



GENERAL GEOLOGY AND DISTRIBUTION OF METAL DEPOSIT IN STREAM SEDIMENT JELI, KELANTAN

by

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DECLARATION

I declare that this thesis entitled "General Geology and Distribution of Metal Deposit in Stream Sediment Jeli, Kelantan" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature	:
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Date	:

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Telok Bayu, Jeli, Kelantan

ABSTRACT

The study of general geology and distribution of metal deposit in stream was covered 25km per square at Kanpung Telok Bayu, Jeli, Kelantan. General geology covered stratigraphy, geomorphology, structural, and historical and produced geological map scale 1:25 000. The geochemistry method are apllied in this research to find the distribution of element Zinc (Zn), Silver(Ag), Lead(Pb), Copper(Cu) and Gold (Au). The sampling are taken at eight different up stream. The Inductive Couple Plasma (OES) machine are used to analysed the sample. The result of the analysis are present in form of anomalies map by used Arc-GIS 10.3.



Geologi Am dan Taburan endapan besi dalam aliran sedimen di Kampung Telok Bayu, Jeli, Kelantan

ABSTRAK

Kajian geologi umum dan taburan endapan besi dalam aliran sedimen seluas 25km s persegi di Kanpung Teluk Bayu, Jeli, Kelantan. Geologi umum membincangkan stratigrafi, geomorfologi, struktur, dan sejarah dan dihasilkan skala peta geologi 1:25 000. Kaedah geokimia digunakan dalam kajian ini untuk mencari taburan unsur Zink (Zn), Perak (Ag), Plumbum (Pb), Tembaga (Cu) dan Emas (Au). Persampelan diambil di lapan aliran yang berbeza. Mesin Inductive Couple Plasma (OES) digunakan untuk menganalisis aliran sedimen. Hasil analisis dibuat dalam bentuk peta anomali menggunakan Arc-GIS 10.3.



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LIST OF ABBREVIATIONS

GIS	Geographic Information System
OES	Optical Emmission Spectrocopy
Au	Gold
Ag	Silver
Cu	Copper
Pb	Lead
Zn	Zinc





CHAPTER 1

INTRODUCTION

1.1 General Background

Peninsular Malaysia has already known by foreign country as "Golden Peninsular" and Malaysian already got the attention worldwide before other main country that produce gold and precious metal fields such as South Africa, Australian and USSR .The rich of economic mineral in Malaysia also help development of economic Malaysia. In 2009 only, Malaysia has produce 2.79million gram of raw gold. This included Pahang state, Kelantan and Terengganu (Tse, 2009). In additional, Malaysia's gold reserves was estimated 106.000 ton and listed as one of the country that has highest reserved. Malaysian land also rich in precious metal.

Gold can be found mostly in the central belt of Malaysia start from Northern Jeli downward to south of Gunung Ledang, Johor (Mahat et.al, 2013). Meanwhile the west belt is known as tin belt and to east belt is commonly known as tin and gold belt. Gold has been mined mainly in the central part of Malaysia, for example Penjom and Selinsing located in Pahang state and Ulu Sokor in Kelantan.

Geochemical analysis will be applied in this research. This study will focus on specific economic mineral which is gold (Au), lead (Pb), Zinc (Zn), Silver(Ag), and Copper (Cu). The outcome of data analysis will give distribution of anomaly in study area. The idea of this study is to gain more understanding of gold and metal deposit in stream sediment specifically in Kelantan state region.

Through a time, the gold mining industry are well develop with new modern and bigger scale such as open pit gold mined. In Raub, Selinsing, Kerchau-Tui, Pulai, Rubber hill, Buffalo Reef, and Tersang are example of new goldfield (Fig. 1). These all goldfield located at the old alluvial deposit. The central gold belt is a 20km wide and major N-S trend of gold mining area. This is because the area have a large type of hydrothermal fluids deposit in development and occurrence of gold in Central Belt. (Ariffin, 2012). The Penjom gold deposit and Selinsing gold mine are located 20km from central belt. It is also a zone a parallel steeply dipping N-S with several periods of reactivation.

Eventhough, the history of gold mining start to be exploited by other foreign people since Portugese era. There are thousand tonne of gold reserved still not been found. Mining company start to invest in Malaysia for example China company which manage gold mine at Ulu Sukor, Tanah Merah and Australia company manage the Penjom Goldfield, Kuala Lipis. The research hope the mining industry can contribute in Malaysia economy.

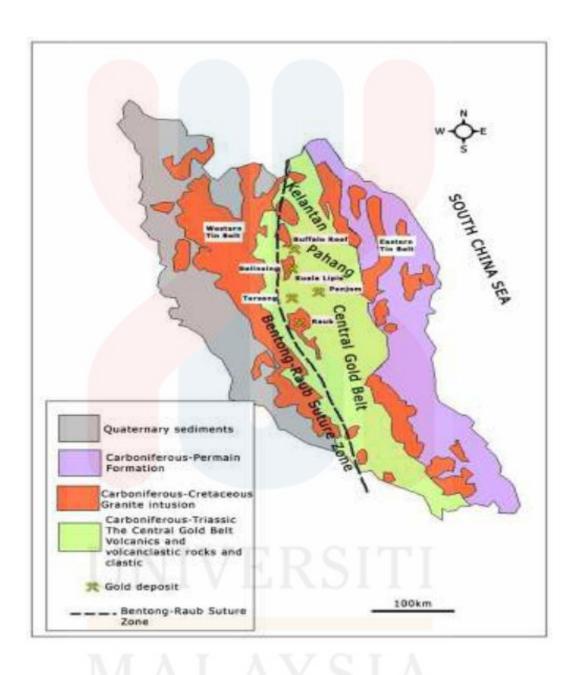


Figure 1.1:Central mineral gold belt of Peninsular Malaysia with major

gold bearing deposits, Makoundi (2012)

1.2 Problems statements

The purpose of this research is to provide geochemical data analysis for metal deposits mineral. Based on previous research, the geochemical analysis has been done but does not have specific mineral. Alternatively, the study to explore, update and enhance geological data information from previous research such as structural analysis, sedimentology, hydrology and stratigraphy.

1.3 Research Objectives

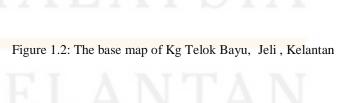
Before a research can be conducted a researcher must have clear objective and understanding the problem from previous research. This will guide a researcher to keep in track before and after during the research in progress.

- 1 To produce a geological map of study area.
- 2. To analyse the distribution of metal deposit in stream sediment of study area.



This research will be conduct in Kg. Baru Telok Bayu, Jeli Kelantan. The research covered 5km×5km per square. From the previous research, The study area are located at west of Gua Setir Yeap (1993) it is known for primary gold prospects The location of study area are near to Kampung Baru Jalan Malaysia and Kampung Telok Bayu. The highest elevetion is 220m and lowest is 80m. In the study area has 4 main rivers which is Sungai Setir, Sungai Belahat, Sungai Maka and Sungai Chalang. The distance from Jeli town to study area approximately 2km.

N 4 101°52'30"E 101°53'0"E 101°53'30"E 101°54'0"E 101°54'30"E 5°41'30"N 5°41'30"N 30 100 ALAN MALAYSI KG BARH \$ 140 140 3.6 5°41'0"N 5°41'0"N 1 B 120 140 160 P. 140 2 14 \$ 90 14 140 120 5°40'30"N 5°40'30"N 10 R 120 S. 8 120 AGITELO 106 5°40'0"N -5°40'0"N Sg.Maka 741 0 5°39'30"N 5°39'30"N 8 80 00 00 -00 2 5°39'0"N 5°39'0"N 100 100 101°52'30"E 101°53'0"E 101°53'30"E 101°54'0"E 101°54'30"E 0 0.5 1 2 Kilometers Legend 1:25,000 Villages Street River Contour



1.4.1 Geography

The geography part basically will cover basic information such as human activities, road, economic of people, building and climate. The researcher will observed the surrounding area of study area.

1.4.2 Demography

In the study area, the population distribution are included Malay, Chinese, India, other Bumiputera, none Malaysian citizen and others. All these made up total 33,186 peoples only. The Jeli district only have 10 small town or village which is Air Lanas, Batu Melintang, Berdang, Bukit Lakota, Gemang, Jeli, Kalai, Kuala Balah, Tunku Abdul Rahman. The total Malay and Bumiputera is 32,126 peoples only. Chinese are 91 peoples. Indians are 58 people. Others are 21 and none citizen890 people

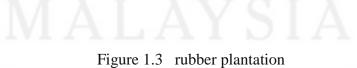
Table 1.1: Total population by ethnic	group, Local authority area and state
---------------------------------------	---------------------------------------

Jajahan/	Jumlah Total	71	Warganegara Malaysia Malaysian citizens					Bukan Warganegara	
Kawasan Pihak Berkuasa		Jumlah	Jumlah Bumiputera			Cina	India	Lain-lain	Malaysia
Tempatan Jajahan/ Local Authority Area		Total	Jumlah Total	Melayu Malay	Bumiputera lain Other Bumiputera	Chinese	Indians Others	Non-Malaysian citizens	
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		/			<u></u>	-	-	-	-
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

1.4.3 Land Use

Land used is define as the human activities or building in order for better life. In study area, almost 80% are used for agriculture activity. Example agricultures is rubber tree plantation, bananas tree plantation and palm plantation.







1.4.4 Road Connection / Accessibility

The study area are located in rural area of Jeli. It's located approximately 7km from main highway of East-West highway .The type of road connection are paved and unpaved road. This the only road that can access to study area.



Figure 1.4: The paved and unpaved road in the study area

Based on observation ,the social in study area is most of villager are farmer. This is because the surrounding area are cover with argriculture activities. The cafe and mini grocery shop are also had in study area.





Figure 1.6 : The small café shop and house in study area

1.4.6 Rainfall

Kelantan has a tropical climate, with temperatures from 21 to 32 °C and intermittent rain throughout the year. The wet season is the east-coast monsoon season from November to March which develops in conjunction with cold air outbreaks from Siberia produce heavy rains which often cause severe floods along the east coast states 8 of Kelantan, Terengganu, Pahang and East Johor in Peninsular Malaysia, and in the state of Sarawak in East Malaysia. During this season, most states experience monthly rainfall minimum (typically 100 - 150 mm). The highest rainfall stated on January 2015 which is last year.

day (year 20)	15) .	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Day (year 2016)	Jan	feb	Mar
	1	0	0	0	0	0	0	0	0	1.5	14.5	0	1.7	1	5.6	0	0
	2	0.5	2	0	0	0	3.5	0	0	0	1	0	2.3	2	2.3	7.2	0
	3	0.5	2.3	0	0	0	0	0	0	0	0	25.9	26.5	3	0.5	13.8	0
	4	0.5	1.7	0	0	0	0	0	0	0	0	0	2	4	1.5	24.8	0
	5	0.4	0	0	0	0	0	0	0	16.5	0	0.5	0.4	5	0	16.9	1
	6	0.1	0	0	0	0	0	0	0	27	8.5	13	7	6	0	10.7	0
	7	46.6	0.2	0	0	0	0	0	0	0.5	0	0.5	6.2	7	0	1.5	0
	8	61.7	0.3	0	0	0	0	0	0	0.5	0	5.3	36	8	0	0.5	0
	9	15.9	2.5	0	0	0	0	0	0	27	19	0.2	1.8	9	0	0	0
	10	5.2	0	0	0	0	10	0	0	0	0	0.4	0	10	0	0.4	0
	11	0.1	0	0	0	0	4	0	0	33	0	11.9	0	11	0	1.1	0
	12	0	0	0	0	0	12.5	0	0	7.5	0	0.7	10.6	12	0	0	0
	13	0	0	0	0	0	0.5	0	0	2.5	13	0	2.4	13	0	1	0
	14	1	0	0	0	0	0	0	0	0.5	0	0	0.5	14	0	0	0
	15	0	0	0	0	0	0	0	0	0	0	0.5	2.5	15	16	0	0
	16	0	0	0	0	0	0	0	0	2.1	0	0.5	0	16	1.5	0	0
	17	0	0	0	0	0	0	0	0	1.4	20.5	7.5	36.3	17	0	0.5	0
	18	0.5	0	0	0	0	0	0	0	0	0.4	0.5	36.7	18	0	5	0
	19	4	0	0	0	0	0	0	0	0	0.1	3.1	0	19	0	24.5	0
	20	0	0	0	0	0	0	0	0	0	0	29.3	0	20	0.5	0	0
	21	0	0	0	0	0	0	0	0	0	0	23.4	0	21	88.5	0	0
	22	0	0	0	0	0	0	0	0	3.5	0	8.8	0	22	0	0	0
	23	0	0	0	0	0	0	0	0	0.5	0	0.5	0	23	0	0	0
	24	0	0	0	0	0	0	0	0	17.5	5.5	2.5	0	24	11.4	0	0
	25	0	0	6.5	0	0	0	0	3.4	64	0	0.5	1	25	25.1	1	0
	26	0	0	1	0	0	0	0	0.1	37.4	0.5	15.2	0.5	26	263.3	2.6	1
	27	0	0	0	0	0	0	0	0.4	25.1	7.4	116.8	26.8	27	45.2	6.3	0.5
	28	0.4	0	4.7	0	0	0	0	4.6	9.5	19.8	45	24.1	28	2.6	7.6	5
	29	4.6	0	0	0	0	0	0	2.6	26	34.4	13.6	1.1	29	0.4	0.5	0
	30	0	0	0	0	0	0	0	0.5	0.5	19.9	28.9	0	30	2.6	0	0
	31	0	0	0	0	0	0	0	0	45	11.5	0	8.1	31	0	0	0
total rainfall		142	9	12.2	0	0	30.5	0	0	44	24	39.4	39.9	21	9.9	73.4	1

 Table 1:2 The rainfall distribution from Jan 2015-March 2016

1.5 Scope of the study

The scope of the study is about Geochemsitry analysis on stream sediment. The study will be used the Atomic Absorption Spectrometry (AAS) and Colorimetry method to analyze the stream sediment. This study also covered other sub-discipline geology such as sedimentology, stratigraphy, structural geology and petrology. The study also concern about gold distribution in the study area.

1.6 Research Importance

The purpose of the study is to provide geochemical data analysis (qualitative) of percentage or anomaly concentration sediment in study area. The data will act as references for other researcher, state government and related party. It is improvidence if we do not exploite our precious economic mineral for sake of our country economic.

1.7 Chapter's Summary

Generally, this study will applied Geochemistry discipline as exploration method. The unique of mineralization in central belt and tropical wheater lead to high whethering process. Thus, the Geochemistry method is recommended method for exploration precious mineral (Flectcher, 1999).Otherwise ,this study also update the change of geographical study area.

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CHAPTER 2

LITERATURE REVIEW

2.1 Regional Geological and Tectonic Setting

Malaysia Peninsular was formed during collision between two plate tectonic. The result of collision had lift up the mountain range in central of Peninsular Malaysia which namely as Titiwangsa range. The east part of Malaysia as Indochina while the west part as Sibumasu. Bentong Raub suture zone is known as the major fault .It divide the peninsular into three belt. The has 15 to 20 km wide zone.It is strike North-South from the Thai border south to Raub, Pahang. According to (Almashoor, 1996) stated that at least 7 tectonic units .It comprise of schist and phyllite sequence , olistostrome and bedded chert with elastic intercalation and a serpentinite lens within the schist.

2.1.1 Structural Geology

The major fault in Peninsular Malaysia is Raub-Bentong suture zone and Lebir fault. These are fault that divide the peninsular into three longitudinal belts or terrane. The Raub-Bentong suture zone is strike N-S from the Thai border south to Raub and SSE into the straits of Malacca off Muar. It has 20km wide zone of deformed rocks. . The formation suture zone is the result of northwards subduction of the Palaeo-Tethys ocean

beneath Indochina in the Late Palaeozoic and the Triassic collision of the Sibumasu terrane with and the underthrusting of Indochina (Metcalfe, 2000).

The Lebir fault is strike NNW-SSE along Lebir river near to Manek Urai in Kelantan. This fault also occur near to granite batholiths east of Lebir river, western part boundary with Gagau formation and eastern part of Koh formation. (Tan, 2009). The fault zone is 10 km wide.Resulted of this fault turn rock into brecciated metasediment, falsered granites and mylonites.There are also formed slickensides on the fault surfaces. (Tan, 2009).

2.1.2 Hydrogeology

Malaysia is a country with humid tropical climate. Therefore, none of drainage system in Peninsular Malaysia has ever dried out. The frequent rainfall season keeps any water basin watered up. In Kelantan, the Sungai Kelantan, is the second longest river in Peninsular Malaysia after Sungai Pahang ,which comprises the entire state of Kelatan .It is flows from eastern flank of the Main Range, to the South China Sea at north. Geologically ,Sungai Kelantan is about 280 km long with the drainage basin of 11,922 km square. It become main river for tributaries in entire Kelantan (Tan, 2009)



2.1.3 Stratigraphy

Stratigraphy is a branch of geology which studies rock layers (strata) and layering. Based on previous research, there are one type of formation in my study area which is Telong formation.

