Petrophysical Study of Gas Shale of the Permian Roseneath and Murteree Formations of the Cooper Basin, Australia.

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Abstract

The Cooper Basin, one of the largest intracratonic basins in Australia, extends from northern South Australia into South-western Queensland covering ~130,000 km2. The concepts of clay and shale have always been unequivocally defined in geology whereas this terminology has been used interchangeably in Petrophysics until the first shale gas discovery. It is interesting to note that prior to the shale gas revolution, shales containing commercial hydrocarbon accumulations (acting as source, seal and reservoir) were typically ignored or bypassed during log processing, and work instead focussed solely on using shale intervals for correction of porosity and resistivity logs for clay effects. Since then, the arrival of new technology, such as hydraulic fracturing, geochemical logging and complex petrophysical modelling, has encouraged greater interest in the exploitation of these reservoirs. This study focuses on the lacustrine Permian Murteree and Roseneath shales, which represent two of the most prospective shale gas plays in the Cooper basin. Both shales were investigated for gas volumes by employing unconventional petrophysical techniques through a combination of different parameters acquired by geochemical analysis, log interpretation and core studies. Qv (Cation exchange capacity per unit total pore volume) determination from well logs was used as a supplement required in the Waxman and Smit's equation when no core derived Cation exchange capacity (CEC) is available. The mineral model was built in the Interactive Petrophysics (IP's) Mineral Solver module by integrating all regional sedimentological, petrographic, SEM (Scanning electronic microscope) and X-ray diffraction data (XRD) from core and ditch cutting samples. The wells with incomplete data were analysed by the output parameters of wells having complete data. Exact mineralogical data is required to establish the mineral model to determine mineral and fluid volumes and the constraints to be used in the log interpretation. On the basis of the extensive study comprising geological and petrophysical analysis, it is concluded that Murteree shales have a better potential than the Roseneath Shales. It might be because we had significant core data in Murteree Formation and we used its parameters to evaluate the Roseneath Formation because both belong to the same depositional environment and geological age. Murteree Shale exhibits excellent potential in Dirkala-1, Dirkala-2, Ecounter-1,Epsilon-1, Moomba-66,Moomba-73, Moomba-76 and Toolachee wells while poor potential in Baratta-1 and Baratta south-1 wells, where brittle minerals decrease significantly to 20-25%, negatively affecting the amount of connected porosity. The low potentiality is also attributed to lower Total Organic Content (TOC) volumes in Baratta well.