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Enhanced Accuracy In The Characterization Of Clay Mineralogy And Partitioning Of Fluid Volumes In Shaly Sand- & Shale Reservoirs Based On Rationalized E-Log Response Parameters: Implications For Reducing Uncertainty & Risk In Prediction Of Reservoir Quality and Reserves: Examples From India & Other Countries

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ABSTRACT

Accuracy of the geological and petrophysical evaluation of shaly sand- as well as the shale oil and shale gas reservoirs requires precise characterization of their clay mineralogy. This paper underscores the need for- and the importance of correctly applying the mineral physics data available from clay science to the petrophysical assessment of bulk fluid volumes and reservoir quality of shales and shaly sand reservoirs.

The models / equations used to compute fluid volumetric for any given clastic reservoir aim to correct for clay bound water in shaly rocks, typically basing the “correction” on computed volume of clay or shale from logs, or from a laboratory-derived weight fraction of clay size particles in rocks (<4 microns). The clay bound water (CBW) represents ionically bound water of adsorption on the clay crystal surface. Laboratory core analysis (NMR and conventional porosity) showed that only the smectite group of clay minerals contain sufficient amount of CBW that could be distinguished from the discrete water phase occupying the porosity (includes capillary bound as well as free fluid). Enhanced accuracy in clay typing can then be achieved by using the log response parameters rationalized on the basis of crystal structure characteristics of smectite, illite, kalolinite and chlorite in the subsurface formations. We demonstrate in this paper how to apply the refined log response parameters in log analysis of shaly sand and shale formations independent of the origin (depositional or digenetic) and the mode of distribution of their clay mineral constituents. Examples from India and USA are presented that support the conclusions of this paper.

In conclusion, an accurate assessment of clay mineral composition of subsurface formations must be done before selecting a saturation model in log analysis! This paper presents a clay mineralogy based rationale so as to correctly partition the pore space saturated with water in the shaly sand reservoirs into "clay bound, capillary bound and free". This has significant implications for reducing the overall uncertainty and risk in E&P in terms of predicting reserves, reservoir quality and the production potential all of which have direct bearing on reservoir modeling and reservoir management.