formation, Aring formation, Ciku formation and Taku schist. Those belt starting from Kelantan to Johor between the eastern foothill of the Main Range. There were two boundaries that subsist and was marked by Lebir fault which are western boundary and eastern boundary. They consisted of Permian clastic and sporatic outcrop.

The wide of the fault zone is 10km. They subsist between the gap of Sungai Lebir and the eastern margin of Taku Schist proximate to Kuala Krai (Singh, 1985). Few studies have been carried out in Kelantan area in order to explicate the geology of this area. MacDonald (1967) introduced the term Taku Schist to describe a sequence of metamorphic rock s cropping out in central Kelantan categorically along the Taku River. Predicated on Tjia, (1969) verbally expressed that the predicated on tension fractures and drag fractures the Lebir fault exposed sinistral slip. This fault resulted the most incipient Triassic to Jurassic- Cretaceous basin were composed and deformed by strike slip forms of kineticism along the fault zone (Mustaffa, 2000).

The western part of central belt recorded aged as upper paleozoic rocks which is located in Gua Musang and Aring formation in south of Kelantan. This kind of rock was predominantly as argillaceous strata and volcanic rock with subordinate arenaceous and calcareous sediments. The depositional environment was shallow marine environment (Foo, 1983). The study area located in the region of Main range which is the backbone of Peninsular Malaysia that is the longest mountain range

commenced from Southern Thailand in the north towards south of Negeri Sembilan that the elevation apex of over 2100 m (Raj, 2009).

For geological study for the area which was occupied with Kemahang granite, which was contained eccentric granite mass that resulted in forms of mountainous range east and west of Jeli town, Kelantan. This mountainous range elongated until to Sukhirin range that located in Thailand. This formation covered of some places which were Jeli Hill, Kemahang Hill, Kusial Hill, and other nearby hills.

The eastern part of the Batu Melintang –Sungai Kolok Transect area was first mapped by H. E. F. Savage in 1992 to 1925 (Savage, 1925). Macdonald (1967) later carried out more detailed study on the geology and mineral resources of Kelantan and North Terengganu on the scale 1:250,000. Mohamad Hussein Jamaluddin et al. (in manuscript) mapped the geology of Batu Melintang area covering topographic map sheets number 21 (Batu Melintang) and 12 (Belum) on the scale of 1:63,360 during 1994 to 1996.

Peninsular Malaysia composed due to the collision between Sinoburmalay to the west and Eastmal-Indonesia to the east. This collision had resulted the Bentong-raub suture and for the proving of this verbal expression was by the suture that can be traced northward to Thailand and southward to Banka and Billiton Island. The Tardy Triassic of major tectonic event had caused the rock deformation in area of Malaysia and Thailand peninsular.

In Peninsular Malaysia, folding resulted in NW-SE and N-S trending fold axes in the most of the bedding plane dips towards east by the several of dip angles. There are numbers of major faults nearby to the study area which are Long-Kolok fault (NE-SW), Pergau fault (NE-SW), and Kalai fault (N-S) (MTGC.2006).

2.3 HISTORICAL GEOLOGY

According to (Macdonald, 1967) verbally expressed that age of Kemahang granite was Triassic. According to field observation by (Cobbing et al., 1992) the Sukhirin granite can be correlated with Tan Yong granite pluton that resulted the intrusion of Sukhirin granite occurred in Triassic period. Kemahang granite assigned by Malaysia-Thai Worrking groups to be Triassic I-type geanite (MTGC.2006). According to Lee 2004, verbalized that Paleozoic formation in Kelantan was found in the central belt of Peninsular Malaysia. The upper rock Paleozoic consist of Gua Musang and Aring Formation in the south Kelantan, The depositional environment is shallow marine that active submarine volcanism starting in Tardy Carboniferous.

2.4 STRATIGRAPHY

Stratigraphy is a branch of geology which study rock layers or strata and layering stratification. According to (T. Suntaharalingam, 1983), Central zone addressed by its border on the west by the Main Range of peninsular which locating largely of granite that age by Lower Paleozoic. Usually stratigraphy were used in the study of sedimentary and layered volcanic rocks. In Kelantan, especially area near the border of Thailand such as Jeli included a few formations that can be distinguished. Formations that included in this area are Gula Formation, Simpang Formation, Beruas Formation, Telong Formation, Taku Schist, Mangga Formation, and Tiang Schist. The youngest formation is Gula Formation compared to the other. The Gula Formation came from marine deposits in the Quaternary period. Menawhile, the oldest formation was the Tiang Schist compared to all of the others and age from Devonian to Silurian. Figure 2.1 shows the geological time scale of Kelantan.

Kelantan Map

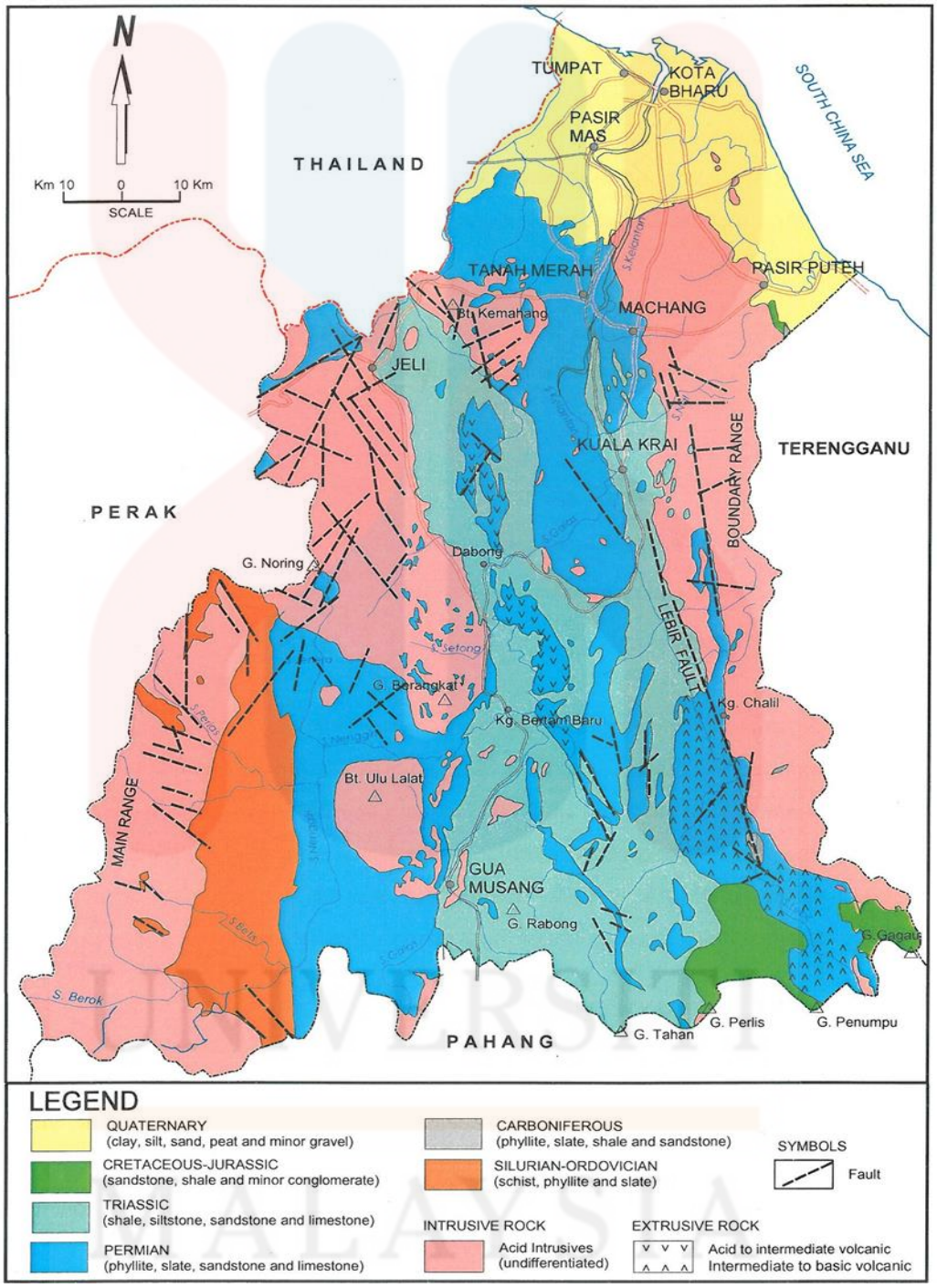

Figure 2.1 : Geological Map of Kelantan (*Jabatan Mineral dan Geosains, 2003*)

2.5 STRUCTURAL GEOLOGY

Structural geology is the study of the three-dimensional distribution of rock units. It also shows their deformational histories including determining the lineament of both positive and negative. A linear feature in a landscape which is an expression of an underlying geological structure such as fault is a lineament. There are few factors that can rise the lineaments such as fracture zone, shear zone and igneous intrusion such as dykes.

2.6 PETROGRAPHY

The granite that found in Kemahang granite resulted the light colour of grey, medium to coarse grained, megacrystic, biotite-hornblende granite. K-feldspar megacrysts resulted for 40% by volume content and have lath shape to tablet with some equant crystals. The size of megacrysts was in range of 1x2cm to 3x12cm. The groundmass was composed of medium to coarse , single to cluster, quartz (20-35%), feldspar (30-40%) and chalky white, subhedral to euhedral, stubby plagioclase (12-20%), whereas dark grey to black in size of 2x10mm, single, flake to book, euhedral, biotite (15%) 2-5mm in size the only mafic minerals found in the rock especially ni granite pluton (MTGC.2006).

A shuttle imaging radar trip study over South Thailand and Northeast Peninsular Malaysia withal include lineaments patterns in Granite of Kemahang Granite (Koopmans B. N. et al 1983). He verbalized that the Kemahang Granite, situated at the boundary between Malaysia and Thailand, is the most minuscule of the granite sub-units treated here, with the highest lineaments density in Kemahang granite was predominantly consisted of medium to coarse of megacyrstic biotie-hornblende granite to granodiorite. The average length of feldspar was about 2 cm any may elongated to 10 cm. The marked lineation was found at different localities. An abundance of varieties resulted which were deformed feldspar crystals, strained polarization and elongated quartz. There were numbers of type of rocks founds withal in this formation which are tardy phase microgranodiorite, micro granite, and leucogranite.

