IOP Conference Series: Earth and Environmental Science

Alluvium Assessment of Gold-Bearing Layer in Buried Old River Channel by using Electrical Resistivity Method at Batu Melintang, Jeli, Kelantan

IOP Conf. Series: Earth and Environmental Science **549** (2020) 012016 doi:10.1088/1755-1315/549/1/012016

Alluvium Assessment of Gold-Bearing Layer in Buried Old River Channel by using Electrical Resistivity Method at Batu Melintang, Jeli, Kelantan

Mohd Syakir Sulaiman[1*], Wani Sofia Udin[1], Arham Muchtar Achmad Bahar[1], Mohamad Fatihi[2], Ahmad Fikri[2].

[1] Geoscience Department, Faculty of Earth Science, Universiti Malaysia Kelantan, Jeli, Kelantan, Malaysia
[2] Ferrogeo Services, 1-4, Arked MARA Jeli, Bandar Baru Jeli, 17600 Jeli, Kelantan, Malaysia

E-mail: syakirsulaiman123@gmail.com

Abstract. The electrical resistivity imaging (ERI) survey was conducted to delineate the distribution of sediment in the gold-bearing layer and the nature of bedrock within the study area at Batu Melintang. The study area is known as a highly potential zone of gold mineralization due to its location within the Bentong-Raub suture zone. Miners are having difficulties to have a proper mining activities plan as the alluvium distribution is not well understood. The objectives of this study are to identify the sediment in the subsurface of the mining area and to locate the high potential deposit containing gold. ERI survey concerns with resistivity (ohm.m) value of rocks in the subsurface. This research was conducted by using the Schlumberger array with the total number of survey lines are four. All the survey line were done in 200m with 2.5m electrode spacing except for survey line 3 which was done at 100m with 1.5m electrode spacing. All the data obtained is processed in RES2DINV software. The results show variable resistivity ranging from 1-4000ohm.m with a depth of investigation is approximately 35m for 200m length of survey line and depth of 16m for 100m length of survey line. Low resistivity zones of 10-800ohm.m show the values for alluvium present in the area while high resistivity zones of 2000-4000ohm.m indicate values for bedrock. Alluvium layer is identified located around 15m depth, whereas the depth of bedrock is about 20m. This survey gives the general idea of the alluvium distribution, old river channel and the depth of bedrock that can be used for volume estimation and facilitates to create a proper sustainable mining plan in the future

1. Introduction

Gold is the most well-known mineral resource that had been mining from the To Mo (Thailand) and Kalai (Malaysia), Batu Melintang areas for many years [1]. Gold is defined as a high economic value commodity, which gives income to local's economic. According to a geochemical sampling by Baharuddin [2], the stream sediment at Ulu Pergau, covering Kampung Kalai Baru and Kampung Lawar, Batu Melintang defined that the area has gold mineral potential with the highest tenor of gold value in heavy mineral concentrate was 1,574.68 mg/m^3 at a tributary of Sungai Tadoh. Another geo-chemical sampling is also carried out at Kampung Kalai, which showed the maximum gold (Au) value was 132 ppb and the highest grade and tenor in heavy mineral concentrate was 214 ppm and 383 mg/m^3, respectively [3]. The geochemical sampling results indicate the high gold mineral potential zone at Batu

Melintang. Nowadays, many small scale miner has conducted mining activities around the area as one of the economic generation for local people.

The use of a geophysical method for gold exploration is to define the distribution of the sediment in gold-bearing layer within the study area at Batu Melintang. The resistivity survey is commonly used in a geophysical method for gold exploration due to its benefits, conceptual simplicity and easy to use, as the technique is environment-friendly. ERI survey is known as a non-destructive method because the surface technique can reduce the interruption and damage to the site [4]. ERI survey is mainly capable of providing information about geology, subsurface structures underlain in the area, alluvium distribution, and old river channel based on the electrical properties of the subsurface [5]. The data acquisition was carried out by making a measurement on the ground surface. Schlumberger array was used in this survey to acquire the resistivity data. This array has advantages that can help to recognize the layering of sediment containing gold, which helps in an effective mining plan.

The study area was located in Batu Melintang, Jeli, Kelantan. The rock formations in the study area mainly consist of metasediment and metamorphic rock of Mangga Formation. Map of the study area is shown in Figure 1 and the view of the survey line is shown in Figure 2.

