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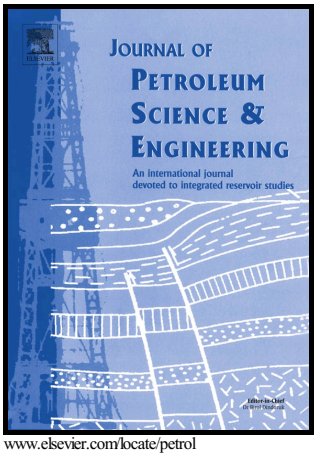

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PII: S0920-4105(16)30313-8
DOI: http://dx.doi.org/10.1016/j.petrol.2016.08.004
Reference: PETROL3579

To appear in: *Journal of Petroleum Science and Engineering*

Received date: 1 April 2016
Revised date: 27 May 2016
Accepted date: 4 August 2016

Cite this article as: Ali Kadkhodaie and Reza Rezaee, A new correlation fo water saturation calculation in gas shale reservoirs based on compensation o kerogen-clay conductivity, *Journal of Petroleum Science and Engineering* http://dx.doi.org/10.1016/j.petrol.2016.08.004

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A new correlation for water saturation calculation in gas shale reservoirs based on compensation of kerogen-clay conductivity

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Abstract

Determination of water saturation in gas shale reservoirs is a very challenging issue due to the incomplete understanding of the non-Archie components. Kerogen and clay content are the two main factors controlling the conductivity of gas shales and resistivity log responses. The presence of clays as conductive materials causes excessive conductivity for the rock that result in an overestimation of water saturation calculation. On the other hand, the presence of solid kerogen has an opposite effect to clays and causes reduction of rock conductivity and thus underestimation of water saturation.

In this research, attempts have been made to develop an effective equation for water saturation determination in gas shale reservoirs based on compensation of kerogen and shale conductivities. The new equation is able to handle both high and low conductivity components. The proposed approach makes one step ahead towards reducing uncertainty in the petrophysical evaluation of gas shale reservoirs. Being independent of formation water resistivity and Archie parameters are of the important and effective aspects of the introduced equation in water saturation calculation of gas shale reservoirs.

Finally, the kerogen-clay compensation equation has successfully been applied to the determination of water saturation in the Goldwyer shale formation, Canning basin, Western Australia.

Keywords: Water saturation, gas shale reservoirs, kerogen, shale resistivity, total organic carbon

Nomenclature

C_o Conductivity of a rock fully saturated with formation water ($S_w = 1$)

C_t True formation conductivity when $S_w < 1$

C_w Conductivity of formation water

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