THE ROLE OF PORE GEOMETRY IN THE INTERPRETATION OF SHALY SANDS

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Knowledge of the degree of excess conductivity of a reservoir rock is fundamental when evaluating the water saturation of hydrocarbon reservoirs. Two conducting pathways, bulk and surface conduction, can co-exist within the interconnected pore geometry of reservoir rock systems. Bulk conduction occurs when the sample is under an electric field and the ions in the electrolyte are the major current source. Surface conduction arises along pore walls where cations are held on net-negatively charged mineral surfaces. The excess conductivity is a laboratory derived parameter which is used to evaluate the water saturation of shaly reservoirs in conjunction with wireline log data.

Traditionally, the excess conductivity is derived from the measurement of the cation exchange capacity of crushed, and dried core samples. These data are not representative of the charge-electrolyte distribution within the original rock pore geometry. Intrinsic excess conductivity can, therefore, only be measured on preserved core samples which give a direct measure of the electric current carried by bulk and surface ions within a 3-dimensional pore geometry. Present methods used to determine the excess conductivity confine the samples in a conductivity cell at low confining pressures (typically 400psi).

New experimental data have revealed that the laboratory derived excess conductivity decreases with increasing confining pressure. This is partly due to the simultaneous change in formation factor but it is also due to changes in surface tortuosity. The rate of change seems to be dependent on the pore geometry of the rock. In this study the pore geometry has been defined by the Archie cementation exponent m. In general the higher the value of m the lower the pore aspect ratio and vice versa. This association has been used to establish a relationship between excess conductivity at reservoir pressure and that at 400 psi. Failure to measure excess conductivity at reservoir pressures, or to compensate at the application stage, could result in errors in water saturations calculated from shaly sand equations using core and log data.