GENERAL GEOLOGY AND RESISTIVITY SURVEY ALONG UMK JELI CAMPUS AND GEMANG AREA, JELI DISTRICT, KELANTAN

By

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

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UNIVERSITI MALAYSIA KELANTAN

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DECLARATION

I declare that this thesis entitled “title of the thesis”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 : _____

Date : _____

ACKNOWLEDGEMENT

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GENERAL GEOLOGY AND RESISTIVITY SURVEY ALONG UMK JELI CAMPUS AND GEMANG AREA, JELI DISTRICT, KELANTAN

ABSTRACT

There are a lot of constructions happening at UMK Jeli Campus and Gemang Area so before this construction start the underground of this site need to be investigate using geophysical investigation survey. When building constructed across subsurface geological structures such as fractures, faults and voids without considering its load-bearing capacity or strength can lead to building failure and collapse. The use of geophysical survey an effective tool for investigate this subsurface. Materials like rocks, soils and structure have an intrinsic property- resistivity that governs the relation between the current density and the gradient of the electrical potential. The subsurface structure such faults, fractures and voids have low resistivity compare to the surrounding. The ABEM Terrameter SAS 4000/ SAS 1000 using wenner array to complete this survey by obtaining 2D resistivity data sets along 1 profiles within the survey area. The acquired data were processed and interpreted using RES2DIINV and Terramter LS Toolbox to produce 2D image of the survey area. The subsurface images showed that the resistivity have 3 level, low, medium and high. The low resistivity with reading from 2.02 Ω meters to 5.75 Ω meters represents by blue colour in the subsurface images. This low resistivity indicated the groundwater. Medium resistivity reading between 9.7 Ω meters to 27.6 Ω meters, green colour to brown colour indicated the soil which covered most the subsurface images. The high resistivity in this surface images are the bedrock due to its character that unable to conduct electric. The resistivity reading are from 46.6 Ω meters to 78.7 Ω meters. So from the subsurface images, the presence of faults, fractures zones of weakness are absent because the area was covered by medium resistivity.

GEOLOGI AM DAN KAJIAN KERINTANGAN SEPANJANG UMK KAMPUS JELI DAN KAWASAN GEMANG, JAJAHAN JELI, KELANTAN

ABSTRAK

Terdapat banyak pembinaan berlaku di Kampus UMK Jeli dan Kawasan Gemang jadi sebelum pembinaan ini dimulakan bawah tanah dari kawasan pembinaan ini perlu di siasat menggunakan kajian penyiasatan geofizik. Apabila bangunan dibina merentasi bawah permukaan struktur geologi seperti keretakan, kerosakan dan lompang tanpa mengambil kira keupayaan menanggung beban atau kekuatan yang boleh membawa kepada kegagalan bangunan dan keruntuhan. Menggunakan kajian penyiasatan geofizik adalah sangat berkesan dalam membuat kajaian bawah tanah. Bahan seperti batu, tanah dan struktur mempunyai ciri intrinsik-kerintangan yang mengawal hubungan antara ketumpatan arus dan kecerunan potensi elektrik. Struktur sub-permukaan seperti sesar, keretakan dan lomoang mempunyai kerintangan rendah berbanding dengan sekitar. Menggunakan ABEM Terrameter SAS 4000/ SAS 1000 dengan cara wenner untuk melengkapkan kaji selidik ini dengan mendapatkan set data kerintangan 2D sepanjang 1 profil dalam kawasan kajian ini. Data yang diperolehi di proses dan ditafsirkan mengunakan RES2DIINV dan Terramter LS Toolbox. Gambaran sub-permukaan menunjukkan ada 3 peringkat kerintangan, rendah, sederhana dan tinggi. Kerintangan rendah dengan bacaan 2.02 Ω meters hingga 5.75 Ω meters yang diwakili oleh warna biru di dalam gambaran sub-permukaan. Kerintangan rendah menunjukan air bawah tanah. Kerintangan sederhana dengan bacaan 9.7 Ω meters hingga 27.6 Ω meters, diwakili oleh warna hijau hingga warna cokolat yang menunjukkan tanah di mana memenuhi gambaran sub-permukaan. Kerintangan tinggi di dalam gambaran sub-permukaan adalah batu hampar kerana ciri-cirinya yang tidak boleh mengalirkan arus elektrik. Baccan kerintangannya adalah dari 46.6 Ω meters hingga 78.7 Ω meters. Berdasarkan gambaran sub-permukaan, kehadiran sesar, keretakan zon lemah tidak ada kerana kawasan ini dipenuhi oleh kerintangan sederhana.

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CHAPTER 1

INTRODUCTION

1.1 General background

The research was conducted at UMK Jeli Campus and Gemang area, Jeli District, Kelantan. This research was conducted to update its geological map based on the study area geological features like its structure, geomorphology and stratigraphy. Other than to update the study area geological map, this research also to determine the study area subsurface geological structures such as fractures, faults and voids. The electrical resistivity method was used to investigate this subsurface geological structures which always bring the inconveniences that pose constraint to building constructions especially to their foundations. The study area was under rapid development so the site for the building foundation need to be totally safe and secure.

1.2 Problems Statements

UMK Jeli Campus and Gemang area are under new development where new buildings and infrastructures will be build. So to ensure this development well planned, organized, the area must be safe and suitable to build something on it, information about subsurface geological structure, the underground strata or its loading-bearing capacities must be obtained. A construction at the site without properly considering all of this information can give problem to building especially to their foundations and cracking which may lead to the collapse of the building. The electrical resistivity method is very suitable tool to obtained information of subsurface geological structure due to subsurface geological structures such as fractures, faults and voids are stand out due to their low resistivity compared to the surrounding. These features are normally identified as anomalies in the electrical resistivity survey as they differ from the host material.

1.3 Research Objectives

There are two main objectives to be achieved in this research in this research as stated below:

i. To update geological map of study area in 1:25 000.
ii. To determine subsurface geological structures such as fractures, faults and others for construction purposes and building development.

1.4 Study Area

The study area for this research is located at UMK Jeli Campus and Gemang area, Jeli District, Kelantan along Jeli-Grik Highway. The study area is 5×5 km² as shown in Figure 1.1.

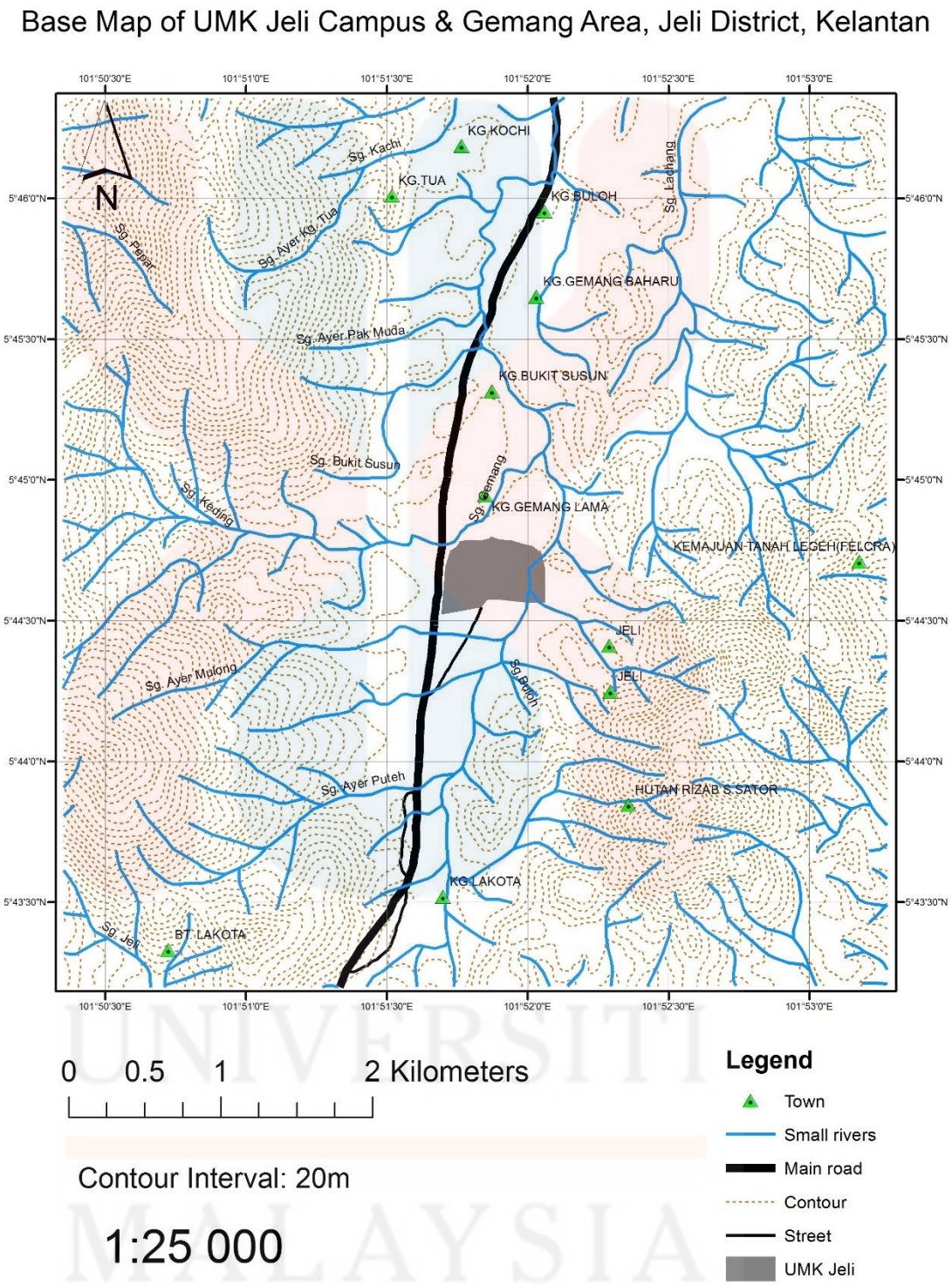


Figure 1.1: Base map of study area.

1.4.1 Demography

Table below shown demography at Jeli District, Kelantan based on their ethnic group, age group and sex, households and living quarters for year 2010.

Table 1.1: Total population by ethnic group, Local Authority area and state, Malaysia.

Source: Prepared and published by Department of Statistics, Malaysia, 2010.

Jajahan/ Kawasan Pihak Berkuasa Tempatan *Jajahan/ Local Authority Area*	Jumlah *Total*	Warganegara Malaysia *Malaysian citizens*							Bukan Warganegara Malaysia *Non-Malaysian citizens*
		Jumlah *Total*	Bumiputera			Cina *Chinese*	India *Indians*	Lain-lain *Others*	
			Jumlah *Total*	Melayu *Malay*	Bumiputera lain *Other Bumiputera*				
M.D. Kuala Krai	**63,575**	**61,069**	**56,164**	**56,113**	**51**	**3,952**	**847**	**106**	**2,506**
Kuala Krai & Guchil	15,503	15,147	12,077	12,063	14	2,784	232	54	356
Kuala Pahi	377	376	366	366	-	10	-	-	1
Kawasan selebih M.D. *Remainder of M.D.*	47,695	45,546	43,721	43,684	37	1,158	615	52	2,149
JELI									
M.D. Jeli	**33,186**	**32,296**	**32,126**	**31,606**	**520**	**91**	**58**	**21**	**890**
Air Lanas	3,271	3,203	3,190	3,189	1	1	8	4	68
Batu Melintang	2,383	2,374	2,362	2,270	92	10	-	2	9
Berdang	1,284	1,202	1,200	1,199	1	-	-	2	82
Bukit Lakota	608	606	606	606	-	-	-	-	2
Gemang	1,047	1,038	1,038	1,038	-	-	-	-	9
Jeli	3,810	3,735	3,687	3,685	2	38	9	1	75
Kalai	1,033	1,006	1,005	1,005	-	1	-	-	27
Kuala Balah	-	-	-	-	-	-	-	-	-
Tunku Abdul Rahman	2,939	2,908	2,903	2,899	4	5	-	-	31
Kawasan selebih M.D. *Remainder of M.D.*	16,811	16,224	16,135	15,715	420	36	41	12	587

Nota : Angka di atas tidak disesuaikan kepada kadar kurang penghitungan.
Note : The above figures have not been adjusted for under-enumeration.

Table 1.2(a): Total population by age group, Local Authority area and state, Malaysia, 2010.

Source: Prepared and published by Department of Statistics, Malaysia, 2010.

Jajahan/ Kawasan Pihak Berkuasa Tempatan *Jajahan/ Local Authority Area*	Jumlah *Total*	Kumpulan umur *Age group*							
		0 - 4	5 - 9	10 - 14	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39
M.D. Kuala Krai	**63,575**	**5,891**	**7,255**	**8,056**	**7,485**	**4,682**	**4,622**	**3,471**	**3,504**
Kuala Krai & Guchil	15,503	1,298	1,737	1,945	1,826	1,023	1,214	842	821
Kuala Pahi	377	30	39	42	35	21	34	20	24
Kawasan selebih M.D. *Remainder of M.D.*	47,695	4,563	5,479	6,069	5,624	3,638	3,374	2,609	2,659
JELI									
M.D. Jeli	**33,186**	**3,767**	**3,950**	**4,352**	**3,705**	**2,312**	**2,131**	**2,014**	**2,035**
Air Lanas	3,271	382	388	547	361	155	135	170	195
Batu Melintang	2,383	303	341	288	228	131	222	147	160
Berdang	1,284	176	132	157	125	72	76	90	91
Bukit Lakota	608	43	75	93	73	40	32	36	35
Gemang	1,047	99	136	144	117	68	68	67	55
Jeli	3,810	534	464	521	315	238	334	250	295
Kalai	1,033	165	179	115	108	63	47	56	58
Kuala Balah	-	-	-	-	-	-	-	-	-
Tunku Abdul Rahman	2,939	230	294	349	386	201	158	216	121
Kawasan selebih M.D. *Remainder of M.D.*	16,811	1,835	1,941	2,138	1,992	1,344	1,059	982	1,025

Nota : Angka di atas tidak disesuaikan kepada kadar kurang penghitungan.
Note : The above figures have not been adjusted for under-enumeration.