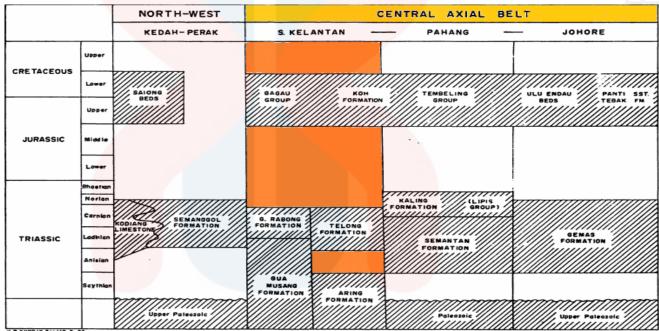


 Table 2.1 : Geological time scale for formation in Kelantan

Source (Peng, 1983)

2.1.3.1 Telong formation

The Telong formation consist of predominantly of argillite associated with tuffs in the Sg. Aring area in south Kelantan. It begin from west of Kelantan extend to south of Gua Musang. The age from Middle to Late Triassic (Peng, 1983). It is unconformable over the Aring Formation to the east and also probably overlain by the Koh Formation to the southeast and southwest. It is interpreted to be more than 1,000 metres thick. The type locality is along Sg. Telong after which the unit is named.

2.2 Gold and Metal Mineralization in Kelantan

Kelantan state is known as one of the state that rich in precious mineral resources such as iron ore, gold , barite, marble, feldspar granite and petroleum in bottom of ocean .It attracted investor around the world to exploited the value of economic mineral. Kelantan state contribute 10% of the annual gold production of Malaysia Gold mineralization in Kelantan mainly distributed in the central part of state, it is bounded by Stong Igneous Complex and Seting Granite on the west, Kemahang Granite in the north and Boundary Range Granite in the east(Fig2.3) (Goh Swee Heng, 2006).The gold mineralized at the rock age Permian-Triassic. Gold mineralization mainly occur in sedimentary-metasedimentary rock.. In Malaysia most of the gold are found on placer deposits.

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Central Gold Belt is located in the north of Jeli downward to south at Mersing .In history of Mining industry stated that many mining located at the centre of central belt example Penjom, Selingsing, Raub and Buffalo reef all in Pahang state and Ulu Sokor in Tanah Merah. The unique of geological feature and process has mineralized many iron ore and gold. In central belt, geologist believe it dominated by gold mineralization (Ariffin, 2012). Thera are three type of gold mineralization in Kelantan which is hydrothermal quartz vein system, skarn and volcanogenic massive sulphide. The main factor of these mineralization is because the principle source rocks. The Permian-Triassic volcanic rocks that associated with sedimentary rock. The heating chamber that induced the hydrothermal fluid is the granitoid bodies that intruded under the volcanic – sedimentary rock Thus, the structure allowing the infiltration and deposition of gold. (Ariffin, 2012)

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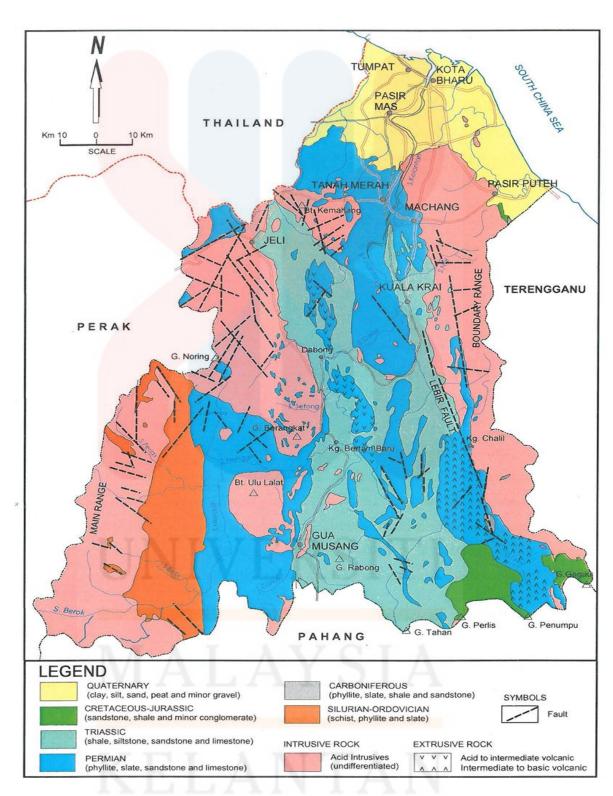


Figure 2.1 : The Geological map of Kelantan State from Department of Minerals and Geoscience Malaysia (2003)

2.3 Stream sediment

Stream sediment is one of exploration technique that are widely used method of mineral exploration in tropical rainforest. The stream sediment is known as the products of weathering and erosion upstream of the sample site and can thus detect anomalous concentrations of metals released from a mineral deposit within the drainage basin. (Flecther, 1999). Stream sediment also represent eroded bedrock that underlies the drainage basin whence the sediment came (Diggles, 1999)

The crucial understanding of stream sediment play important role in choose where to locate and take a sediment sample. There are many potential or strategic location has been recommended by other researcher. The range of sediment are active silt and fine to medium sand that has been transported and in active stream (Flecther, 1999). The factor need to consider before sampling is the catchment scale, bar scale and field sample. At the catchment scale, the enrichment of heavy mineral in stream sediments compared to soils . This is where clay-size particles from newly weathered regolith are rapidly flushed from the streambed by high frequent discharge condition. For bar scale , the heavy mineral element concentration are high on the streambed. The coarser fraction and heavy mineral element will deposit at low density. For the field sample, The heavy mineral element are finer than about 100 μ m and it is less influenced by local hydraulic effects. Thus, it will best represent the catchment and consistent anomalous dispersion trains. The sample can be collected from high or low energy sites.

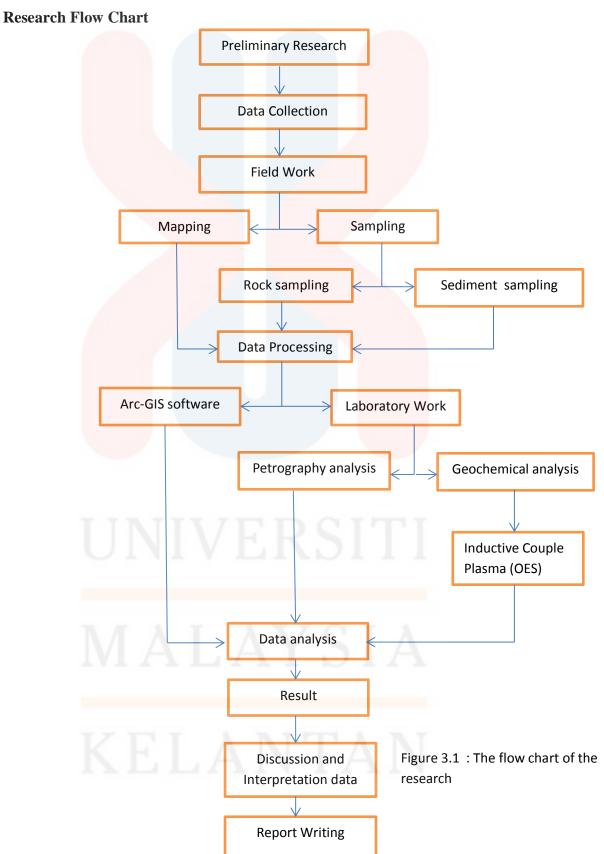
The potential or possible sediment to take is bar head, pools, riffles, below the boulder, between two river and river bed about 5 feet depth Otherwise, the samples are need to take at different stream order. All these factor need to consider because the gold will deposit at the bottom of riverbed. It has highest density which is 19.3 grams per cm3 and is so high relative to that of common minerals such as 2.6 grams per cm3 for quarts and feldspar. The running water will constantly flushed out the lighter mineral and leave behind concentration of gold and other heavier minerals.

CHAPTER 3

MATERIAL AND METHODOLOGIES

3.1 Introduction

This chapter discuss about a material and methodology that will carried out through this study. The list of material and equipment are obtained from laboratory. The methodology consist of preliminary research, data collection, data processing, data analysis and report writing. This chapter will be my guide during this research. The research flow has been planned in order to guide this study.



3.2 Preliminary Researches

The preliminary research stage is an important connection between pre-writing and formulating a thesis for researcher. This stage is characterized by many of the components of the pre-writing stage, such as gathering information from a variety of sources.

3.3 Material and Methods

This chapter discuss about a material and methodology that will carried out through this study. The list of material and equipment are obtained from laboratory .The methodology consist of preliminary research, data collection ,data processing, data analysis and report writing. This chapter will be my guide during this research.

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3.3.1 Base Map

Base map is a map that provide Geologist about the geological data information such as main road, stream ,contour and landform.

3.3.2 Brunton Compas

Brunton Compass is used to help geologist read a base map. It will give direction towards our interest of locality. It also useful in structural analysis for example strike and dip reading.

3.3.3 Geological Hammer

Geological hammer can divide into two type. The pick-end hammer and chiselend hammer. The pick-end hammer has a flat face on one side of the hammer head and a pick-end on the other. It usually very help in cracking rock in half especially for toughest rock like igneous and metamorphic rock. The chisel-end hammer provide striking surface than the pick-end and is suitable for opening up layers of sedimentary rocks.

3.3.4 Sample Bag

Sample bag is used for packaging the sample. It also easy to carry our sample to anywhere without loss original condition of sample.

3.3.5 Hand Lens

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. It magnify a small mineral or rock that cannot be seen with naked eyes

3.3.6 Portable Geography Position System (GPS)

Geography Position System (GPS) is used to trek and mark our sampling or geological feature on a map.

3.3.7 Digital Camera

Camera is used to capture the outcrop or geological feature in order to document and write a report.

3.3.8 Measuring tape

Measuring tape is used to measure the size of outcrop or geological feature.

3.3.9 Paper Mark

Paper mark is used to label the sample. It helps geologist do their work well organized.

3.3.10 Gold Panning

Gold panning is a form of placer mining and traditional mining that extracts gold from a placer deposit using a pan. It is a cheapest find gold.

3.3.11 Polarising microscopy

A thin section is made by grinding down a slice of rock which has been glued to a glass slide until it reaches a thickness of about 0.03mm (30 microns). At this thickness most minerals become more or less transparent and can therefore be studied by a microscope using transmitted light.

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3.3.12 Geological Mapping

The Geological mapping is the basic practical or outdoor work for geologist. A geologist will used all their knowledge in theory will turn in practical way. During geological mapping, a geologist will do collecting data, observed, determine the distribution type of rock and predict the tectonic setting in she study area.

3.3.13 Sediment Sampling

In this study, we focus on stream sediment as our sample. Therefore, before sampling process start the researcher need to plan and locate first on the map where a sample need to take. This technique is recommended by (Ab Halim bin Hamzah, 2003).

Step 1- The sample location need to mark on the map first. Each sample located in between 1.5km2 to 2km2.

Step 2- The sample will take only in 1 to 3 river order. The 4 order river no need to take because high erosion.

Step 3 - Silt sample are taken at the active and high energy river only. Sediment can take by hand or tools that made up of iron. The distance from each sample are 10 m to 30 m along sampling location. Polluted sediment such as wasted from river cliff, road, and factory try to avoided.

Step 4- One sample are collect for each location. The sample weight around 300-400g to get 60g after being filter.

Step 5- The sample are label and bring to laboratory for next procedure.

3.3.14 Rock Sampling

Rock sampling is used for petrographic analysis. The petrographic analysis where Geologist cut the rock into thin section. After that, the thin section will observed and analyse under polarising microscopy .A Geologist can determine precisely by the mineral that made variety of rock.

3.4 Field Studies

The field of this study is Geochemistry. Goldschmidt had stated that the geochemistry is the study of the distribution and amounts of the chemical elements in minerals, rocks, soils, water, and the atmosphere, and the study of the circulation of the elements in nature, on the basis of the properties of their atoms and ions. The professional applied this application of geochemistry to geological, economic, and environmental problems because it is very powerful tool, when properly applied by those trained in the interpretation of analytical results. The geochemical study is one of a method that used for exploration based on chemical properties of a naturally occurring material. The main purpose of geochemical study is to locate of geochemical anomalies or chemical pattern that can trace an occurrence of ore in the vicinity. The anomalies can divide into two. The primary anomalies and secondary anomalies. The primary anomalies due to apparent local variation in the original composition of the earth crust, impregnation of rock by mineralizing fluid and transported volatile element in gases form. While for secondary anomalies formed due to weathering of rock by gravity, moving water and glacial ice (Hawkes, 1957).

3.5 Laboratory Investigations

Data processing is the part where the sample will be undergo processing stage. The process included Arc-GIS software and geochemical analysis which is Colorimetry and Atomic Absorption Spectroscopy (AAS).All the analysis will be doing at University's Malaysia Kelantan laboratory.

3.5.1 Arc-GIS Software

The Arc-GIS software are used for making a base map, geological map ,topography map and 3D topography map and with drainage map a researcher can identify type of drainage pattern. It's help Geologist to construct a new geological map after site investigations and analysis .From the map , a researcher will present the result of the study by produce the map. For geochemistry study, at the end of study the percentage anomalies will present in form of map.

3.5.2 Petrographic analysis

The Petrographic analysis will cover analysis on thin section of rock by using Polarising microscopy. A Geologist can determine and examined the mineral inside of rock.

3.5.3 Geochemical analysis

This research will be using method Inductive Couple Plasma-Emission Optical Spectrocopy. It is one of the most powerful and popular analytical tools for the determination of trace elements in a myriad of sample types such sediment, soil and water (Jones, 2000)



CHAPTER 4

GENERAL GEOLOGY

4.1 Introduction

The general geology provided general information of the study area. In this part, it will cover geological information such as topographic, drainage pattern and weathering process .These part are important for a Geologist before start the main study or do specification. It helps Geologist predict and expect what type of rock, type of landform, type of drainage pattern and tectonic setting of the study area. The topographic, geological information such as contour. What is the highest and lowest elevation on study area Geologist can predict. Other than that, a Geologist can plan where path can walk and help prevent from danger. The drainage pattern, from this data it can tell the weak zone of the area. Generally, stream will formed when there is a weak zone, But sometimes others factor also influenced the formation of stream such as structural geology and different type of rock. Otherwise, the weathering process. There are three type of weathering process which is physical, chemical and biological weathering. The rock that exposed directly by a sunlight or weather has highly weathering occurrence. The physical weathering on rock we can see such as joint and fracture. This happen due to regional deformation. Meanwhile, for chemical basically the surface of rock has changed from original colour to others colour and biological is where the above or on rock a plant or tree has growth within the fracture or joint of rock.

4.2 Geomorphogy

4.2.1 Topographic

The topographic of study area are almost 70% hilly area and 30% flat area. The highest elevation is 220m from sea level and lowest is 80m from sea level. The study area also has steep hill and moderate hill.

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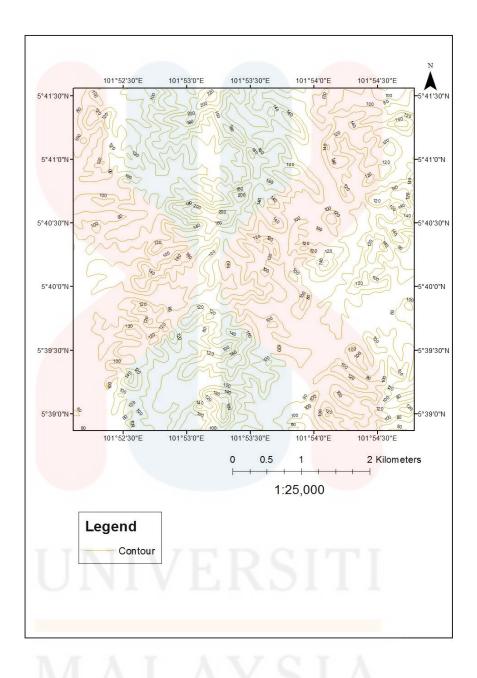


Figure 4.1 : Topography of study area



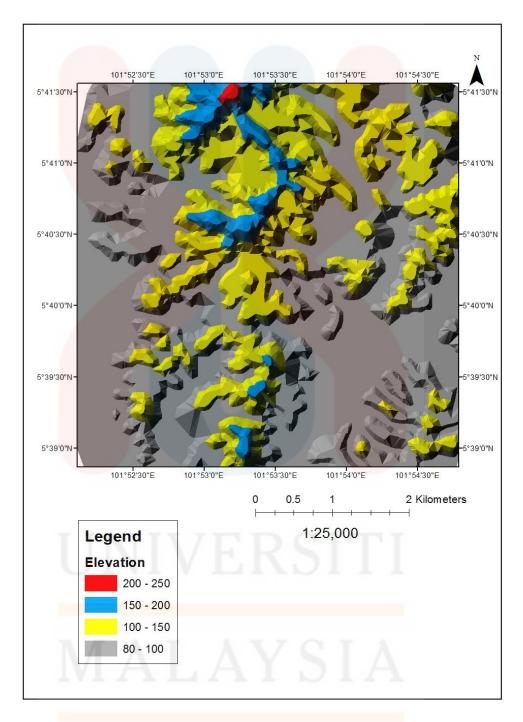


Figure 4.2: The 3D topography of study area.