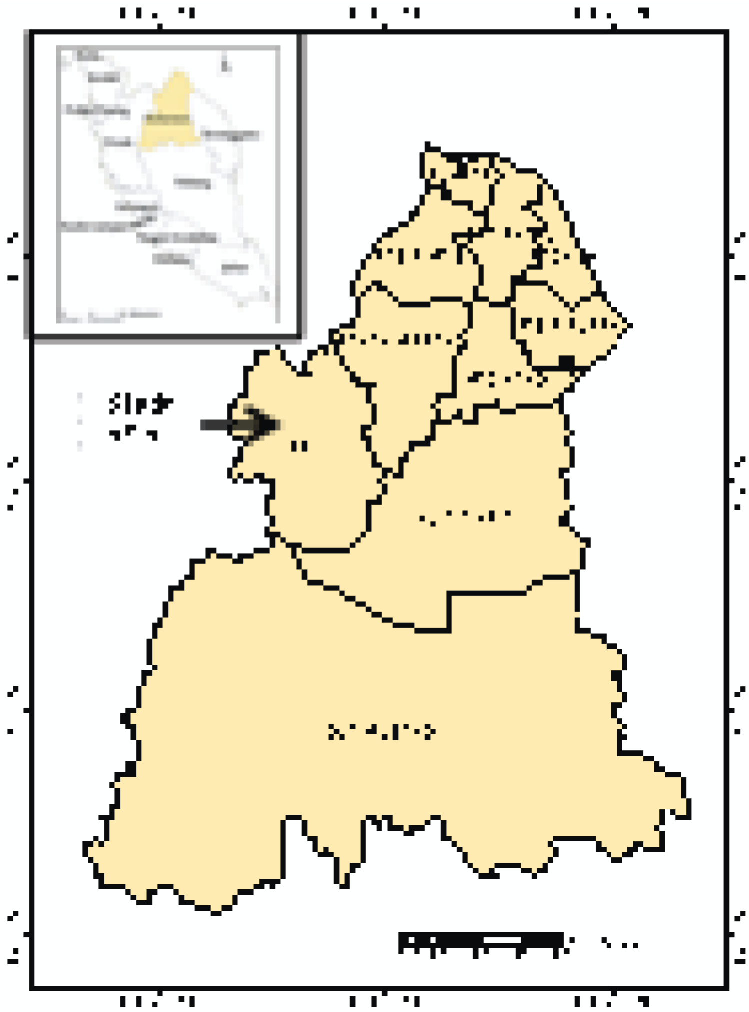

Figure 1. Map of study area location.

Figure 2. Centre of the survey line.

2. Material and Methods

Four lines of Schlumberger arrays are carried out in the study area. Schlumberger array was used due to its better resolution, greater probing depth, and less time-consuming [6]. The survey lines have length 200/100m with 2.5/1.5m electrode spacing. The equipment used in this survey as shown in Figure 3 including ABEM Terrameter LS, battery, Lund imaging cable, electrode clip, cable connector, steel electrode, 200m multiconductor cable, GPS and hammer. The raw survey data undergoes inverse modeling by using RES2DINV software to obtain the pseudosection data that show the resistivity values of the subsurface area.

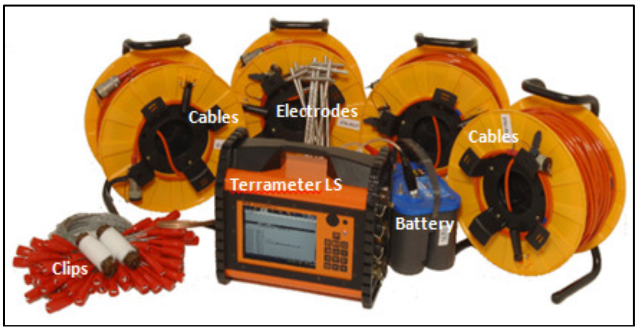

Figure 3. Equipment used for ERI

3. Results and Discussion

Generally, the resistivity values obtained from this survey ranging from 10Ωm to 4000Ωm. Each survey line is processed and undergoes a 2D inversion process by using RES2DIV software including the topographic correction. The interpretation of each pseudosection is made by comparing the resistivity value of material display in pseudosection with resistivity value by previous research as shown in Figure 4. However, the resistivity values can change due to the geological structure, weathering and ground condition. For this survey, the focus is on the resistivity values produced by the geological structure and sediment.

The total profile length of resistivity line 1 is 200m with 2.5m electrode spacing. The maximum depth of penetration is 35m. Based on the pseudosection profile Schlumberger 1 shown in Figure 5, there are three river channels (in dotted lines) with low resistivity values suspected exist in the area with an

IOP Conf. Series: Earth and Environmental Science **549** (2020) 012016 doi:10.1088/1755-1315/549/1/012016

average of depth is 10 meters. The location of the channels located at 70m, 120m and 160.5m from the starting of the survey line (0m). Thus, these channels indicate an ancient river which had a probability for gold sediment was deposited. The area with a high resistivity value of > 900Ωm, which located at an elevation between 75m to 100m has been interpreted as a hard layer bedrock.