Table 1.2(b): Total population by age group, Local Authority area and state, Malaysia, 2010.

Source: Prepared and published by Department of Statistics, Malaysia, 2010.

Jajahan/ Kawasan Pihak Berkuasa Tempatan *Jajahan/ Local Authority Area*	Kumpulan umur *Age group*							
	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65 - 69	70 - 74	75 +
M.D. Kuala Krai	**3,725**	**3,610**	**3,405**	**2,552**	**1,857**	**1,284**	**1,106**	**1,070**
Kuala Krai & Guchil	942	918	973	689	495	299	246	235
Kuala Pahi	19	23	22	12	15	13	12	16
Kawasan selebih M.D. *Remainder of M.D.*	2,764	2,669	2,410	1,851	1,347	972	848	819
JELI								
M.D. Jeli	**1,864**	**1,826**	**1,498**	**1,112**	**946**	**623**	**431**	**620**
Air Lanas	204	193	143	92	79	77	59	91
Batu Melintang	127	93	82	71	71	49	34	36
Berdang	84	60	38	51	32	28	14	58
Bukit Lakota	40	33	33	15	21	13	13	13
Gemang	56	38	48	43	30	37	18	23
Jeli	255	232	148	90	56	45	9	24
Kalai	49	40	49	30	29	20	12	13
Kuala Balah	-	-	-	-	-	-	-	-
Tunku Abdul Rahman	123	198	186	131	137	70	59	80
Kawasan selebih M.D. *Remainder of M.D.*	926	939	771	589	491	284	213	282

Nota : Angka di atas tidak disesuaikan kepada kadar kurang penghitungan.
Note : The above figures have not been adjusted for under-enumeration.

Table 1.3: Total population by sex, households and living quarters, Local Authority area and state, Malaysia, 2010.

Source: Prepared and published by Department of Statistics, Malaysia, 2010.

Jajahan/ Kawasan Pihak Berkuasa Tempatan *Jajahan/ Local Authority Area*	Penduduk *Population*			Isi rumah *Households*	Tempat kediaman *Living quarters*
	Jumlah *Total*	Lelaki *Male*	Perempuan *Female*		
M.D. Kuala Krai	**63,575**	**32,559**	**31,016**	**13,602**	**15,373**
Kuala Krai & Guchil	15,503	7,835	7,668	3,389	3,710
Kuala Pahi	377	187	190	82	90
Kawasan selebih M.D. *Remainder of M.D.*	47,695	24,537	23,158	10,131	11,573
JELI					
M.D. Jeli	**33,186**	**17,302**	**15,884**	**7,072**	**7,714**
Air Lanas	3,271	1,610	1,661	714	796
Batu Melintang	2,383	1,195	1,188	516	536
Berdang	1,284	648	636	287	316
Bukit Lakota	608	297	311	127	134
Gemang	1,047	536	511	228	248
Jeli	3,810	2,012	1,798	937	1,023
Kalai	1,033	537	496	200	207
Kuala Balah	-	-	-	-	-
Tunku Abdul Rahman	2,939	1,486	1,453	690	736
Kawasan selebih M.D. *Remainder of M.D.*	16,811	8,981	7,830	3,373	3,718

Nota : Angka di atas tidak disesuaikan kepada kadar kurang penghitungan.
Note : The above figures have not been adjusted for under-enumeration.

1.4.2 Rainfall

Table below shown rainfall at Kelantan for December 2014 and Mac 2015.

PERATUS JUMLAH HUJAN TAHUNAN
NEGERI KELANTAN BULAN 31 DISEMBER 2014

BIL	NAMA STESEN	BULAN												JUMLAH
		JAN	FEB	MAC	APR	MEI	JUN	JULAI	OGOS	SEPT	OKT	NOV	DIS	
1	Kota Bharu @ Jeti Kastam	80.0	2.0	30.0	6.0	127.0	146.0	74.0	239.0	121.0	264.0	837.0	994.0	2,920.0
2	Tumpat @ Pengkalan Nangka	69.0	1.0	58.0	8.0	75.0	118.0	138.0	140.0	137.0	278.0	660.0	803.0	2,485.0
3	Pasir Mas @ Kasar	135.0	0.0	39.0	0.0	75.0	193.0	148.0	166.0	112.0	367.0	586.0	959.0	2,780.0
4	Machang @ Kusial	316.0	6.0	58.0	40.0	117.0	195.0	221.0	283.0	237.0	280.0	487.0	1686.0	3,926.0
5	Bachok @ Serdang Gunung Barat	45.0	0.0	30.0	1.0	152.0	312.0	120.0	237.0	165.0	216.0	1021.0	970.0	3,269.0
6	Pasir Puteh @ Bkt. Gedombak	262.0	1.0	60.0	21.0	122.0	176.0	234.0	314.0	443.0	197.0	816.0	1236.0	3,882.0
a.	**PURATA PANTAI**	**151.17**	**1.67**	**45.83**	**12.67**	**111.33**	**190.00**	**155.83**	**229.83**	**202.50**	**267.00**	**734.50**	**1108.00**	**3,210.33**
b.	**PURATA PANTAI TERKUMPUL**	**151.17**	**152.83**	**198.67**	**211.33**	**322.67**	**512.67**	**668.50**	**898.33**	**1,100.83**	**1,367.83**	**2,102.33**	**3,210.33**	**267.53**
1	Dabong	178.0	0.0	16.0	0.0	146.0	129.0	56.0	427.0	258.0	227.0	262.0	967.0	2,666.0
2	Jeli	432.0	6.0	225.0	245.0	368.0	251.0	198.0	446.0	301.0	451.0	442.0	1542.0	4,907.0
3	Gua Musang	136.0	3.0	196.0	169.0	225.0	215.0	90.0	618.0	489.0	313.0	175.0	591.0	3,220.0
4	Laloh	152.0	8.0	74.0	98.0	199.0	73.0	151.0	262.0	172.0	148.0	354.0	706.0	2,417.0
5	Aring	174.0	5.0	251.0	144.0	206.0	251.0	130.0	306.0	495.0	545.0	233.0	881.0	3,621.0
6	Gunung Gagau	171.0	22.0	208.0	59.0	461.0	192.0	317.0	341.0	562.0	252.0	579.0	2686.0	5,850.0
c.	**PURATA PENDALAMAN**	**207.17**	**7.33**	**161.67**	**119.17**	**267.50**	**185.17**	**157.00**	**403.33**	**379.50**	**322.67**	**340.83**	**1228.83**	**3,780.17**
d.	**PURATA PENDALAMAN TERKUMPUL**	**207.17**	**214.50**	**376.17**	**495.33**	**762.83**	**948.00**	**1,105.00**	**1,508.33**	**1,887.83**	**2,210.50**	**2,551.33**	**3,780.17**	**315.01**
e.	**PURATA KESELURUHAN**	**179.17**	**4.50**	**103.75**	**65.92**	**189.42**	**187.58**	**156.42**	**316.58**	**291.00**	**294.83**	**537.67**	**1168.42**	**3,495.25**
f.	**JUMLAH PURATA TERKUMPUL**	**179.17**	**183.67**	**287.42**	**353.33**	**542.75**	**730.33**	**886.75**	**1,203.33**	**1,494.33**	**1,789.17**	**2,326.83**	**3,495.25**	**291.27**
g.	**Peratus = Purata x 100 / 2700**	**6.64**	**0.17**	**3.84**	**2.44**	**7.02**	**6.95**	**5.79**	**11.73**	**10.78**	**10.92**	**19.91**	**43.27**	**129.45**
h.	**PERATUS PURATA TERKUMPUL**	**6.64**	**6.80**	**10.65**	**13.09**	**20.10**	**27.05**	**32.84**	**44.57**	**55.35**	**66.27**	**86.18**	**129.45**	**129.45**

Catatan :

i) Peratus Purata Negeri hanya menggambarkan anggaran purata hujan turun di keseluruhan negeri Kelantan.
ii) Stesen kawasan pantai dan pedalaman adalah Stesen Telemetri
iii) Jumlah hujan bagi setiap stesen adalah dalam unit milimeter (mm)

Kg. Aring data sehingga: 23.12.2014
Kg. Laloh data sehingga: 24.12.2014
Gua Musang data sehingga : 23.12.2014
Dabong data sehingga : 24.12.2014
} Masalah Peralatan di stesen.

Disediakan Oleh :
AKMALULIZZAH BT. MOHD ZAIN
Juruteknik
Bahagian Sumber Air dan Hidrologi
JPS Negeri Kelantan

PERATUS JUMLAH HUJAN TAHUNAN
NEGERI KELANTAN BULAN MAC 2015

BIL	NAMA STESEN	BULAN												JUMLAH
		JAN	FEB	MAC	APR	MEI	JUN	JULAI	OGOS	SEPT	OKT	NOV	DIS	
1	Kota Bharu @ Jeti Kastam	298.0	1.0	9.0										308.0
2	Tumpat @ Pengkalan Nangka	121.0	2.0	6.0										129.0
3	Pasir Mas @ Kasar	101.0	3.0	16.0										120.0
4	Machang @ Kusial	277.0	23.0	11.0										311.0
5	Bachok @ Serdang Gunung Barat	173.0	8.0	13.0										194.0
6	Pasir Puteh @ Bkt. Gedombak	210.0	9.0	27.0										246.0
a.	**PURATA PANTAI**	**196.67**	**7.67**	**13.67**										**218.00**
b.	**PURATA PANTAI TERKUMPUL**	**196.67**	**204.33**	**218.00**										**18.17**
1	Dabong		0.0	67.0										67.0
2	Jeli	332.0	41.0	41.0										414.0
3	Gua Musang		0.0	42.0										42.0
4	Laloh			60.0										60.0
5	Aring													-
6	Gunung Gagau	264.0	112.0	49.0										425.0
c.	**PURATA PENDALAMAN**	**99.33**	**25.50**	**43.17**										**168.00**
d.	**PURATA PENDALAMAN TERKUMPUL**	**99.33**	**124.83**	**168.00**										**14.00**
e.	**PURATA KESELURUHAN**	**148.00**	**16.58**	**28.42**										**193.00**
f.	**JUMLAH PURATA TERKUMPUL**	**148.00**	**164.58**	**193.00**										**16.08**
g.	**Peratus = Purata x 100 / 2700**	**5.43**	**0.61**	**1.05**										**7.15**
h.	**PERATUS PURATA TERKUMPUL**	**5.43**	**6.10**	**7.15**										**7.15**

Catatan :

i) Peratus Purata Negeri hanya menggambarkan anggaran purata hujan turun di keseluruhan negeri Kelantan.
ii) Stesen kawasan pantai dan pedalaman adalah Stesen Telemetri
iii) Jumlah hujan bagi setiap stesen adalah dalam unit milimeter (mm)

i) Kg. Aring : 23.12.2014 - Sekarang - Peralatan rosak akibat ditenggelami air banjir 2014

Disediakan Oleh :
AKMALULIZZAH BT. MOHD ZAIN
Penolong Juruukur JA29
Bahagian Sumber Air dan Hidrologi
JPS Negeri Kelantan.

1.4.3 Land used

The land used in Jeli District are mostly used for agricultural such as rubber plantation, durian and vegetables. For the land that are near to Tanah-Merah Highways was used for houses, construction for town development and government building such as hospital, post office and school. The rest land in Jeli still covered by forests. Below shown land used map in the study area.

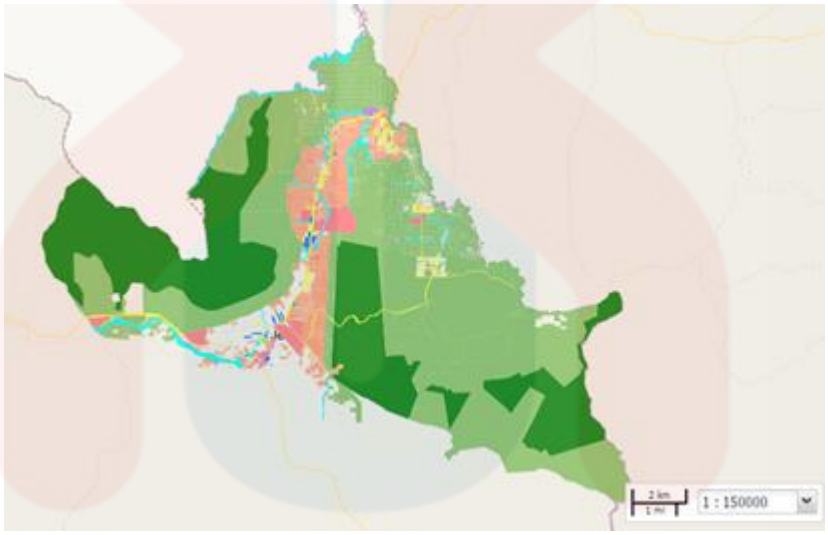


Figure 1.4: Land used map

Table 1.4: The land used in study area in year 2015.

Source: Information System of an Integrate Land Used Planning Website, 2016.

Colour	Land Used
	Badan Air
	Hutan
	Industri dan Utiliti
	Institusi dan Kemudahan Masyarakat
	Komersial
	Pembangunan Bercampur
	Pengangkutan
	Pertanian
	Perumahan
	Tanah Kosong
	Tanah Lapang dan Rekreasi
	Zon Pembangunan
	Zon Penampan
	Zon Perlancongan

1.4.4 Social Connection

Jeli is connected to the main transportation grid by road. The study area was connected by Tanah Merah-Grik highways and Dabong-Tanah Merah highway. There are three entrances to Jeli, from the west via the Grik, from the east via Tanah Merah

and from south via Jelawang in Kuala Krai. It has good facalities for transportation user to came this study area. Figure 1.4 show the Tanah Merah-Grik highway.

Figure 1.5: Social connection map.

1.5 Scope of Research

In this research there are two parts. First part is to update the geological map of the study area. While the second part, is to determine subsurface geological structures such as fractures, faults and others using electrical resistivity survey.