4.2.2 Drainage System

The drainage pattern is a plan of a river system. The river that has been formed through particular geological process for example erosion, transportation and sedimentation within a period of time. The drainage pattern has varies pattern and it is very complex to determined which one a major river. There are directly or indirectly influenced by several factors such as the initial slopes over which the river flows, the difference in rock hardness, lithological variation, structure of the area such folds, faults, joint lineation and bedding, the recent history of earth movement in the drainage area, the geological and geomorphological history of the area and lastly the climate and rainfall regime of the area. Some of the typical pattern existed is dendritic, parallel, rectangular, trellised, radial and annular pattern. All these pattern was formed by difference geological characteristic. A dendritic pattern, it is most common. This pattern are formed in basin drainage composed of homogeneous rock without control by the underlying geologic structure. A parallel pattern, it was formed in an area where the strata of sedimentary rock decline in the same direction and it channel area formed in the steepest direction. A rectangular pattern, it is formed if structural geology such fault or large joint are developed. A trellised pattern, is formed if the drainage basin composed of alternation of tilted hard and soft strata and it can also be paralled folding. A radial pattern, it appear on newly born volcano or an area composed of domed structure. A annular pattern, it was formed in an area with a dome structure. (Matsuda,

2004)

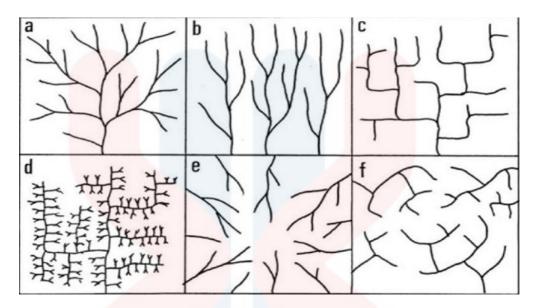
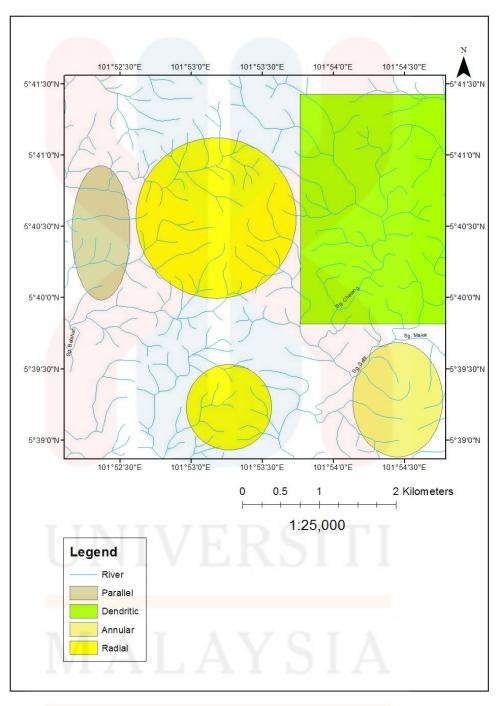


Figure 4.3: The figures show type of Drainage pattern a: dendritic; b: parallel; c:rectangular; d:trellised; e:radial; f:annular

After analysis and observation on drainage map, there are 4 type of drainage pattern can be identified in study area, it is parallel, dendritic, annular and radial drainage pattern. The figure 1.10 show the location of drainage pattern.









4.2.3 Weathering

In the study area, we have find out that fresh outcrop are complicated to search or been found. Most of the outcrop we have found such as marble, granite, quartzite and mudstone are highly weathered. As we aspect from the climate data, it show these area among the highest rainfall in Kelantan particularly. The figure showed a Granite outcrop that has been 90 % fully cover by soil and the tree can well growth at top of the Granite outcrop. It called Biological weathering.



Figured 4.5: The outcrop of Granite are fully covered with vegetation.



For chemical weathering, we have found a outcrop of quartzite that has been highly weathered by iron oxide. The colour of iron in red and orange. Figure 4.6 showed the condition of quartzite and resulted of chemical weathered. For mechanical weathering in study area. The outcrop we have found is Marble and the set of joint. The uniform force has been released on this outcrop.



Figure 4.6 : Iron oxide at quartzite outcrop



Figure 4.7 : set of joint at marble outcrop

4.3 Stratigraphy

4.3.1 Lithostratigraphy

Rocks are often deposited in layers or strata, and the sequence of these strata can be correlated from place to place. These sequences of different rocks are used to establish the changing geological conditions or geological history of the area through time. The description, definition and naming of the rock units is termed lithostratigraphy (rock stratigraphy). The strata can also be described in other ways depending on the types of information availabl, Lithostratigraphy is fundamental to most geological studies. Rock units are described using their gross lithological characteristics and named according to their perceived rank in a formal hierarchy.

In the study area there are 4 type of lithostratigraphy unit(Fig.4.8) that are mappable. These are mudstone unit, reddish mudstone unit, granite unit and alluvium. The mudstone unit are the oldest while alluvium was the youngest unit. Otherwise, for structural there are fault line that has been identified based on topography but the research failed to indentify what type of fault.

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Period	Fo rmation	Rock Unit	Rock Description
Quaternary	Alluvium	Alluvium	Sand, gravel, and clay
Cretaceous	Kemahang granite	Granite	Granite phaneritic
Triassic		Reddish mudstone	Reddish mudstone are
			the major rock unit.
	Telong formation		Claystone and marble
			found as pebble and float
Permian		Mudstone	Mudstone are major
			rock unit. The outcrop
			quartzite are found at
			certain area and shale
			outcrop are covered
			small region.
Carboniferous	Taku schist	Schist	Biotite schist are not
			mapable.

Table 4.1 : The stratigraphic column of study area

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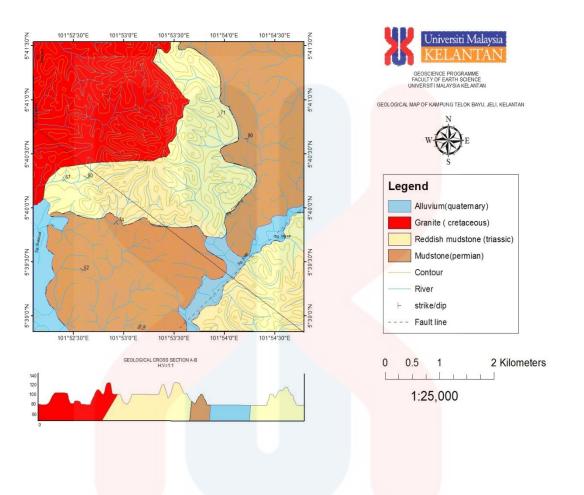


Figure 4.8 : The geological map of study area

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4.3.2 Petrography

Petrography is the study of petrology that observing with the description and systematic classification of rocks (Winter, 2014). This part cover crucial part in determination of rock in terms of stage of crystalline by using cross and polarized plane. From this part, we will gain information that cannot been seen with our naked eyes like true colour, interference colour, shape of grain, pleochroism, cleavage, fracture, twinning and relief. Each of mineral has their owns identification.

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a. Taku Schist

Sample 1 Biotite Schist



Figure 4.9 : The outcrop of biotite schist.

The sample was collected at coordinate 101'52'25.8 E, 5'40'13.4 N elevation 24m. This metamorphic rock consist of Biotite, Mica and Quartz. The Biotite mineral are dominant in this sample. Thus it called Biotite schist. The rock was formed due to regional metamorphism. It occurs over an area of wide extent, affect the rock volume. The large scale tectonic processes such as ocean floor spreading or crustal thickening related to plate collision are example of the regional metamorphism.

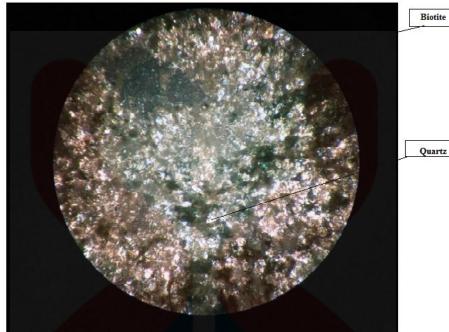




Figure 4.10 : The foliation of Biotite Schist

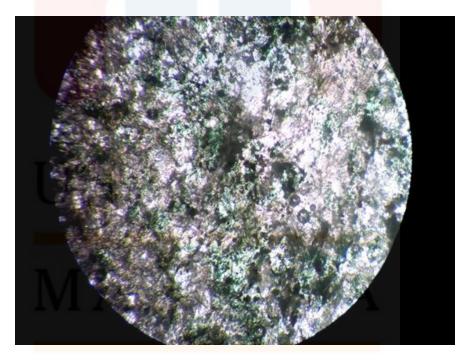
Based on figure4.10 we can see clearly the Biotite and Quartz grains had been metamorph and grain shape had turn form rounder to angular shape.

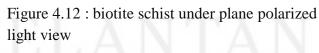




Quartz

Figure 4.11 : biotite schist under crossed polarized view





b. Telong Formation

Sample 2 Marble



Figure 4.13 : The hand sample of marble

The sample was collected at coordinate N 5'40'15.8 E 101'52'32.5 elevation 26m. This marble are colour in milky white with clear crystalline. This type of metamorphic rock was formed due to contact metamorphism. The limestone was intruded by magma and change to marble.



Calcite

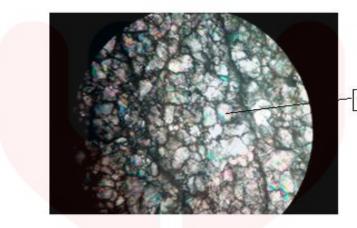


Figure 4.14: Marble under crossed polarised view

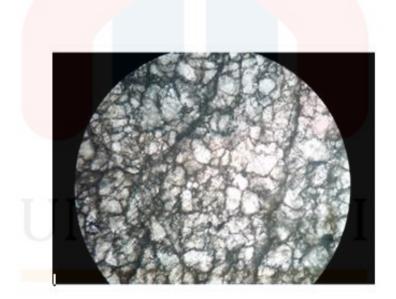


Figure 4.15: Marble under plane polarised view

Based on figure 4.14 showed the mineral calcite under cross polarized view while figure 4.3.4 under plane polarized view can seen the texture of marble which are interlocking anhedral.

Sample 3 Reddish Mudstone



Figure 4.16: Hand sample of reddish mudstone



The sample was found at locality N 5'40'21.7 E 101'52'36.7 elevation 26m. The colour of mudstone are reddish. The size of grain are fine. The chemical weathering that make mudstone colour in red. The formation of mudstone happen in marine sedimentary basin. In early stage, its deposited as soft mud sediment. During lithification process, this soft mud was being force by compaction and de-watering beneath succession of sedimentary rock (R J Merriman, 2013)

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Sample 5 Quartzite



Figure 4.22 Quartzite outcrop



Figure 4.23 Hand sample of quartzite



The sample was collected at coordinates 101'53'38.3 E, 5'40'51.1 N. This type of metamorphic rock are called Quartzite. The colour texture are white with crystal. Quartzite are non-foliated metamorphic rock.



Figure 4.24 iron oxide on quartzite

Some of outcrop has been weathered by iron oxide. Based on figure 4.3. dark spot and reddish colour with shiny crystal.

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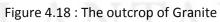
c. Kemahang Granite

Sample 4 Granite



Figure 4.17 Hand sample of Granite





The Granite outcrop was found at coordinate N 05'40'12.9 E 101'52'24.9 and elevation 25m. The basic information about sample. It has texture phaneritic which is coarse grained. The mineral can see clearly with naked eye. It colour in white generally. The minerals consists of quartz, alkali feldspar and biotite only. Based on texture, the sample was categorized as intrusive plutonic and crystallized slowly below the earth surface. The result analysis of Granite thin section by using ternary diagram of plutonic rock showed that the sample was classified as Quartz rich granitoids.

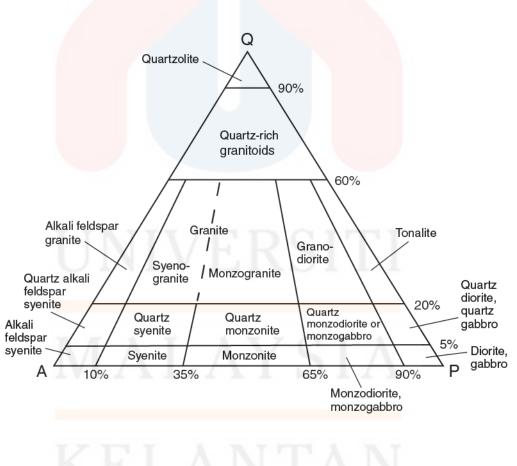


Figure 4.19 Ternary diagram of plutonic rock

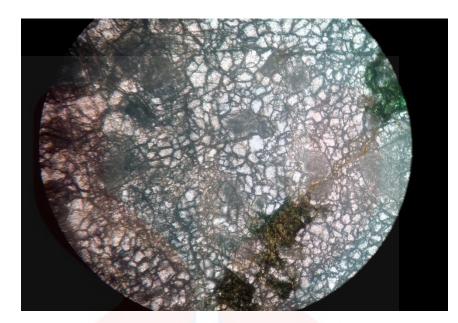


Figure 4.20 Granite under plane polarized light view

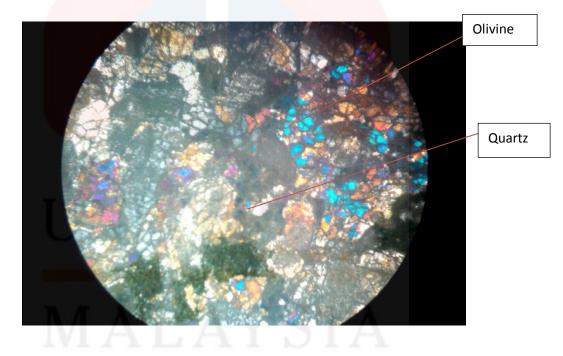


Figure 4.21 : Granite under crossed polarized view



4.4 Structural Geology

4.4.1 Lineament Analysis

A lineament is a linear feature in a landscape which is an expression of an underlying geological structure such as a fault. Typically a lineament will comprise a fault-aligned valley, a series of fault or fold-aligned hills, a straight coastline or indeed a combination of these features. Fracture zones, shear zones and igneous intrusions such as dykes can also give rise to lineaments.

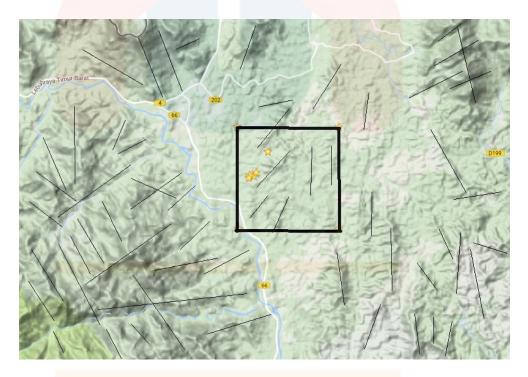
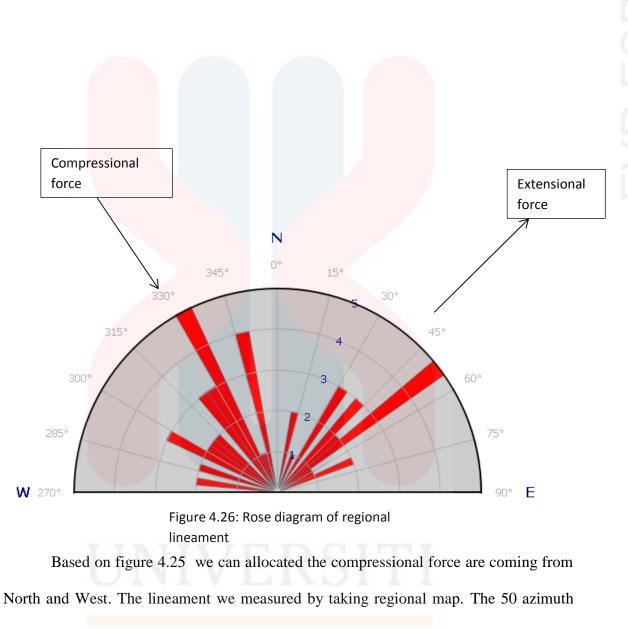


Figure 4.25 Regional lineament of study area



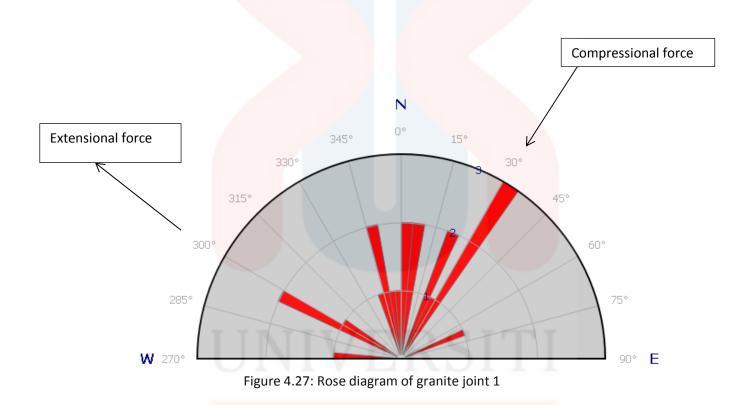
reading was measured their direction.



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4.4.2 Joint Analysis

The objective of joint analysis are to find or allocate where the regional forces comes from. The analysis can be done by take a strike reading on joint. A joint is a fracture without significant relative displacement of the walls, which is a member of a group of fractures spatially extensive in three dimensions generally (Mitcham, 1963)



Based on figure 4.26 the compressional force are coming from North and East direction. The strike reading was taken on Granite joint. The extensional forces are towards West and North direction.