The total profile length of resistivity line 2 is 200m with 2.5m electrode spacing. The maximum depth of penetration of survey line 2 is 35m. Based on the pseudosection profile Schlumberger 2 shown in Figure 5, there are six river channels (in dotted lines) displayed at the area with an average of 10 meters depth. The location of the channels located at 10m, 40m, 60m, 120m, 140m and 160.5m length from starting survey point. There is a high probability for gold sediment deposited at this area as many channels are found with the depth up to 10m from the surface. The sector with a high resistivity value of > 900Ωm, which located at a depth between 75m to 100m has been classified as a hard layer bedrock.

The total profile length of resistivity line 3 is 100m with 1.25m electrode spacing. The maximum depth of penetration is 16m. Based on the pseudosection profile Schlumberger 3 shown in Figure 5, there are three river channels (in dotted lines) found in the area The location of the channels located at 10m, 40m, and 60.5m length from the starting survey line (0m). The channel located at 60.5m has 12m depth with wide channel compared to other channels in this survey line. Bedrock or hard layer with a high resistivity value of > 900Ωm located at depth between 90m to 102m.

The total profile length of resistivity line 4 is 200m with 2.5m electrode spacing. The maximum penetration is 35m. According to the pseudosection profile Schlumberger 4 shown in Figure 5, three river channels (in dotted lines) with low resistivity value were identified. The location of the channels located at 40m, 60m, and 120m length from the starting survey line with various width and depth. The extent of these channels is up to 35 meters, which are more in-depth compared to other channels. The probability for gold sediment deposited is at the bottom of the channel (up to 35m from the surface).

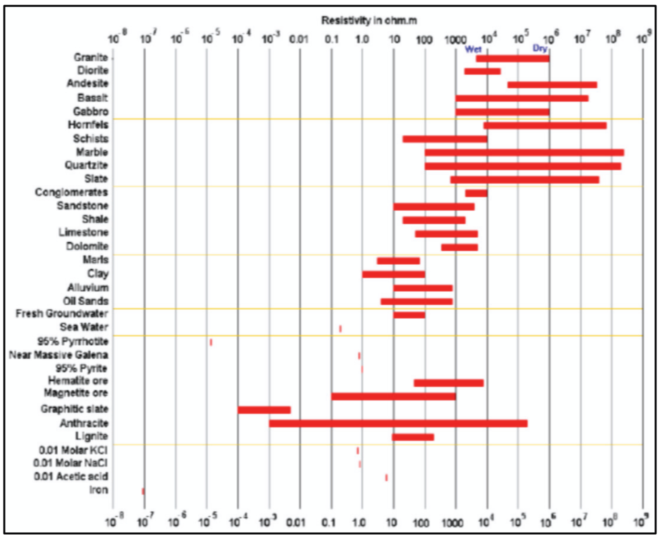

Figure 4. Resistivity value of rocks, soils and minerals [7].

The possibility of buried old river channels are identified from the pseudosection for each survey line. The proposed old river channels are shown in Figure 6 based on the interpretation of low resistivity value from total four survey lines. There are four main channels of an old river in the area. These hidden-rivers are the most promising area for sediment to be deposited with gold. As a result, the miner can concentrate on the mining activities at these specific locations. These will facilitate a more sustainable mining plan as the primary target zone are prominent.

