

## Practical inversion of high definition induction logs using a priori information

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Model-based fast 2-D inversion is becoming one of the key tools in petrophysical interpretation of array induction type logging data. Several practical examples showing the advantages of the High Definition Induction Log (HDIL) fast 2-D inversion are discussed.

The data uncertainties and resolution limits of the HDIL measurements allow us to drive the inversion solution towards a priori known petrophysical features of the formation. The standard technique of introducing a priori constraints complicates the profile of an objective function and significantly slows down the inversion. In addition, it is necessary to repeat the entire inversion run to test a new set of a priori information. We have developed a method of incorporating a priori information at a post inversion stage, when new a priori information can be taken into account without actually performing a new run of the inversion algorithm.

A log analyst can better link the HDIL measurements to other geological and petrophysical information by trying various sets of a priori information at the post inversion stage. For example, the measurements of a shallow resistivity device can be very helpful in case of shallow resistive invasion. Some indicators of permeable formations (for example, the ratio of deep resistivity measurement to shallow) may reduce inversion nonuniqueness when the contrast between formation resistivity and the resistivity of the invaded zone is low or the radius of the flushed zone is small. The layering information taken from other logging devices can help when the shallow HDIL measurements are not sensitive to formation parameters (conductive mud systems, rugose borehole).

More accurate estimates of reserves may be calculated by incorporating the results of the inversion into volumetric analysis and reservoir thickness computation. Induction measurements of deep resistivity can be suppressed by nearby conductive beds or even erroneously elevated in laminated sections.

Examples are presented of volumetric analyses and pay/sand counts using both conventional curve data and "squared" inversion results. Oil in place calculations and the gross value of those reserves are also compared to demonstrate potential improvements in accuracy using these types of measurements.