1.6 Research Importance

To ensure the building foundation totally safe and strong after considering its load bearing capacity. The safe and strong foundation are free from subsurface geological structures such as fractures, faults and voids. This weak zone can lead to building collapse.

CHAPTER 2

LITERATURE REVIEWS

2.1 Introduction

This chapter discuss on different opinions about previous researches that has been done relating to this topic. There are many application of resistivity survey in geophysical investigations. One of application of resistivity survey in geophysical investigations is using electrical resistivity technique to gaining knowledge of the subsurface structure, in particular, for identifying anomalies and defining the complexity of the subsurface geology and is fast gaining grounds (Lapenna et al., 2005; Siddiqui and Osman, 2012). This may mainly be due to the fact that on electrical resistivity tomographies, faults lines and other geological formations such as fractures, easily stand out due to their low resistivity values compared to the surrounding (Aning et al., 2013). These features are normally identified as anomalies in the electrical resistivity tomographies as they differ from the host material.

Field studies by Ozegin et al., (2011) predicted that a geologic structure which was most probably a fracture was established and confirmed to be a potential source of building failure in a site, and this happens when building is constructed across the

geologic structure. Garg (2007) found that if a building is constructed at a site, without properly considering the underground strata or its load-bearing capacity, it may settle excessively or differentially, causing development of cracks in the building which may ultimately lead to its failure and collapse. Subsurface geological features such as fractures, voids, and nearness of water table to the surface are among the inconveniences that pose constraint to constraint to building constructions especially to their foundations (Andrews et al., 2013).

The electrical resistivity method is very good tool for resolving geological problems ranging from the delineating of subsurface geological structures such as fractures and faults water accumulation

2.2 Regional Geology and Tectonic Setting

Due to the collision between two huge terrenes of Sibumasu and Indochina, resulting the existence of Peninsular Malaysia which formed Bentong-Raub suture and divided Peninsular Malaysia into three longitudinal belts, Western, Central and Eastern, Hutchison (2009).

Kelantan is part of Central Belt. This Central Belt consists of Permian-Triassic clastics, volcanic and limestones. During Late Triassic and Late Cretaceous there are significant plutonic acid magmatism occurrence. Meanwhile, during Permian and Triassic there are the occurrence of significant acid to andesitic volcanism and in the Late Mesozoic the volcanic activities continued to manifest after the cratonization of the Peninsular.

2.2.1 General Background of the Kemahang Granite

Kemahang Granite in Malaysia covers Bukit Jeli, Bukit Kemahang, Bukit Kusial and several smaller hills which formed N-S trending mountainous area near the central part of the transect area, Jeli town. MacDonald (1976) suggested that the age of this Kemahang Granite is triassic based on age determination. This granite is described as granodiorite because its show strong foliated with gneissic together with porphyritic granite. In general, this Kemahang Granite consists of predominantly grey, medium to coarse grained megacrystic biotite-hornblende granite to granodiorite in composition (MT-JGSC, 2006).

2.4 Structural Geology

In the east and west side of the study area are occupied by mountainous area with north-south trend that are formed by orogenic process. According to Hobbs et al. (1976), orogeny is deformation process where rocks become folded, faulted and incorporated in an extensive linear or arcuate region which are characterized by extensive metamorphism and zones where the rock strongly deformed. This orogenic process resulting the structural of rocks, such as lineament. Lineament is a linear feature which is an expression of an underlying geological structures such as a fault. Lineament can be seen obviously from aerial or satellite photographs and often apparent in geological and topographic map. There are negative and positive lineament.

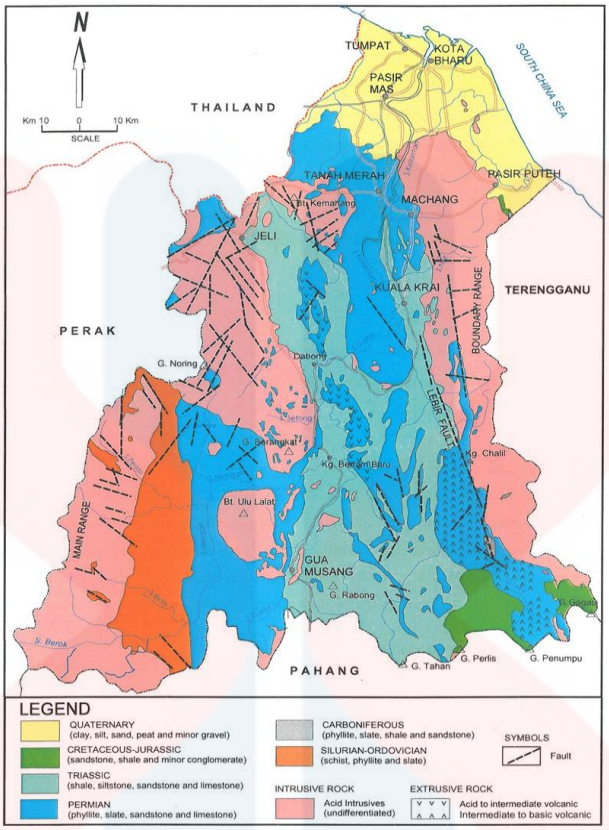


Figure 2.2: Lineaments map of Kelantan.

Source: The Malaysia-Thailand Border Joint Geological Survey Committee (2006).

2.5 Petrography of Jeli Igneous Complex and Kemahang Granite

According to research carried by Malaysia-Thailand Border Joint Geological Survey Committee (2006) petrographically describe Kemahang Granite as light grey, medium to coarse grained, megacrystic, biotite-hornblende granite. The K-feldspar megacrysts are up to 40% volume with lath shape to tablet with some equant crystals. Their size was range from 1×2 cm to 3×12 cm. Its groundmass composed of quartz (20%-35%. 2×2 to 5×8 mm in size) with colour, light grey to pale grey, euhedral to subhedral crystals, medium to coarse grained and single to cluster. This groundmass also composed of K-feldspar (30%-40%, 2×10 to 3×15 mm in size), chalky white colour, subhedral to euhedral and stubby and plagioclase (15%-20%, 2×10 mm in size),

with colour dark grey to black, single, euhedral and flake to book. For biotite (15%, 2-5 mm in size) is the only mafic mineral found while others are accessory minerals such as sphene, allanite, apatite and monazite. Along the margin of the granite pluton, the size of xenolith, quartz strings and quartz blebs are varied and the K-feldspar megacrysts are increase in size and population from east to west.

2.6 Resistivity Surveys

Resistivity survey are to determine the subsurface resistivity distribution by making measurements on the ground surface so that the true resistivity of the subsurface can be estimated. The ground resistivity is related to various geological parameters such as the mineral and fluid content, porosity and degree of water saturation in the rock. Electrical resistivity surveys have been used for many decade subsurface geological structure, mining and geotechnical investigations. More recently, it has been used for geophysical surveys.

The resistivity measurements are conducted by injecting current into the ground through two current electrodes (C1 and C2 in Figure 2.3), and measuring the resulting voltage difference at two potential electrodes (P1 and P2). From the current (I) and voltage (V) values, an apparent resistivity (*pa*) value is calculated.

$$pa = k\ V / I$$

where k is the geometric factor which depends on the arrangement of the four electrodes. Figure 2.4 shows the common arrays used in resistivity surveys together with their geometric factors.

Resistivity meters normally give a resistance value, R = V/I, so in practice the apparent resistivity value is calculated by

$$pa = k\ R$$

The calculated resistivity value is not the true resistivity of the subsurface, but an "apparent" value which is the resistivity of a homogeneous ground which will give the same resistance value for the same electrode arrangement.

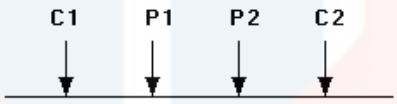


Figure 2.3: A conventional four electrode array to measure the subsurface resistivity.

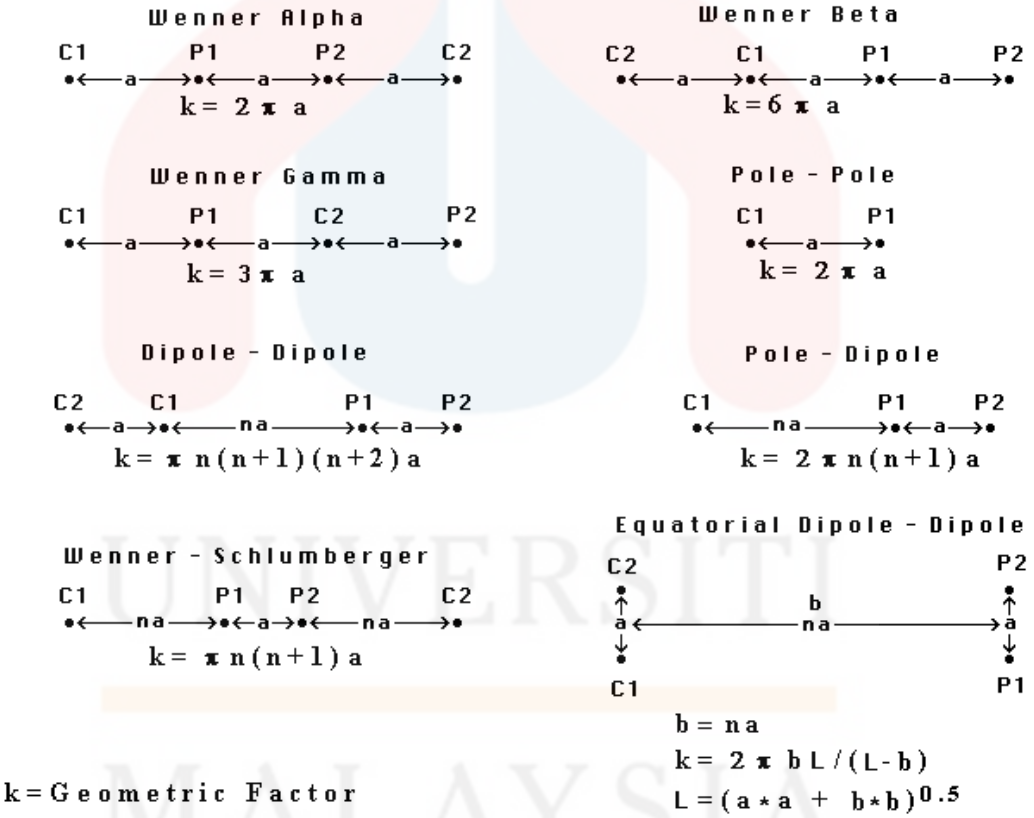


Figure 2.4: Common arrays used in resistivity surveys and their geometric factors.

2.6.1 The relationship between geology and resistivity

Resistivity surveys give a picture of the subsurface resistivity distribution. To convert the resistivity picture into a geological picture, some knowledge of typical resistivity values for different types of subsurface materials and the geology of the area surveyed, is important. Table 2.1 shows the resistivity values of igneous rock, metamorphic rocks and sedimentary rocks (Keller and Frischknecht 1966, Daniels and Alberty 1966). Igneous and metamorphic rocks typically have high resistivity values. The resistivity of these rocks is greatly dependent on the degree of fracturing, and the percentage of the fractures filled with ground water.

Sedimentary rocks, which usually are more porous and have a higher water content, normally have lower resistivity values. Wet soils and fresh ground water have even lower resistivity values. Clayey soil normally has a lower resistivity value than sandy soil. However, note the overlap in the resistivity values of the different classes of rocks and soils. This is because the resistivity of a particular rock or soil sample depends on a number of factors such as the porosity, the degree of water saturation and the concentration of dissolved salts.

Resistivity values have a much larger range compared to other physical quantities mapped by other geophysical methods. The resistivity of rocks and soils in a survey area can vary by several orders of magnitude. In comparison, density values used by gravity surveys usually change by less than a factor of 2, and seismic velocities usually do not change by more than a factor of 10. This makes the resistivity and other electrical or electromagnetic based methods very versatile geophysical techniques.

Table 2.1: Resistivities of some common rocks, minerals and chemicals.

Source: Electrical methods in geophysical prospecting.