Quartz veins and lenticels additionally found in several localities. Kemahang granite formation covered astronomically immense area and act as major proportion of rock unit (MTGC.2006). The Taku Schist formation had been injected by Kemahang granite and resulted astronomically immense scale of Cretaceous Biotite K: Ar age of 124 +/- 4 Ma. The rock in Kemahang granite is predominantly by quartz-mica schist with subordinate quartz-mica-garnet schist and garnet-mica schist. The other types of rock located in this formation are amphibolite, serpentinite and granite gneiss. The presence of metamorphic rock designated the metamorphism process that occurred Upper Triassic from K:Ar dating. This metamorphism transpired due to collision of Sibumasu with East Malaya same as Stong involute formation (Bignell & Snelling 1997).

2.7 RESEARCH SPECIFICATION

Electrical resistivity of the soil can be considered as a proxy for the spatial and temporal variability of many other soil physical. Because the method is non-destructive and very sensitive, it offers a very attractive tool for describing the subsurface properties without digging. It has been already applied in various contexts like: groundwater exploration, landfill and solute transfer delineation, agronomical management by identifying areas of excessive compaction or soil horizon thickness and bedrock depth, and at least assessing the soil hydrological properties. The surveys, depending on the areas heterogeneities can be performed in one-, two- or three-dimensions and also at different scales resolution from the centimetric scale to the regional scale.

In this research, Werner-Schlumberger array will be used. The classical Schlumberger array is one of the most commonly usedarray. A modified form of this array so that it can be used on a system with the electrodes arranged with a constant spacing. The “n” factor for tis array is the ratio of the distance between the C1-P1 (or (C2-P2) electrodes to the spacing between P1-P2 potential pair.

The sensitivity pattern for the Schlumberger array is slightly different from the Wenner array with a slight vertical curvature below the centre of the array, and slightly lower sensitivity values in the regions between the C1 and P1 (and also C2 and P2) electrodes. Loke (1999), suggest that there is a slightly greater concentration of high sensitivity values below the P1-P2 electrodes. This array is moderately sensitive to both horizontal and vertical structures. In areas where both types of geological structures are expected, this array might be a good compromise between

the Wenner and the dipole-dipole array. The median depth of investigation for this array is about 10% larger than that for the Wenner array for the same distance between the outer (C1 and C2) electrodes. The signal strength for this array is smaller than that for the Wenner array, but it is higher than the dipole-dipole array(Loke, 1999).

CHAPTER 3

MATERIALS AND METHODOLOGIES

3.1 INTRODUCTION

Methodology is very important when conducting a research because it makes our research more successful by its step and procedure. This chapter will mainly described about the procedure and materials used in Geological Resistivity Survey in the study area. Various topographic patterns and elements that occur along East Coast because of the direction of prevailing long shore currents of South East China.

By using geological mapping, there several outcrops that confirmed as granite. For granite landforms by (Hutchinson, 1997) explained that the granitic terrains of the peninsular are divided by five charactheristic due to deep chemical weathering, charctheristics of the humid tropics (Twidale, 2005).

3.2 PRELIMINARY RESEARCH

Preliminary researches have been done before anything else in carrying out this research. Information from internet, book, journal, and geological map was used thoroughly. Internet was used as an early research of data and information of study area. Books and journal research was also used for references.

3.2.1 GEOLOGICAL SURVEY

A geological survey is the systematic investigation of the geology beneath a given piece of ground for the purpose of creating a geological map or model. Geological surveying employs techniques from field mapping such as studying outcrops and landforms.

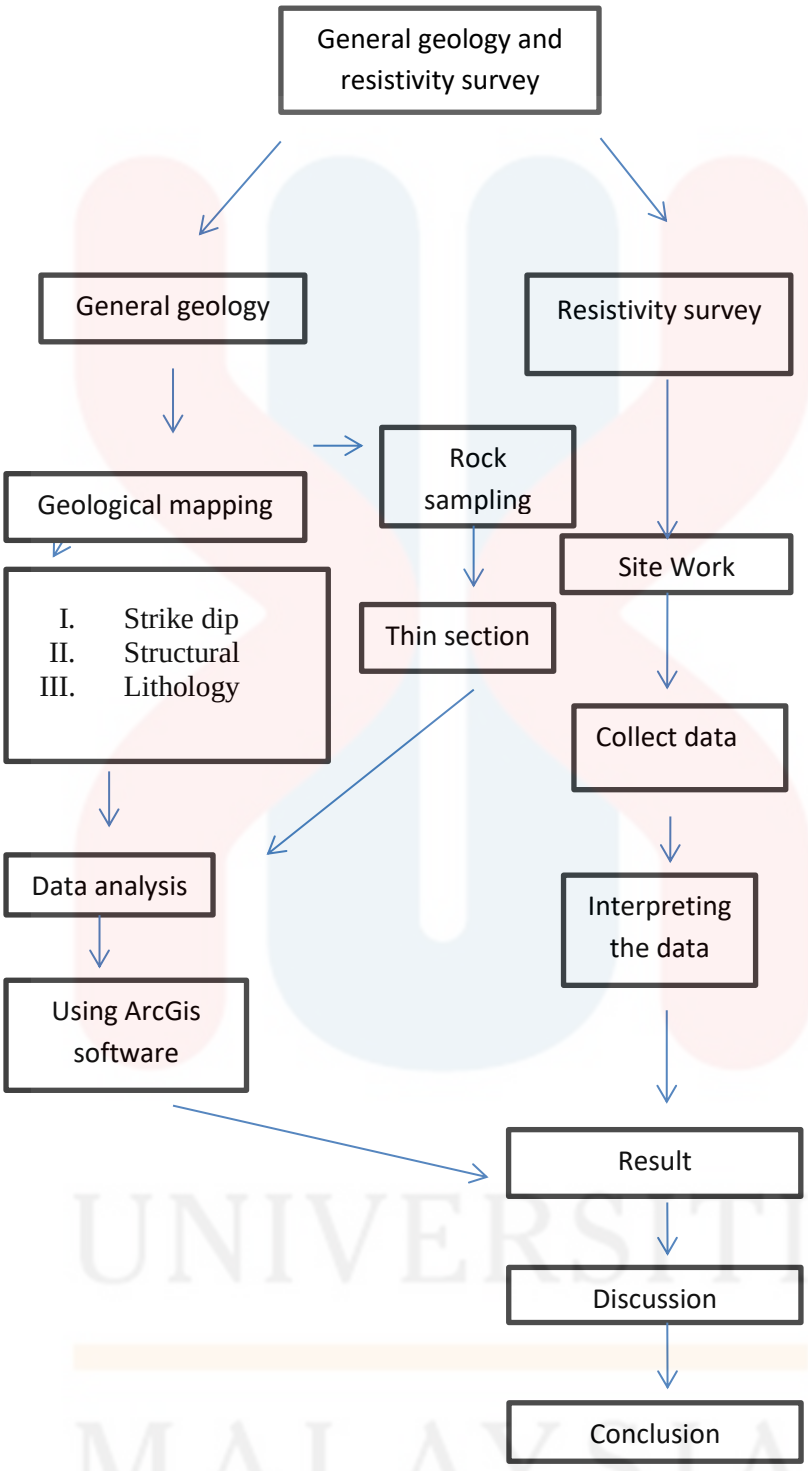

Table 3.1: Research flow chart

3.3 MATERIALS AND EQUIPMENTS

Materials for geological survey

- Garmin gps

  -The Global Positioning System (GPS) is a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense. GPS satellites circle the earth twice a day in a very precise orbit and transmit signal information to earth. GPS receivers take this information and use trilateration to calculate the user's exact location. Essentially, the GPS receiver compares the time a signal was transmitted by a satellite with the time it was received. The time difference tells the GPS receiver how far away the satellite is. Now, with distance measurements from a few more satellites, the receiver can determine the user's position and display it on the unit's electronic map.

- Hammer
  - Geological hammer is a hammer used for splitting and breaking rocks. In field geology, they are used to obtain a fresh surface of a rock to determine its composition, nature, mineralogy, history, and field estimate of rock strength. In fossil and mineral collecting, they are employed to break rocks with the aim of revealing fossils inside. Geologist's hammers are also sometimes used for scale in a photograph.

- Suunto compass
  - Suunto compass clinometer is a professional flip open mirror compass clinometer for precise directional measurements, navigational use and the ability to read vertical degrees. Some model has a two Zone System, meaning it will work anywhere in the world. (both northern & southern hemispheres). Some comes with a built in gravity operated clinometer to obtain degree readings such as dip and strike for geologists and with some maths, you can also obtain height readings.

- Hand lenses
  - Geologists working in the field, lab or office often need to closely examine rocks, sediments, soils, sand, minerals and other materials with tiny features. A hand lens provides a quick and easy way to perform that work. Many field geologists use a hand lens so frequently that they wear it on a lanyard or cord around their neck. Some tuck the lens into their button-down shirt pocket when not in use.

- Base mape
  - A geologic map or geological map is a special-purpose map made to show geological features. Rock units or geologic strata are shown by color or symbols to indicate where they are exposed at the surface. Bedding planes and structural features such as faults, folds, foliations, and lineations are shown with strike and dip or trend and plunge symbols which give these features' three-dimensional orientations.

- Microscope
    - A petrologist uses microscopes and chemical tests to determine the nature of rocks and minerals. Microscope examination of a rock specimen mounted on a thin section slide is the principle technique used to identify the rock specimen. Further study can determine the components and features of the rock along with its composition, how it was formed and the geological setting of the rock.

Materials for thin sections

- Slab saw
- Glass slide
- Epoxy
- Cut-off saw

Materials for electrical resistivity

- ABEM Terrameter SAS 4000
- Electrode selector
- Lund Imaging cable
- Electrode jumper
- Steel electrode
- Cable conector
- Multifunction cable
- Battery (25-70[7] Ah)

3.4 FIELD STUDIES

Field study components are divided into two methods which is the geological mapping to know basically about the study area and resistivity survey within Politeknik Jeli area. Field investigation is an important method that must be done in this research. To analyse the general geology of Politeknik Jeli, field mapping are run in the first part of research focussing on the study area using basemap of Politeknik Jeli. The steps in field study involve mapping, sampling, and recording data. Mapping of the study area must be done to acquired the geological data of the studied area. These include the type of rock found, structural geology, and measurement of lineament in that particular area. Traversing using GPS has also been carried out. Strike and dip reading was obtained using a compass. For the sampling process, rock specimens of every identified facies were taken for further laboratory analysis.

3.4.1 RESISTIVITY METHOD

Electrical survey are used to determine subsurface resistivity distribution through current injections from electrodes on the surface. The ground resistivity is related to various geological parameters such as the mineral as fluid content, porosity and degree of water saturation in the rock.

Roughly, resistivity measurements are made by injecting current into subsurface through current electrodes. The resulting voltage differences at potential electrodes are measured by instrument. The apparent resistivity is then calculated.

