A New Log Interpretation Technique for Evaluating Thin-Bedded, Sand-Shale Sequences

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Abstract
Laminated formations frequently exhibit resistivity anisotropy. That is, resistivity measured perpendicular to the bedding (Rv) is significantly higher than resistivity measured parallel to the bedding (Rh). This situation occurs when high resistivity sand layers are interspersed with low resistivity shale layers. In this environment, standard induction tools respond primarily to Rh. Therefore, average resistivity over the induction tools vertical resolution can be misleadingly low and computed water saturation pessimistically high. These formations are a major cause of "low resistivity pay".

Modern induction tools now have the capability of measuring both Rv and Rh. Reservoir properties are determined by using a sand-shale model that combines Rv and Rh logs with porosity and shale indicator logs. Bulk properties are calculated separately for the sand and shale components over a vertical interval. For the sand component, these properties are sand resistivity, sand porosity and sand water saturation. Because shales are generally anisotropic, the model calculates both vertical and horizontal shale resistivity, together with shale porosity and shale water saturation. Finally, a total water saturation is calculated by averaging the sand and shale water saturations by their relative abundance. This technique represents a departure from previous laminated sand evaluation techniques as there is no attempt to resolve each lamination.

The utility of this new interpretation technique has been demonstrated with recently acquired Rh and Rv logs. Low resistivity pay zones have been identified and subsequently confirmed by fluid sampling and production.