The study of Chepor Member facies at Bumita Quarry, Perlis using seismic refraction and electrical resistivity method

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Abstract: The existance of outcrops allows observation and sampling of bedrock for geological analysis, they give highly detailed and spatially continuous information on petrology, facies, sedimentary structure, texture, grain types, morphometric properties, fractures and their orientations, joint patterns, compaction, diagenetic changes, and petrophysical and physicochemical properties (Van Dam *et al.*, 2015). The parameters of seismic refraction and electrical resistivity is very important in geological studies as the values indicate the type of rock or soil beneath the earth subsurface. In Perlis, the stratigraphic succession basically youngs eastward starting from the Setul Boundary Range (Jones, 1981; Meor, 2013). The bottom unit of the Kubang Pasu Formation (KPF) is known as Chepor Member. The Chepor Member consists of thick grey to red mudstone with interbedded tabular beds of quartzitic and feldspathic sandstone and sometimes bedded diamictite (Meor, 2004). The study is carried out to fulfill the following objectives : to study geological outcrop of Chepor Member at Bumita Quarry, Utan Aji and to integrate both seismic refraction and electrical resistivity parameter with the porosity and permeability of mudstone in Chepor Member. The data acquisition was carried out at Bumita Quarry, Utan Aji. The survey line at Bumita Quarry, Utan Aji was conducted perpendicular to the exposed bedrock. The geophone spacing applied is 2 m while electrode spacing for electrical resistivity method is 1 m. Both methods were conducted simultaneously on the same survey line. The rock samples are taken from the exposed outcrop using rock hammer for laboratory test. The rock specimen was cut into cylindrical shape using a diamond drill bit core driller. The method used for permeability test is nitrogen permeability test whereas for porosity, water immersion under vacuum is used. The rock samples were also brought to Mineralogical and Geosciences Department (JMG) in Ipoh to produce the thin section. Generally, the seismic velocity and resistivity value of mudstone produced by Reynolds, 1997 and Loke, 1999 respectively is in a wide range (Table 1), this research characterize the resistivity value of red mudstone and grey mudstone of Chepor Member at Utan Aji. Previous researchers have established the range values of seismic velocity and resistivity with respect to type of rocks presented in a table for references (Table 1). The broad range of this values might cause difficulties in interpretation since the range values overlapped with each other. In Perlis, Malaysia, seismic refraction and electrical resistivity methods were conducted at Chepor Member of Kubang Pasu Formation at Bumita Quarry, Utan Aji and the results were integrated with the values of porosity and permeability. The Chepor Member consist of red mudstone and grey mudstone. The seismic velocity of both mudstone is nearly the same with slight difference within 200 m/s. Pole-dipole array was used for the resistivity method. For resistivity values, red mudstone gives lower values (15 – 100 Ωm) than grey mudstone (120 – 500 Ωm). The porosity value for red mudstone is 0.95% while its permeability, 5.58×10^{-5} µd. Porosity value for grey mudstone is 1.9% with permeability 2.06×10^{-5} µd. Thus, the seismic velocity and resistivity values of mudstones of Chepor Member were established (Table 2).

Table 1: Geophysical parameter of mudstone with seismic velocity and resistivity values.

Geophysical parameter of mudstone	*Values*
Seismic velocity (Reynolds, 1997)	1000 – 4100 m/s
Electrical resistivity (Loke, 1999)	20 – 2000 Ωm

Table 2: Table of red mudstone and grey mudstone with respect to its parameters.

Parameters	*Red mudstone*	*Grey mudstone*
Seismic velocity (m/s)	1500 – 2100	1500 – 2300
Resistivity (Ωm)	15 – 100	120 – 500
Porosity (%)	0.95	1.9
Permeability (µd)	5.58×10^{-5}	2.06×10^{-5}

Keywords: seismic refraction, electrical resistivity, sedimentary rocks, Chepor Member, porosity, permeability

References

Van Dam, R.L., Storms, J E.A., Schuster, G.T., Malehmir, A., Kenter, J.A.M. & Forte, E., 2015. Introduction to special section: Geophysical imaging and interpretation of outcrops. SEG and AAPG, Interpretation, vol. 3, no. 3, SYi-SYii.

Loke, M. H., 1999. Electrical imaging survey for environmental and engineering studies. A practical guide to 2-D and 3-D surveys.

Reynolds, J.M., 1997. An introduction to applied and environmental geophysics. New York, John Wiley and Sons.

Jones, C.R., 1981. The geology and mineral resources of Perlis,

north Kedah and the Langkawi Islands. Geological Survey of Malaysia District Memoir 17, 1-257.

Meor, H.A.H., 2013. Post-Conference Field Excursion to Northwest Peninsular Malaysia: Third International Conference on Palaeontology of South East Asia. ICPSEA 3, 10th-13th October 2013.

Meor, H. A. H. & Lee, C. P., 2004. The depositional environment of the Mid-Paleozoic red beds at Hutan Aji, Perlis and its bearing on global eustatic sea level change. Geological Society of Malaysia, Bulletin 48, 65-72.