There are many methods of electrical surveying. Some make use of naturally occurring fields within the earth while others require the introduction of artificially generated currents into the ground. The resistivity method is used in the study of horizontal and vertical discontinuities in the electrical properties of the ground and also in the detection of three-dimensional bodies of anomalous electrical conductivity. It is routinely used in engineering and hydrogeological investigations to investigate the shallow subsurface geology. The induced polarization method makes use of the capacitative action of the subsurface to locate zones where conductives minerals are disseminated within their host rocks. The self potential method makes use of natural currents flowing in the ground that generated by electrochemical processes to locate shallow bodies of anomalous conductivity.

Electrical methods utilize directs currents or low frequency alternating currents to investigatethe electrical properties of the subsurface, in contrast to the electromagnetic methods discussed in the next chapter that use altenating electromagnetic fields of higher frequency to this end

3.5 LABORATORY INVESTIGATIONS

Fresh rock sample from the field are made into thin section in the laboratory. Generally, standard thin section production can be broken down into the following basic steps:

i. Prepare the glass slide

The glass slide you will glue the rock to ust be flat in order for the rock section to end up with a constant thickness. In order to achieve this, you need to “frosts” the slide, which accomplishes two goals. It removes the thick spots on the slide and the slide face is adjusted to be parallel to the grinding whell’s face.

ii. Frosts the glass slide

“Frosts” or grind the glass slide is done to flatten it out and roughen the surface so the epoxy can bind well. To accomplish this, place the slide on the grinder in the same orientation.

iii. Marking the sample

Decision must be made on where to cut the rock sample. For rocks that have a fabric. The sample will usually be cut on a plane perpendicular to any planar

fabric, but for particular purposes other orientations might be preferable. A line should be mark on the rock.

iv. Cutting and cleaning the slab

Using the slab saw, a slab is cut from the rock sample along the line that was marked.

v. Cut the chip

The size of the slab need to be reduced to slightly smaller to a thin section. The thin saw is used to cut the slab. You need to carefully decide from what part of the slab you want to cut the section.

vi. Glue the slide to the chip

The frosted side of the slide is glued to the side of the chip that was ground down. Constant thickness of epoxy across the section needs to be ensured.

vii. Cutting the chip from the slide

Most of the chip is cut off, leaving a thin slice attached.

viii. Grind the slice to the correct thickness.

Most of the rock that remains on the slice must be grind. This must be done carefully as it is the step which most thin sections go bad.

3.6 DATA ANALYSIS AND INTERPRETATION

Data analysis and interpretations are made after all the data from preliminary study, fieldwork and laboratory analysis are amassed . Predicated on the data that were recorded and interpreted from research and ,conclusions can be made. The data that are recorded includes geology data, petrography data, hand specimen analysis, resistivity data, lineaments and fracture traces analysis.

CHAPTER 4

GENERAL GEOLOGY

4.1 Introduction

There are three components to be discussed under this chapter which are geomorphic processes, and the geological aspects of study area. In the first section, geography of Kelantan is interpreted by using the existing data. It is followed by describing the topography and drainage pattern of research area under geomorphology. Geology of the study area will be discuss in the last section.

The study area is located at Jeli District in the northwestern part of Kelantan. Based on Jeli District Tourism Development Plan 2020 (1976), Jeli is a main town that is located about 98 km away from the Kota Bharu city centre through the East West Highway. In terms of geography, the District of Jeli is border by Thailand State on the northern part, Tanah Merah district on the eastern part, Kuala Krai and Gua Musang Districts on the southern part, and Perak State on the western part. The geographical area of Jeli is 129,680.26 hectare with three districts which ae Jeli, Batu Melintang and Kuala Balah.

Figure 4.1 below shows the traverse map of the study area. The traverse map is done in order to make a complete mapping. Traverse map act as a prove for the mapping that has been done.

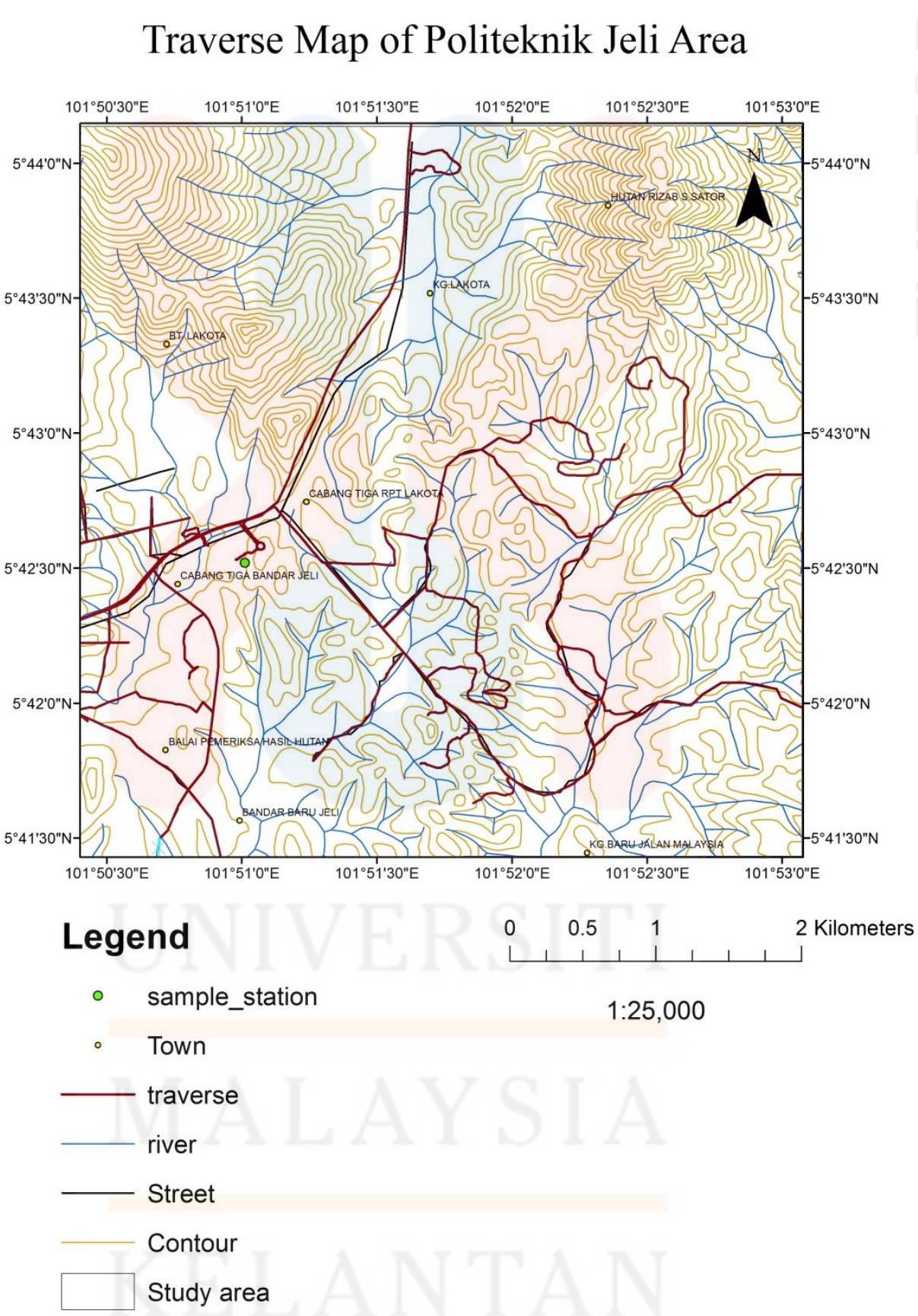

Figure 4.1 Traverse Map of The Study Area

4.2 Geomorphology

Geomorphology is the study of landforms, their processes, form and sediments at the surface of the Earth. It includes the geomorphological process and its agents, such as water, air and ice, which will give effect to the landscape. Landforms are produced by two geomorphological process known as endogenic and exogenic process.

Endogenic system means the internal system of the earth. The geomorphological process was driven by heat from pressure and radioactive decay. This system can fracture the earth's surface, sets in motion, build mountains and triggers volcanoes and earthquakes. The example for this system is tectonic cycle.

Exogenic system means the system that are external to the earth. This system was driven by solar radiation. It gives energy to the air, water, and ice and setting them in motion under the influence of gravity. The example for this system is the hydrologic cycle.

The different climatic environments produce different suites of landforms. Geomorphologists map the distribution of these landforms so as to understand better their occurrence.

Geomorphologically, 82% of Jeli area is covered by undulating terrain with rubber plantation, hilly and forest. Another 18% of the area is covered by low-relief area. Figure 4.2 below shows the geological map in the study area.