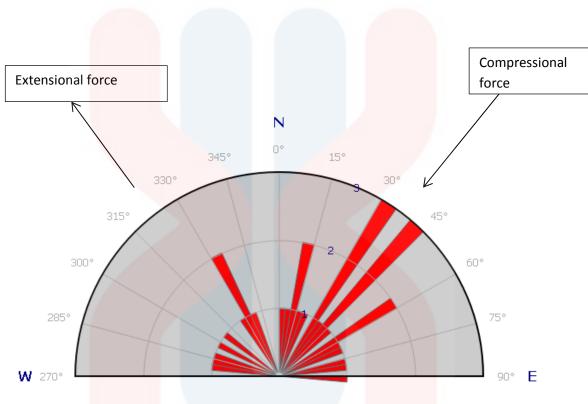


Figure 4.28: Rose diagram of quartzite joint 2

Based on figured 4.5.2 is the strike reading on Quartzite joint. The direction of compressional force are from North and East direction. The extensional force are measured by taking perpendicular of compressional force therefore the extensional force towards West and North.

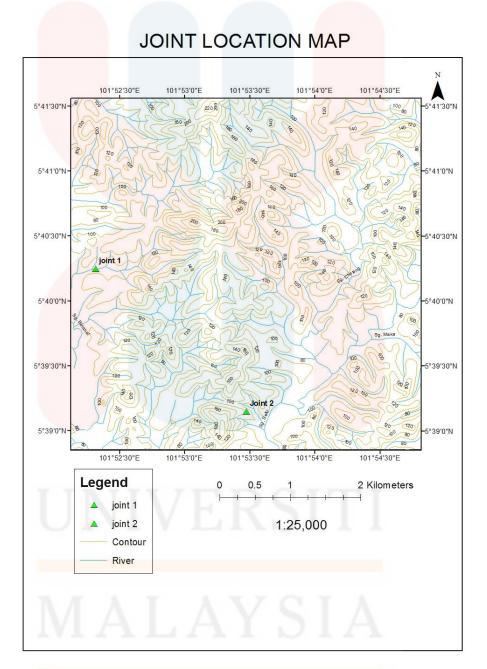


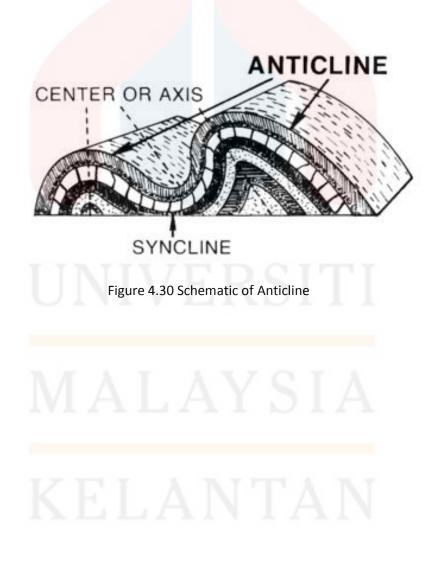
Figure 4.29 Location of map joint

4.4.3 Fault and Fold Analysis

A fault is a planar fracture or discontinuity in a volume of rock, across which there has been significant displacement as a result of rock mass movement. Large faults within the Earth's crust result from the action of plate tectonic forces, with the largest forming the boundaries between the plates, such as subduction zones or transform faults. Energy release associated with rapid movement on active faults is the cause of most earthquakes .A fault plane is the plane that represents the fracture surface of a fault. A fault trace or fault line is the intersection of a fault plane with the ground surface. A fault trace is also the line commonly plotted on geologic maps to represent a fault

A geological fold occurs when one or a stack of originally flat and planar surfaces. such as sedimentary strata, bent or curved are as а result of permanent deformation. Folds are those due to slumping of sedimentary material before it is lithified. Folds in rocks vary in size from microscopic crinkles to mountain-sized folds. They occur singly as isolated folds and in extensive fold trains of different sizes, on a variety of scales. Folds form under varied conditions of stress, hydrostatic pressure, pore pressure, and temperature gradient, as evidenced by their presence in soft sediments, the full spectrum of metamorphic rocks, and even as primary flow structures in some igneous rocks. A set of folds distributed on a regional scale constitutes a fold belt, a common feature of orogenic zones. Folds are commonly formed by shortening of existing layers, but may also be formed as a result of displacement on a non-planar fault.

Based on the basemap of study area, for structure analysis the contour has been analysed there are 2 type of structure existed in study area. The anticline fold and fault. The type of fault cannot been determined. But based on topography and elevation between the formation can clearly distinguish. The anticline fold is known as a ridgeshaped fold of stratified rock in which the strata slope downward from the crest.



4.5 Historical Geology

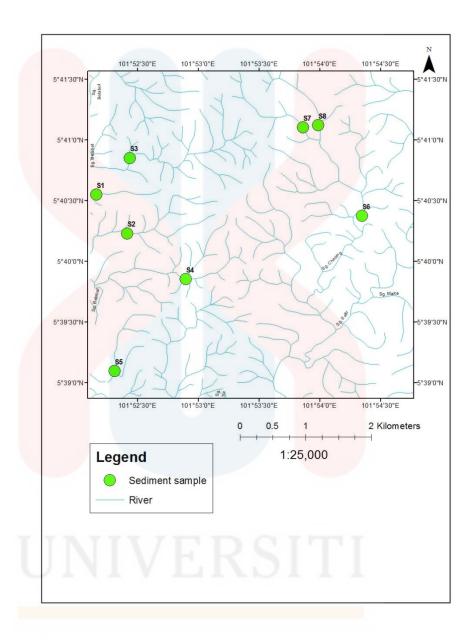
Based on the lithology, the type of rock that dominant in in study area is mudstone. Mudstone are form where environmental conditions in which fine sediment is abundant and water energy is sufficiently. It gives silt to deposited (Boggs, 2006). The depositional environment of mudstone and shale closely related. On other hand, the limestone indicated that environment at that time are shallow marine and rise up during the collision of Sibumasu plate and Indocina plate. After hundred years ago, the magmatic has intruded this sedimentary rock area. The limestone had been contact with magma and changes the mineral in limestone to marble.

Chapter 5

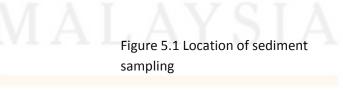
Distribution of metal deposits in stream sediments

5.1 Introduction

The analysis of metal deposits by using Inductive Couple Plasma-OES start with preparation of sample and standard solution. For this analysis, the sediment sample need to prepared in solution. It will explain in part procedure. The raw data has been analysed present in table. The anomalies map will produce. The sediment sample has been collected at eight different up stream. The sample was dug at point bar and river bed.



FYP FSI





5.2 Sampling and Sample preparations

The analytical result of metal deposit from Inductive couple plasma (OES) has been analysed and classified based on parameter given. Each sediment sample were collected from different river. Before the sample going through analysis. The sample sediment need to follow sample preparation procedure in order to produce sample in liquid.

Procedure sample preparation

1- Each sediment left out overnight in oven at 100 Celcius

2- After the sediment completely dried. Filter the sediment into 120 μ m.

3- The sediment was weighed 1.0 g for all the sediment and placed in a 250ml beaker.

4- 10ml of nitric acid (HNO3) was added and been heated on hot plate at 90 Celsius for about15minutes.

5- The sample are allowed to cool and added another 5ml of nitric acid (HNO3). Make sure the sample are not evaporated more than 5ml.

6- The sample was added with 2ml of distilled water and 3ml of 30% Hydrogen Peroxide (H2O2).

7- The sample was added with distilled water until up to 30ml.

8. The sample are poured into the falcon tube 50ml. Centrifuge the sample at speed 2000rpm

9- The sample was filter with No 41 Whatmann filter paper to filter balanced sediment and poured into medium beaker. The distilled water are added up to 80ml.

10- The sample was poured about 5ml into test tube on the ICP-OES machine.

11- The sample start to be analysed.



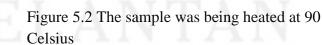




Figure 5.3 The centrifuge



Figure 5.4 The sample was rotated at speed 2000rpm



Figure 5.5 The sample was being filter



Figure 5.6 The icp-oes machine

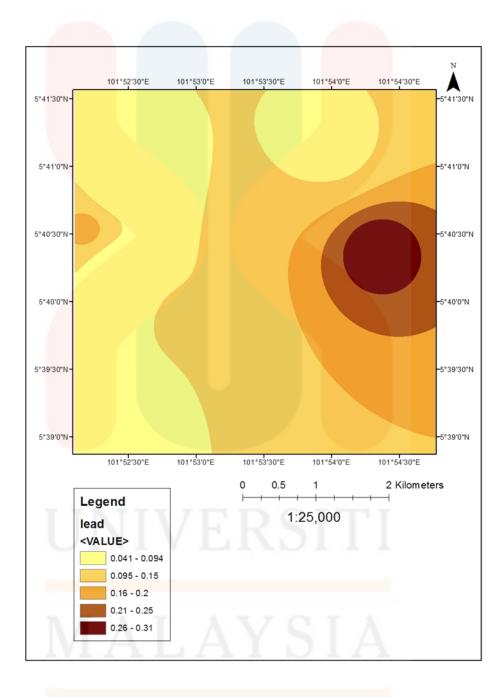
5.3 Distribution of metal deposits

NO.SAMPLE		ELEMENT	in (ppm)		
	Zinc	Lead	Copper	Gold	Silver
1	0.094	0.171	0.056	0.005	0.123
2	-0.012	0.041	0.029	0.001	0.134
3	-0.048	0.047	0.044	0.001	0.136
4	0.117	0.100	0.070	0.004	0.132
5	-0.028	0.063	0.038	0.006	0.116
6	0.075	0.308	0.057	0.002	0.131
7	0.007	0.091	0.039	0.002	0.129
8	-0.055	0.063	0.035	0.002	0.132

Table 5.1 The result of ICP-OES

The distribution of element Lead (Pb) in study area are found in all sediment sample. The highest ppm value are in sample 6 which has 0.308ppm and the lowest ppm value are in sample 2 which has 0.041ppm.The distribution of element Zinc (Zn) in study area are found only in sample 1, sample 4, sample 6 and sample 7. The balanced sample showed negative value. The highest ppm value are sample 4 which has 0.117ppm while the lowest ppm value are sample 7 which has 0.007ppm.The distribution of element Copper (Cu) in study area are found in all sample. The highest ppm value is sample 4 which is 0.070ppm and the lowest sample 2 which has 0.029ppm.The distribution of element Silver (Ag) in study are found in all sample.The highest sample ppm value is sample 3 which is 0.136ppm value and the lowest is sample 5 which has 0.116ppm value. The distribution of element Gold (Au) in study area found in all sample. The highest ppm value is sample 5 which has 0.005ppm and the lowest ppm value are sample 2 and sample 3 which has 0.001ppm value.







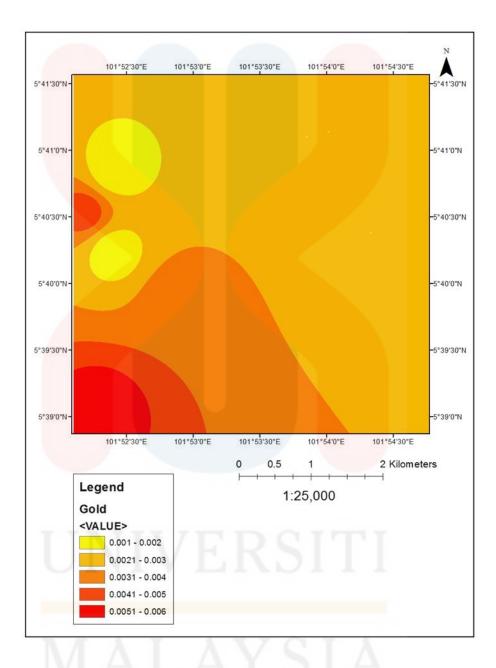


Figure 5.8 Anomalies map of Gold



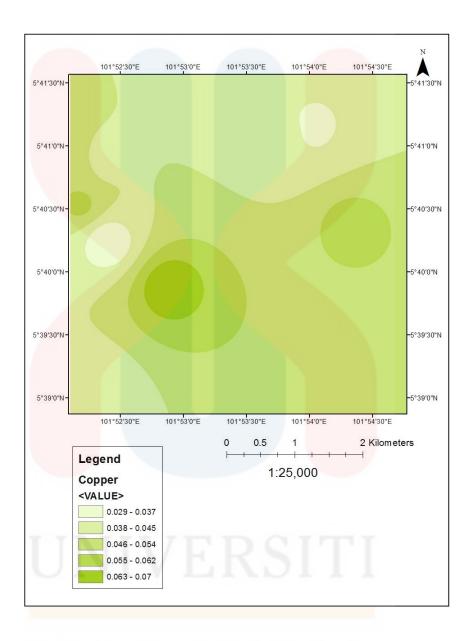


Figure 5.9 Anomlies map of Copper

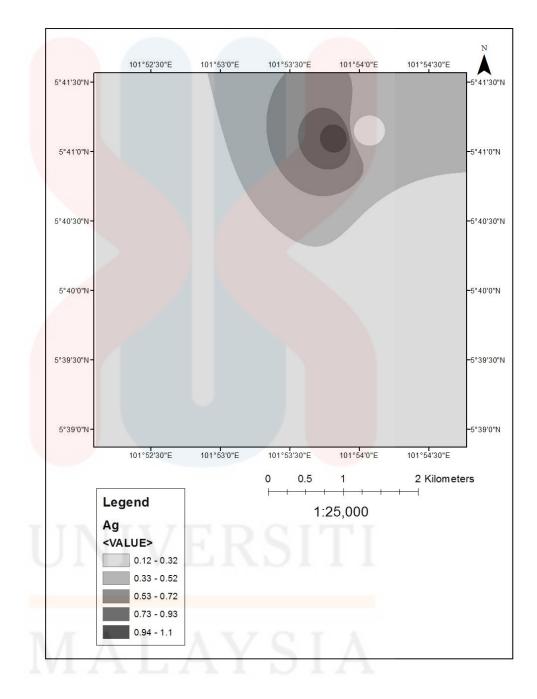


Figure 5.10 Anomalies map of Silver



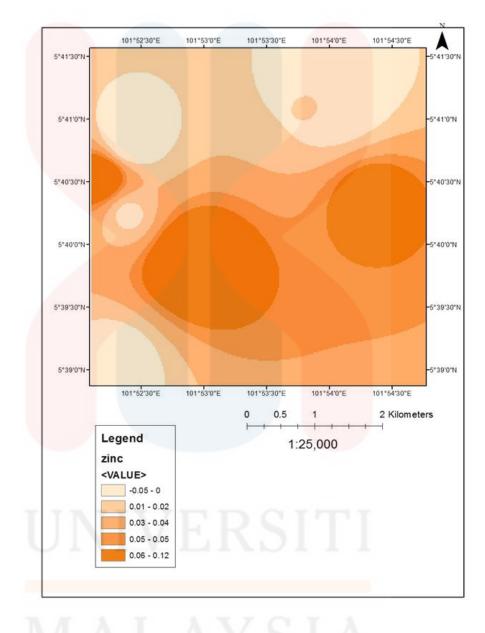


Figure 5.11 Anomalies map of Zinc



Table 5.3	The ore	of geo	logical	setting
			\mathcal{O}	0

	Depth	Temperature (°C)	Occurrence	Metals
Telethermal	Near surface	±100	In sedimentary rocks or lava flows; open fractures, cavities, joints. No replacement phenomena	Pb, Zn, Cd, Ge
Epithermal	Near surface to 1.5 km	50-200	In sedimentary or igneous rocks; often in fault systems; simple veins or pipes and stockworks; little replacement phenomena	Pb, Zn, Au, Ag, Hg, Sb, Cu, Se, Bi, U
Mesothermal	1.2–4.5 km	200–300	Generally in or near intrusive igneous rocks; associated with regional faults; extensive replacement deposits or fracture fillings; tabular bodies, stockworks, pipes	Au, Ag, Cu, As, Pb, Zn, Ni, Co, W, Mo, U etc.
Hypothermal	3–15 km	300-600	In or near deep-seated felsic plutonic rocks in deeply eroded areas. Fracture-filling and replacement bodies; tabular or irregular shapes	Au, Sn, Mo, W, Cu, Pb, Zn, As

Source : (N. Arndt , 2015).

The result of anomalies map of each element had showed different style. There are many kind of geological setting theory from other research . One of the opinion, has stated that classifications of ore deposited were based on the types of rocks that host the ore deposits or on the geological context such as the geometry of the deposit and its relation to its host rocks. (N. Arndt , 2015). Based on figure 5.2.3 showed that ore deposited will be determined by depth and temperature. The depth can be differentiation into 4 level which is near surface, near surface to 1.5km, 1.2-4.5km and 3-15km. The

temperature are directly proportional to a depth. Therefore, in study area can possibly classify as near surface and near surface deposited which called as Telethermal and Epithermal.The Telethermal deposited introduced by American geologist it is hydrothermal mineral deposited formed as a result of the precipitation of a mineral mass from hot mineralization soloution flowing at shallow depth below earth's surface and having temperature of 50-200 Celcius.There we usually sheetlike.

Based on the result and relationship of geological map. In study area. skarn deposits are posibble main type of deposited. Skarn deposits are one important sources of base and precious metals (Hammarstrom, 1991) In general Skarns are coarse-grained metamorphic rocks composed of calcium, iron, magnesium, manganese, aluminum silicate that form by replacement of carbonate-bearing rocks during contact or regional metamorphism and metasomatism. It related to magmatic hydrothermal activity, granitoid plutons in orogenic tectonic setting. Eventhough limestone outcrop was not found but the float or outcrop of marble was found in study area. Thus, the limestone outcrop could buried depth in earth's crust and contact with magma.