Material	Resistivity (Ω*m)	Conductivity (Siemen/m)
Igneous & Metamorphic Rocks		
Granite	5×10^{3} - 10^{6}	10^{-6} - 2×10^{-4}
Basalt	10^{3} - 10^{6}	10^{-6} - 10^{-3}
Slate	6×10^{2} - 4×10^{7}	2.5×10^{-8} - 1.7×10^{-3}
Marble	10^{2} - 2.5×10^{8}	4×10^{-9} - 10^{-2}
Quartzite	10^{2} - 2×10^{8}	5×10^{-9} - 10^{-2}
Sedimentary Rocks		
Sandstone	8 - 4×10^{3}	2.5×10^{-4} - 0.125
Shale	20 - 2×10^{3}	5×10^{4} - 0.05
Limestone	50 - 4×10^{2}	2.5×10^{-3} - 0.02

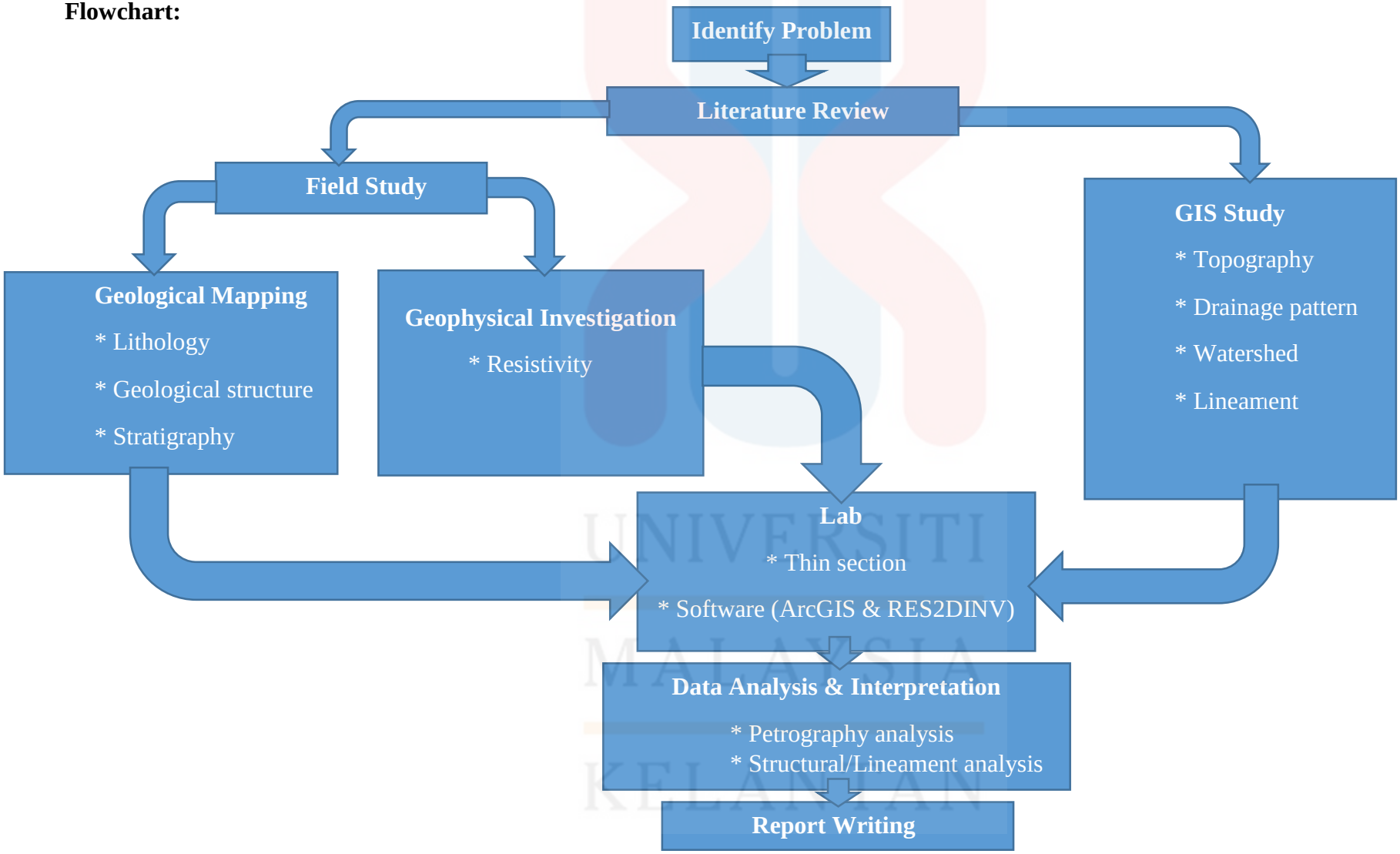
CHAPTER 3

MATERIALS AND METHODOLOGIES

3.1 Introduction

Methodology show the steps need to be carry out in a research. In this chapter purposely shows and described how the research being conducted and what the method and materials being used to determine the Geology and Resistivity Survey of UMK Jeli Campus and Gemang Area. The subtopics that will be discuss in this chapter are preliminary studies, field assessments, laboratory investigation and software application.

Flowchart:


Identify Problem
Literature Review
Field Study
GIS Study
* Topography
* Drainage pattern
* Watershed
* Lineament
Geological Mapping
* Lithology
* Geological structure
* Stratigraphy
Geophysical Investigation
* Resistivity
Lab
* Thin section
* Software (ArcGIS & RES2DINV)
Data Analysis & Interpretation
* Petrography analysis
* Structural/Lineament analysis
Report Writing

3.2 Preliminary Research

Preliminary research is the first step to be done before carrying out research. Preliminary research was conduct by finding information from internet, books, and journals that are related to this research to be use as a references. This kind of references can get from libraries and JUPEM and Department of Geoscience Malaysia.

3.3 Field Survey

In this research there are two field survey need to be done. First is geological survey of UMK Jeli Campus and Gemang Area where its geology data such as lithology, geomorphology, stratigraphy, and geological structural are taken. While geophysical survey, focus on resistivity of UMK Jeli Campus and Gemang Area. This is to determine subsurface geological structures such as fractures, faults and others for construction purposes and building development.

3.3.1 Geological Survey

Geological survey is a survey to get lithology, geomorphology, stratigraphy, and structural data. This data was used to produce geological map.

a) Materials for geological survey

Materials needed in geological survey are listed in Table 3.1.

Table 3.1: Materials needed.

Source: Basic Geological Mapping, Fourth edition John Barnes.

No.	Materials/Equipment	Uses
1	Garmin GPS	Determine coordinates, mapping lithologies, tracking structures and measuring elevation.
2	Hammer	Obtain rock samples for thin section.
3	Suunto/Brunton compass	Measure strike/dip.
4	Measuring tape	Measure thickness of lithologies and structures.
5	Hand lenses	To analyse rock type, colour, texture, identifiable mineralogy, alteration as well as the physical properties such as folding, foliation, intrusions and layering.
6	Base map	As a reference during geological survey and to plot geological observations in the field.

b) Methodology for geological survey

Geological survey is an important method that must be carry out in this research. To analyse the general geology of the study area, the survey was using the base map of the study area. The steps in this survey are mapping, sampling and recording data. Mapping of the study area must be done to acquire the geological data of this study area. These data include the type of rocks, structural geology and measurement of lineament in that particular area. GPS are used in traversing the track of the survey.

The reading of strike and dip are obtained using compass. For the sampling, rock samples were taken for further analysis in the laboratory. The image for every rock samples, its outcrops and locality must be taken.

The samples taken from the field will be made into thin sections and later analysed using petrographic microscope in the laboratory. The results from every observation important in determine the types of the rock in the study area.

3.3.2 Geophysical Investigation

In this investigation, electrical resistivity being used to determine subsurface geological structures such as fractures, faults and others.

a) Materials for geophysical investigation

The equipment that needed in electrical resistivity are listed as in Table 3.2 and Figure 3.1.

Table 3.2: Electrical resistivity equipments.

Source: Instruction Manual Terrameter SAS 4000/ SAS 1000

No.	Instruments	Uses
1	ABEM Terrameter SAS 4000	To measure resistivity in resistivity survey.
2	Electrode selector	To operate the ABEM Terrameter SAS 4000.
3	Lund Imaging cable	Cable joints and cable jumpers.
4	Electrode jumper	Jump the electrode to each other.
5	Steel electrode	Tranfer electric current into the ground.
6	Cable connector	Connect cable to ABEM Terramter SAS 4000.
7	Battery (25-70^{7} Ah)	Supply power to ABEM Terrameter SAS 4000.
8	Multifunction cable	Connect the ABEM Terrameter SAS 4000 with electrode selector.

Figure 3.1: Resistivity Equipments.

b) Methodology for geophysical survey - Wenner Array

Wenner array is used in this research because it is relatively sensitive to vertical changes in the subsurface resistivity below the centre of the array but it is less sensitive to horizontal changes in the subsurface resistivity. In Figure 3.2, the sensitivity plot for the Wenner array has almost horizontal contours beneath the centre of the array. So, in general Wenner array is good in resolving vertical changes (horizontal stuctures) but relatively poor in detecting horizontal changes (narrow vertical structures). If the survey is carried in areas with high background noise, Wenner has the advantage because it has strongest signal strength. One of the disadvantage of Wenner array is the relatively poor horizontal coverage as the

electrode spacing is increased (Figure 3.3). This could be a problem if a system with a relatively small number of electrodes being use.

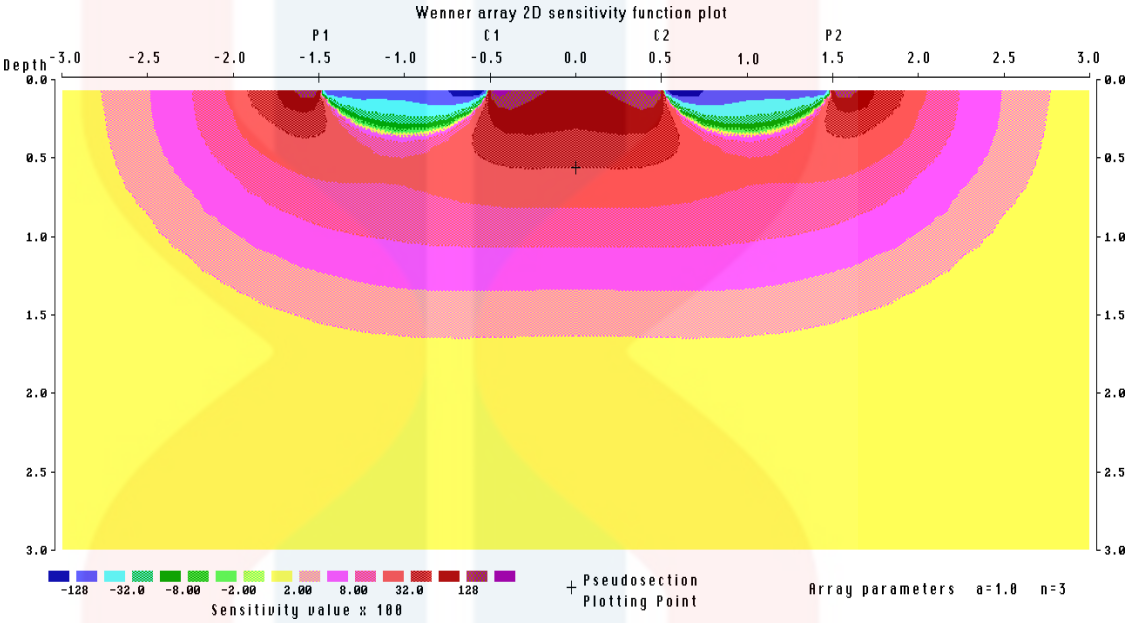


Figure 3.2: The sensitivity patterns for the Wenner.

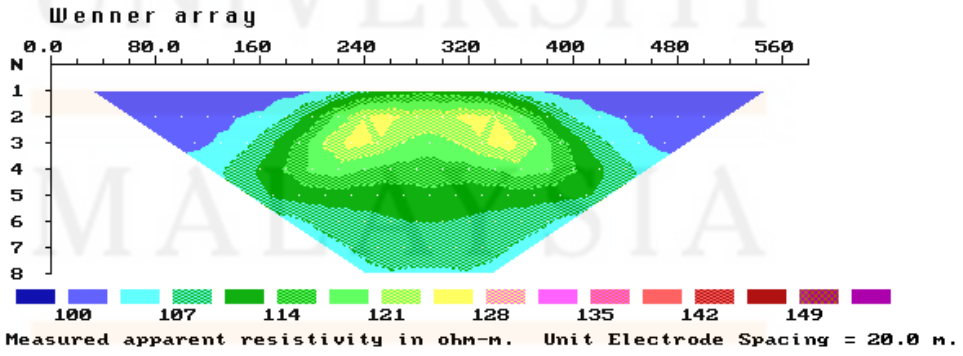


Figure 3.3: The apparent resistivity pseudosections from 2-D imaging surveys with different arrays over a rectangular block.

3.4 Laboratory Investigation

Investigation involve in preparing the thin sections for each sample taken in the field. This thin section later was analyse using petrography test under the microscope to identify its minerals content.

3.4.1 Thin Sections

The fresh rock samples that have been collected from the field are made into thin section following below steps:

i. Prepare the glass slide

Glue the flatten rock sample unto the glass slide in order for the rock section to end up with a constant thickness. The slide is first to be “frost” to removes the thick spots on the slide and the slide face is adjusted to be parallel to the grinding wheel’s face.

ii. Frost the glass slide

Flatten the glass slide by “frost” or grind it and roughen the surface so the epoxy can bind well. Firstly, the glass slide must place on the grinder in the same orientation.

iii. Marking the sample

Before cut the rock sample you must mark where you want to cut it. Usually the rock was cut on a plane perpendicular to any planar fabric, but for particular purposes other orientations might be preferable. A line to be cut should be mark on the rock.

iv. Cutting and cleaning the slab

A slab is cut from the rock sample along the line that was marked using the slab saw.

v. Cut the chip

The size of the slab must be slightly smaller than thin section. The slab trim was needed to cut the slab and be careful to decide from what part of the slab you want to cut.

vi. Glue the slide to the chip

The side of the chip that was ground don is glued to the frosted side of the slide. During this the constant thickness of epoxy across the section needs to be ensure.

vii. Cutting the chip from the slide

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

viii. Grind the slide to the correct thickness

The remaining rock sample on the sample must be grind follow the previous steps. This must be done carefully to ensure the correct thickness and to avoid the thin section go bad.

3.5 Software Applications

In this research there two software application been used which are ArcGIS and RES2DIN. ArcGIS is used in work involve maps and geographic information is done using this software. Second is RES2DINV, a computer program that automatically determine two-dimensional (2D) resistivity model of the subsurface using the data that obtained from the electrical imaging survey.

3.5.1 ArcGIS software

ArcGIS is a geographic information system (GIS) used for creating and using maps, compiling geographic data, analysing mapped information, sharing and discovering geographic information and managing geographic information in a database. ArcGIS also stored geology data such as lithology, lineament analysis and drainage system in its database.

3.5.2 RES2DINV software

RES2DINV software is used to analyse the resistivity data obtained from ABEM Terrameter SAS 4000. In this software, the obtained are display in the form of

image and this image will display ranges of resistivity values of medium. Then this resistivity values will be compare with standard resistivity value of materials based on existing analysis. The image from this software later on use to interpret the potential of groundwater and determine the existence and depth of potential groundwater.

3.6 Data Analyses and Interpretations

Data from preliminary study, fieldwork and laboratory analysis need to analyse and interpret to conclude it. This also include the data from geology data, petrography data, hand specimen analysis, resistivity data, lineaments and fracture traces analysis.

3.6.1 Petrography Analysis

Petrography analysis is done to identify the rock sample name based on their mineral contents using petrography microscope. During the observation of thin section under petrography microscope the thin sample's image must be capture to calculate the mineral contents of that sample. The calculation of the percentage of minerals in the samples is done by drawing grids on the captured image. The calculated percentage is then record in Dickinson diagram (QFL diagram) for interpretation to naming the rock sample.

