Estimation of Shale Content Calculation using log data in Kutai Basin

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ABSTRACT

Log data from the study area is located in the Kutai Basin, precisely in the Pulubalang Formation which is used to calculate the estimated shale content. Shale content estimation is one of the petrophysical parameters. In this study, the calculation of shale content estimation uses 3 methods, namely linear, Clavier and Stieber methods. The results of the calculation will provide the volume value of shale in the research area. In the process of calculating the shale content is calculated by separating the range of zones that will be calculated after determining the shale baseline by positioning the zone line on the highest gamma ray log and sand baseline on the lowest gamma ray which then shows the shale content contained in the zone to be analyzed. The results of the calculation of shale content in well A at a depth of 2750 - 3224 m ranged from 36.57% to 71.99%. The results of the analysis of clay content in the study area have an average clay content of 49.22%, meaning that the more clay content, the smaller the permeability and resistivity values will be and will increase the water saturation value.

Keyword: Volume Shale, Petrophysics, Log Gamma ray

INTRODUCTION

Well Logging is a method of measuring physical parameters, in a borehole, that varies with depth. The logging method is very important because it can provide a detailed description of the physical properties of the rock around the drilling hole.

Gamma Ray Log is a method of measuring gamma radiation produced by radioactive elements contained in the rock layers along the borehole. According to Asquith (1982) Log GR measures radioactivity in the formation and can be used for lithologic identification and for zone correlation. Log Gamma Ray radioactivity comes from 3 radioactive elements present in the rock namely Uranium (U), Potassium (K), and Thorium (Th) which continuously emit Gamma Ray in the form of pulses of high radiation energy. The uses of Gamma Ray logs include evaluation of shale content (Vsh), determining permeable layers, and correlation between wells.

Radioactive elements are generally found in non-permeable layers such as shale and very little in sandstone, limestone, dolomite, coal, etc. The gamma ray response in shale is very significant with other rocks, the Gamma Ray curve will show a deflection to the left. The shale content indicated from the Gamma ray log is interpreted into grain size terms. Changes in grain size will be followed by changes in gamma ray values, Figure 1 (rider, 2002).

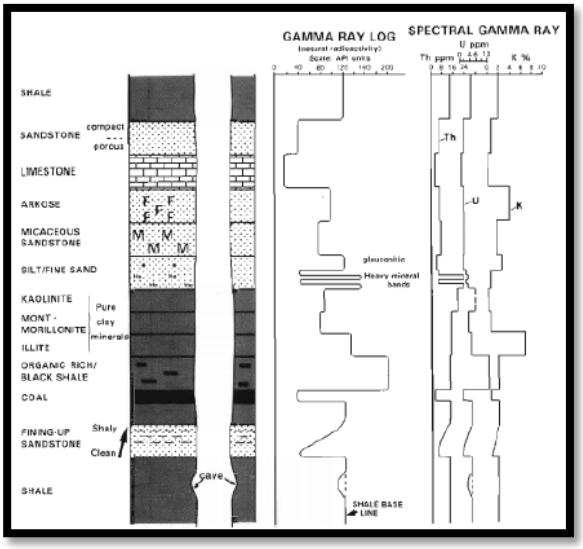

Figure 1. Gamma Ray Log interpretation of rock (rider, 2002)

Clay content or shale volume is the percentage of shale content present in a rock. Shale is a rock with a fine grain size that contains clay and silt minerals (Ellis & Singer, 2008). Clay contained in a rock is an obstacle to fluid flow because clay has impermeable properties.

The Kutai Basin is composed of Tertiary-aged sedimentary deposits that exhibit marine transgression and regression phase deposits (Allen and Chambers, 1998). The Paleogene sedimentation phase began when extensional tectonics and rift filling occurred in the Eocene. During this time, the Barito, Kutai,

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and Tarakan Basins were interconnected subsidence zones (Chambers & Moss, 2000), then Paleogene sedimentation reached a peak in the filling phase when the basin did not experience significant movement, thus depositing regional deep-sea shale and carbonate rocks in the Late Oligocene. In this study, an estimation of shale content in the Kutai Basin was calculated,

RESEARCH METHOD

The research method used is quantitative analysis. Calculation of clay content using log Gamma Ray, while the equation in the calculation of clay content used in this study is the Linear, Clavier and Stieber equation. The following is the clay content equation used in the study:

Linear Equations:

$$Vshale = I_{GR} = \frac{GR\log - GRmin}{GR\max - GRmin} \text{.....(1)}$$

Clavier Equations:

$$Vshale = 1{,}7\sqrt{3.38} - (Igr + 0{,}7)\text{^}2 \text{.....(2)}$$

Stieber Equations:

$$Vshale = \frac{Igr}{3 - 2Igr} \text{.....(3)}$$

RESULT AND DISCUSSION

The calculation of shale volume using gamma ray logs with a three-method approach including linear, Clavier, and Stieber provides a shale volume value for each measurement point.

In the calculation process, the shale content is calculated by separating the zone range that will be calculated after determining the shale baseline by positioning the zone line on the highest gamma ray log and the sand baseline on the lowest gamma ray which will then show the shale content contained in the zone to be analyzed.

The results of the calculation of Shale Volume in well A obtained by each method are listed in table 1. The results of the calculation of shale content in well A at a depth of 2750 - 3224 m ranged from 36.57% to 71.99%. Linear method shows smaller results (pessimistic) compared to other methods. So from the results of the clay content in well A, it is possible that the permeability and resistivity values will be smaller and will increase the water saturation value.

CONCLUSION

Based on the results of quantitative analysis in well A, the estimated shale content has an average value of 49.22% shale volume. The linear method shows smaller results (pessimistic) compared to other methods. So from the results of the clay content in well A, it is possible that the permeability and resistivity values will be smaller and will increase the water saturation value.

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Table 1. Calculation results of shale yield estimation

Zone	Linear	Clavier	Stieber
1	37.50%	21.94%	17.82%
2	36.57%	21.54%	17.63%
3	71.99%	55.71%	49.66%
4	53.40%	38.18%	33.21%
5	46.61%	30.37%	25.42%

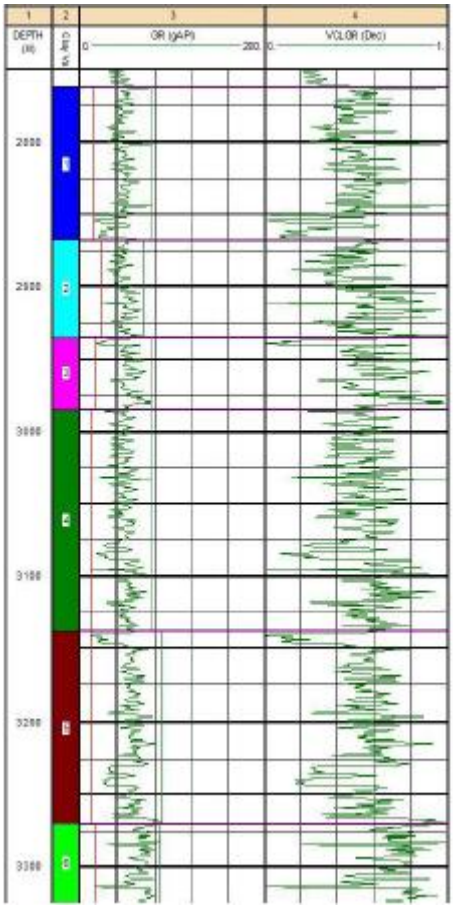

Figure 2. Clay content of each zone in well A

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