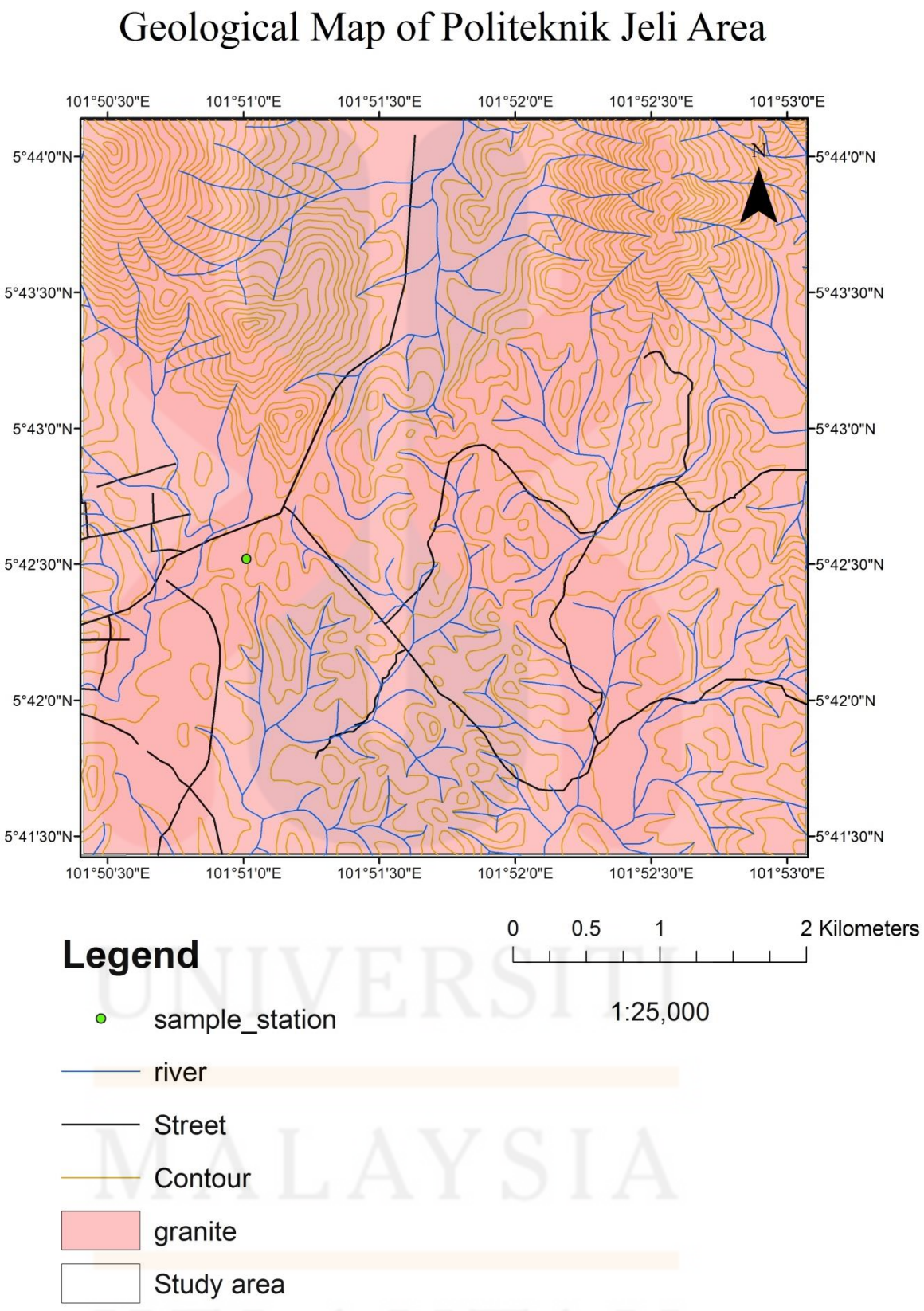

Figure 4.2 Geological Map of The Study Area

4.2.1 Drainage system

In geomorphology, a drainage system is the pattern formed by the streams, rivers, and lakes in a particular drainage basin. They are governed by the topography of the land, wether a particular region is dominated by hard or soft rocks, and the gradient of the land. The nearer rivers at this area are Pergau River, Resing River, Jeli River and also Rusa River.

There are many types of drainage pattern such as shown in figure 4.3. there are dendritic, parallel, trellis, rectangular, angular and contorted pattern. The very common pattern that usually found are dendritic and parallel.

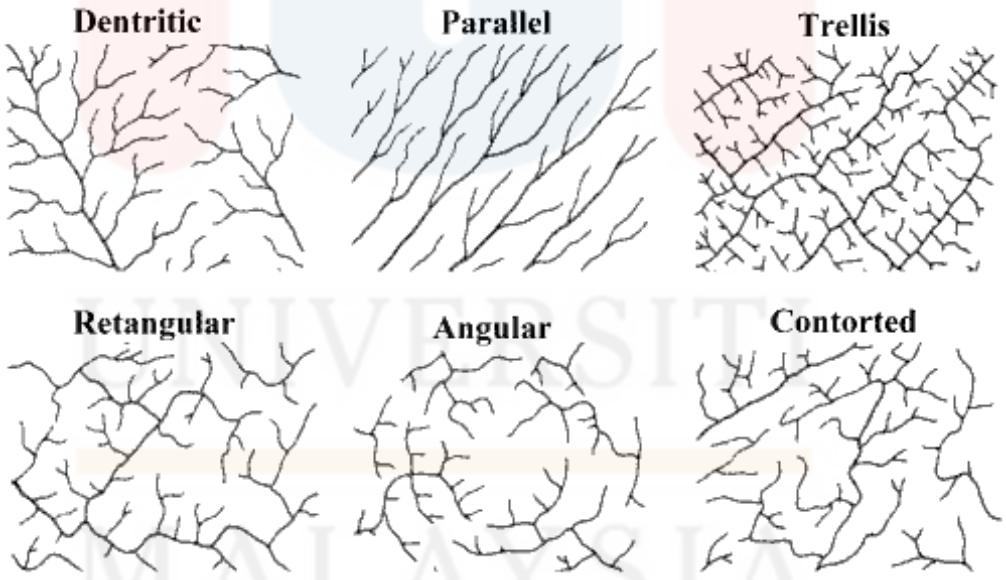

Figure 4.3 Types of Drainage Pattern

The location, length, size and type of drainage sytem are controlled by the topography of the area. Based on the topographic, the information stated that the of water mostly from the meteoric water which was rain water which flow from the high level to the low level of contour.

There are patterns of drainage system in the study area which are dendritic drainage pattern and parallel drainage pattern. Figure 4.4 shows the drainage system of study area. The dendritic drainage system is the most common form for drainage system. The dendritic drainage system mostly look like the tree due to streams that joined together to the main rivers. Mostly in this dendritic drainage system had impervious and non-porous rock types. Parallel drainage system formed where it was pronounced slope to the surface.

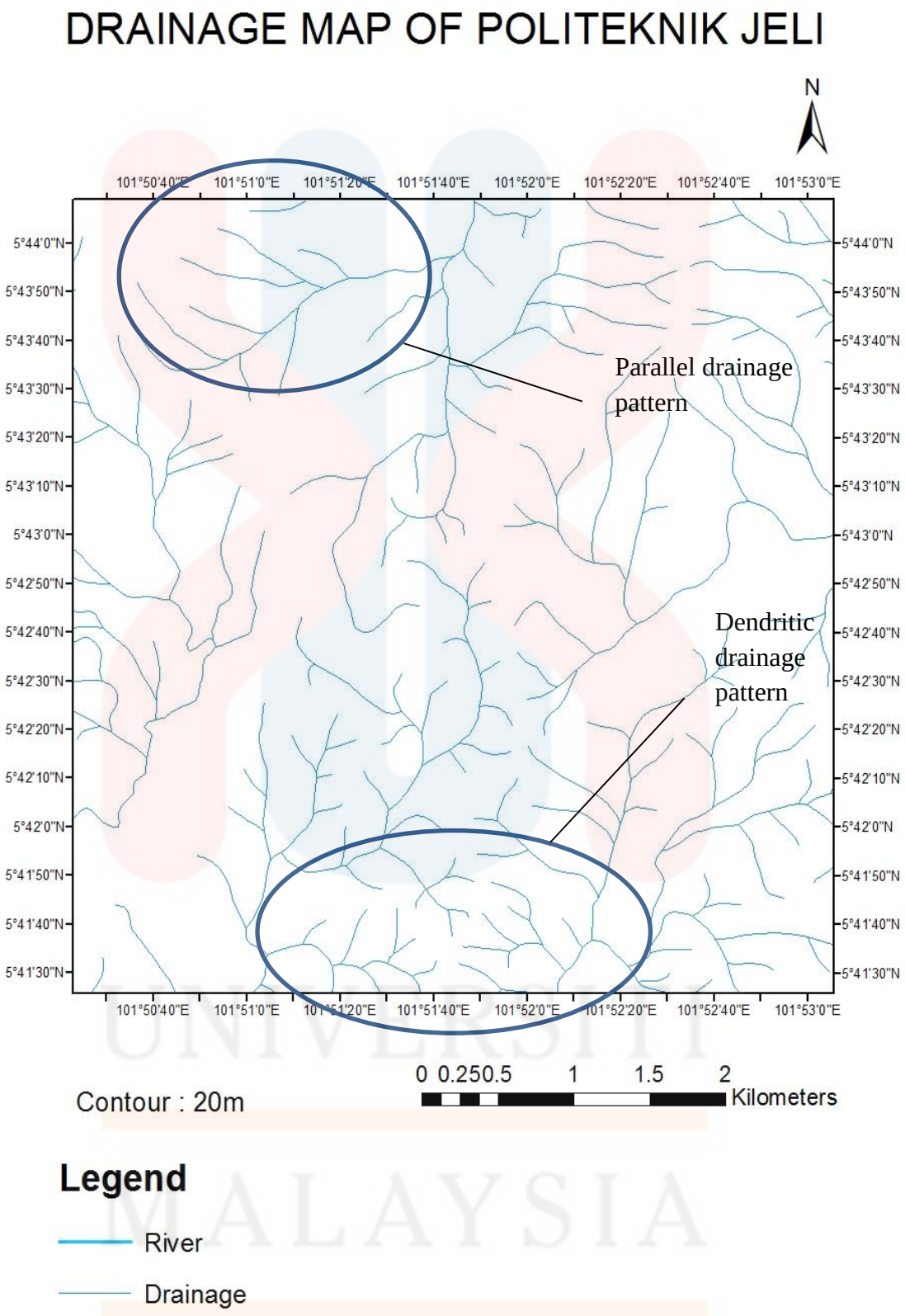

Figure 4.4: Drainage system for Politeknik Jeli

4.2.2 Watershed

Watershed is land area where all water in the area goes to the same place. Watershed area capture rainfall and other precipitation and funnels and carry them into the stream, wetland or lake. Watershed area can be seen in figure 4.5 below.

