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An integrated approach to determine low-resistivity pay zones in thin laminated clastic reservoirs: A case study from the Gulf of Suez

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The problem of LRP zone is that it is not recognized by conventional resistivity log. This problem causes a decrease in resistivity log response, so the estimated water saturation will be higher than the observed water cut. Resistivity anisotropy is observed in the interbedded parallel layers of laminations of sand-shale sequences. When these laminations thickness is less than the vertical resolution of conventional resistivity measuring device itself, the measured resistivity values are no longer representative to these laminations, however, it becomes an average of the resistivities of these thin laminations, dominated by the laminations with lower resistivities. In Morgan Belayiem reservoir located in the Gulf of Suez in Egypt, detailed interpretation analyses have been done to re-interpret thin sand shale laminations showing LRP phenomenon. The pay was identified using (Rv) and (Rh) calculations utilizing previous conventional resistivity and lithology logs. In the present study, an innovative technique is developed to calculate the resistivity of sand intervals within thin laminated reservoirs. This is achieved considering two main concepts; separating apparent resistivity in Rh and Rv using Moran and Gianzero (1979) formula and calculating sand resistivity using sand - shale resistivity connections (parallel and series connections). Archie Equation is applied to calculate water saturation using the obtained sand resistivity values and subsequently plotted versus the conventionally calculated values. As a result of this study, Belayiem reservoir was proven to have LRP zones, new water saturation estimation was calculated, which matched with the production wellhead samples.

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