Direct Method for Determining Organic Shale Potential from Porosity and Resistivity Logs to Identify Possible Resource Plays

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Today many geoscientists are faced with the identifying possible resource plays throughout the world. Determination of potential organic content of the shale sections is one of the first estimations that is often made, and time and again there is a lack of information readily, and inexpensively available to make these preliminary estimates. As Passey (AAPG 1990) and others have shown, there are several methods that can be used to determine the organic content various electric logs. One such method, referred to as the Δ log R technique, used for identifying and calculating total organic carbon in organic-rich rocks can be quickly estimated by the improvement of cross-plotting sonic logs (DT) and log (natural logarithm) of resistivity data and determining the shale line that can then be used to calculate a pseudo-sonic log that is then displayed over the existing sonic logs to determine the organic shale potential for a zone in an individual well. In water-saturated, organic-lean rocks, the two curves parallel each other and allow the shale calculation line to be determined. However, in either hydrocarbon reservoir rocks or organic-rich shale sections a separation between the curves occur. Using the gamma-ray curve, reservoir intervals can be identified and eliminated from the analysis. The separation in organic-rich intervals results from two effects: the porosity curve responds to the presence of low-density, low-velocity kerogen, and the resistivity curve responds to the formation fluid. In mature source rocks the magnitude of the resistivity increases because of the presence of generated hydrocarbons. By cross-plotting multiple wells this technique can provide relative information for an area or entire shale section. This method requires little more than a simple cross-plot and log calculation mathematics to provide a geoscientist sufficient data to easily and quickly determine potential organic shale sections. Across an area, these log cross-plot displays support the correlation and mapping of organic rich shale sections and allow the geoscientist to quickly determine high graded areas of focus for further study. This method allows organic richness to be assessed in a wide variety of lithologies and maturities using common well logs and has been applied to many of the North American shale plays such as the Barnett, Woodford, Eagle Ford and Marcellus Shale.