3.6.2 Lineament analysis

Lineament analysis can be made by interpreting satellite image because the image (positive lineament and negative lineament) are distinguish.

CHAPTER 4

GENERAL GEOLOGY

4.1 Introduction

This chapter discuss about the general geology of the study area in terms of its geomorphology, stratigraphy, petrography, structural and historical geology.

4.2 Geomorphology

Study of landforms and its processes that create them (Ahnert, F. (1998) Introduction to Geomorphology. London: Arnold). Geomorphology are denudation process where the landforms of the certain area undergone weathering, erosion and mass wasting. These process are continually throughout the time and it repeated.

4.2.1 Topography

Topography are the arrangement of the natural and human made physical features of an area. The topography for this study area are mountainous which are mostly covered by forest and rubber plantations. There were only small rivers in this study area but half of this river are dry up. The central part of this study area are villages due to its nearest to the main road, Tanah Merah-Gerik Highways. Below is topography map for the study area, Figure 4.1.

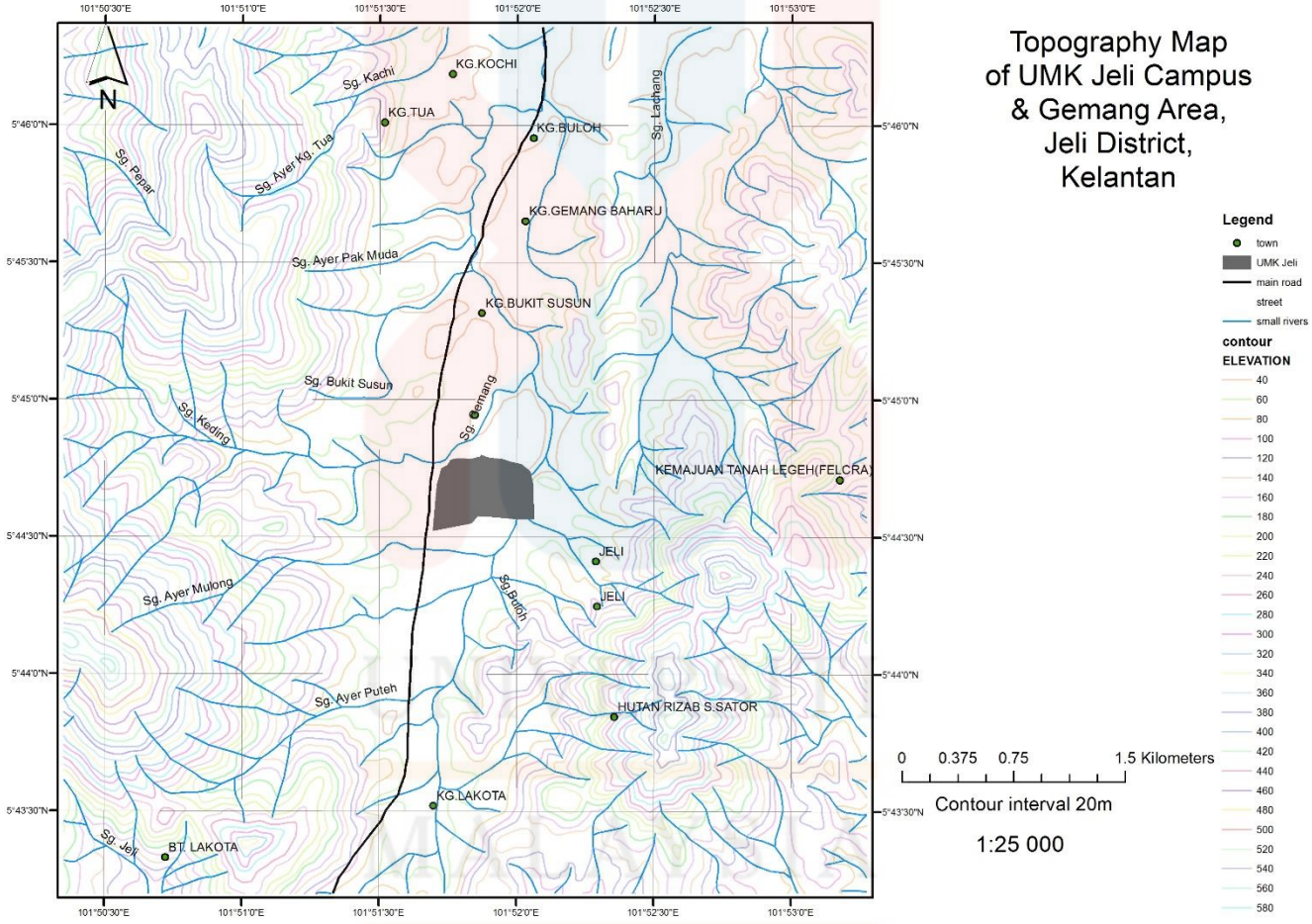


Figure 4.1: Topography map.

4.2.2 Weathering and Related Landforms

Denudation is the process where the landforms of land areas continually changes by weathering, erosion and mass wasting. This land area that area exposed undergone different type of weathering and erosion. The weathering process involved in this process can be classified into mechanical weathering, chemical weathering and biological weathering. Different types of weathering produced different types of weathered product. This weathered product later on undergone erosion process by an agent such as streams or glaciers.

The denudation process at the study area are by mechanical weathering because the rock broke up into small size, granular. The mechanical weathering process involved are block disintegration and root wedging. Block disintegration caused by temperature changes which influenced by climate of the study area. The changes of temperature caused the repeated expansion and contraction, the rock breaks up along the joints as shown below Figure 4.2. Root wedging occurs when a plant, especially trees, sink root systems into existing joints and fractures. Similar to frost wedging, as the root grows it forces the fracture to expand as shown below Figure 4.3. This process is also important for soil. Its biological processes can also produce chemical weathering, for example plant roots or microorganisms produce organic acids which help to dissolve minerals and nurture the soil.

In the upper course of some river at this study area, the large sediment such as boulders and cobles are moved by heavy rain. When this large sediment was transported they are bounced and rolled along the bed causing vertical erosion thus produced a steep-sided v-shaped valley. The shape of this valley affect by climate of the study area because the more rainfall occurred the higher the discharge and erosion

rates. The rock structure also affects the shape, mostly rock at this have discontinuities and the slopes in this location are less stable soil valley sides due to the absent of vegetation. Main process of fluvial erosion in this location are abrasion when the erosion of the river bottom and the riverbank material being carried by the river itself and attrition, the rocks and pebbles being carried by the river crash against each other, wearing them down to become smaller, rounded pebbles. Once it has been eroded, material in the river is transported down the river. Whilst this happening the erosion process, attribution and abrasion continue to occur. The fluvial transportation processes depending on the size of the material being moved. Traction where the largest rocks in the river are slowly roiled along the bottom of the river by the force of the water. This primarily occurs in the upper reaches of the river. Saltation, smaller rocks are bounced along the river bed. This occurs in the upper and middle sections of the river in general. Suspension, the water carries smaller particles of material. This process occurs throughout the course of the river, but increases the closes you are to the mouth of the river. Solution, materials dissolved within the water and carried along by it. Primarily this occurs in the middle and lower reaches of the river. The fluvial deposition for this location occur at floodplain, where the river losses energy and therefore cannot continue to carry the material it is transporting.

Figure 4.2: Root wedging breaks along the joints.

Figure 4.3: Rock breaks up.

Figure 4.4: Boulders.

Figure 4.5: Deposited of boulders.

4.2.3 Drainage system

Drainage system is the pattern formed by streams, rivers and lakes in a drainage basin. There are different types of drainage patterns as shown below with its patterns and characteristic, Figure 4.6 and Table 4.1. The different types of drainage patterns are affected by the topography of the area, whether the area are contained soft rock or hard rock. The rivers in this study area are all dendritic and parallel pattern but mostly are dendritic. This dendritic pattern was the mountains due the mountainous of the study area. Based on the map below Figure 4.7, this dendritic pattern river all started from the higher elevation, peak of the mountain and its continue flow to low elevation, foot of the mountain. In this dendritic river system, tributaries of a main river will join together at the right angles causing a shape like twigs of a tree as its flow downward. While for parallel pattern, formed due to pronounced slope to the surface of the study area. This happened at steep mountain where the tributary rivers tend to stretch out following the slope of surface in parallel pattern.

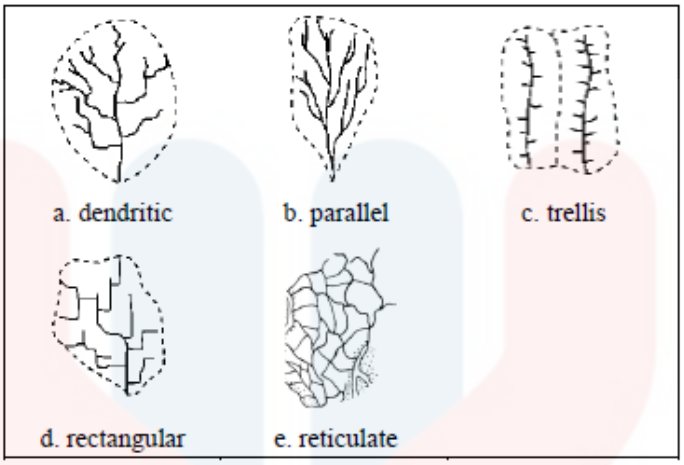


Figure 4.6: Drainage network patterns.

Table 4.1: Drainage pattern characteristic.

Source: Geomorphic Classification of Rivers

Drainage pattern	Geometric and Topologic Characteristic
Dendritic	-Tributaries joining at acute angle
Parallel	- Parallel-like - Elongated catchment - Long straight tributaries - Tributaries joining at small acute angle
Trellis	- Short straight tributaries - Tributaries joining at almost right angle
Rectangular	- Tributary bends - Tributaries joining at almost right angle
Reticulate	- Tributaries cross together forming a cycle

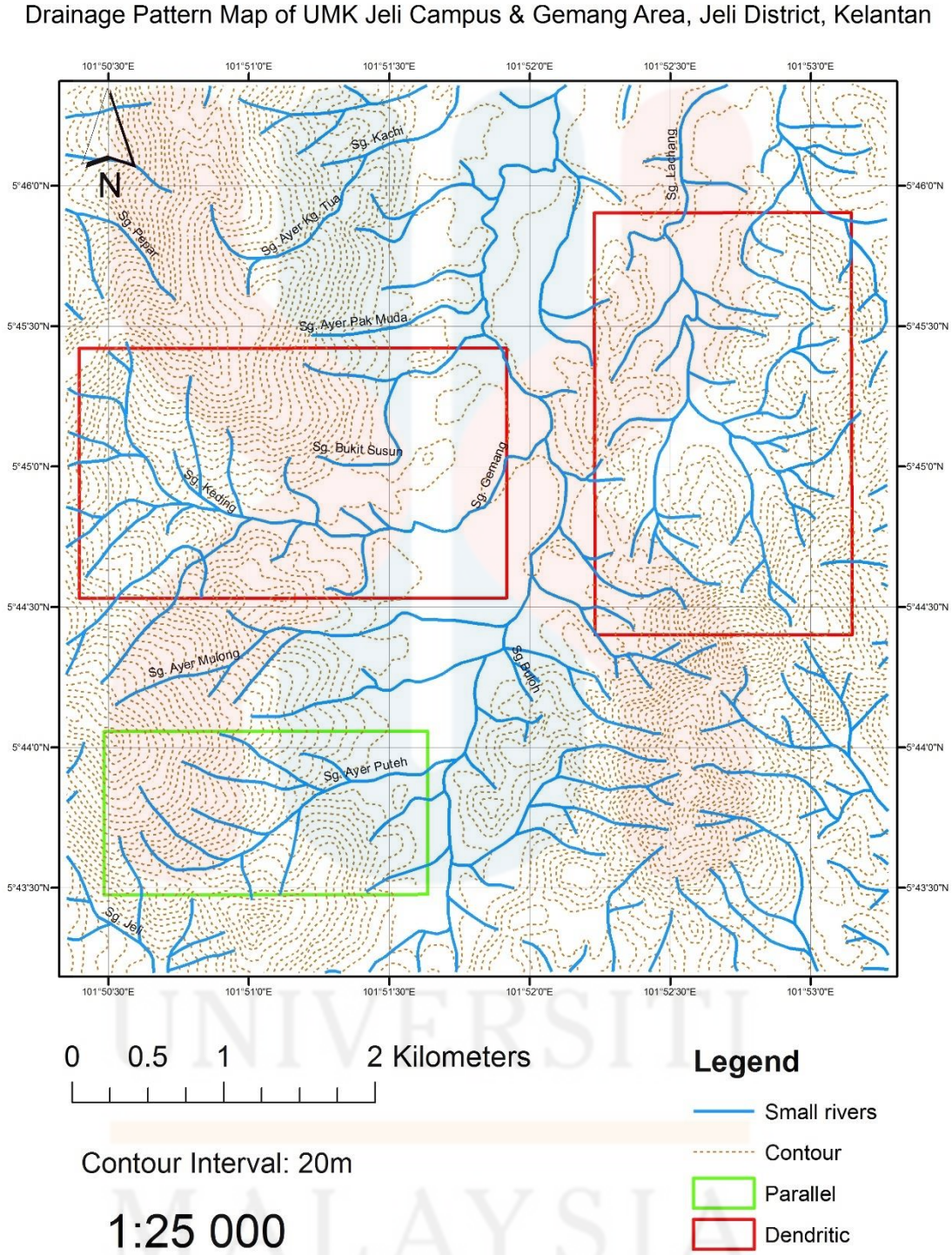


Figure 4.7: Drainage pattern map.