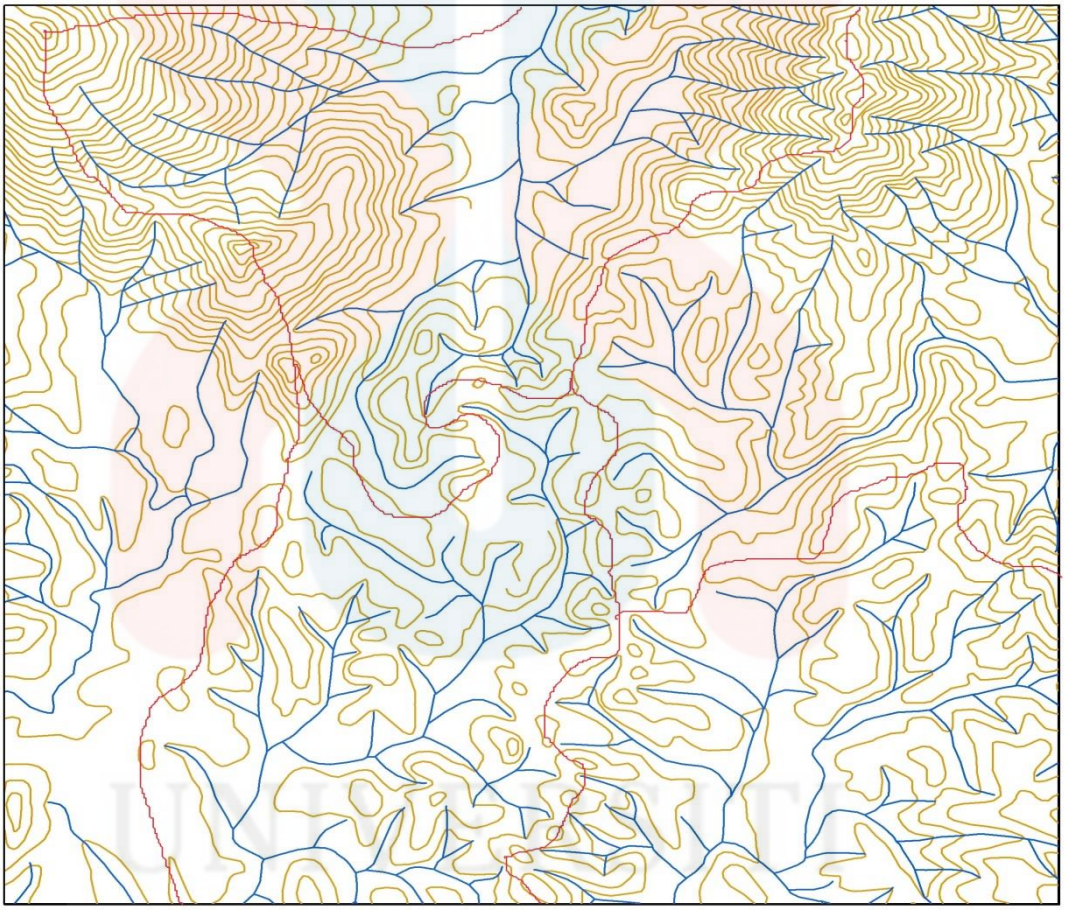

Figure 4.5 water catchment area

Water catchment area

Contour

Drainage

4.2.3 Weathering Process

Weathering process is the adjustment of the minerals of which the rock is composed to the conditions to the prevailing on the surface of earth. Weathering of rock is caused by physical disintegration, chemical decomposition and biology activity. Other overview which defined weathering as process by which rock deteriorates until it eventully breaks down to a soil which occurs close to Earth's surface and depends very much on climatic influences.

The rate of weathering is cotrolled by weathering agents such as gravity, water, wind and moving ice. Weathering also is controlled by the presence of discontinuities in that they provide access into rock mass for the agents of weathering. Some of the earliest effects of weathering canbe seen along discontinuity surfaces.

The type and rate of weathering varies from one climatic regime to another. Chemical and chemical – biological process are generally much more significant in humid regions compared to mechanical disintegration. Degree and rate of weathering in these regions depends primarily on temperature and amount of moisture available.

Weathering can be classified into three which are mechanical or physical weathering and chemical and biological weathering. Mechanical weathering such as alternate free-thaw action causes cracks, fissures, joints and some pore space to be widened. Chemical weathering leads to mineral alteration and the solution of rocks while biological weathering causes by plants and animal effect the breakdown and decaying activity of rocks.

The weathering process for the figure 4.6 below is biological weathering. Biological weathering can be caused by plants, animals and microbes. Growing plant roots can exert stress or pressure on rock. Although the process is physical, the pressure is exerted by a biological process.

The figure shows many plant exist on the outcrop surface and their existance put many pressure towards the outcrop and made it weathered biologically.

This outcrop is located by the Jeli-Grik Highway. The construction of this Jeli-Grik Highway has effected the outcrop as in the beginning, this outcrop is a hill. The hill has been cut along the middle to make a highway.

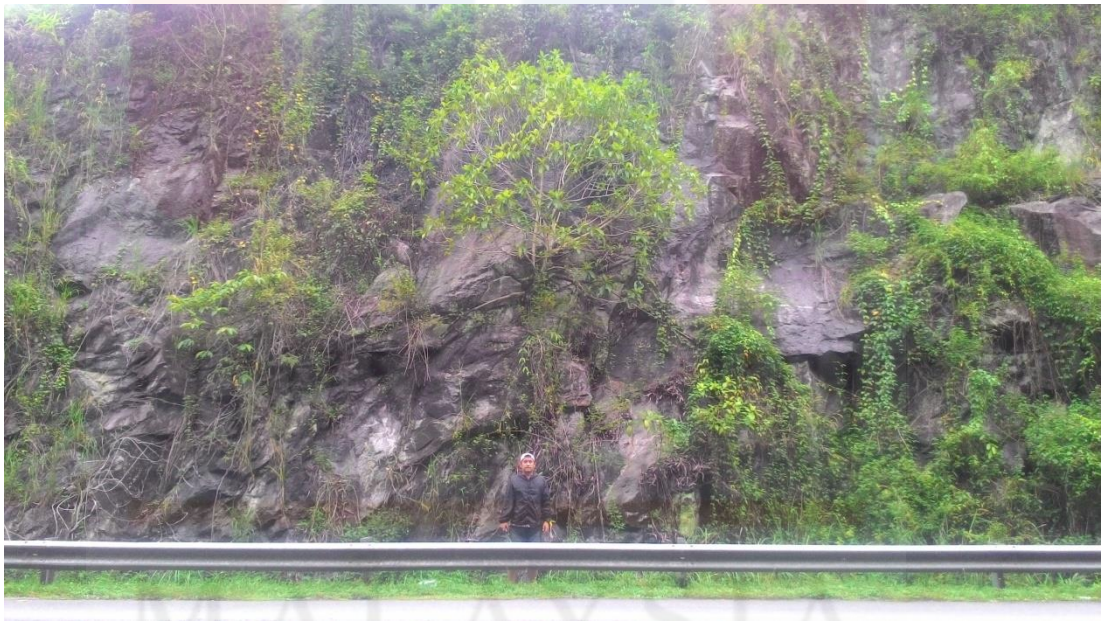

Figure 4.6 the biological weathering

Chemical weathering can be seen in figure 4.7 below. Chemical weathering is what happens when rocks are broken down and chemically altered. There are many types of chemical weathering, including hydrolysis, oxidation, carbonation, acid rain and acids produced by lichens.

Figure 4.7 the chemical weathering

Figure 4.8 shows the physical weathering process. Physical weathering is a term used in science that refers to the geological process of rocks breaking apart without changing their chemical composition. Over time, movements of the Earth and environment can break apart rock formations, causing physical weathering.

Figure 4.8 the physical weathering

4.2.4 Topography

Topography is a detailed map of the surface features of land. It includes the mountains, hills, creeks, and other bumps and lumps on a particular hunk of earth.The topography of this area is a moderately to steeply rising gradually to the west and north, dissected by numerous creek and stream channels forming narrow valleys. Jeli district has an elevation varies from 90m to 500m from the sea level.

The areas of Jeli district are about 128, 020.56 hectar or 1,280.21 km^2. It is also known as the third highest district area in Kelantan. The geomorphology of Jeli district is mountainous and covers mostly with reserve forest. The elevation of

mountainous of the study area can be classified as moderate to steeply rising gradually to the west and north, interconnected with numerous creek and stream channels forming narrow valleys. At the northwest and southwest of the study area, the contour interval shows very small as a result of steep slope while at the northeast and southeast the slope is moderate.

The highest elevation of the study area is 520m located at the north west of study area as shown in Figure 4.9 the geomorphology of the study area is mountainous. High elevation of the area is 340m and located at the north east of the study area as shown in figure 4.10. lastly, the lowest elevation of the study area is 40-100m which is flat area.