Chapter 6

Conclusion and Suggestion

6.1 Conclusion

In conclusion, The objective of this research are to determine the distribution of metal deposits are accomplished. Based on the result and analysis that has been done,, the research can give possibility geological setting of ore deposited are skarn deposits.

6.2 Recommendation

In order to get precisely geological data of that area. This research suggest for to do a research in field such as geophysic analysis, structural analysis and sedimentology analysis. This is because the area of study has lot of sedimentary and metamorphic rock that has almost 90 degree dip direction. Otherwise for structure analysis, based on map we can see fault line but this research failed to obtained structure data due to problems that cannot avoided.

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APPENDIX

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1	Pb 220.393	1/86-9	3596.	r [0.		18:24:49	
1	Au 267.505 Cu 327.393	-847.0	-847.1	B 10.	001 mg/L	18:25:20 18:23:41	
2	Zm 204.200	-100.5	-100.	5 10	001 mg/L	18-22:22	
2	Ph 220.353	1695-3	1695. 3687	10	001 mg/L	18:25:00	
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3	Ph 220.353	1740.4	1740.	4 [0	.00] mg/L	18:25:09	
3	An 267.595	3696.9	3696.	9 10	.001 mg/L	18:25:37	
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1	Sn 206.	700	1165471.4	1165512.4	161		35:35:04	
1	Pb 220.	353	266401.7	264660.3 6788.6	161 (6)	31108	18:35:18	
1	An 267.	595	the second second second second	and the second sec	10.061	mm/L	18:35:38	
1	An 267. Cu 327. Sn 206.	363	3980424.0	3981354.7	[6]	sig/L	18:36:06	
22	Sn 206. Pb 220.	200	1178301.1	1172022-1	101	ng/L	18:35:09	
2	P0 220. Au 267.	505	266184.6 10411.8	8751.5	[0.06]	mg/G	18:35:25 18:35:48	
20	Cu 327.	393	4001160.9	4002091.5	161	sig/L	18:35:46	
	Sn 206.			1102928.2	101	ng/1	10:35:12	
2	Fb 220.	353	267752.7	266011.3	(6)	mg/L	10:35:31	
3	Au 207.		10378.8	6718.4	10.061	mg/1.	18:35:56	
3.5	Cu 327.	393	3881721.0	3982651.7	163	ng71	18:36:15	
		10	Maan Corrected			Cali		
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1 1	in 206.200		1978337.1	1976378	.1	1017	ng/L ng/L	18:42:5		
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angla 1	m: Calib	Std	5		Date	Collect	Location: ted: 11/10	/2016 6	:40:39 PM /19/2016 9:41:	03 AM
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			349219.1	1323.25	0.38%		[8] mg/L			
-				8td.Dev. 1893.20			01 mg/L			
			an Corrected			-				

MALAYSIA

Date: 11/19/2016 10:17:27 AM 5 Page dawi umk Autosampler Location: 26 Date Collected: 11/19/2016 9:47:33 AM Tuence No.: 1 Data Type: Reprocessed on 11/19/2016 9:53:08 AM mple ID: 1 Analyst: Logged In Analyst (Original) : Optima 2100DV Initial Sample Vol: Initial Sample Wt: Sample Prep Vol: Dilution: Nebulizer Parameters: 1 Flow Back Pressure Analyte 0.80 L/min 109.0 kPa A11 Analysis Replicate Data: 1 Net Corrected Calib. Sample Conc. Units Time Intensity Intensity 11210.4 11251.4 Conc. Units 09:48:47 Repl# Analyte 11251.4 8708.1 0.094 mg/L 0.094 mg/L Zn 206.200 09:49:19 0.172 mg/L 0.172 mg/L 10449.5 Pb 220.353 Au 267.595 09:49:55 0.005 mg/L 551.2 0.005 mg/L 4211.6 09:50:24 0.056 mg/L 0.094 mg/L 0.056 mg/L 33658.4 Cu 327.393 09:48:58 0.094 mg/L 11284.9 11325.8 2 Zn 206.200 0.170 mg/L 09:49:31 8625.5 0.170 mg/L 10366.9 09:50:05 Pb 220.353 2 0.006 mg/L 0.006 mg/L 0.055 mg/L 648.2 4308.5 Au 267.595 09:50:29 0.055 mg/L 32837.4 31906.6 Cu 327.393 0.094 mg/L 09:49:07 0.094 mg/L 11217.2 Zn 206.200 0.170 mg/L 09:49:42 3 0.170 mg/L 0.003 mg/L 8599.2 Pb 220.353 10340.5 09:50:13 0.003 mg/L 3 4095.7 435.3 Au 267.595 09:50:33 0.057 mg/L 0.057 mg/L 34214.2 33283.5 3 Cu 327.393 Mean Data: 1 Sample Calib. Mean Corrected RSD Conc. Units Std.Dev. Std.Dev. Conc. Units Intensity 0.0002 0.22% 0.094 mg/L 0.171 mg/L 0.005 mg/L Analyte 0.0002 0.094 mg/L Zn 206.200 11278.5 0.0013 0.76% 0.171 mg/L 0.005 mg/L 8644.3 0.0011 23.31% Pb 220.353 0.0011 544.9 0.0010 1.85% Au 267.595 0.056 mg/L 0.0010 0.056 mg/L 33570.0 , Cu 327.393 Reprocessing Begun Technique: ICP Continuous Logged In Analyst: Optima 2100DV Results Data Set (original): dawi_umk Results Library (original): C:\pe\Optima 2100DV\Results\Results.mdb Results Data Set (reprocessed): Results Library (reprocessed) : Autosampler Location: 27 Date Collected: 11/19/2016 9:51:18 AM Sequence No.: 1 Data Type: Reprocessed on 11/19/2016 9:55:48 AM Sample ID: 2 Analyst: Logged In Analyst (Original) : Optima 2100DV Initial Sample Vol: Initial Sample Wt: Sample Prep Vol: Dilution: Nebulizer Parameters: 2 Analyte Back Pressure All 109.0 kPa Flow 0.80 L/min A11 Replicate Data: 2 Sample Analysis Calib. Corrected Conc. Units -0.012 mg/L 0.040 mg/L Net Time Intensity Conc. Units -0.012 mg/L -9788.6 4670 Intensity 09:52:29 Repl# Analyte 1 Zn 206.200 1 Pb 220.353 -9747.7 2937.9 0.040 mg/L 09:53:03

d: dawi umk		Pag	ge 6		/19/2016 10:	
Au 267.595	3818.9	158.5	0.001 mg/L	0.001 π		53:38
_ Cu 327.393	14337.8	15268.5	0.029 mg/L	0.029 m -0.012 m		54:07 52:40
2 Zn 206.200		-9801.3		0.043 n		53:15
2 Pb 220.353	4835.6	3094.2	0.043 mg/L 0.002 mg/L			53:48
2 Au 267.595	3955.5	295.1	0.031 mg/L	0.031 m		54:12
2 Cu 327.393	15936.3 -9816.7	16867.0 -9775.8	-0.012 mg/L	-0.012 r		52:51
3 Zn 206.200	4656.8			0.039 r	3.	53:26
3 Pb 220.353 3 Au 267.595	3909.5	249.2	0.002 mg/L	0.002 r		53:57
3 Cu 327.393	14094.6	15025.3	0.028 mg/L	0.028 r	mg/L 09:	54:16
ean Data: 2				Sample		
	an Corrected Intensity	Calib. Conc. Units	Dea.Der.	Conc. Units	Std.Dev. 0.0001	RSD 1.10%
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o 220.353		0.041 mg/L		0.001 mg/L	0.0007 4	
u 267.595	234.3		0.0015	0.029 mg/L	0.0015	5.11%
1 327.393		0.029 mg/L	0.0013			
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EYP FSB

Date: 11/19/2016 10:17:27 AM Page 7 dawi umk Autosampler Location: 29 Date Collected: 11/19/2016 9:58:47 AM guence No.: 2 Data Type: Reprocessed on 11/19/2016 10:13:44 AM ample ID: 4 Analyst: Logged In Analyst (Original) : Optima 2100DV Initial Sample Vol: Initial Sample Wt: Sample Prep Vol: Dilution: Nebulizer Parameters: 4 Back Pressure Flow Analyte 0.80 L/min 110.0 kPa A11 Replicate Data: 4 Analysis Sample Calib. Corrected Net Conc. Units Time 09:59:58 Conc. Units Intensity Intensity 16002.1 Repl# Analyte 1 Zn 206.200 1 Pb 220.353 0.118 mg/L 0.118 mg/L 0.099 mg/L 15961.1 7242.0 10:00:27 0.099 mg/L 5500.7 0.003 mg/L 10:00:58 0.003 mg/L 4095.5 435.2 Au 267.595 10:01:32 0.070 mg/L 0.070 mg/L 0.116 mg/L 42464.2 41533.5 10:00:08 Cu 327.393 1 0.116 mg/L 15741.0 15700.0 10:00:37 Zn 206.200 0.102 mg/L 2 0.102 mg/L 5663.3 530.7 7404.7 10:01:10 Pb 220.353 0.004 mg/L 2 0.004 mg/L 4191.0 10:01:38 0.071 mg/L 0.117 mg/L Au 267.595 2 43190.5 0.071 mg/L Cu 327.393 42259.8 10:00:16 2 0.117 mg/L 15906.8 15865.8 Zn 206.200 0.098 mg/L 10:00:47 3 0.098 mg/L 7203.2 5461.9 10:01:20 Pb 220.353 0.004 mg/L 482.0 0.004 mg/L 4142.3 Au 267.595 10:01:43 3 0.070 mg/L 0.070 mg/L 42620.6 Cu 327.393 41689.9 3 Mean Data: 4 Sample Calib. Mean Corrected Std.Dev. RSD Conc. Units Std.Dev. 0.0007 0.57% 0.0024 2.46% Conc. Units 0.117 mg/L Intensity 0.117 mg/L Analyte 0.0007 15883.3 5541.9 Zn 206.200 Pb 220.353 0.100 mg/L 0.100 mg/L 0.0005 12.09% 0.004 mg/L 0.0005 482.6 0.004 mg/L 0.82% Au 267.595 0.070 mg/L 0.0006 0.0006 0.070 mg/L 42758.5 Cu 327.393 Autosampler Location: 30 Date Collected: 11/19/2016 10:02:28 AM Sequence No.: 3 Data Type: Reprocessed on 11/19/2016 10:13:44 AM Sample ID: 5 Analyst: Logged In Analyst (Original) : Optima 2100DV Initial Sample Vol: Initial Sample Wt: Sample Prep Vol: Dilution: Nebulizer Parameters: 5 Flow Back Pressure Analyte 0.80 L/min 110.0 kPa All Sample Calib. Analysis Replicate Data: 5 Corrected Net Time 10:03:40 Conc. Units Conc. Units Intensity -12845.8 3943.4 **Intensity** -12886.7 -0.028 mg/L -0.028 mg/L 0.063 mg/L Repl# Analyte 10:04:11 Zn 206.200 0.063 mg/L 5684.7 10:04:51 0.005 mg/L Pb 220.353 0.005 mg/L 590.4 4250.7 0.038 mg/L 10:05:23 Au 267.595 0.038 mg/L 1 20151.7 21082.4 10:03:51 Cu 327.393 -0.028 mg/L -0.028 mg/L -12854.4 -12813.5 10:04:25 0.063 mg/L 0.006 mg/L 2 Zn 206.200 0.063 mg/L 3962.6 5704.0 10:05:02 Pb 220.353 2 0.006 mg/L 717.7 4378.1 10:05:29 Au 267.595 0.038 mg/L 2 0.038 mg/L 21394.6 Cu 327.393 20463.9 10:04:00 -0.028 mg/L 2 -0.028 mg/L Cu 327.393 Zn 206.200 -12870.5 -12911.5 10:04:37 3 0.064 mg/L 0.064 mg/L 5733.2 3991.9 Pb 220.353 3

Date: 11/19/2016 10:17:27 AM 8 Page dawi umk 0.006 mg/L 10:05:12 0.006 mg/L 663.0 4323.3 10:05:33 0.039 mg/L Au 267.595 0.039 mg/L 22260.3 21329.6 Cu 327.393 Mean Data: 5 Sample Calib. Mean Corrected RSD Conc. Units Std. Dev. Std.Dev. Conc. Units -0.028 mg/L 0.0001 0.52% Intensity -0.028 mg/L 0.063 mg/L 0.006 mg/L 0.0001 0.0006 Analyte 0.0006 0.88% -12843.2 Zn 206.200 0.063 mg/L 0.0006 11.22% 3965.9 Pb 220.353 0.0006 0.006 mg/L 0.0009 2.40% 0.038 mg/L 657.0 A11 267.595 0.0009 0.038 mg/L 21579.1 Cu 327.393 Autosampler Location: 31 Date Collected: 11/19/2016 10:06:19 AM Sequence No.: 4 Data Type: Reprocessed on 11/19/2016 10:13:45 AM Sample ID: 6 Analyst: Logged In Analyst (Original) : Optima 2100DV Initial Sample Vol: Initial Sample Wt: Sample Prep Vol: Dilution: Nebulizer Parameters: 6 Flow Back Pressure Analyte 0.80 L/min 111.0 kPa A11 Analysis Replicate Data: 6 Sample Calib. Net Corrected Time 10:07:30 Conc. Units Conc. Units Intensity Intensity 0.076 mg/L 0.076 mg/L 0.308 mg/L 0.002 mg/L Repl# Analyte 7677.8 Zn 206.200 7636.8 10:08:05 0.308 mg/L 16373.0 10:08:36 0.002 mg/L Pb 220.353 261.0 10:09:09 3921.4 0.057 mg/L Au 267.595 0.057 mg/L 34023.0 33092.3 10:07:42 0.075 mg/L Cu 327.393 0.075 mg/L 0.307 mg/L 7535.8 7494.8 10:08:17 0.307 mg/L 0.003 mg/L Zn 206.200 14603.0 10:08:48 16344.3 Pb 220.353 0.003 mg/L 357.5 10:09:15 4017.8 Au 267.595 0.057 mg/L 0.057 mg/L 2 34305.2 33374.4 10:07:52 0.075 mg/L Cu 327.393 0.075 mg/L 7634.7 7593.7 0.308 mg/L 10:08:25 Zn 206.200 0.308 mg/L 14655.3 10:08:57 0.003 mg/L Pb 220.353 0.003 mg/L 3 4021.0 360.7 10:09:19 Au 267.595 0.057 mg/L 3 34298.5 0.057 mg/L 33367.8 Cu 327.393 3 Sample Mean Data: 6
 Std.Dev.
 RSD

 0.0004
 0.49%

 0.0006
 0.20%

 0.0006
 23.73%
 Calib. Mean Corrected Conc. Units 0.075 mg/L Conc. Units Std.Dev. Intensity Analyte 0.0004 0.075 mg/L Zn 206.200 Pb 220.353 7616.1 14630.0 0.308 mg/L 0.308 mg/L 0.002 mg/L 0.0006 0.002 mg/L 0.057 mg/L 0.0006 0.0002 0.42% 326.4 Au 267.595 0.0002 0.057 mg/L 34208.9 Cu 327.393 Technique: ICP Continuous Reprocessing Begun Logged In Analyst: Optima 2100DV Results Data Set (original): dawi_umk Results Library (original): C:\pe\Optima 2100DV\Results\Results.mdb Results Data Set (reprocessed): Perults Library (constant) Results Library (reprocessed) : Autosampler Location: 32 Date Collected: 11/19/2016 10:10:04 AM Sequence No.: 1 Data Type: Reprocessed on 11/19/2016 10:17:20 AM Sample ID: 7 Analyst: Logged In Analyst (Original) : Optima 2100DV Initial Sample Vol: Sample Prep Vol: Initial Sample Wt: Dilution:

Net Corrected Callb. Conc. Units Time Repl# Analyte Intensity Intensity Conc. Units Conc. Units 0.055 mg/L 0.055 mg/L 10:15:00 1 Zn 206.200 -18278.3 -10237.3 -0.055 mg/L 0.063 mg/L 10:15:40 1 Pb 220.353 5675.6 3934.2 0.063 mg/L 0.001 mg/L 0.001 mg/L 10:16:42 1 Au 267.595 18298.7 19229.4 0.035 mg/L 0.035 mg/L 10:16:52 2 Zn 206.200 -18161.3 -18120.3 -0.054 mg/L 0.063 mg/L 10:16:52 2 Zn 206.200 -18161.3 -18120.3 -0.054 mg/L 0.063 mg/L 10:16:52 2 Pb 220.353 5684.8 3943.4 0.0603 mg/L 0.0063 mg/L 10:16:33 2 Au 267.595 3977.4 317.0 0.002 mg/L 0.002 mg/L 10:16:33 3 Zn 206.200 -18318.7 -18277.8 -0.055 mg/L 0.002 mg/L 10:16:63 3 <td< th=""><th>Nebulizer Parameters Analyte All</th><th>Eack Pressure</th><th>Flow 0.80 L/min</th><th></th><th></th><th></th></td<>	Nebulizer Parameters Analyte All	Eack Pressure	Flow 0.80 L/min			
Map: Net Corrected Calls Conc. Units Title Repl# Analyte Intensity Conc. Units Conc. Units Conc. Units Ioilitie Repl# Analyte Intensity Conc. Units Conc. Units Ioilitie Ioilitie Repl# Analyte Intensity Conc. Units Conc. Units Ioilitie Ioilitie 1 Pb 220.353 4015.2 333.3 0.007 mg/L 0.003 mg/L 10113102 2 Pb 220.353 6044.2 5165.6 0.031 mg/L 0.002 mg/L 10113102 2 Ch 27.595 20542.9 21473.6 0.038 mg/L 0.039 mg/L 101131302 3 R2 206.333 6944.2 5102.6 0.038 mg/L 0.0038 mg/L 10112150 3 R2 206.333 5396.7 3224.4 0.0028 mg/L 0.0002 mg/L 10122150 3 Ch 27.595 21317.6 0.0028 mg/L 0.0004 0.007 mg/L 10122150 3 Ch 28.7.595 21917.2 0.039 mg/L 0.0001 mg/L </th <th></th> <th></th> <th></th> <th></th> <th></th> <th>Analysis</th>						Analysis
Mean Life Internet ty 1 Intensity 2 Output 0 Output 0 Output 0 <th>Replicate Data: 7</th> <th>Net</th> <th></th> <th></th> <th></th> <th>Time</th>	Replicate Data: 7	Net				Time
1 fn 206.200 -934.1.7 \$208.3 0.092 mg/L 0.093 mg/L 1011139 1 ha 267.595 4003.0 21933.7 0.039 mg/L 1011129 1 ha 267.595 4003.0 21933.7 0.039 mg/L 1011129 2 fn 206.200 -604.3 -6007.0 7007 mg/L 0.039 mg/L 1011129 2 fn 206.200 -604.3 -6007.0 2008 mg/L 0.038 mg/L 0.038 mg/L 1011129 2 fn 206.200 -604.6 -6020 mg/L 0.038 mg/L 0.038 mg/L 10111307 3 fn 206.200 644.2 5102.8 0.039 mg/L 0.038 mg/L 10112350 3 fn 207.595 321.5 0.022 mg/L 0.039 mg/L 0.002 mg/L 1012350 3 fn 207.595 321.5 0.002 mg/L 0.001 mg/L 0.002 mg/L 0.001 mg/L 1013311 Ch 207.595 321.5 0.002 mg/L 0.0004 0.0004 0.0002 mg/L 0.0011 mg/L 1.013131 Sample ID: 0 fn analyst fn 203 mg/L 0.0001 mg/L 0.0001 mg/L 0.0004	Repl# Analyte				0.007 mg/L	
1 hu 167:395 4015.2 354.8 0.003 mg/L 0.003 mg/L 10:13:02 1 Out 2013:3.7 0.007 mg/L 0.007 mg/L 0.003 mg/L 10:11:127 2 fit 206:200 -6054.3 -6013.3 0.007 mg/L 0.001 mg/L 10:11:27 2 fit 202:353 6907.0 5165.6 0.001 mg/L 0.002 mg/L 10:12:40 2 fit 202:353 20562.9 2147.6 0.008 mg/L 10:11:37 3 fit 202:353 20562.9 2147.6 0.008 mg/L 10:12:50 3 fit 202:353 66044.2 5102.8 0.008 mg/L 10:12:50 3 fit 202:353 5156.9 0.007 mg/L 0.002 mg/L 0.002 mg/L 10:12:50 3 fit 202:0 -5984.8 0.002 mg/L 0.002 mg/L 0.0021 mg/L 0.0001 m	1 Zn 206.200					
1 Con 327.393 21003.0 2193.3 0.007 mg/L 0.007 mg/L 0.007 mg/L 101112103 2 Zn 206.200 -6054.3 -6013.3 0.001 mg/L 0.001 mg/L 101112103 2 Pb 220.353 6907.0 5165.6 0.001 mg/L 0.002 mg/L 10112103 2 Au 267.595 3940.7 280.4 0.038 mg/L 0.038 mg/L 101113107 2 Cu 327.393 20542.9 21473.6 0.006 mg/L 0.008 mg/L 10112103 3 Pb 220.353 6844.2 5126.8 0.002 mg/L 0.002 mg/L 10123107 3 Pb 220.353 5138.9 0.001 mg/L 0.002 mg/L 0.002 mg/L 1011311 4 Intensity Conc. Units Std_Dev. Conc. Units Std_Dev. Conc. Units Std_Dev. Std_Dev. No044 0.002 mg/L 10.0014 10.012112 1.348 2 203.53 5131.9 0.001 mg/L 0.0004 0.002 mg/L 0.0004 0.0022 mg/L 0.001111113131						
2 2n 206.200 -6004.3 5014.5.5 0.091 mg/L 1012103 2 PD 220.353 3940.7 2143.6 0.002 mg/L 0.003 mg/L 1012140 2 Au 267.595 3940.7 2143.6 0.006 mg/L 0.006 mg/L 1011317 3 Cu 327.393 20542.9 -6078.0 -6078.0 0.006 mg/L 0.008 mg/L 10112150 3 Pb 220.353 6644.2 329.4 0.002 mg/L 0.002 mg/L 0.002 mg/L 10112150 3 Au 267.595 3989.7 2394.4 0.002 mg/L 0.0024 0.0004 0.0007 mg/L 0.0004 5.29 2n 206.200 -5989.8 0.0007 mg/L 0.0012 0.0012 0.0012 0.0007 0.008 1.013117 Va 267.595 321.5 0.002 mg/L 0.0012 0.0012 0.0007 1.03017 1.0004 0.0007 1.0302 Cu 327.393 21917.2 0.039 mg/L 0.0004 0.002 mg/L 0.0007 1.698 Au 267.595 321.5 0.002 mg/L 0.0007 0.039 mg/L 0.0007 1.698						
2 Pb 220.353 3940.72 280.4 0.002 mg/L 0.002 mg/L 1011213 2 Au 267.595 3240.4 0.038 mg/L 0.038 mg/L 10113107 2 Cu 327.393 20542.5 210542.5 0.008 mg/L 0.008 mg/L 10113107 3 Ph 220.353 6684.2 322.8 0.008 mg/L 0.002 mg/L 10112150 3 Ph 220.353 6584.2 322.4 0.002 mg/L 0.002 mg/L 10112150 3 Cu 327.393 21413.6 22344.3 0.039 mg/L 0.003 mg/L 10.012150 Mean Data: 7 Mean Corrected Construction Mark Calib. Sample Sample Std.Dev. RsD Au 267.595 321.5 0.002 mg/L 0.0004 0.007 mg/L 0.0004 0.0007 0.028 mg/L 0.0017 1.684 Au 267.595 321.5 0.002 mg/L 0.0007 0.039 mg/L 0.0007 1.684 Autosampler Location: 3 3 Data Smple Prep Vol: 3 Data Smple Vol: 3 Sample TD: 8 Panalyte Intensity Intensity Conc. Units Conc. Units Tise Conc. Unit	2 Zn 206.200				0.091 mg/L	
2 Au 267.333 20542.9 21473.6 0.038 mg/L 0.038 mg/L 10.138 mg/L 10.11215 3 Zn 206.200 6844.2 5102.8 0.008 mg/L 0.008 mg/L 10.11215 3 String 201.333 3989.7 329.4 0.002 mg/L 0.008 mg/L 10.11215 3 Cu 227.333 20413.6 22344.3 0.033 mg/L 0.033 mg/L 10.13111 Mean Data: 7 Mean Corrected Calib. Sample Sample 10.13111 Mainter 201.333 Siss.9 0.001 mg/L 0.002 mg/L 0.0024 5.298 Zn 206.200 -5584.8 0.002 mg/L 0.0014 0.0004 5.298 Cu 327.393 21917.2 0.032 mg/L 0.0004 0.0027 mg/L 0.0004 1.698 Cu 327.393 21917.2 0.039 mg/L 0.0004 0.0027 mg/L 0.0007 mg/L 0.0004 1.698 Sequence No.: 2 Sample TD: 8 Analyst: Data Type: Reprocessed on 11/19/2016 10:17:20 AM Thitial Sample VC: Thitial Sample Vol: Sample Acalysis Data Type: Reprocessed on 11/19/2016 10:17:20 AM Thitial Samp				0.002 mg/L		
3 2n 206.200 -6078.0 -6037.3 0.008 mg/L 0.009 mg/L 10:12:15 3 Rb 220.353 3995.7 329.4 0.008 mg/L 0.003 mg/L 10:12:15 3 Cu 327.393 21413.6 22344.3 0.033 mg/L 0.039 mg/L 10:13:11 Mean Data: 7 Mean Corrected Calib. Sample Sample 0.0004 5.29% 2n 206.200 5158.9 0.091 mg/L 0.0012 0.91 mg/L 0.0004 10:021 2.1.34% Au 267.595 32197.2 0.039 mg/L 0.0012 0.031 mg/L 0.0004 16:18% Au 267.595 21917.2 0.039 mg/L 0.0007 0.039 mg/L 0.0007 1.039 mg/L 0.0007			21473.6			
3 Pb 220.353 6844.2 5102.9 0.002 mg/L 10.122150 3 Au 267.595 399.7 329.4 0.039 mg/L 0.039 mg/L 10.132150 Maalyte Intensity Conc. Units 0.039 mg/L 10.132150 0.039 mg/L 10.13111 Maalyte Intensity Conc. Units Std.Dev. Sample Rsp. Xu 267.595 321.5 0.002 mg/L 0.0014 0.007 mg/L 0.0004 5.001 mg/L 0.0004 1.6012 1.348 Cu 327.393 21917.2 0.039 mg/L 0.0004 0.007 mg/L 0.0004 1.6012 1.638 Sequence No.: 2 Sample TD: 8 Analyst: 0.0007 0.039 mg/L 0.0007 1.698 Nabulizer Parameters: 8 Analyst: Nates Collected: 11/19/2016 10:17:20 AM Thitial Sample W: 111.0 kPa 0.80 L/min Nates Collected: 11/19/2016 10:15:40 Sequence No.: 2 Back Pressure Analyse: Corrected Collected: 11/19/2016 10:15:40 10:15:70 Sequence No.: 1 Sample Malyse Theomaily Core. Units Sample Malyse: 10:15:70 10:15:70						
3 Au 267.595 .303.1 0.039 mg/L 0.039 mg/L 1013.11 Mean Data: 7 Mean Corrected Calib. Sample Sample Manlyte Intensity Conc. Units Std.Dev. Conc. Units Std.Dev. RSD Tn 206.200 -5984.8 0.007 mg/L 0.0014 0.007 mg/L 0.0004 2.007 mg/L 0.0004 2.007 mg/L 0.0004 1.6.18% Cu 327.393 21917.2 0.039 mg/L 0.0001 0.007 mg/L 0.0007 1.63% Sequence No.: 2 Sample TD: 8 Analyst 0.0007 0.039 mg/L 0.0007 1.63% Logged In Analyst (Original): Optima 21000V Initial Sample Vol: 33 Date Collected: 11/19/2016 10:17:20 AM Sample TD: 8 Raalyste Back Pressure Flow Antosampler Location: 33 Dilution: Intensity Conc. Units Sample Analyst 10115/10 Logged In Analyste Intensity Conc. Units Sample Prep Vol: Sample Prep Vol: Sullation: Back Pressure Flow Analyte Conc. Units Sample Analysti Logged In Analyte	3 Pb 220.353				0.002 mg/L	
3 Cu 327.393 Linear Mean Data: 7 Mean Corrected Calib. Sample Analyte Intensity Conc. Units Std.Dev. Conc. Units Std.Dev. RSD Yn 206.200 -5984.8 0.007 mg/L 0.0012 0.091 mg/L 0.0004 5.298 Au 267.595 321.5 0.002 mg/L 0.0007 0.039 mg/L 0.0007 0.0004 16.188 Sequence No.: 2 Sample ID: 8 Autosampler Location: 33 Data Type: Reprocessed on 11/19/2016 10:13:56 AM Sequence No.: 2 Data Type: Reprocessed on 11/19/2016 10:17:20 AM Data Collected: 11/19/2016 10:13:56 AM Jate Collected: 11/19/2016 10:13:56 AM Data Type: Reprocessed on 11/19/2016 10:17:20 AM Initial Sample Wt: Data Type: Reprocessed on 11/19/2016 10:17:20 AM Data Type: Reprocessed on 11/19/2016 10:17:20 AM Initial Sample Vol: Sample Back Pressure Flow Nabulizer Parameters: 8 Nat Corrected Calib. Replit Analyte Intensity Conc. Units Conc. Units Time 1 27.06.200 -18276.3 -0.055 mg/L -0.055 mg/L 10.0154					0.039 mg/L	10:13:11
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3 Cu 32/.333 Mean Data: 8 Sample Mean Corrected Calib. Sample Analyte Intensity Conc. Units Std.Dev. Conc. Analyte Intensity Conc. 0.055 mg/L 0.0004 -0.055 mg/L 0.0004	Sequence No.: 2 Sample ID: 8 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Paramete Analyte Analyte All Replicate Data: 8 Repl# Analyte 1 Zn 206.200 1 Pb 220.353 1 Au 267.595 1 Cu 327.393 2 Zn 206.200 2 Pb 220.353 2 Au 267.595 2 Cu 327.393 3 Zn 206.200	(Original) : Optin rs: 8 Back Pressu 111.0 kPa Net Intensit -18278. 5675. 3878. 18298 -18161 5684 3977 18094 -18318 5666	re Flow 0.80 L/n Corrected y Intensity 3 -18237.3 6 3934.2 0 217.7 7 19229.4 3 -18120.3 8 3943.4 4 317.0 1 19024.6 7 -18277.4 6 3925.5	Autosampler Loca Date Collected: Data Type: Repro Initial Sample V Sample Prep Vol: Cali Conc. Unit -0.055 mg/L 0.063 mg/L 0.035 mg/I 0.063 mg/I 0.063 mg/I 0.063 mg/I 0.063 mg/I 0.063 mg/I 0.065 mg/I 0.002 mg/I 0.005 mg/I 0.005 mg/I 0.005 mg/I	<pre>tion: 35 tion: 3</pre>	le Analysis s Time 10:15:00 10:15:21 10:16:5, 10:15:21 10:15:3 10:16:3 10:16:5 , 10:16:3 10:16:0 10:16:4
Mean Corrected Callb. Conc. Units Std.Dev. Conc. Units Std.Dev. RS Analyte Intensity Conc. Units Std.Dev. 0.0004 -0.055 mg/L 0.0004 0.	Sequence No.: 2 Sample ID: 8 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Paramete Analyte All Replicate Data: 8 Repl# Analyte 1 Zn 206.200 1 Pb 220.353 1 Au 267.595 2 Cu 327.393 3 Zn 206.200 3 Pb 220.353 3 Au 267.595 2 Cu 327.393 3 Zn 206.200 3 Pb 220.353 3 Au 267.595	(Original) : Optin rs: 8 Back Pressu 111.0 kPa Net Intensii -18278. 5675. 3878. 18298 -18161 5684 3977 18094 -18318 5666 3924	re Flow 0.80 L/n Corrected y Intensity 3 -18237.3 6 3934.2 0 217.7 7 19229.4 .3 -18120.3 .8 3943.4 .4 317.0 .1 19024.6 .7 -1827.6 .6 3925.2 .2 263.2	Autosampler Loca Date Collected: Data Type: Repro Initial Sample V Sample Prep Vol: Conc. Unit -0.055 mg/L 0.063 mg/L 0.003 mg/L 0.003 mg/L 0.003 mg/L 0.003 mg/L 0.003 mg/L 0.003 mg/L 0.003 mg/L 0.003 mg/L 0.003 mg/L 0.002 mg/L 0.002 mg/L 0.002 mg/L 0.002 mg/L	<pre>tion: 35 Lify/19/2016 10:13:56 Ai cessed on 11/19/2016 10 cessed on 11/19</pre>	le Analysis s Time 10:15:00 10:15:21 10:16:5, 10:15:21 10:15:3 10:16:3 10:16:5 , 10:16:3 10:16:0 10:16:4
Mean Corrected Callb. Conc. Units Std.Dev. Conc. Units Std.Dev. RS Analyte Intensity Conc. Units Std.Dev. 0.0004 -0.055 mg/L 0.0004 0.	Sequence No.: 2 Sample ID: 8 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Paramete Analyte All Replicate Data: 8 Repl# Analyte 1 Zn 206.200 1 Pb 220.353 1 Au 267.595 2 Cu 327.393 3 Zn 206.200 3 Pb 220.353 3 Au 267.595 2 Cu 327.393 3 Zn 206.200 3 Pb 220.353 3 Au 267.595	(Original) : Optin rs: 8 Back Pressu 111.0 kPa Net Intensii -18278. 5675. 3878. 18298 -18161 5684 3977 18094 -18318 5666 3924	re Flow 0.80 L/n Corrected y Intensity 3 -18237.3 6 3934.2 0 217.7 7 19229.4 .3 -18120.3 .8 3943.4 .4 317.0 .1 19024.6 .7 -1827.6 .6 3925.2 .2 263.2	Autosampler Loca Date Collected: Data Type: Repro Initial Sample V Sample Prep Vol: Conc. Unit -0.055 mg/L 0.063 mg/L 0.003 mg/L 0.002 mg/L 0.0062 mg/L 0.0062 mg/L	<pre>tion: 35 Lify2016 10:13:56 A Cessed on 11/19/2016 1 cessed on 11/19/2016 1 col: col: col: col: col: col: col: col:</pre>	le Analysis s Time 10:15:00 10:15:21 10:16:5, 10:15:21 10:15:3 10:16:3 10:16:5 , 10:16:3 10:16:0 10:16:4
Analyte Intensity Conc. Units Stat. Dev. 0.055 mg/L 0.0004 0.7	Sequence No.: 2 Sample ID: 8 Analyst: Logged In Analyst Initial Sample Wt: Dilution: 	(Original) : Optin rs: 8 Back Pressu 111.0 kPa Net Intensii -18278. 5675. 3878. 18298 -18161 5684 3977 18094 -18318 5666 3924	re Flow 0.80 L/n Corrected y Intensity 3 -18237.3 6 3934.2 0 217.7 7 19229.4 .3 -18120.3 .8 3943.4 .4 317.0 .1 19024.6 .7 -1827.6 .6 3925.2 .2 263.2	Autosampler Loca Date Collected: Data Type: Repro Initial Sample V Sample Prep Vol: Conc. Unit -0.055 mg/L 0.063 mg/L 0.003 mg/L 0.002 mg/L 0.0062 mg/L 0.0062 mg/L	b. Sampl s Conc. Unit: -0.055 mg/L 0.063 mg/L 0.063 mg/L 0.001 mg/L 0.003 mg/L 0.003 mg/L 0.003 mg/L 0.003 mg/L 0.004 mg/L 0.004 mg/L 0.034 mg/L 0.002 mg/I 0.034 mg/I 0.034 mg/I	le Analysis s Time 10:15:00 10:15:21 10:16:5, 10:15:21 10:15:3 10:16:3 10:16:5 , 10:16:3 10:16:0 10:16:4
	Sequence No.: 2 Sample ID: 8 Analyst: Logged In Analyst Initial Sample Wt: Dilution: 	(original) : Optin rs: 8 Back Pressu 111.0 kPa Net Intensit -18278 -5675. 3878. 18298 -18161 5684 3977 18094 -18318 5666 3924 18092 Mean Corrected	re Flow 0.80 L/n Corrected y Intensity 3 -18237.3 6 3934.2 0 217.7 7 19229.4 3 -18120.3 8 3943.4 4 317.6 1 19024.6 7 -18277.6 6 3925.7 .2 263.1 6 19023.	Autosampler Loca Date Collected: Data Type: Repro Initial Sample V Sample Prep Vol: Conc. Unit -0.055 mg/L 0.063 mg/L 0.063 mg/L 0.063 mg/L 0.063 mg/L 0.063 mg/L 0.063 mg/L 0.063 mg/L 0.063 mg/L 0.065 mg/L 0.065 mg/L 0.062 mg/J 3 0.002 mg/J 3 0.002 mg/J 3 0.0034 mg/L	tion: 35 tion: 35 cessed on 11/19/2016 cessed on 11/19/2016 ol: col	le Analysis s Time 10:15:00 10:15:20 10:15:5 10:16:2 10:16:5 10:15:5 10:16:3 10:16:6 10:16:4 10:17:0 Std.Dev. RSI
	Sequence No.: 2 Sample ID: 8 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Paramete Analyte All Replicate Data: 8 Repl# Analyte 1 Zn 206.200 1 Pb 220.353 1 Au 267.595 1 Cu 327.393 2 Zn 206.200 2 Pb 220.353 2 Au 267.595 2 Cu 327.393 3 Zn 206.200 3 Pb 220.353 3 Au 267.595 3 Cu 327.393	(original) : Optin rs: 8 Back Pressu 111.0 kPa Net Intensit -18278. 5675. 3878. 18298 -18161 5684 3977 18094 -18318 5666 3924 18092 Mean Corrected Intensity	re Flow 0.80 L/n Corrected y Intensity 3 -18237.3 6 3934.2 0 217.7 7 19229.4 3 -18120.3 8 3943.4 4 317.0 1 19024.5 6 3925.2 2 263.3 6 19023. Cali Conc. Unit	Autosampler Loca Date Collected: Data Type: Repro Initial Sample V Sample Prep Vol: Conc. Unit -0.055 mg/L 0.063 mg/L 0.064 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.062 mg/L 0.064 mg/L 0.063 mg/L 0.064 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.0	<pre>tion: 35 tion: 3</pre>	le Analysis s Time 10:15:00 10:15:20 10:15:5 10:16:2 10:16:5 10:15:5 10:16:3 10:16:6 10:16:4 10:17:0 Std.Dev. RSI
	Sequence No.: 2 Sample ID: 8 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Paramete Analyte All Replicate Data: 8 Repl# Analyte 1 Zn 206.200 1 Pb 220.353 1 Au 267.595 1 Cu 327.393 2 Zn 206.200 2 Pb 220.353 2 Au 267.595 2 Cu 327.393 3 Zn 206.200 3 Pb 220.353 3 Au 267.595 3 Cu 327.393	(original) : Optin rs: 8 Back Pressu 111.0 kPa Net Intensit -18278. 5675. 3878. 18298 -18161 5684 3977 18094 -18318 5666 3924 18092 Mean Corrected Intensity	re Flow 0.80 L/n Corrected y Intensity 3 -18237.3 6 3934.2 0 217.7 7 19229.4 3 -18120.3 8 3943.4 4 317.0 1 19024.5 6 3925.2 2 263.3 6 19023. Cali Conc. Unit	Autosampler Loca Date Collected: Data Type: Repro Initial Sample V Sample Prep Vol: Conc. Unit -0.055 mg/L 0.063 mg/L 0.064 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.062 mg/L 0.064 mg/L 0.063 mg/L 0.064 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.0	<pre>tion: 35 tion: 3</pre>	le Analysis s Time 10:15:00 10:15:20 10:15:5 10:16:2 10:16:5 10:15:5 10:16:3 10:16:6 10:16:4 10:17:0 Std.Dev. RSI
	Sequence No.: 2 Sample ID: 8 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Paramete Analyte All Replicate Data: 8 Repl# Analyte 1 Zn 206.200 1 Pb 220.353 1 Au 267.595 1 Cu 327.393 2 Zn 206.200 2 Pb 220.353 2 Au 267.595 2 Cu 327.393 3 Zn 206.200 3 Pb 220.353 3 Au 267.595 3 Cu 327.393	(original) : Optin rs: 8 Back Pressu 111.0 kPa Net Intensit -18278. 5675. 3878. 18298 -18161 5684 3977 18094 -18318 5666 3924 18092 Mean Corrected Intensity	re Flow 0.80 L/n Corrected y Intensity 3 -18237.3 6 3934.2 0 217.7 7 19229.4 3 -18120.3 8 3943.4 4 317.0 1 19024.5 6 3925.2 2 263.3 6 19023. Cali Conc. Unit	Autosampler Loca Date Collected: Data Type: Repro Initial Sample V Sample Prep Vol: Conc. Unit -0.055 mg/L 0.063 mg/L 0.064 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.062 mg/L 0.064 mg/L 0.063 mg/L 0.064 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.0	<pre>tion: 35 tion: 3</pre>	le Analysis s Time 10:15:00 10:15:20 10:15:5 10:16:2 10:16:5 10:15:5 10:16:3 10:16:6 10:16:4 10:17:0 Std.Dev. RSI
	Sequence No.: 2 Sample ID: 8 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Paramete Analyte All Replicate Data: 8 Repl# Analyte 1 Zn 206.200 1 Pb 220.353 1 Au 267.595 1 Cu 327.393 2 Zn 206.200 2 Pb 220.353 2 Au 267.595 2 Cu 327.393 3 Zn 206.200 3 Pb 220.353 3 Au 267.595 3 Cu 327.393	(original) : Optin rs: 8 Back Pressu 111.0 kPa Net Intensit -18278. 5675. 3878. 18298 -18161 5684 3977 18094 -18318 5666 3924 18092 Mean Corrected Intensity	re Flow 0.80 L/n Corrected y Intensity 3 -18237.3 6 3934.2 0 217.7 7 19229.4 3 -18120.3 8 3943.4 4 317.0 1 19024.5 6 3925.2 2 263.3 6 19023. Cali Conc. Unit	Autosampler Loca Date Collected: Data Type: Repro Initial Sample V Sample Prep Vol: Conc. Unit -0.055 mg/L 0.063 mg/L 0.064 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.062 mg/L 0.064 mg/L 0.063 mg/L 0.064 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.0	<pre>tion: 35 tion: 3</pre>	le Analysis s Time 10:15:00 10:15:20 10:15:5 10:16:2 10:16:5 10:15:5 10:16:3 10:16:6 10:16:4 10:17:0 Std.Dev. RSI
	Sequence No.: 2 Sample ID: 8 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Paramete Analyte All Replicate Data: 8 Repl# Analyte 1 Zn 206.200 1 Pb 220.353 1 Au 267.595 1 Cu 327.393 2 Zn 206.200 2 Pb 220.353 2 Au 267.595 2 Cu 327.393 3 Zn 206.200 3 Pb 220.353 3 Au 267.595 3 Cu 327.393	(original) : Optin rs: 8 Back Pressu 111.0 kPa Net Intensit -18278. 5675. 3878. 18298 -18161 5684 3977 18094 -18318 5666 3924 18092 Mean Corrected Intensity	re Flow 0.80 L/n Corrected y Intensity 3 -18237.3 6 3934.2 0 217.7 7 19229.4 3 -18120.3 8 3943.4 4 317.0 1 19024.5 6 3925.2 2 263.3 6 19023. Cali Conc. Unit	Autosampler Loca Date Collected: Data Type: Repro Initial Sample V Sample Prep Vol: Conc. Unit -0.055 mg/L 0.063 mg/L 0.064 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.062 mg/L 0.064 mg/L 0.063 mg/L 0.064 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.065 mg/L 0.064 mg/L 0.065 mg/L 0.0	<pre>tion: 35 tion: 3</pre>	le Analysis s Time 10:15:01 10:15:20 10:15:5 10:16:5 10:16:5 10:16:3 10:16:6 10:16:4 10:17:0 5td.Dev. RSI