4.2.4 Watershed

Watershed was an area of land that drains downslope to the lowest point as shown below, Figure 4.8. The water flow either from underground or on the surface moves by network of drainage pathways that later on will converge into a drainage system that becomes larger as the water moves downstream. Watersheds can be small or big when the small watershed combine. The watershed boundaries will follow the major ridge-line around the channels and meet at the bottom where the water flows out of the watershed, commonly referred to as the mouth of the stream or river.

Figure 4.8: Watershed is an area of land that drains downslope to the lowest point.

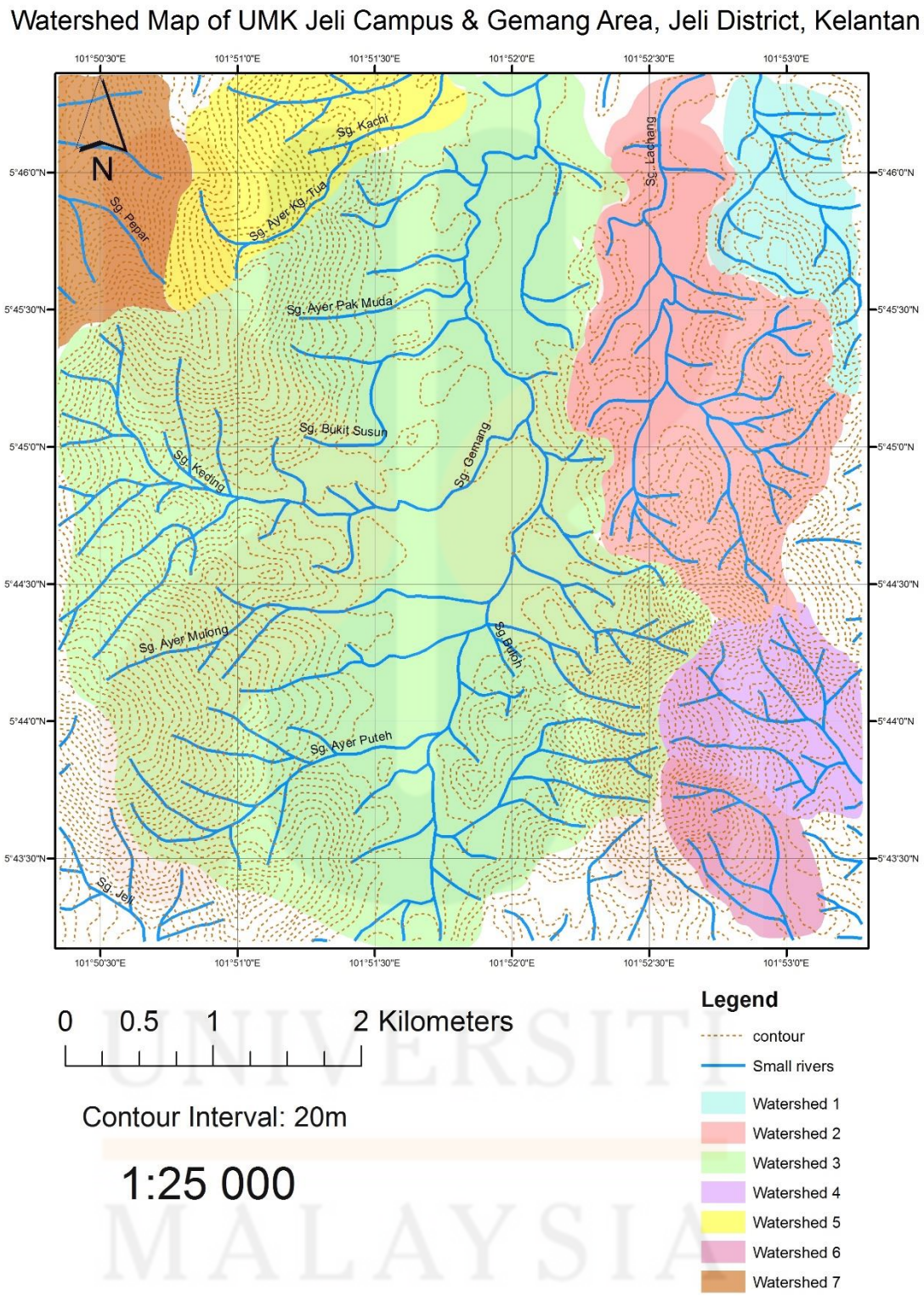


Figure 4.9: Watershed map.

4. 3 Stratigraphy

Stratigraphy is the study of rock strata, their relative and absolute ages, and the relationships between strata. The way rock beds are situated in relation to each other and to the Earth tells a lot about how and when the rocks were formed. Stratigraphy are used to know past environments of the Earth based on the physical characteristics of the rocks and the changes in environment that occurred over time. The stratigraphy of the study area was analysed based on their lithostratigraphy. Lithostratigraphy are one of the stratigraphy type that defined the stratigraphy based on their lithology property.

4.3.1 Lithostratigraphy

Lithostratigraphic are rocks units defined on the basis of their physical properties, and lithostratigraphy deals with the study of the stratigraphic relationships among strata that can be identified on the basis of lithology. Table below shown the lithostratigraphy of the study area.

Table 4.2: Lithostratigraphy of UMK Jeli Campus and Gemang Area & its vicinity.

Era	Period	Unit	Description
Cenozoic	Quaternary	Colluvium Deposit	Unconsolidated sediments that have been deposited at the base of hillslopes by surface runoff, rainwash or sheetwash that slow continuous downslope creep. Colluvium composed rock types and sediments ranging from silt to rock fragments of various size.
Mesozoic	Triassic	Kemahang Granite	This granite is described as granodiorite because its show strong foliated with gneissic together with porphyritic granite. In general, this Kemahang Granite consists of predominantly grey, medium to coarse grained megacrystic biotite-hornblende granite to granodiorite in composition.

4.4 Petrography

Petrography work are deals with microscopic examination of thin sections using petrographic microscope. This examination was to identified type of mineral contain of the thin section. Then the data from this examination put into QAP triangle to naming the rock.

4.4.1 Hand specimen

During the field observation and mapping, only 3 rocks are taken as hand specimen. All of it was granite with medium to coarse grain texture with grey and black colour. Its mineral contain such as quartz, alkali feldspar visible to naked eyes. This specimen also hard and massive, as shown below.

Figure 4.10: Specimen 1.

Figure 4.11: Specimen 2.

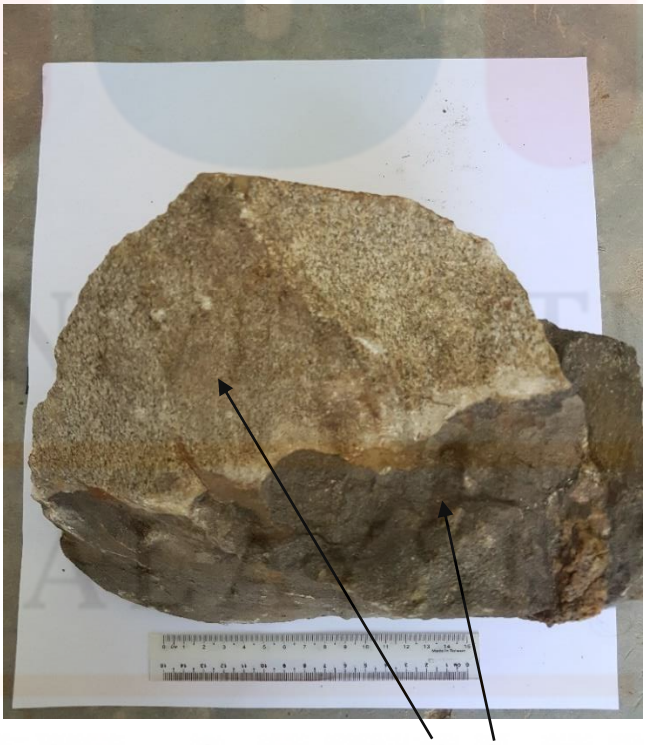


Figure 4.12: Specimen 3 & 4

4.4.2 Thin section

Typical minerals of granite such as quartz, alkali feldspar, plagioclase clearly visible during petrography analysis. The quartz will appear grey but is actually colourless and reflecting. Alkali feldspar are the ones give granite colour, yellow to orange to pink or blue while plagioclase was generally white and black, zebra-crossing look like. Minor essential also occurred in this granite include olivine and biotite. Biotite are black colour. The dominant mineral is this granite was quartz with 40%, follow by alkali feldspar 25%, plagioclase 15%, biotite 15% and olivine 5%. Due to the presence of biotite in this granite so this granite was biotite granite which it gave the dark colour to his granite.

Reference No.: D1S16001 **Name of Rock:** Biotite Granite

Rock Type: Intrusive Igneous Rock

Classification : Dunham (1962)

Magnify : 4×10^4

Description of Mineralogy

Composition of Mineral	Amount (%)	Description of Optical Mineralogy
Plagioclase	15	Black and white zebra look like.
Biotite	15	Dark black.
Alkali feldspar	20	Black and white. Twinning.
Quartz	50	Milky white.

Foto

Reference No.: D1S16002 **Name of Rock:** Biotite Granite

Rock Type: Intrusive Igneous Rock

Classification : Dunham (1962)

Magnify : 4×10^4

Description of Mineralogy

Composition of Mineral	Amount (%)	Description of Optical Mineralogy
Plagioclase	15	Black and white zebra look like.
Biotite	20	Dark black.
Alkali feldspar	20	Black and white. Twinning.
Quartz	45	Milky white.

Foto

Reference No.: D1S16003 **Name of Rock:** Biotite Granite

Rock Type: Intrusive Igneous Rock

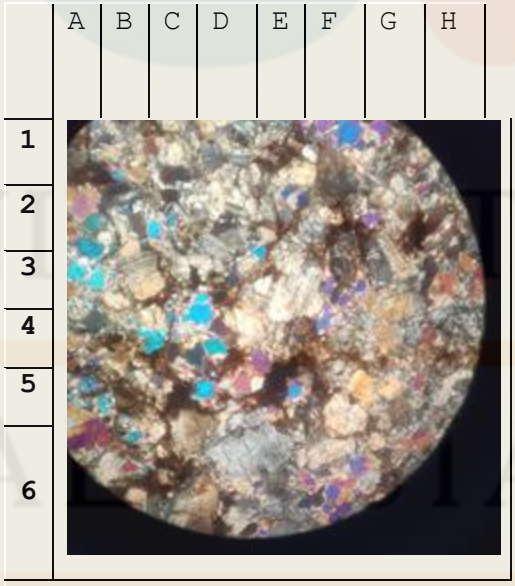
Classification : Dunham (1962)

Magnify : 4×10^4

Description of Mineralogy

Composition of Mineral	Amount (%)	Description of Optical Mineralogy
Olivine	15	Greenish, pinkish, blueish.
Biotite	20	Dark black.
Alkali feldspar	25	Black and white. Twinning.
Quartz	40	Milky white.

Foto



Reference No.: D1S16004 **Name of Rock:** Biotite Granite

Rock Type: Intrusive Igneous Rock

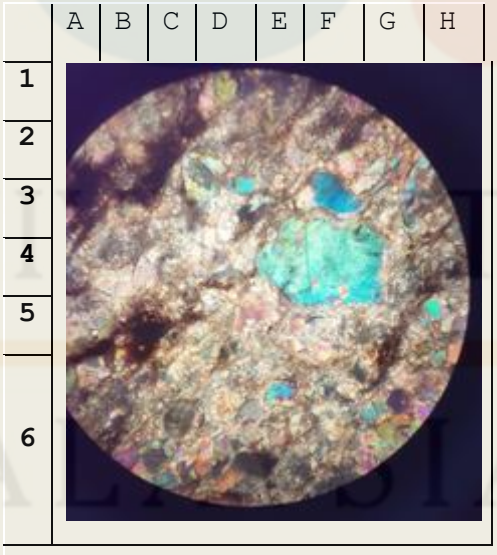
Classification : Dunham (1962)

Magnify : 4×10^4

Description of Mineralogy

Composition of Mineral	Amount (%)	Description of Optical Mineralogy
Plagioclase	10	Black and white zebra look like.
Olivine	20	Greenish, blueish, pinkish.
Alkali feldspar	20	Black and white. Twinning.
Quartz	50	Milky white.

Foto



4.5 Structural Geology

Structural are the study of geological structures by learning how, when and why the structures formed. Geologic structure is a geometric feature in rock whose shape, form and distribution can be described. For the structural work at the field, structural geologist examines geological phenomena looking specifically for signs of deformation which show the kinds of stress put on the rock as it formed. The structural geology of this study area was examines by its lineament and joint analysis.

4.5.1 Lineament

A lineament is a linear feature in a landscape which reveal the hidden structure of the rock basement. This lineament comprised fault zones, fold zones, fractures zones and sometimes igneous intrusions such as dykes also can give rise to lineaments. Sometimes a lineament is clearly shown on the geological or topographic maps and can appear obvious on aerial or satellite photographs but does not appear to correspond to any observable physical feature. The lineaments at the study area are consisted of positive lineament and negative lineament. Based on Figure below shown the appeared lineament of the study area.