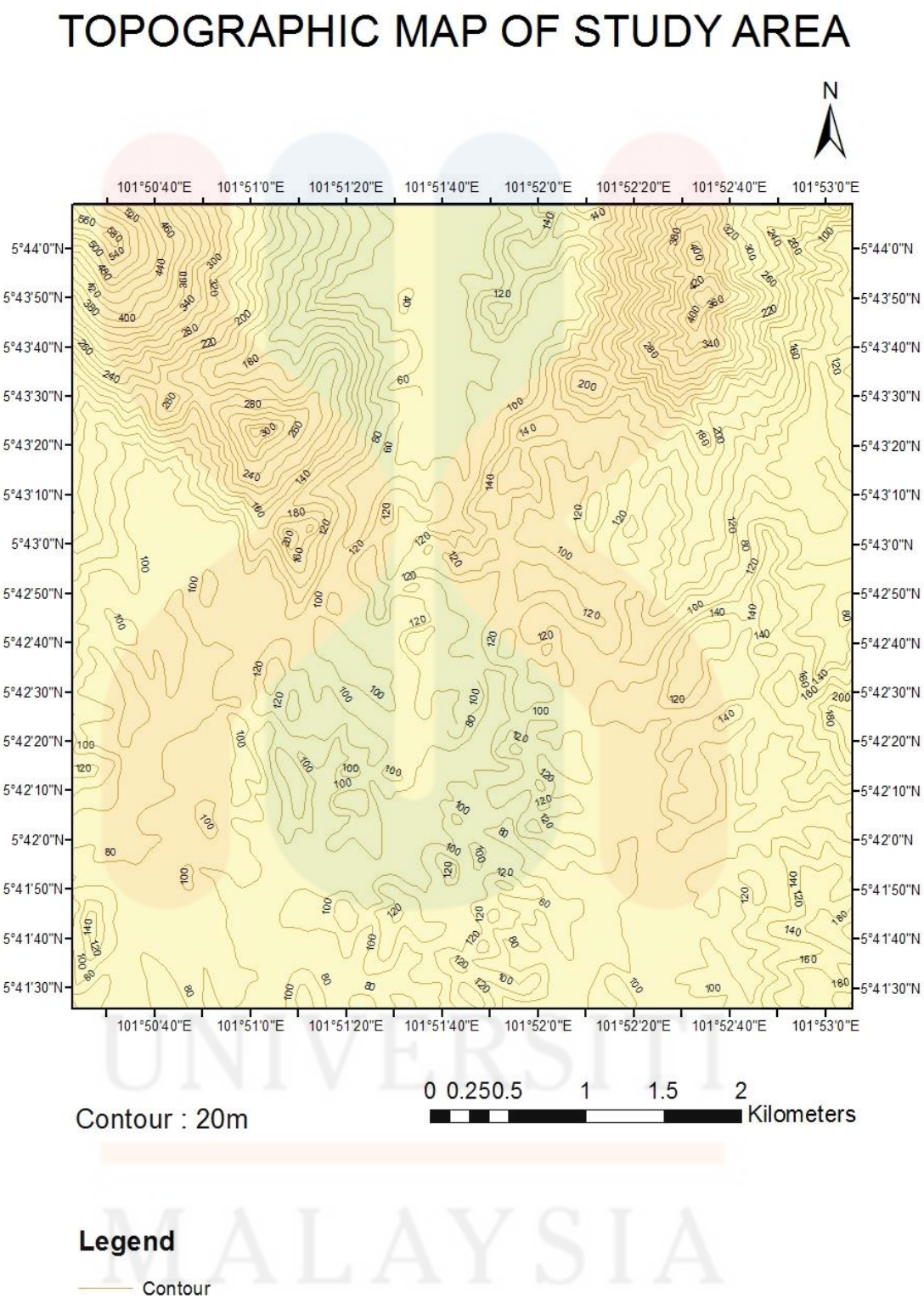

Figure 4.9 : Topographic Map of Politeknik Jeli

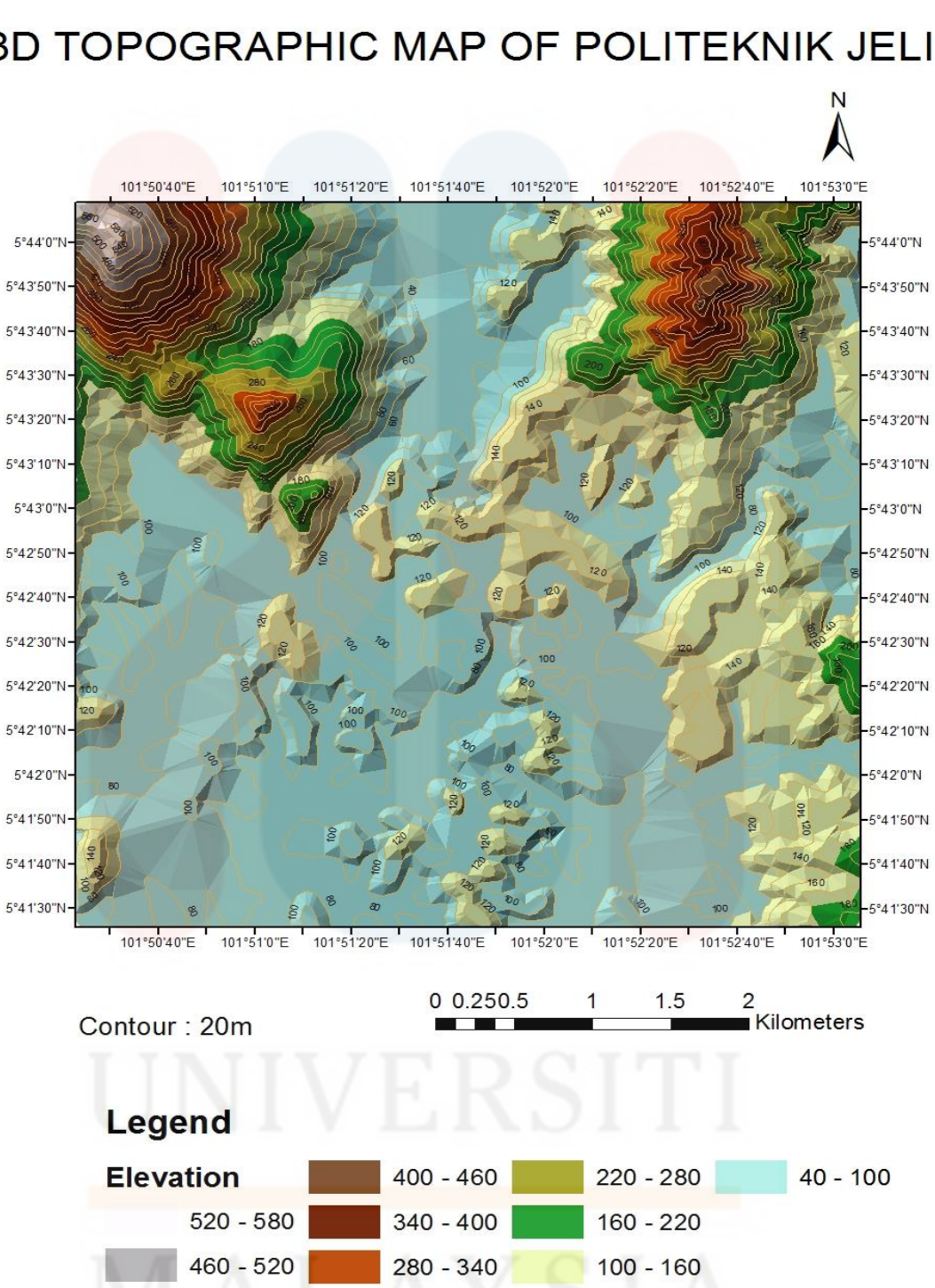

Figure 4.10: 3D Topographic Map of Politeknik Jeli

4.3 Stratigraphy

The stratigraphy of the study area can be determine as the study area has been mapped. In the study area, there are two massive granite outcrop can be found. The outcrop need to be taken first as hand specimen and for petrographic analysis in order to know about the minerals information. There is one place where the massive outcrop have been touched by human to make highway so the place and the outcrop can be easily reached.

4.3.1 Lithostratigraphy

Lithostratigraphy is a sub-discipline of stratigraphy. There are massive granite outcrop in the study area which is located in Politeknik Jeli and along the Jeli-Grik highway. Both of the outcrop has weathered. Both of the outcrop is granite. A hand sample was taken for both of the outcrop for mineral identification.

There are no sediment in the study area and the outcrop is very limited there. As both of the outcrop were granite, only one thin section has been made.

4.3.2 Petrography

Petrographic analysis is very important in order to study the minerals that lays in the outcrop. Petrography in geology focuses on the mineral characteristic in very detail way by using microscope. With petrographic analysis,we can study more about the study area because the minerals can be a good indicator to determine the type of rock there.

Two rock samples are taken in the field for petrographic analysis. The rock sample is examined under the microscope for mineral identification.

In the figure 4.11, it shows the image for mineral identification using microscope with polarized view. It shows many mineral exist in the granite rock. There are quartz, biotite, feldspar and olivine.

The mineral observation has to be made carefully to avoid any mistake and any harm to the thin section slide. The thin section is very fragile as it has been cut into the smallest pieces that possible. The thin section would not success if there are still any part of the thin section that still thick because the microscope light cannot go through the thin section.

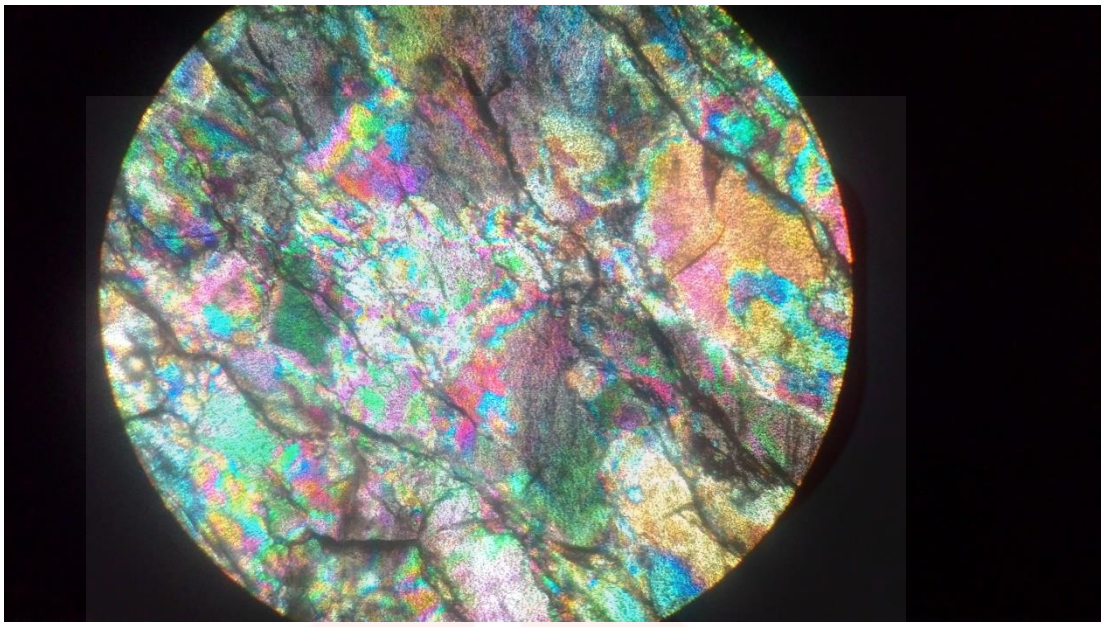

Figure 4.11 mineral identification process under microscope (polarized)

For the figure 4.12, it shows the mieral identification process under microscope with visible version. No mineral can be seen through this view. To identify this mineral under microscopre, this section process has to be made first.

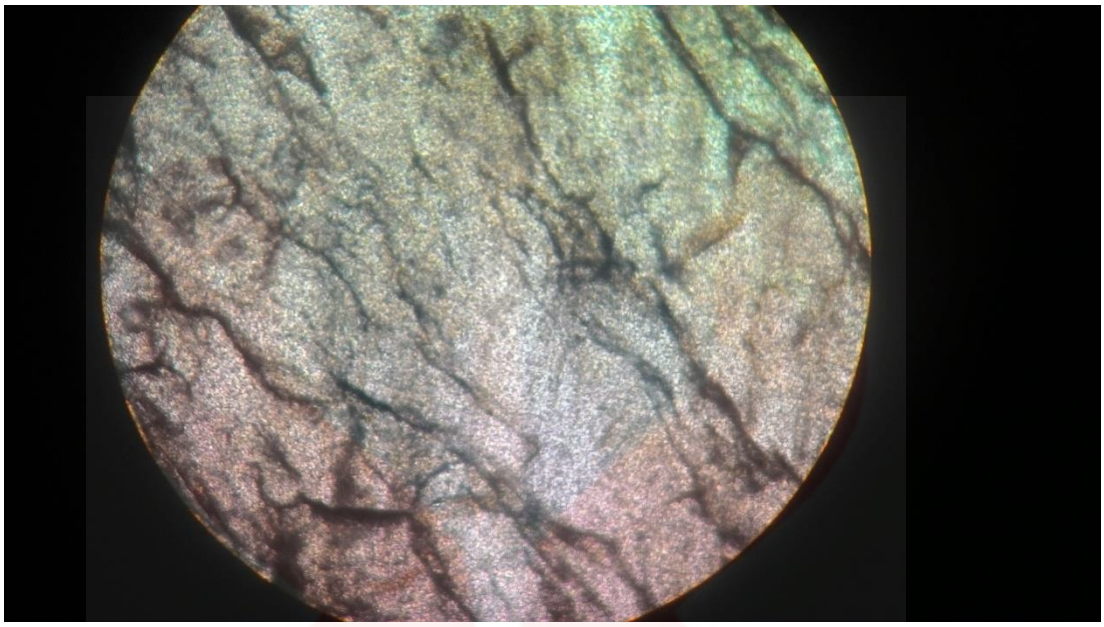

Figure 4.12 mineral identification process under microscope (visible)

Figure 4.13 shows the massive outcrop where the hand sample has been taken. This outcrop is located nearby the Jeli-Grik highway. This outcrop can be easily reached but hard to extract the hand sample. The figure shows the physical condition of the outcrop which most part on the surface has weathered.