eprocessing Begun					
ogged In Analyst: Opt	tima 2100DV		Technique: ICP Co	ntinuous	
esults Data Set (orig	ginal): ag				
esults Libra <mark>ry (orig</mark> esults Data Set (rep	<pre>jinal): C:\pe\Opt rocessed):</pre>	ima 2100DV\F	lesults\Results.md	b	
Results Library (rep					
Method Loaded Method Name: Ag Test			Method Last Saved	: 11/14/2016 6:57:34 PM	
EC File:			MSF File:		
Method Description: d	etermination of s	ediment			
Sequence No.: 1			Autosampler Locat	zion: 14	
Sample ID: Calib Blan	k 1			1/14/2016 7:06:36 PM	6.02 M
Analyst: Logged In Analyst (Or	iginal) : Optima	2100DV	Data Type: Reproc	essed on 11/19/2016 10:2	0:02 AM
Initial Sample Wt: Dilution:			Initial Sample Vo Sample Prep Vol:	bl :	
Dilution:			Sample Frep Vol.		
Nebulizer Parameters:	Calib Blank 1				
Analyte All	Back Pressure 106.0 kPa	Flow	1.		
411	100.0 KF4	0.00 1/1			
Replicate Data: Calib	Blank 1				
	Net	Corrected	Calib.	Analysis Time	
Repl# Analyte 1 Ag 328.068	-2987.2	Intensity -2987.2	[0 001 mg/L	19:07:43	
2 Ag 328.068	-2904.8	-2904.8	[0.00] mg/L	19:07:53	
3 Ag 328.068	-2952.2	-2952.2	[0.00] mg/L	19:08:01	
Mean Data: Calib Blan					
Me	an Corrected			alib	
Analyte Ag 328.068	Intensity 5 -2948.1	Std.Dev. R 41.39 1.	SD Conc. Un 40% [0.00] m		
Sequence No.: 2			Autosampler Loca		
Sample ID: Calib Std Analyst:	1			11/14/2016 7:08:50 PM cessed on 11/19/2016 10:2	26:02 AM
Logged In Analyst (Or	iginal) : Optima	2100DV			
Initial Sample Wt: Dilution:			Initial Sample Vol:	D1:	
Nebulizer Parameters					
Analyte All	Back Pressure 106.0 kPa	Flow 0.80 L/m	in		
Replicate Data: Calil					
	Net	Corrected	Calib Conc. Units		
	2034171.3	2037119.4	[2] mg/L	19:09:53	
1 Ag 328.068	2021874.8	2024822.8			
2 Ag 328.068	2025500.5	2002000.0	[2] mg/ 1		
All Replicate Data: Calij Repl# Analyte	106.0 kPa 5 Std 1 Net Intensity 2034171.3	0.80 L/m Corrected Intensity 2037119.4	Calib Conc. Units [2] mg/L	Time 19:09:53	
2 Ag 328.068	2029586.9	2032535.0	[2] mg/L	19:10:00	
2 Ag 328.068 3 Ag 328.068	1				
2 Ag 328.068 3 Ag 328.068 Mean Data: Calib Std	1 ean Corrected		c	alib	
2 Ag 328.068 3 Ag 328.068 Mean Data: Calib Std			c	alib	
2 Ag 328.068 3 Ag 328.068 Mean Data: Calib Std			c	alib	
2 Ag 328.068 3 Ag 328.068 Mean Data: Calib Std			c	alib	
2 Ag 328.068 3 Ag 328.068 Mean Data: Calib Std				alib	
2 Ag 328.068 3 Ag 328.068 Mean Data: Calib Std				alib	

328.068	Intensity 2031492.4		31%	Conc. Units [2] mg/L		
Sequence No.: 3 Sample ID: Calib Sto Analyst: Logged In Analyst (Initial Sample Wt: Dilution:	d 2 Original) : Optim		Autosamp Date Col Data Typ	ler Location lected: 11/1 e: Reprocess Sample Vol:	1: 16 4/2016 7:10	
Nebulizer Parameter Analyte All		re Flow 0.80 L/m				
Replicate Data: Cal	ib Std 2					
Repl# Analyte 1 Ag 328.068 2 Ag 328.068 3 Ag 328.068	Net Intensity 4103244.3 4188930.1	Corrected Intensity 4106192.4 4191878.2 4104952.6	Cor	Calib. ac. Units 4] mg/L 4] mg/L 4] mg/L	Analysis Time 19:11:47 19:11:51 19:11:55	
Mean Data: Calib St						
	Mean Corrected	Std.Dev. 1 49832.48 1	RSD .21%	Cali Conc. Unit [4] mg/L	S	
Initial Sample Wt: Dilution: Nebulizer Parameter Analyte All	cs: Calib Std 3 Back Pressu: 107.0 kPa	re Flow 0.80 L/:	Sample 1	Sample Vol: Prep Vol:		
Replicate Data: Cal	Lib Std 3					
Repl# Analyte 1 Ag 328.068 2 Ag 328.068 3 Ag 328.068	Intensit 6128288. 6057202.	Corrected y Intensity 4 6131236.4 4 6060150.5 6 6106091.7	Co	Calib. nc. Units [6] mg/L [6] mg/L [6] mg/L	Analysis Time 19:13:43 19:13:47 19:13:51	
Mean Data: Calib St						
Analyte Ag 328.068			RSD .59%	Cali Conc. Unit [6] mg/I	s	
Sequence No.: 5 Sample ID: Calib S Analyst:	td 4		Date Co		/14/2016 7:14	1:36 PM 9/2016 10:26:03 AM
Logged In Analyst Initial Sample Wt: Dilution:		ma 2100DV		Sample Vol Prep Vol:		
Nebulizer Paramete	rs: Calib Std 4	_A	Y	S	IA	