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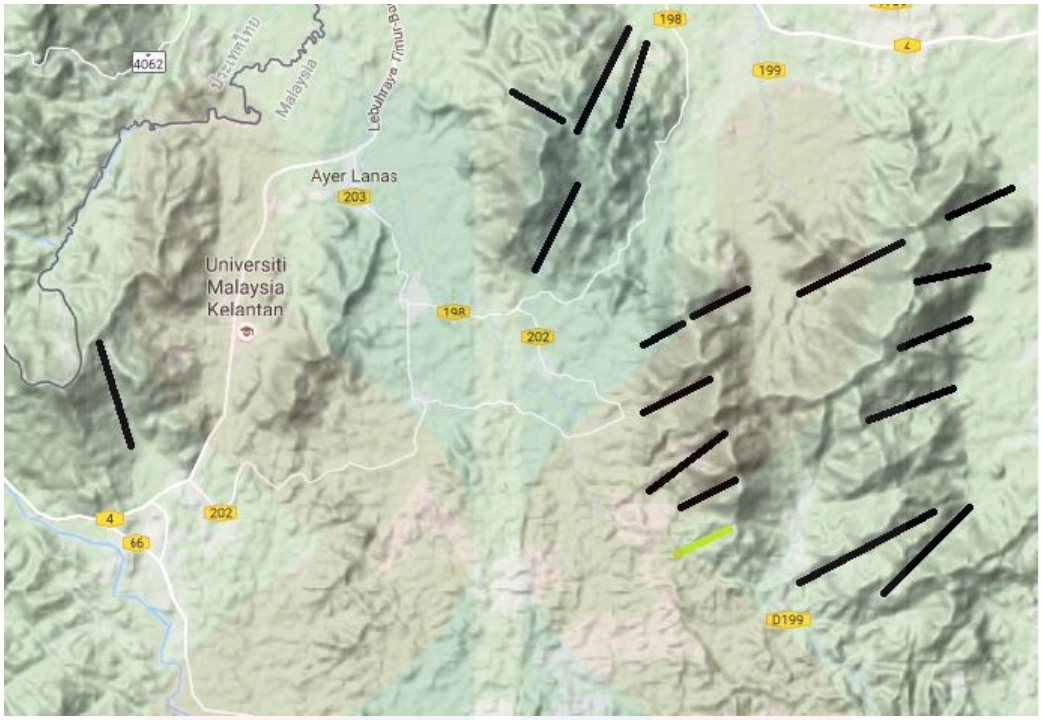


Figure 4.13: Regional lineament map of UMK Jeli Campus and Gemang Area.

4.5.2 Joints Analysis

Joint are one of the fractures within the rock which there has been no appreciable displacement parallel to the fracture and only tiny movement to the fracture plane. Thus the amount and direction of movement of the joint only can be identified when the joint cuts a discrete object such as pebbles or fossil. Joint are most abundant structural element in the crust and its formed before faults. Joint are product of brittle failure and they formed when the tensile strength of stressed rock is exceeded. For the joint analysis in this research are conducted by take 100 strikes reading of

joints. Then this 100 strikes reading are analyze using software to know the direction of the force that acting on the rock.

Based on 2 rose diagram below, Figure 4.14 and Figure 4.16 the direction of the force acting on the rock are from North-West direction. This direction of force acting on the rocks are same for 2 different location of the rock. First location are located at 5˚46’6.13”N 101˚52’32.029”E and second location at 5˚43’55.458”N 101˚50’48.826”E.

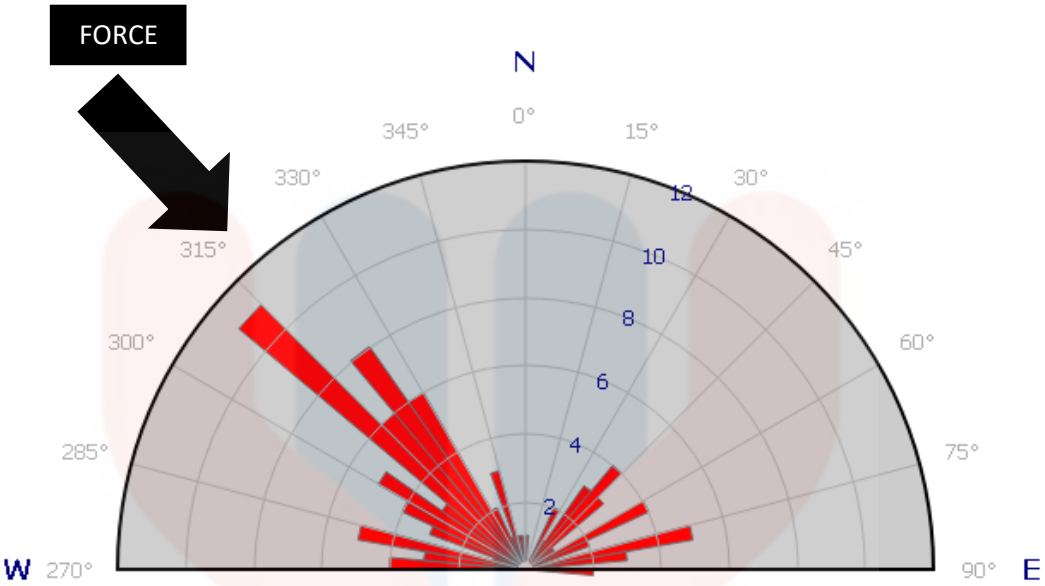


Figure 4.14: Rose diagram A

Table 4.3: Strike Readings A.

137	305	285	314	314	146	320	083	296	131
134	149	281	259	310	115	324	278	309	069
103	080	319	256	344	120	341	271	086	094
131	045	322	255	340	142	331	229	027	316
142	030	326	256	300	147	302	278	317	182
141	039	270	221	246	135	143	312	327	270
144	039	243	271	256	303	131	316	331	053
226	043	242	276	170	101	101	325	134	174
217	113	239	311	156	110	296	295	123	083
209	292	244	313	139	044	084	280	126	238

Figure 4.15: Joints set.

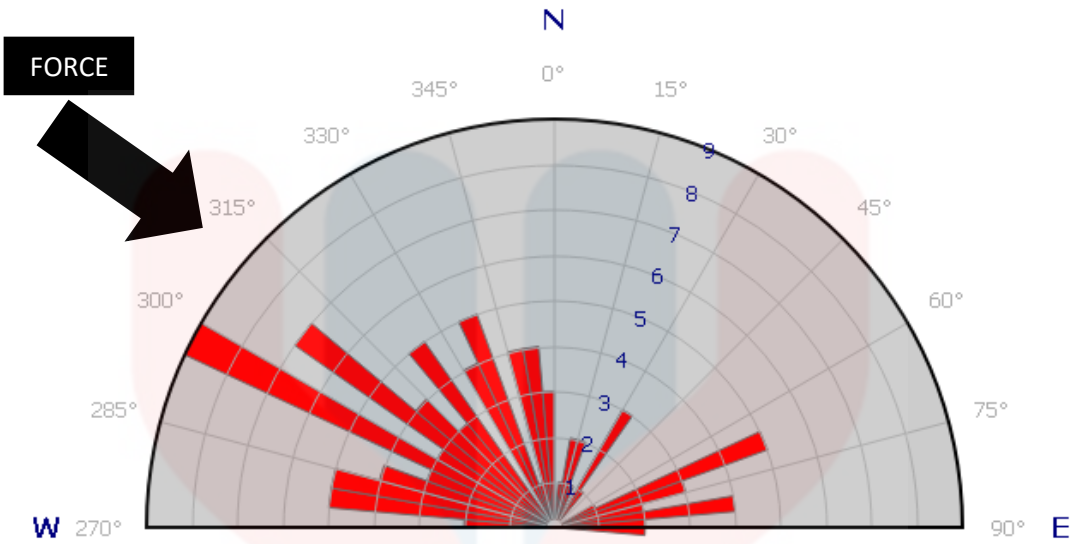


Figure 4.16: Rose diagram B

Table 4.4: Strike Readings B.

296	311	306	261	175	287	248	298	348	337
309	204	331	264	263	287	254	219	351	339
299	212	306	268	194	285	286	339	032	254
306	290	330	246	117	296	298	336	346	249
323	294	283	210	282	299	279	335	332	255
310	272	351	270	270	312	283	334	298	176
307	279	352	271	276	312	009	012	126	121
304	319	347	256	355	199	017	062	121	111
265	324	324	249	345	279	284	354	138	082
315	323	323	251	284	278	341	349	118	127

Figure 4.17: Joints set.

4.6 Historical Geology

The granite existed in this study area was Kemahang Granite because its colour mostly grey with medium to coarse grained. From the result, the granite in this are in Triassic period which was same with Kemahang granite, MacDonald (1976) suggested that the age of this Kemahang Granite is triassic based on age determination. Kemahang Granite in Malaysia covers Bukit Jeli, Bukit Kemahang, Bukit Kusial and several smaller hills which formed N-S trending mountainous area near the central part of the transect area, Jeli town. The study area was located at the Jeli town where the Kemahang granite covered.

4.7 Field Observation and Mapping

The objective of field observation and mapping this research was to obtained data from the field and bring it to the lab for processing. The field observation and mapping for this research was carried by traversing through the whole study area. During this field observation and mapping, sample like outcrops was collected for hand specimen and thin section. Also the strike and its dip reading for structures such as joints was taken to determine the direction of the force that acting on the rock. Other than collected sample and take reading, this field observation and mapping also observed the geomorphology and landforms of the study area and weathering, erosion and deposition that take place in this study area. Photo are taken during observation.

The routes during this field observation and mapping are shown below, Figure 4.18.

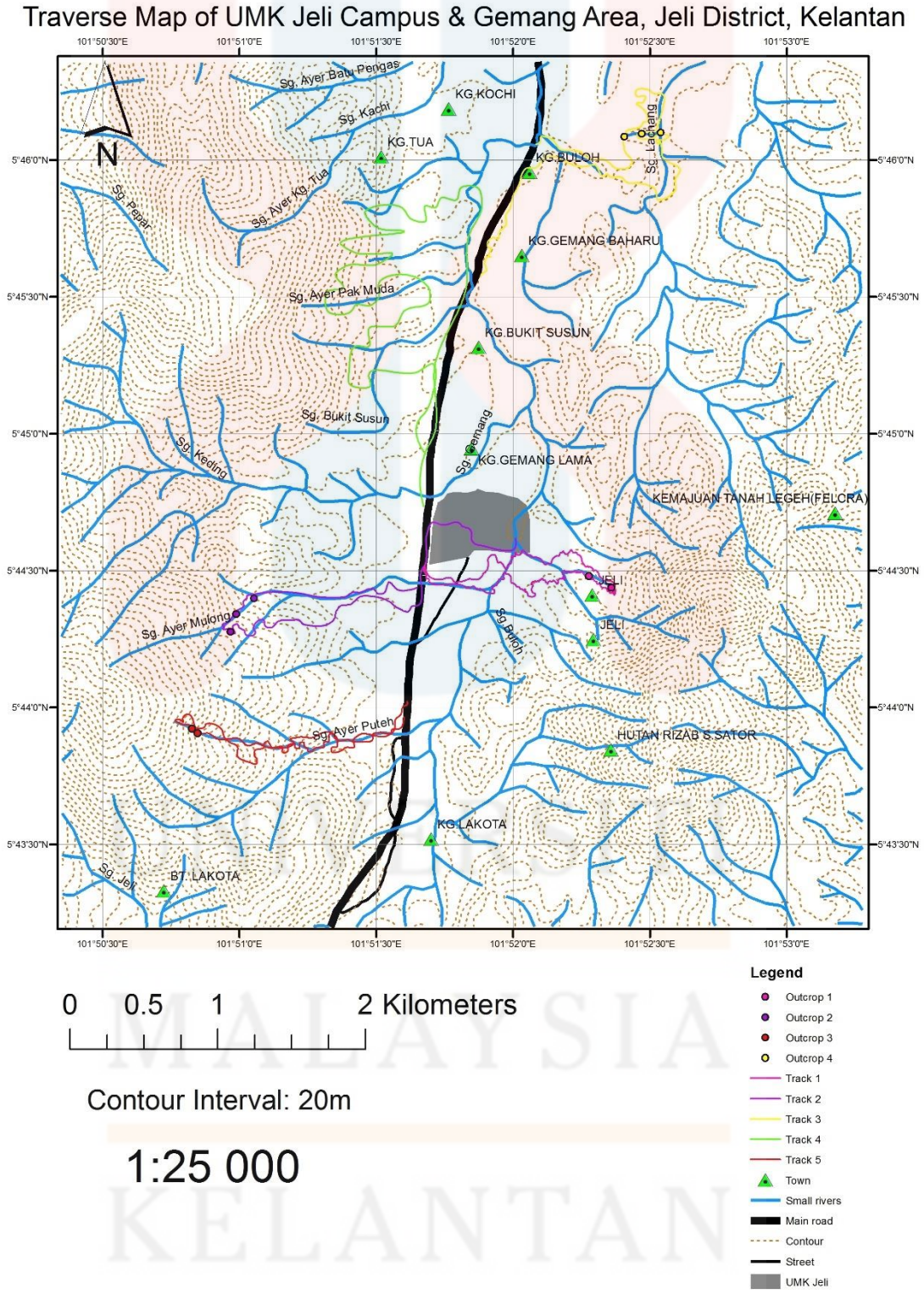


Figure 4.18: Traverse map.

Figure 4.19: Metasediment.

Figure 4.20.

Figure 4.21: Deposited cobbles.

Figure 4.22: Visible mineral.

4.6.1 Lithology

Lithology are the study and description of the physical character: rock type, colour, mineral composition, and grain size. All of this are lithologic characteristic. The lithology for this study area was granite, one of intrusive igneous rock. The granite in this study area was coarse to medium grain. This size of grain due to the slowly cooling magma. Magma that cooling down slowly will have bigger size of mineral grain due to its fullest crystallize. The texture for this granite are phaneritic due to its mineral visible to naked eyes. The colour of this granite are grey due to low iron and magnesium contain. Most the study area covered by granite while the rest was alluvial deposit. This alluvial deposit concentrate at near river bank while the granite covered the hill, foothill and in the river.

