COMPLEX CONDUCTIVITY MEASUREMENTS OF RESERVOIR PROPERTIES

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Abstract The frequency dependence of complex electrical conductivity in the IP frequency range (10^{-3} to 10^{4} Hertz) has been investigated for a variety of shaly sandstones. The laboratory measurements were made with a computer controlled four-electrode system on plugs saturated and partially saturated with brine of different composition.

It has been found that the complex nature of the conductivity is caused solely by the capacitive behaviour of the interlayer region between the solid matrix and the electrolytic pore solution. The resulting main feature of the conductivity spectra is a constant negative phase angle over the investigated frequency range combined with a nearly identical power law frequency dependence of the real as well as the imaginary parts.

The frequency exponent is in the order of about 0 to 0.03. It is related to common IP-parameters. The relationships between the frequency exponent and reservoir properties are of special interest. The results of the study show that the frequency exponent is (1) proportional to the surface area to porosity ratio, (2) inversely proportional to water salinity, and (3) it shows a complicated dependence on water saturation.

Complex conductivity measurements enable an uncomplicated separation of electrical volume and interface effects to be made. Moreover, the results suggest that determination of specific surface area of reservoir rocks directly from complex electrical measurements can be made.