Figure 4.13 The outcrop where the hand sample was taken

Figure 4.14 shows the image of the hand sample that has been taken from the outcrop. This hand sample first has to be cut into small pieces then can be placed on a slide before attach glue on it. Geological hammer is used in order to extract this sample as the sample is too big. Most of the outcrop surface has weathered as its been exposed for too long. The weathered rock has to be smashed first in order to extract the fresh mineral that lay beneath the weathered surface. Only one thin section has been made as the other outcrop also located nearby the area and from previous study, also has been stated that the outcrop is granite rock.

Figure 4.14 The hand sample that was taken from the outcrop

4.4 Structural Geology

Structural geology is the study about the structure of rocks at all scales and the processes that produce all of those structures. There are 2 sub topics under structural geology which are lineament analysis and joint analysis. Lineament analysis is about the mappable linear surface features that we can see from a map.

Joint analysis is analysis that can be done with the joint reading at the study area. It is to find where the extention force (maximum force and minimum force).

4.4.1 Lineament Analysis

Lineament can always be seen on a map as it is mappable cause lineament have the linear surface features. Lineaments are generally displayed on a map. The lineaments line can easily be seen by naked eye as can be seen in the figure 4.15 below.

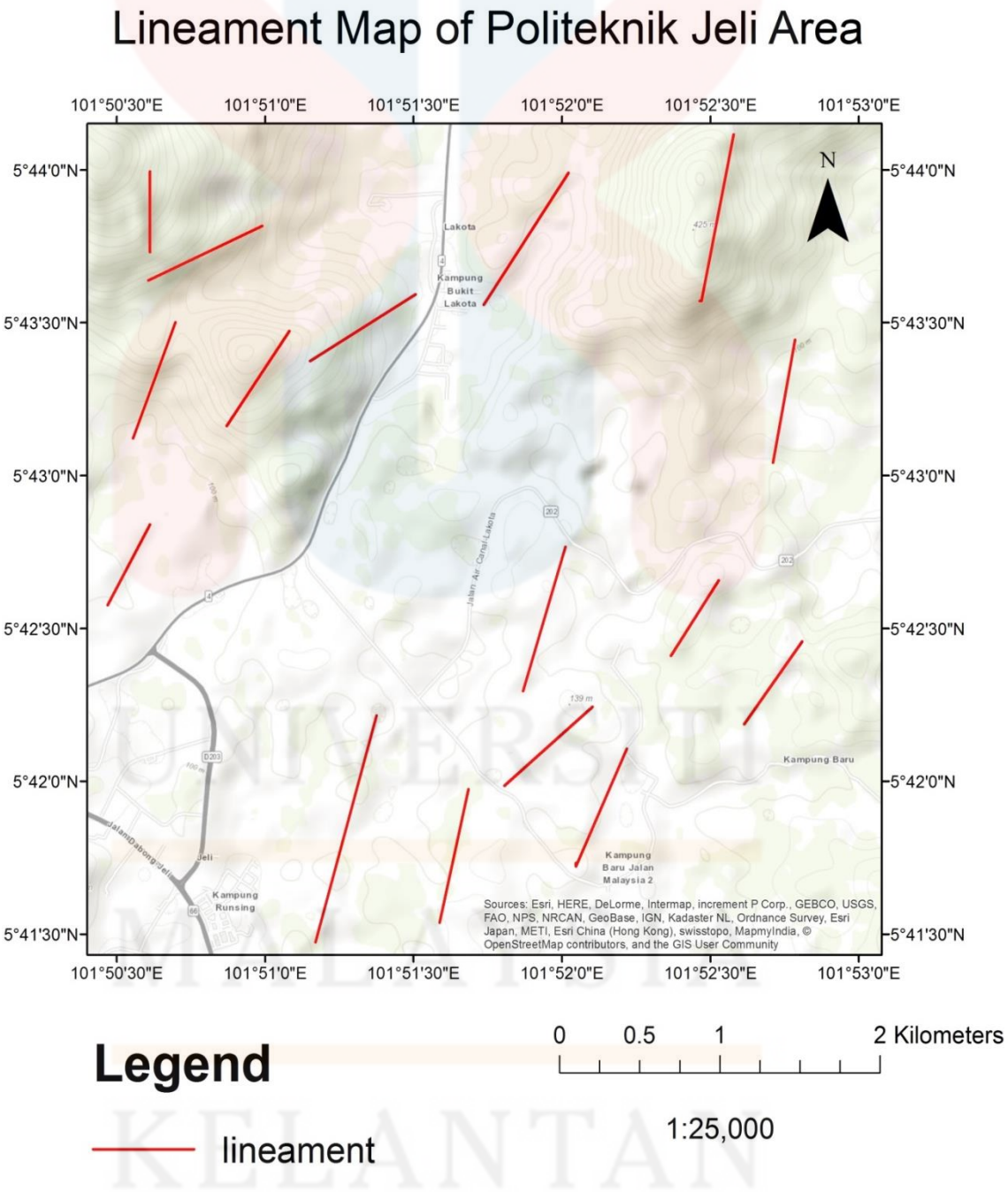

Figure 4.15: Lineament map of the study area.

Figure 4.16 shows the rose diagram of the lineament. In the study area, 16 lineamentreading has been taken to measure the extensional force. The major force is coming from N 25°E whereas the minor force is coming from N 290° W.

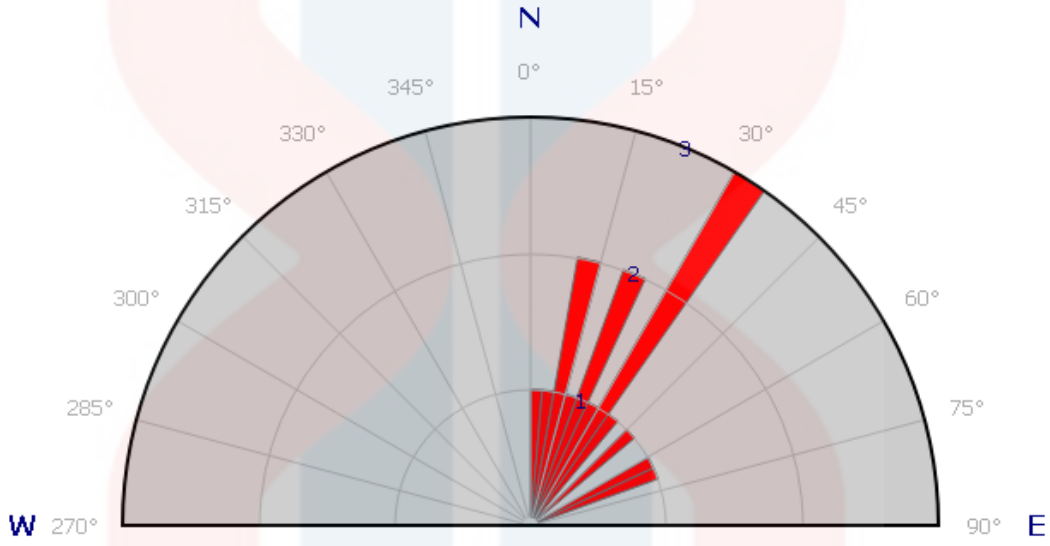

Figure 4.16 lineament strike

4.4.2 Joint Analysis

Joint analysis is made to study more about the orientation of tectonic stresses. Based on geology study, a joint is known as a fracture that divides the rocks into two section. Sometimes there are no displacement trace can be seen as the movement was so little.

The rose diagram as can be seen in figure 4.18 below shows the result of the 100 joints that have been processed. The joint that the reading was taken can be seen at figure 4.17 below.

This joint analysis has been conducted in Politeknik Jeli area nearby the football field. It can be easily reached as there is no bushes and the joint also can easily be seen.

There is also have fracture and vein in this area but it is hard to reach as the vein lays at the higher place.

Figure 4.17 Joint At Politeknik Jeli Area.

In the study area, 100 readings have been collected to produce a rosediagram. Every single reading that have been take from the joint then processed using the georose software to produce a rosediagram. The rose digram is as shown is figure 4.18. The major force is coming from N 23° E whereas the minor force is coming from N 293° E.

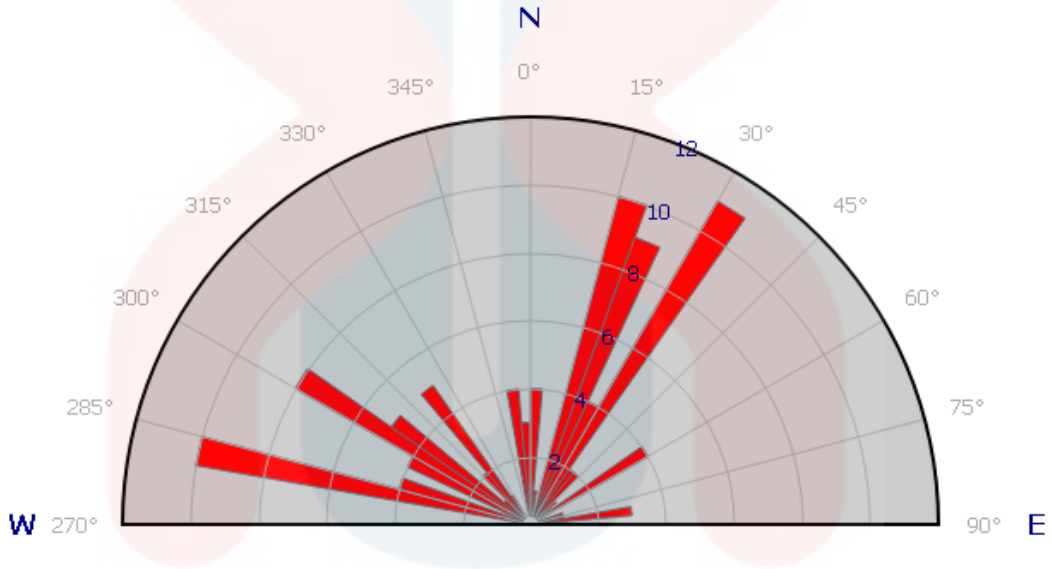

Figure 4.18: Rose diagram for joint analysis

4.4.3 Historical geology

There are two massive outcrop can be found in the study area. Both of the outcrop is granite. Those outcrop age was Mesozoic era. It has very fine grained. Every outcrop in the study area can be easily reach and extracted as it located in the Politeknik Jeli area and another one located nearby the Jeli Grik highway.

CHAPTER 5

RESULT

5.1 Introduction

Electrical resistivity imaging (ERI) method have been used in this project to get the result. Electrical resistivity imaging is a geophysical technique for imaging sub-surface structure. The electrical resistivity imaging was made on the certain surface area. By injecting electrodes into the ground, the electric current that flows through the electrodes can measure the resistivity underground.