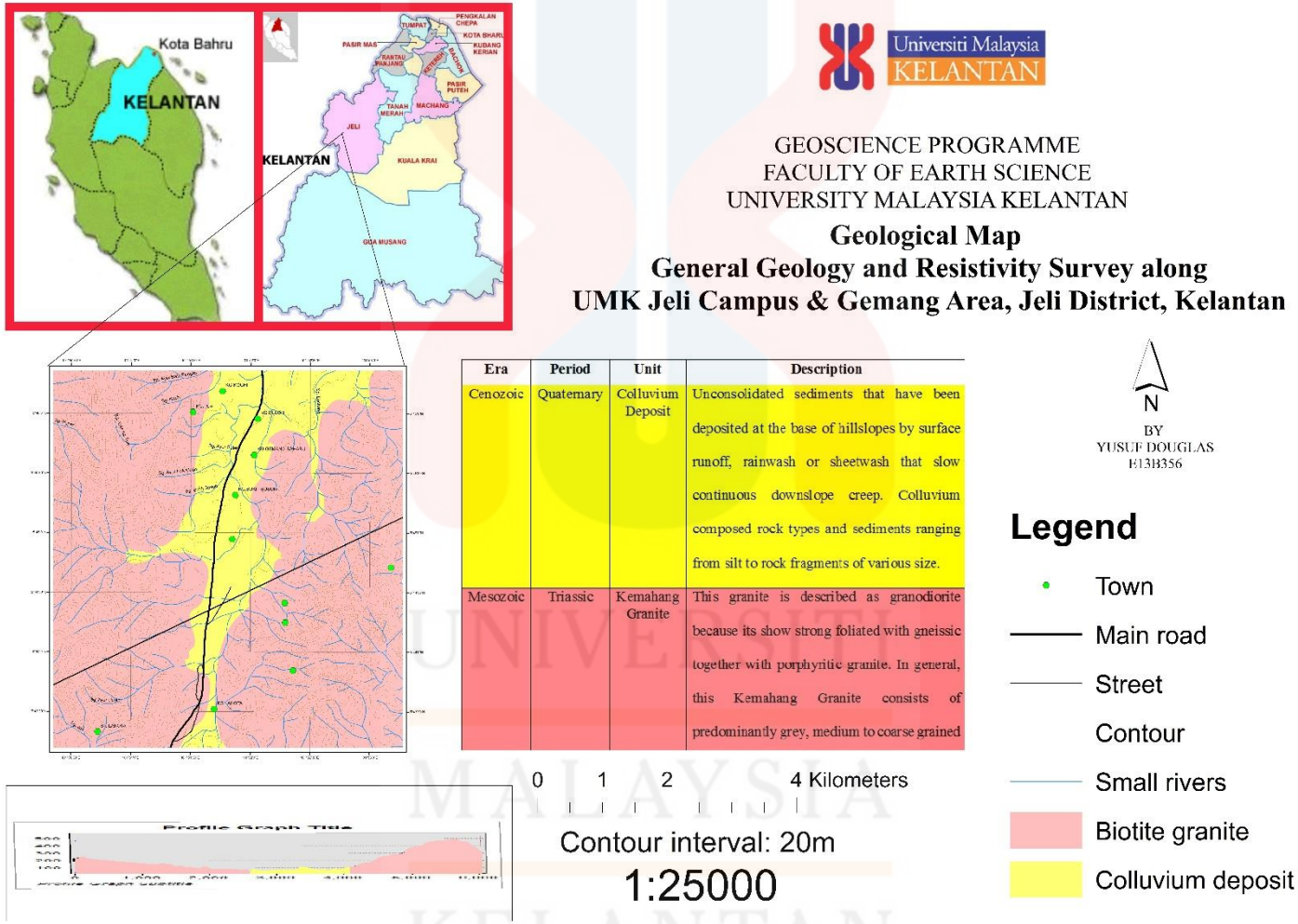

Kota Bahru
KELANTAN
KELANTAN
PENGKALAN CHEPA
KOTA BHARU
KUBANG KERIAN
PASIR MAS
TUMPAT
RANTAU PANJANG
PASIR PUTEH
MACHANG
TANAH MERAH
JELI
KUALA KRAI
GUA MUSANG
GEOSCIENCE PROGRAMME
FACULTY OF EARTH SCIENCE
UNIVERSITY MALAYSIA KELANTAN
Geological Map
General Geology and Resistivity Survey along
UMK Jeli Campus & Gemang Area, Jeli District, Kelantan
Era | Period | Unit | Description
Cenozoic | Quaternary | Colluvium Deposit | Unconsolidated sediments that have been deposited at the base of hillslopes by surface runoff, rainwash or sheetwash that slow continuous downslope creep. Colluvium composed rock types and sediments ranging from silt to rock fragments of various size.
Mesozoic | Triassic | Kemahang Granite | This granite is described as granodiorite because its show strong foliated with gneissic together with porphyritic granite. In general, this Kemahang Granite consists of predominantly grey, medium to coarse grained
N
BY
YUSUF DOUGLAS
E13B356
Legend
Town
Main road
Street
Contour
Small rivers
Biotite granite
Colluvium deposit
0 1 2 4 Kilometers
Contour interval: 20m
1:25000

Figure 4.23

4.6.2 Quartz vein

Quartz vein formed when rocks are fracturing due to hard pressure from the surrounding rocks. This hard pressure exceeding the rock strength causing the rock to lose cohesion along its weakest plane. This fractures later on filled with mineral or mineralization by mineral such as quartz, calcite. In this study area, mostly the fractures are filled by quartz as shown below.

Figure 4.24: Quartz vein 1.

Figure 4.25: Quartz vein 2.

CHAPTER 5

RESISTIVITY SURVEY OF UMK JELI CAMPUS AND GEMANG AREA, JELI DISTRICT, KELANTAN

5.1 Introduction

This chapter discuss the result from the resistivity survey of the study area and the interpretation of its results.

5.2 Location of Horizontal Lines

For this survey only 1 horizontal line managed to be done due to certain problem cannot be avoided. The location for this survey are at Agropark, UMK Jeli Campus. This location was chosen due to its rough topography that maybe have high potential subsurface structure below it.

5.3 Interpretation of Subsurface

The data from the resistivity survey was processing using RES2DINV software. The result from this processing are then interpret by comparing it with previous research at the literature review.

5.3.1 Electrical Resistivity Horizontal Line-1

The location for this Line-1 are at the hill and foothill. There also present small river at this location just below the foothill. The length for this line was 200 meter. Figure below the location of this Line-1.

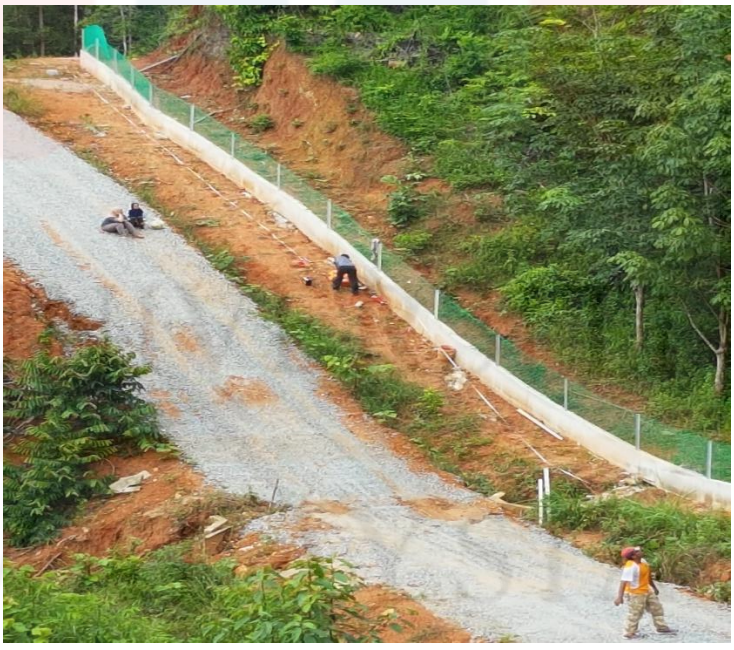
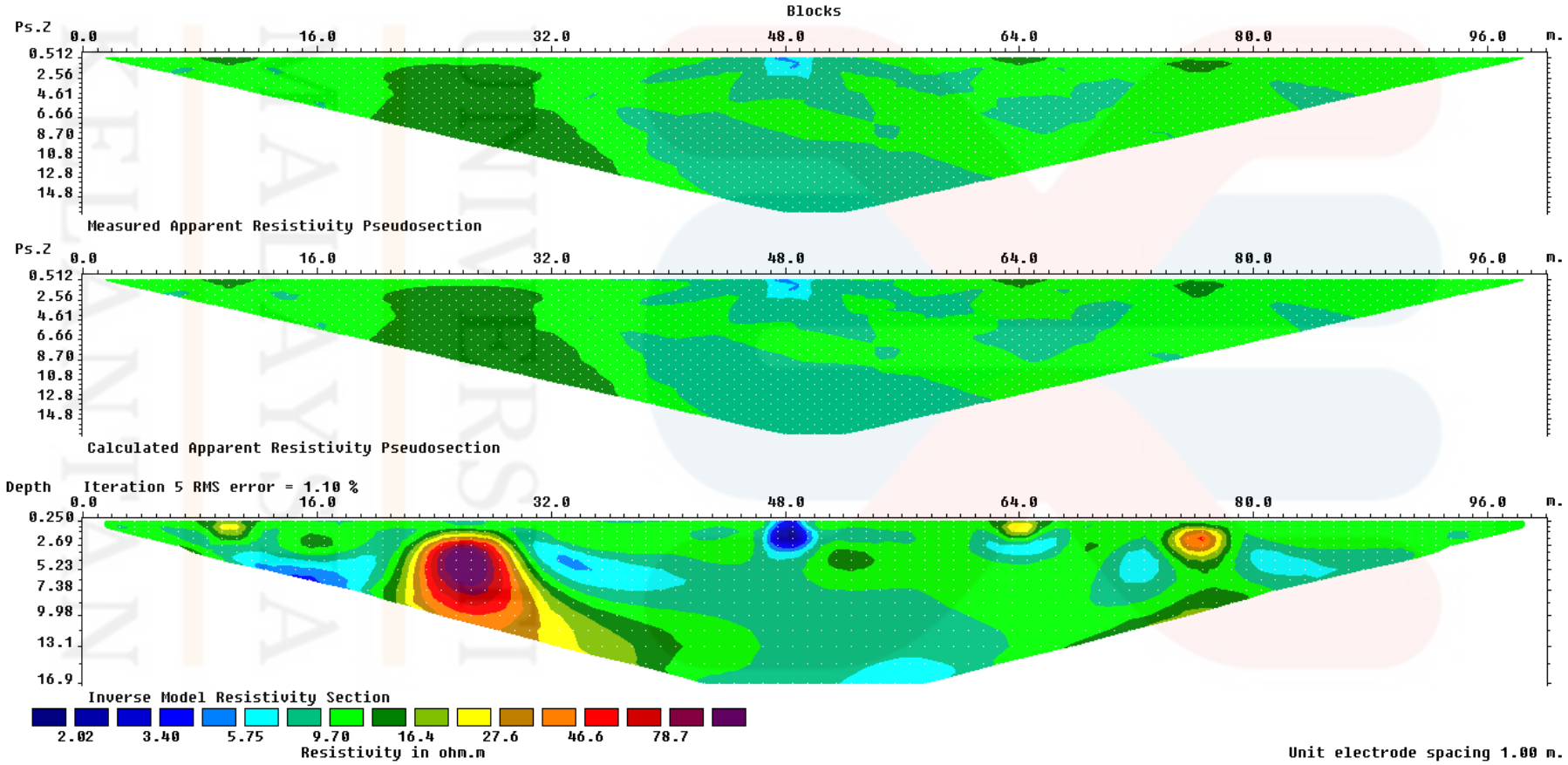


Figure 5.1

Figure 5.2

Figure 5.3

Figure 5.4


Blocks
Ps.Z
0.0
16.0
32.0
48.0
64.0
80.0
96.0
m.
0.512
2.56
4.61
6.66
8.70
10.8
12.8
14.8
Measured Apparent Resistivity Pseudosection
Ps.Z
Calculated Apparent Resistivity Pseudosection
Depth
Iteration 5 RMS error = 1.10 %
0.250
2.69
5.23
7.38
9.98
13.1
16.9
Inverse Model Resistivity Section
2.02
3.40
5.75
9.70
16.4
27.6
46.6
78.7
Resistivity in ohm.m
Unit electrode spacing 1.00 m.

From the result, medium resistivity reading between 9.7 Ω meters to 27.6 Ω meters, green colour to brown colour. Mostly this area was had medium resistivity from upper surface to lower surface. The highest resistivity shown by the red colour and purple colour with reading from 46.6 Ω meters to 78.7 Ω meters. This resistivity was indicated the bedrock that located at depth 0.250 meters to 7.38 meters. Bedrock has high resistivity due its character the disability to conduct electricity. While the blue colour are represent the low resistivity with the reading from 2.02 Ω meters to 5.75 Ω meters. This low resistivity was the small river that present at survey location. Its located at the upper surface of the site.

5.4 Discussion

From the result we can know that medium with high resistivity are not easily conduct electricity while medium with low resistivity are easily to conduct electricity. In the other word, high resistivity has low resistivity. From the result, the high resistivity in this survey was from bedrock, granite. The low resistivity from the result only just a few regions which indicated a small groundwater. While, the medium resistivity indicated soil was covered all the region. For this survey we are focus to low resistivity because subsurface such faults, fractures and void have low resistivity compare to their surrounding resistivity. So basically this study area safe as foundation of building because its subsurface free from structure that can pose constraint to building foundation.

CHAPTER 6

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The objective for this research was to update the geological map of UMK Jeli Campus and Gemang Area, the conclusion after the field observation and mapping the lithology for this study area was Kemahang Granite. Mostly the study area was covered by granite intrusive igneous rock and the rest especially near to river was alluvial deposit. The drainage pattern for the river in this study area was only 2 type, dendritic and parallel. The denudation occurred here from mechanical weathering such as root wedging where the agent of erosion for denudation was fluvial transportation from the rivers. The structure that can be found was joints, fractures and vein. The objective of this research also was to determine subsurface geological structures such as fractures, faults and others for construction purposes and building development. The conclusion from the resistivity survey was this study area mostly have medium resistivity, 9.7 Ω meters to 27.6 Ω. This value indicated the study area contained soil.

6.2 Recommendation

This resistivity survey gave a picture of the subsurface resistivity distribution by convert the resistivity picture into a geological picture, some knowledge of typical resistivity values for different types of subsurface materials and the geology of the area surveyed. This geological picture important to know the subsurface geology for many purposes such as engineering purpose, mining purpose and safety purpose. So this kind of survey very important and its data need to be save.

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