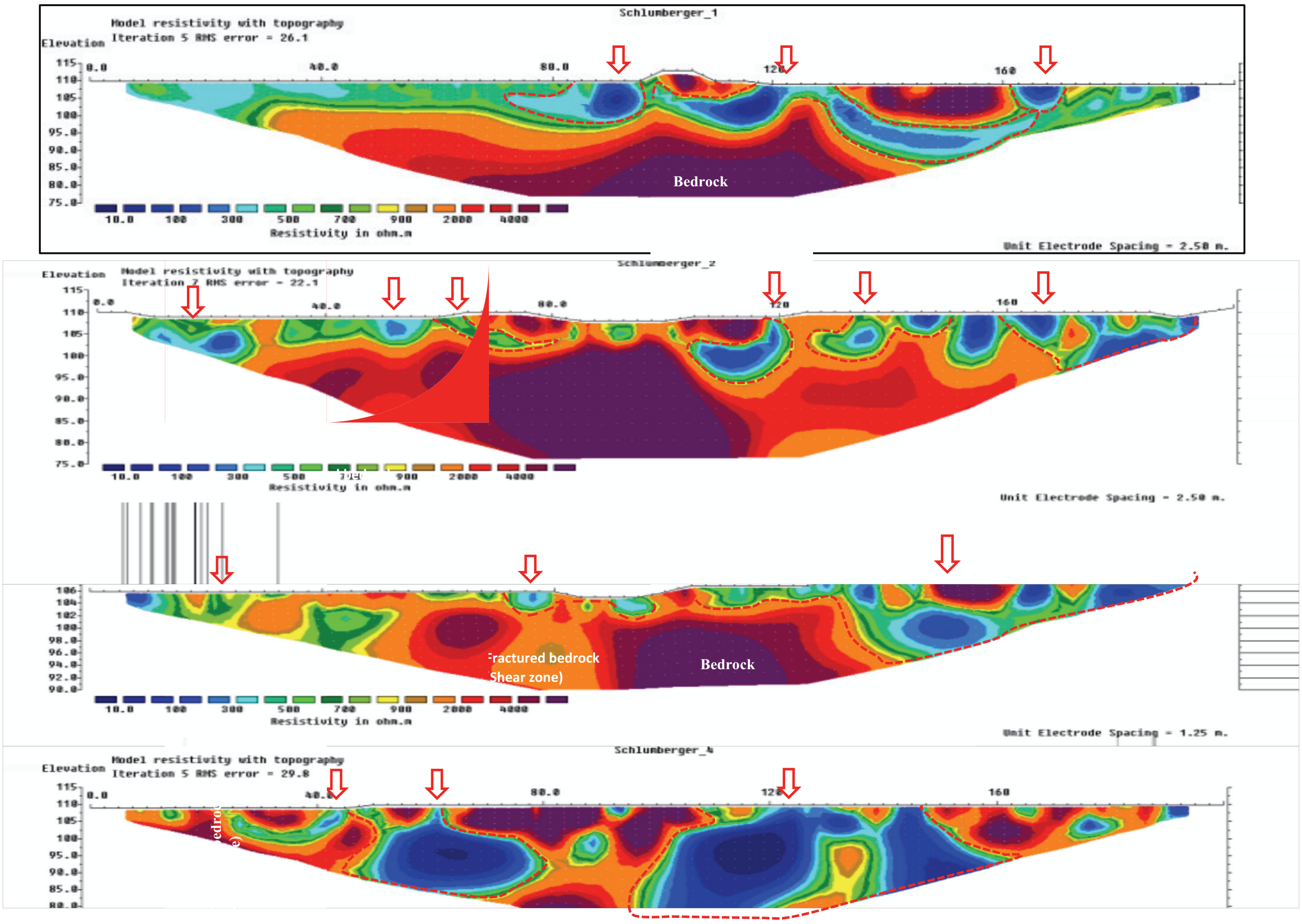

Figure 5 Survey line 1, 2, 3 and 4

Figure 6. Location of the survey line with proposed ancient river channels.

4.Conclusion

The electrical resistivity survey is commonly used in for hydrogeology and exploration. However, there is no detailed research conducted in Malaysia with the purpose of alluvium assessment for the gold-bearing layer. The results of the survey lines show several channels of olden rivers with a different sediment distribution. The results give a lot of benefits to the miner by enabling them to plan a cost and time productive mining activities as the location, distribution, and thickness of high potential gold-bearing alluvium are be identified and focused.

Acknowledgements

The authors would like to thank Universiti Malaysia Kelantan and Ferrogeo Services team for financial and equipment support in this research.

References

[1] MT-JGSC (Malaysia – Thailand Border Joint Geological Survey Committee) 2006 Geology of the Batu melintang – Sungai kolok transect area along the Malaysia-Thailand border. Minerals and Geoscience Department Malaysia and Department of Mineral Resources, Thailand 1-70
[2] Safeen Baharudin 1987 Gold Investigation in Batu Melintang area, Kelantan. *Geological Survey Malaysia*. (in Malay)
[3] Mohd Azmer Ashari, Che Abdul Rahman Jaafar and Ong, W.S.1995 *Reconnaissance Geochemical Exploration for Gold in Kelantan*. *Geological Survey Malaysia, Report No*: EMR 03/95 (in Malay)
[4] Azhar A T S, Hazreek Z A M, Aziman M, Haimi D S, and Hafiz Z M 2016 , *Journal of Physics: Conference Series* 710 1-9.
[5] Arifin M.H., Kayode J.S., Izwan M.K., Zaid H.A.H. and Hussin H. 2019 *Data in brief* 22 830-835
[6] Loke, M.H. 1999 Electrical imaging surveys for environmental and engineering studies, *A practical guide to 2D and 3-D surveys* 1-60