Laboratory Study: The Effect of Clay Mineral in Sandstone on Resistivity of Rock

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Abstract. One of the cases of low resistivity pay zone in several oil and gas fields is due to the presence of shale in the sandstone. This can lead to misinterpretation of what should be a hydrocarbon prospect zone looking like a water zone. The purpose of this study was to analyze how much influence the presence of shale in the sandstones has so that it is hoped that a solution can be obtained to solve the low resistivity pay zone problem. The greater the percent volume of shale, the greater the percentage decrease in resistivity. This will result in an error reading of the Resistivity price, so that this zone the Sw price looks too high. Thus, the prospect layer of hydrocarbon can be missed. (By Pass Zone). The calculation method with Water Saturation (Sw) correction is based on the Archie formula. To overcome the deviation of the Archie formula on sandstones that contain shale, an empirical approach is used. With this approach, the corrected Sw Archie is the Sw Archie measurement that has been substituted with the Sw Archie parameter and the volume of shale and shale. The empirical equation of the research results is presented in the form of the relationship between shale volume and water saturation. To validate the results of the Corrected Sw Archie calculation, other methods are needed, including: Sw Archie, Indonesia, Simandoux as comparative data. Meanwhile, Sw measurement as reference data. The comparison results show that Sw Archie is corrected to the closest measure to Sw.

1. Introduction
In research and data analysis, it is expected that the effect of shale minerals on rock resistivity is due to the presence of shale in sandstones. From the measurement and calculation of Water Saturation using various Archie methods, the formation factor, various constants (a), cementation factor (m), saturation exponent (n) are also calculated. As well as various water saturation deviations on the two types of cores with shale and shale content.

2. RESULT AND DISCUSSION
In research and data analysis, it is hoped that the effect of shale minerals on rock resistivity is known because the presence of shale in the rock will cause the resistivity to be low.
The Relationship Between Shale Volume and Porosity
The relationship between Shale Volume and Porosity shows that the greater the shale volume, the smaller the porosity. With the presence of shale, the greater the volume of shale, the smaller the porosity. This is because shale which has very fine grains can clog the spaces between the pores of the sandstone.

The Relationship Between Shale and Shale Volume on Permeability
The relationship between Shale Volume and permeability, the greater the shale volume, the smaller the permeability. The presence of shale that spreads out in the pores of the rock causes a pore throat and reduces the value of its porosity and permeability.

The relationship between shale volume and resistivity.
The greater the shale volume, the smaller the resistivity price. This is because shale can conduct electricity. So that the greater the Shale content, the greater the conductivity or the smaller the resistivity. In addition, with the decrease in the price of Water Saturation, the resistivity is getting bigger. This is because the smaller the water content, the smaller the conductivity or the greater the resistivity. Cores with shale content have a sharper price drop in resistivity than cores without shale. The Effect of Shale and the Effect of Shale Volume of Shale on Decreasing Rt (ΔRt) where the greater the Shale content, the greater the decrease in Rock Resistivity (ΔRt).

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The Relationship Between Shale Volume and Formation Factors
Relationship between Shale Volume and Relationship between Shale Volume and Formation Factors. From the graph, it can be seen that the greater the Volume Shale & Volume Shale, the greater the Formation Factor. This is because the greater the Shale Volume Shale Volume, the smaller a, m, n and rock porosity and Ro.

The Relationship Between Shale and Shale Volume Against Constants a, m, and n
The relationship between Shale Volume Percent and Shale Volume to Constants a, m, and n, the greater the shale volume, the constants a, m, and n decrease.
Relationship between Capillary Pressure vs Water Saturation on Shale Volume. The price of Water Saturation is getting bigger with increasing percentage of shale volume and at the same capillary pressure. This is because the greater the percent volume of shale, the greater the surface area of the shale volume absorption, so that Sw is getting bigger.

Relationship between Shale Volume and Water Saturation Deviation. The methods used as comparisons include: Archie's formula, Simandoux, Indonesia and Hossin. Of the various calculation methods, it turns out that the Corrected Sw Archie has the smallest deviation.

Conclusion
From the results of research that has been conducted on the effect of shale minerals on sandstone resistivity, several conclusions can be obtained. among others:
1. The presence of shale in the rock will cause the resistivity to be low. The shale content has an effect on the decline in resistivity prices.
2. Among the various methods of calculating Sw used, it turns out that the Corrected Sw shale Sw Archie has the smallest deviation.
3. Based on the analysis of synthetic cores, the relationship between Vshale and resistivity can be obtained. So as to produce empirical equations to correct for RT and Sw low resistivity hydrocarbon prospect zones.

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