Electrical Resistivity and Formation Factor

Geophysics 457
Safian Omar Qureshi
Kenneth Olusola Adebayo
ID 10086638

Purpose:

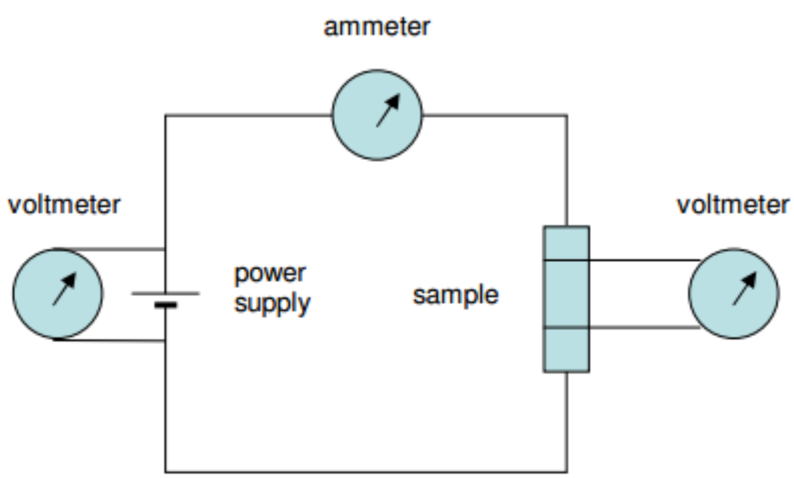
The purpose of this experiment is to measure the electrical resistivity and conductivity of water saturated rock samples and to also determine the formation factor.

Materials:

- Voltmeter
- Ammeter
- Conductive cables
- Water/rectangle bowl
- Mass scale
- Power supply
- Calipers

Relevant Formulae/Basic Diagram:

$$R = \rho \frac{L}{A} \quad F = \frac{\rho_{eff}}{\rho_w} \quad F = a\phi^{-m}$$



Procedure:

*Refer to lab manual

Analysis:

1. On excel sheets.

2. Values on excel sheets. The equations used in the excel sheet are found above. There were also some basic equations used such as finding the area of a circle. For standard deviations, excel function was used. Graph on excel. Some of the trends we can see on the graphs is that generally as axial stress increases, the P wave and S wave velocity stay relatively linear. Obviously the S wave plot is lower than the P wave plot, because P wave velocity is always higher than S wave.

3. On excel sheets.

4.

Sample	Rock Description
Gneiss	coarse grained, biotitic grain alignment, angular elongate grains, biotite, muscovite, plagioclase, quartz, very low porosity
Palliser	coarse grained, sub angular grains, moderate sorting, med to low porosity.
Limestone	Fine to Medium grained lime mudstone. Low to medium porosity, sub rounded grains, well sorted

If we look at the formation factor equation, it tells us that rocks with high formation factor tend to have high values of resistivity. And similarly, rocks with low formation factors generally have lower resistivity's. This is a noteworthy trend, having a link between these two values. Individual resistivities of rocks can also tell us even more about the rocks properties. Since formation factor is in terms of electrical resistivity of saturation with respect to water, thus rocks with high resistivity values will then have more water content within their pores. This indicates that highly resistive rocks tend to have a higher porosity value.

Now let's look a little closer into our values versus actual literature values to compare/contrast;

Our sandstone samples had values of 7.9, 5.2, 5.1, and 7.3. According to the literature values for sandstone, the formation factor should be around 3-20. Therefore these values make sense.

For the Gneiss rock type, we found the formation factor to be 106. According to the literature value, the formation factor should be roughly 100. Therefore this value makes sense.

For our formation factor values of high porosity quartz sandstone, we got a value of 10.2. This is within the literature range we found which is roughly 3-20. Therefore our formation factor values make sense.

The formation factor values for Palliser DS1 and DS2 is 41.3 and 54.3. The literature value for this type of rock ranges from 50-100. Therefore the formation factor values are reasonable.

For our various limestone formation factor values we got 27.0, 28.2, and 12.0. The literature value for limestone is roughly 3-20. Therefore these formation factors do make sense.

The low porosity quartz sandstone had a lab value of 26.6, which is less than the literature value of 50-100. This still follows the trend of a low porosity rock having a higher formation factor value. Therefore these formation factor values are reasonable[1].

Overall, the experimental values do align with accepted literature values and the laboratory produced excellent figures.

[1]http://www.georentals.co.uk/tn5.pdf