malyte	Back Pressure	Flow			
11	107.0 kPa	0.80 L/mi	n		
Replicate Data: Cali					
	Net	Corrected	Calib. Conc. Units	Analysis Time	
1 Ag 328.068	Intensity 7356988.9	Intensity 7359937.0	[8] mg/L	19:15:39	
2 Ag 328.068	7285338.7	7288286.7	[8] mg/L	19:15:43	
3 Ag 328.068	7300701.2	7303649.2	[8] mg/L	19:15:47	
Mean Data: Calib Sto	1 4				
	Mean Corrected		Cal		
Analyte		Std.Dev. RS	SD Conc. Uni 52% [8] mg/		
Ag 328.068	7317291.0 3	7722.83 0.5			
Sequence No.: 6			Autosampler Locati	on: 19	
Sample ID: Calib Sto	d 5		Date Collected: 11 Data Type: Reproce	/14/2016 7:16:3	32 PM
Analyst: Logged In Analyst (6	Original) : Optima	2100DV	Data Type: Reproce	3384 ON 11/19/2	10.20.00 AM
Initial Sample Wt:			Initial Sample Vol	:	
Dilution:			Sample Prep Vol:		
Nebulizer Parameter	s: Calib Std 5				
Nebulizer Parameter Analyte	Back Pressure				
All	108.0 kPa	0.80 L/m	in		
Replicate Data: Cal	Net		Calib.	-	
Repl# Analyte	Intensity	Intensity	Conc. Units	Time 19:17:35	
1 Ag 328.068	11160863.2 11118215.2	11163811.3	[10] mg/L [10] mg/L	19:17:35	
2 Ag 328.068 3 Ag 328.068	11118215.2 11206275.0		[10] mg/L [10] mg/L	19:17:40	
Mean Data: Calib St	d 5. Mean Corrected		Ca	lib	
Analyte		Std.Dev. R 44037.13 0.			
Ag 328.068	11104752.5	11007.10 0.			
Calibration Summary	τ				
					. Coef. Reslop
	. Equation	Intercept	Slope Curv	ature Corr	
	Equation Lin, Calc Int				990028
Analyte Stds Ag 328.068 5	Lin, Calc Int		1052000 0.	00000 0.	990028
Analyte Stds Ag 328.068 5 Sequence No.: 7	Lin, Calc Int		1052000 0. Autosampler Locat Date Collected: 1	000000 0. ion: 26 1/19/2016 10:18	990028
Analyte Stds Ag 328.068 5 Sequence No.: 7 Sample ID: 1 Analyst:	Lin, Calc Int	-135917.0	1052000 0. Autosampler Locat	000000 0. ion: 26 1/19/2016 10:18	990028
Analyte Stds Ag 328.068 5 Sequence No.: 7 Sample ID: 1 Analyst: Logged In Analyst	Lin, Calc Int	-135917.0	1052000 0. Autosampler Locat Date Collected: 1 Data Type: Reproc	00000 0. ion: 26 1/19/2016 10:18 essed on 11/19/	990028
Analyte Stds Ag 328.068 5 Sequence No.: 7 Sample ID: 1 Analyst: Logged In Analyst Initial Sample Wt:	Lin, Calc Int	-135917.0	1052000 0. Autosampler Locat Date Collected: 1	00000 0. ion: 26 1/19/2016 10:18 essed on 11/19/	990028
Analyte Stds Ag 328.068 5 Sequence No.: 7 Sample ID: 1 Analyst: Logged In Analyst	Lin, Calc Int	-135917.0	1052000 0. Autosampler Locat Date Collected: 1 Data Type: Reproc Initial Sample Vo	00000 0. ion: 26 1/19/2016 10:18 essed on 11/19/	990028
Analyte Stds Ag 328.068 5 Sequence No.: 7 Sample ID: 1 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Parameter	Lin, Calc Int (Original) : Optim	-135917.0	1052000 0. Autosampler Locat Date Collected: 1 Data Type: Reproc Initial Sample Vo	00000 0. ion: 26 1/19/2016 10:18 essed on 11/19/	990028
Analyte Stds Ag 328.068 5 Sequence No.: 7 Sample ID: 1 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Parameter Analyte	Lin, Calc Int (Original) : Optim rs: 1 Back Pressur	-135917.0 a 2100DV	1052000 0. Autosampler Locat Date Collected: 1 Data Type: Reproc Initial Sample Vo Sample Prep Vol:	00000 0. ion: 26 1/19/2016 10:18 essed on 11/19/	990028
Analyte Stds Ag 328.068 5 Sequence No.: 7 Sample ID: 1 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Parameter	Lin, Calc Int (Original) : Optim	-135917.0 a 2100DV	1052000 0. Autosampler Locat Date Collected: 1 Data Type: Reproc Initial Sample Vo Sample Prep Vol:	00000 0. ion: 26 1/19/2016 10:18 essed on 11/19/	990028
Analyte Stds Ag 328.068 5 Sequence No.: 7 Sample ID: 1 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Parameter Analyte	Lin, Calc Int (Original) : Optim rs: 1 Back Pressur 112.0 kPa	-135917.0 a 2100DV e Flow 0.80 L/1	1052000 0. Autosampler Locat Date Collected: 1 Data Type: Reproc Initial Sample Vo Sample Prep Vol:	00000 0. ion: 26 1/19/2016 10:18 essed on 11/19/ 1:	990028 3:04 AM /2016 10:26:03 AM
Analyte Stds Ag 328.068 5 Sequence No.: 7 Sample ID: 1 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Paramete: Analyte All Replicate Data: 1	Lin, Calc Int (Original) : Optim rs: 1 Back Pressur 112.0 kPa Net	-135917.0 a 2100DV e Flow 0.80 L/r Corrected	1052000 0. Autosampler Locat Date Collected: 1 Data Type: Reproc Initial Sample Vo Sample Prep Vol: min Calib.	00000 0. ion: 26 1/19/2016 10:18 essed on 11/19/ 1:	990028
Analyte Stds Ag 328.068 5 Sequence No.: 7 Sample ID: 1 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Parameter Analyte All	Lin, Calc Int (Original) : Optim rs: 1 Back Pressur 112.0 kPa	-135917.0 a 2100DV e Flow 0.80 L/r Corrected	1052000 0. Autosampler Locat Date Collected: 1 Data Type: Reproc Initial Sample Vo Sample Prep Vol: min Calib.	00000 0. ion: 26 1/19/2016 10:18 essed on 11/19/ 1:	990028 3:04 AM /2016 10:26:03 AM Sample Analysi
Analyte Stds Ag 328.068 5 Sequence No.: 7 Sample ID: 1 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Paramete: Analyte All Replicate Data: 1	Lin, Calc Int (Original) : Optim rs: 1 Back Pressur 112.0 kPa Net	-135917.0 a 2100DV e Flow 0.80 L/r Corrected	1052000 0. Autosampler Locat Date Collected: 1 Data Type: Reproc Initial Sample Vo Sample Prep Vol: min Calib.	00000 0. ion: 26 1/19/2016 10:18 essed on 11/19/ 1:	990028 3:04 AM /2016 10:26:03 AM Sample Analysi
Analyte Stds Ag 328.068 5 Sequence No.: 7 Sample ID: 1 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Paramete: Analyte All Replicate Data: 1	Lin, Calc Int (Original) : Optim rs: 1 Back Pressur 112.0 kPa Net	-135917.0 a 2100DV e Flow 0.80 L/r Corrected	1052000 0. Autosampler Locat Date Collected: 1 Data Type: Reproc Initial Sample Vo Sample Prep Vol: min Calib.	00000 0. ion: 26 1/19/2016 10:18 essed on 11/19/ 1:	990028 3:04 AM /2016 10:26:03 AM Sample Analysi
Analyte Stds Ag 328.068 5 Sequence No.: 7 Sample ID: 1 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Paramete: Analyte All Replicate Data: 1	Lin, Calc Int (Original) : Optim rs: 1 Back Pressur 112.0 kPa Net	-135917.0 a 2100DV e Flow 0.80 L/r Corrected	1052000 0. Autosampler Locat Date Collected: 1 Data Type: Reproc Initial Sample Vo Sample Prep Vol: min Calib.	00000 0. ion: 26 1/19/2016 10:18 essed on 11/19/ 1:	990028 3:04 AM /2016 10:26:03 AM Sample Analys:
Analyte Stds Ag 328.068 5 Sequence No.: 7 Sample ID: 1 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Paramete: Analyte All Replicate Data: 1	Lin, Calc Int (Original) : Optim rs: 1 Back Pressur 112.0 kPa Net	-135917.0 a 2100DV e Flow 0.80 L/r Corrected	1052000 0. Autosampler Locat Date Collected: 1 Data Type: Reproc Initial Sample Vo Sample Prep Vol: min Calib.	00000 0. ion: 26 1/19/2016 10:18 essed on 11/19/ 1:	990028 3:04 AM /2016 10:26:03 AM Sample Analysi
Analyte Stds Ag 328.068 5 Sequence No.: 7 Sample ID: 1 Analyst: Logged In Analyst Initial Sample Wt: Dilution: Nebulizer Paramete: Analyte All Replicate Data: 1	Lin, Calc Int (Original) : Optim rs: 1 Back Pressur 112.0 kPa Net	-135917.0 a 2100DV e Flow 0.80 L/r Corrected	1052000 0. Autosampler Locat Date Collected: 1 Data Type: Reproc Initial Sample Vo Sample Prep Vol: min Calib.	00000 0. ion: 26 1/19/2016 10:18 essed on 11/19/ 1:	990028 3:04 AM /2016 10:26:03 AM Sample Analysi

: Ag Test Page 4 Date: 11/19/2016 10:33:33 AM -6206.4 Ag 328.068 -9154.5 0.123 mg/L 0.123 mg/L 10:19:09 0.123 mg/L 0.123 mg/L 0.123 mg/L 0.123 mg/L -6525.8 10:19:14 Ag 328.068 -9473.9 Ag 328.068 -9419.4 -6471.3 10:19:18 Mean Data: 1 Mean Corrected Calib. Sample Std.Dev. Analyte Intensity Conc. Units -6401.2 0.123 mg/L, Conc. Units 0.123 mg/L Std.Dev. RSD 0.0002 0.13% Ag. 328.068 0.0002 ------Sequence No.: 8 Autosampler Location: 27 Sample ID: 2 Date Collected: 11/19/2016 10:20:03 AM Analyst: Data Type: Reprocessed on 11/19/2016 10:26:03 AM Logged In Analyst (Original) : Optima 2100DV Initial Sample Wt: Initial Sample Vol: Dilution: Sample Prep Vol: Nebulizer Parameters: 2 Back Pressure 112.0 kPa Analyte Flow 0.80 L/min A11 Replicate Data: 2 Calib. Net Corrected Sample Analysis
 Intensity
 Conc.
 Units

 5299.1
 0.134 mg/L
 0.135 mg/L

 4939.9
 0.134 mg/L
 Repl# Analyte Intensity Conc. Units Time 10:21:06 1 Ag 328.068 2 Ag 328.068 3 Ag 328.068 2351.0 2693.0 0.134 mg/L 0.135 mg/L 0.135 mg/L 0.134 mg/L 10:21:10 1991.9 10:21:14 Mean Data: 2
 Mean Corrected
 Calib.

 Intensity
 Conc. Units
 Std.Dev.

 5293.4
 0.134 mg/L
 0.0003
 Sample Std.Dev. RSD 0.0003 0.25% Conc. Units 0.134 mg/L Analyte Ag 328.068 Autosampler Location: 28 Sequence No.: 9 Sample ID: 3 Date Collected: 11/19/2016 10:21:59 AM Data Type: Reprocessed on 11/19/2016 10:26:03 AM Analyst: Logged In Analyst (Original) : Optima 2100DV Initial Sample Wt: Initial Sample Vol: Dilution: Sample Prep Vol: Nebulizer Parameters: 3 Analyte Back Pressure Flow 112.0 kPa 0.80 L/min All Replicate Data: 3 Net Corrected Calib. Sample Analysis
 Repl# Analyte

 1
 Ag 328.068

 2
 Ag 328.068

 3
 Ag 328.068
 Intensity Intensity Conc. Units Conc. Units Time 10:23:03 0.136 mg/L 0.136 mg/L 0.136 mg/L 3898.3 4204.9 3788.3 0.136 mg/L 6846.4 7152.9 0.136 mg/L 10:23:07 3788.3 6736.3 0.136 mg/L 0.136 mg/L 10:23:10 Mean Data: 3 Calib. Mean Corrected Sample
 Std.Dev.
 Conc. Units
 Std.Dev.
 RSD

 0.0002
 0.136 mg/L
 0.0002
 0.15%
 Conc. Units Analyte Intensity Ag 328.068 0.136 mg/L 0.0002 6911.9 _____ Sequence No.: 10 Autosampler Location: 29 Sample ID: 4 Date Collected: 11/19/2016 10:23:55 AM

Date: 11/19/2016 10:33:33 AM 5 : Ag Test Page Data Type: Reprocessed on 11/19/2016 10:26:03 AM alyst: gged In Analyst (Original) : Optima 2100DV Initial Sample Vol: Initial Sample Wt: Sample Prep Vol: Dilution: Nebulizer Parameters: 4 Back Pressure 112.0 kPa Flow Analyte 0.80 L/min A11 Replicate Data: 4 Net Corrected Calib. Sample Analysis Conc. Units 0.133 mg/L Conc. Units Time Intensity Intensity Repl# Analyte 10:24:57 0.133 mg/L Ag 328.068 Ag 328.068 3655.0 3328.3 707.0 0.132 mg/L 0.132 mg/L 10:25:02 2 10:25:07 Ag 328.068 349.0 3297.0 0.132 mg/L 0.132 mg/L 3 Mean Data: 4 Sample Mean Corrected Calib.
 Std.Dev.
 Conc.
 Units
 Std.Dev.
 RSD

 0.0002
 0.132 mg/L
 0.0002
 0.14%
 Analyte Intensity Conc. Units 3426.8 0.132 mg/L, Conc. Units Ag 328.068 Reprocessing Begun Logged In Analyst: Optima 2100DV Technique: ICP Continuous Results Data Set (original): ag Results Library (original): C:\pe\Optima 2100DV\Results\Results.mdb Results Data Set (reprocessed): Results Library (reprocessed): Autosampler Location: 30 Sequence No.: 1 Date Collected: 11/19/2016 10:25:52 AM Sample ID: 5 Data Type: Reprocessed on 11/19/2016 10:32:12 AM Analyst: Logged In Analyst (Original) : Optima 2100DV Initial Sample Vol: Initial Sample Wt: Sample Prep Vol: Dilution:
 Nebulizer
 Parameters:
 5

 Analyte
 Back
 Pressure

 all
 112.0 kPa
 0.80 L/min
 Replicate Data: 5 Calib. Sample Analysis Net Corrected Conc. Units 0.117 mg/L 0.117 mg/L Conc. Units 0.117 mg/L Intensity Intensity Time Repl# Analyte 1 Ag 328.068 2 Ag 328.068
 Intensity
 Intensity

 -16040.7
 -13092.7

 -15637.2
 -12689.1

 15520.4
 15520.4
 10:26:56 0.117 mg/L 10:27:01 Ag 328.068 -15590.4 10:27:06 0.114 mg/L 0.114 mg/L -18538.4 3 Ag 328.068 Mean Data: 5 Calib. Conc. Units Analyte Mean Corrected Sample Std.Dev. RSD 0.0015 1.29% Std. Dev. Conc. Units Intensity 0.116 mg/L 0.116 mg/L 0.0015 Ag 328.068 -13790.7Autosampler Location: 31 Sequence No.: 2 Date Collected: 11/19/2016 10:27:52 AM Sample ID: 6 Data Type: Reprocessed on 11/19/2016 10:32:12 AM Analyst: Logged In Analyst (Original) : Optima 2100DV Initial Sample Vol: Initial Sample Wt: Sample Prep Vol: Dilution:

Rg Test Page 6 Date: 11/19/2016 10:33:33 AM olizer Parameters: 6 Mmalyte Back Pressure Flow 112.0 kPa 0.80 L/min Replicate Data: 6 Net Corrected Calib. Sample Analysis Repl# Analyte 1 Ag 328.068 Intensity Intensity Conc. Units Conc. Units Time 10:28:55 -400.8 -797.1 2547.3 2151.0 0.132 mg/L 0.132 mg/L 2 Ag 328.068 0.131 mg/L 0.131 mg/L 10:28:59 3 Ag 328.068 -874.0 2074.1 0.131 mg/L 0.131 mg/L 10:29:04 Mean Data: 6 Mean Corrected Calib. Sample Analyte Intensity Conc. Units Std.Dev. Conc. Units Std.Dev. RSD 0.0002 0.18% Ag 328.068 2257.4 0.131 mg/L 0.0002 0.131 mg/L Reprocessing Begun Logged In Analyst: Optima 2100DV Technique: ICP Continuous Results Data Set (original): ag Results Library (original): C:\pe\Optima 2100DV\Results\Results.mdb Results Data Set (reprocessed): Results Library (reprocessed) : Sequence No.: 1 Autosampler Location: 32 Date Collected: 11/19/2016 10:29:49 AM Sample ID: 7 Analyst: Data Type: Reprocessed on 11/19/2016 10:33:26 AM Logged In Analyst (Original) : Optima 2100DV Initial Sample Wt: Initial Sample Vol: Dilution: Sample Prep Vol: Nebulizer Parameters: 7 Back Pressure Analyte Flow 112.0 kPa A11 0.80 L/min Replicate Data: 7 Net Corrected Calib. Sample Analysis Repl# Analyte Intensity Intensity Conc. Units Conc. Units Time 10:30:54 1 Ag 328.068 0.129 mg/L -3097.0 -149.0 0.129 mg/L Ag 328.068 0.130 mg/L 0.130 mg/L 10:30:58 Ag 328.068 3 -2684.0 264.1 0.129 mg/L 0.129 mg/L 10:31:02 Mean Data: 7 Mean Corrected Calib. Sample Intensity Conc. Units 278.9 0.129 mg/L Std.Dev.Conc. Units0.00040.129 mg/L Std.Dev. RSD 0.0004 0.32% Analyte Ag 328.068 _____ Sequence No.: 2 Autosampler Location: 33 Sample ID: 8 Date Collected: 11/19/2016 10:31:47 AM Analyst: Data Type: Reprocessed on 11/19/2016 10:33:26 AM Logged In Analyst (Original) : Optima 2100DV Initial Sample Wt: Initial Sample Vol: Dilution: Sample Prep Vol: Nebulizer Parameters: 8 Analyte Back Pressure Flow

Ag	Test				Page 7				Date: 11/19/2016 10:33:33 #		
		112	.0 kPa	0	.80 L/min						
Replicate I Repl# Anal 1 Ag 3 2 Ag 3 3 Ag 3	yte 28.068 28.068 28.068			Cor y Int 0 9 4	rected ensity 2839.0 2361.2 3573.5	Conc. 0.132 0.131 0.133	Calib. Units mg/L mg/L mg/L		Conc. 0.132 0.131 0.133	Sample Units mg/L mg/L mg/L	Analysis Time 10:32:51 10:32:56 10:32:59
Mean Data: Analyte Ag 328.068	8			Conc . 0.132	Calib. Units mg/L	Std.De 0.000	v .	Conc. 0.132	Sample Units mg/L	Std.De 0.000	v. RSD 6 0.44%