This method usually done in order to investigate the subsurface condition for futurework and groundwater information. This method also conducted in order to investigate the geohazard potential in the area.

5.2 Electrical Resistivity Profile

For the electrical resistivity profile, 3 survey line have been done at the study area. Every line was set in one large area. Two survey lines using werner configuration whereas the other one line is using schlumberger configuration.

For the first line, werner array was used. The electrical resistivity was conducted at coordinate N 05°42’17.4” E 101°50’10.5” with elevation of 107 meter from the sea level. The length of the electrical resistivity line was 180 meters. The gap between every electrodes was 4.4 meter.

For the second line, schlumberger array was used. The electrical resistivity was conducted at coordinate N 05°42’18.3” E 101°50’15.5” with elevation of 134 meter from the sea level. The length of the electrical resistivity line was 100 meter. The gap between every electrodes was 2.5 meter.

For the third line, werner array was used. The electrical resistivity was conducted at coordinate N 05°42’14.8” E 101°50’14.0” with elevation of 100 meter from the sea level. The length of the electrical resistivity line was 200 meter. The gap between every electrodes was 5 meter.

5.3 Analysis

The raw data must be processed through Terrameter LS Toolbox and Res2dinv. Exterminating bad data points was done in the Res2dinv software and inversion also can be done there. The final result only shows when the inversion is done.

During conducting this survey, 41 electrode, 42 clip, 2 100 meter resistivity cable, hammer, Abem Terrameter and 2 100 meter measuring tape has been used.

The measuring tape was used to measure the line survey distance before using the actual resistivity cable. Then, every electrodes has to be inserted into the ground with certain distance between each of them. Every clip attached at their own spot through the resistivity cable. The raw data can be extracted after all setting done.

Figure 5.1 shows the actual image of electrode and clip that used in this survey. Figure 5.2 shows the image of Abem Terrameter, figure 5.3 shows the resistivity cable and figure 5.4 shows the measuring tape.

Figure 5.1 Electrodes and Clip

Figure 5.2 Abem Terramater

Figure 5.3 Resistivity Cable (100 meter)

Figure 5.4 Measuring tape (100 meter)

5.4 Result

For survey line 1, total length of 180 meter is done at coordinate N 05°42'18.3" E 101°50'15.5". The electrodes spacing for survey line 1 is 4.5 meter. For survey line 1, three zone has been identified for interpretation.

Zone A has the resistivity value of 65.0-250 Ωmeter with depth of 0-15 meter. Zone A can be interpreted as slightly saturated sand.

Zone B has the resistivity value range from 247-550 Ωmeter with depth of 13-20 meter. Zone B can be interpreted as dry sand.

Zone C has the resistivity value range from 935-1459 Ωmeter with depth of 18-28.1 meter. Zone C can be interpreted as weathered granite. Figure 5.5 below shows the image result after processed while figure 5.6 shows the first survey line conducted.

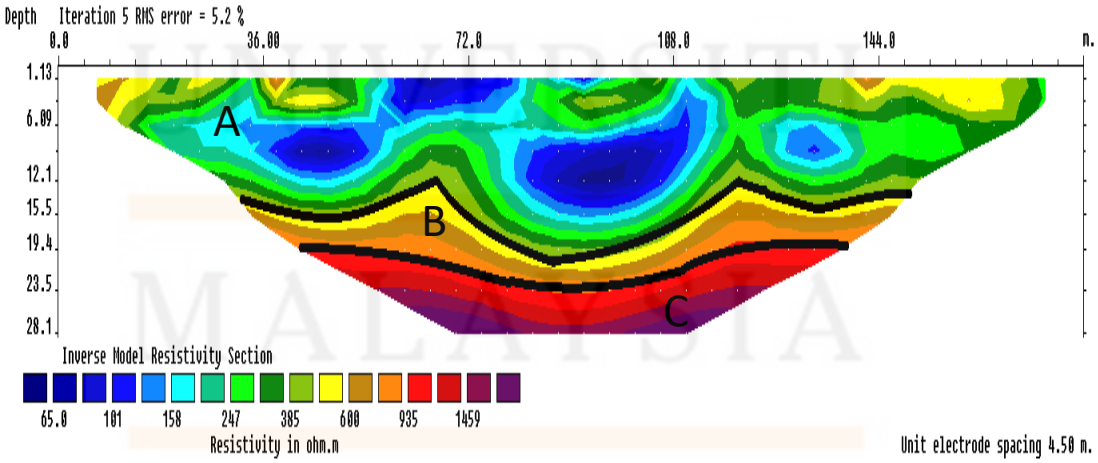

Figure 5.6 The first survey line

For survey line 2, total length of 100 meter is done at coordinate N 05°42’18.3” E 101°50’15.5”. The electrodes spacing for survey line 1 is 2.5 meter. For survey line 2, four zone has been identified for interpretation.

Zone A has the resistivity value of 500-1275 Ωmeter with depth of 0-6 meter. Zone A can be interpreted as slightly wet sandstone.

Zone B has the resistivity value range from 72.1-180 Ωmeter with depth of 0-11 meter. Zone B can be interpreted as saturated sand.

Zone C has the resistivity value range from 300-1000 Ωmeter with depth of 8.5-18.2 meter. Zone C can be interpreted as weathered granite.

Zone D has the resistivity value range from 1275-2057 Ωmeter with depth of 14-18.4 meter. Zone D can be interpreted as fresh granite. Figure 5.7 below shows the image result after processed while figure 5.8 shows the second suvey line conducted.

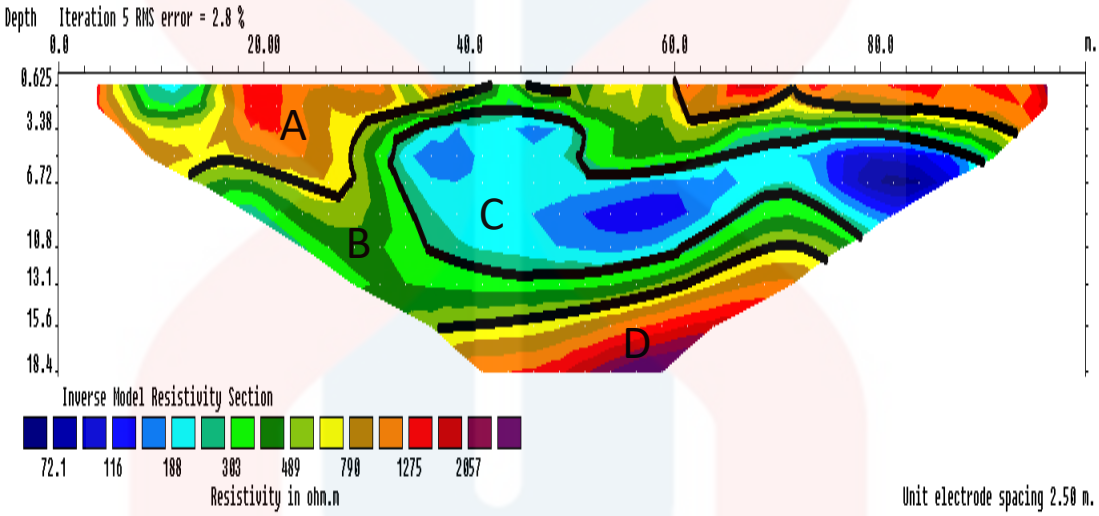

Figure 5.7 Resistivity image for survey line 2

Figure 5.8 The second survey line

For survey line 3, total length of 200 meter is done at coordinate N 05°42’14.8” E 101°50’14.0” . The electrodes spacing for survey line 1 is 5 meter. For survey line 2, three zone has been identified for interpretation.

Zone A has the resistivity value of 8.76-1480 Ωmeter with depth of 0-10 meter. Zone A can be interpreted as slightly wet sandstone .

Zone B has the resistivity value range from 5000-69834 Ωmeter with depth of 11-31.3 meter. Zone B can be interpreted as fresh granite and bedrock.

Zone C has the resistivity value range from 8.76-114 Ωmeter with depth of 13-31.3 meter. Zone C can be interpreted as fresh groundwater. Figure 5.9 below shows the image result after processed while figure 5.10 shows the second suvey line conducted.

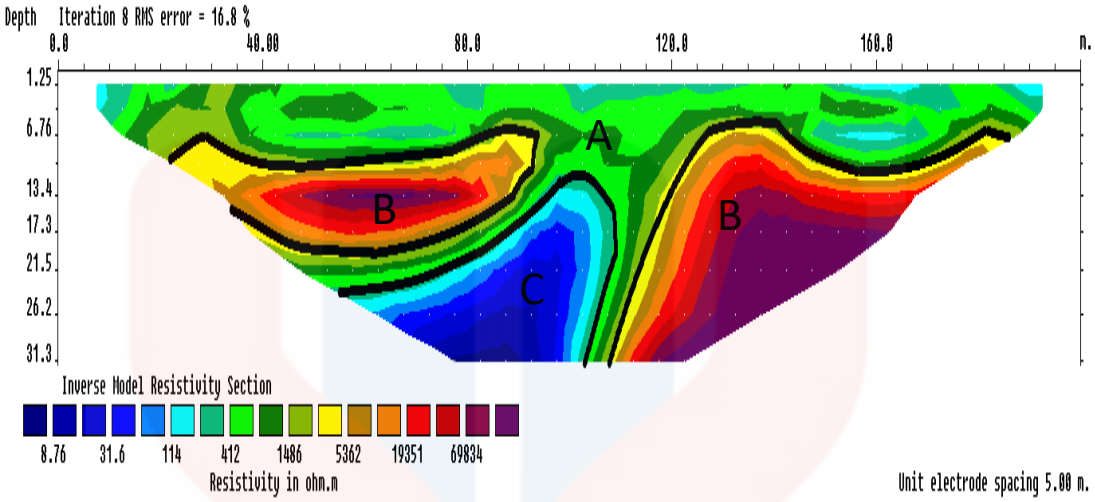

Figure 5.9 Resistivity image for survey line 3

Figure 5.10 The third survey line

CHAPTER 6

CONCLUSION AND SUGGESTION

6.1 Conclusion

For the conclusion, after the resistivity survey are done, the geological map of the study area can be updated with the new result. The subsurface structure also has been identified after done using the electrical resistivity imaging. Through this resistivity survey, it shows that the subsurface condition was not suitable for any construction in the future as there are too many water under the surface.

6.2 Suggestion

Through this project, the result shows the condition of the subsurface of the study area but the reading are not very accurate as there is no borehole data. For future study, a different method would be nice to know more about the study area.

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