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Original Paper

Variations in Formation Resistivity and Geometric Tortuosity Factors for Consolidated Niger Delta Formations

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Formation resistivity evaluation is an essential part of electrical properties measurement of porous media. Such deduced properties are often considered in modeling of associated rock properties for better hydrocarbon exploitation. Cognizance of these properties trend are necessary to ensure acceptable magnitudes for regional-based analyses. The aim of this research study was to establish a trend in formation resistivity factor and geometric tortuosity factor for Niger delta formations in Nigeria. These electrical properties were evaluated via core analysis using direct and alternating current sources. Consolidated core samples were procured from different terrains of producing oilfields in Nigeria. Characterized samples in terms of porosities and permeabilities conformed to existing trends. However, clay minerals embedded in acquired samples resulted in lower values of formation resistivity factor. Deduced formation resistivity factors show acceptable values in the range of 3.55–10.26. Geometric tortuosity factor was adopted to evaluate the tortuous nature of Niger delta porous media due to electrical conductivity. Results obtained for geometric tortuosity factors were all < 1. This was used to infer the highly tortuous and sinuous nature of consolidated Niger delta formations. Furthermore, experimental data were subjected to multivariate regression analysis model of second order. All deduced mathematical formulations were comparatively analyzed with existing geometric tortuosity factor models. Mathematical models show reasonable forecast ability for prescribed porosity range with corrected Akaike's Information Criteria difference of 0.98 and 1.59.

KEY WORDS: Formation resistivity factor, Geometric tortuosity factor, Niger delta, Consolidated formations, Regression analysis.

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INTRODUCTION

Electrical properties of fluid-saturated rocks are often evaluated when drilling for hydrocarbon resources. This formation evaluation stage allows identification of fluid type with respect to its saturation. Their measurements are strongly influenced by fluid found in pore spaces, void orientation/network, and rock type (Bai et al., 2013). Fluid in pore spaces promotes electrical conductivity, while the rock grains transmit no electrical signals. However, clayey formations and hydrocarbons present in voids