Accepted Manuscript

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PII: S1464-343X(17)30321-7

DOI: 10.1016/j.jafrearsci.2017.08.004

Reference: AES 2986

To appear in: *Journal of African Earth Sciences*

Received Date: 5 August 2016

Revised Date: 2 July 2017

Accepted Date: 9 August 2017

Please cite this article as: Adeoti, L., Ayolabi, E.A., James, L., An innovative technique for estimating water saturation from capillary pressure in clastic reservoirs, *Journal of African Earth Sciences* (2017), doi: 10.1016/j.jafrearsci.2017.08.004.

An innovative technique for estimating water saturation from capillary pressure in clastic reservoirs

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ABSTRACT

A major drawback of old resistivity tools is the poor vertical resolution and estimation of hydrocarbon when applying water saturation (S_w) from historical resistivity method. In this study, we have provided an alternative method called saturation height function to estimate hydrocarbon in some clastic reservoirs in the Niger Delta. The saturation height function was derived from pseudo capillary pressure curves generated using modern wells with complete log data. Our method was based on the determination of rock type from log derived porosity-permeability relationship, supported by volume of shale for its classification into different zones. Leverette-J functions were derived for each rock type. Our results show good correlation between S_w from resistivity based method and S_w from pseudo capillary pressure curves in wells with modern log data. The resistivity based model overestimates S_w in some wells while S_w from the pseudo capillary pressure curves validates and predicts more accurate S_w. In addition, the result of S_w from pseudo capillary pressure curves replaces that of resistivity based model in a well where the resistivity equipment failed. The plot of hydrocarbon pore volume (HCPV) from J-function against HCPV from Archie shows that wells with high HCPV have high sand qualities and vice versa. This was further used to predict the geometry of stratigraphic units. The model presented here freshly addresses the gap in the estimation of S_w and is applicable to reservoirs of similar rock type in other frontier basins worldwide.

Keywords: Water saturation, Leverette-J functions, Reservoir, Core data, Pseudo capillary pressure curves