Integrated Petrophysical Model to Correct Shale Volume for Porosity Determination

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Abstract

Accurate determination of shale volume is critical for pay identification. The shale volume factor affects final porosity, which is a key parameter in STOIIP calculation. Previous methods for shale volume determination lack the direct connection to core lithofacies and geological facies honored by each field. This new approach best describes the connection via an interactive model to get accurate porosity and, therefore, accurate saturation. Core parameters and raw logs are calipered via an interactive script and workflow to correct final computed porosity.

The selection of the new shale points was done based on creating a NEU-DEN cross-plot to differentiate between shale and reservoir using log data. This was confirmed by XRD data from core analysis. The cross-plot was divided into areas based on shale percentage for each group of points (core plugs). A python script was used to represent shale volume based on core data (from the cross-plot) as codes, and then NEU-DEN shale points were modified to get codes for shale volume from log data. The process is repeated until similar codes are matched to that of the cores cross-plot. The new shale points were entered into python script to calculate final porosity and then compared to the porosity measured from core plugs after correction.

Shale volume from cross-plot was displayed as codes in the reservoir data log (RDL) layout. This was done based on the point location in the plot according to its NEU and DEN measurements. The calculated shale volume from log was displayed as volume fraction and as codes, in order to compare it with that from the cross-plot. The NEU- DEN shale points were modified while running the script until getting similar codes to that from cross-plot. In order to decide whether the chosen shale points are good or not, the calculated shale volume using those points, and NEU-DEN response were taken into account. The final chosen points were applied in 428 wells and good results were achieved in 92.62% of total intervals. The calculated porosity from finalized shale points was found to differ from original ones as shale volume is changing in reservoir intervals. However there is a slight difference in porosity in argillaceous intervals, no matter how much the change in shale volume is. This observation has confirmed the robustness of our new approach.

The workflow of the NEU-DEN shale point's determination will give the ability to petrophysicists to update the calculation of shale volume and porosity, whenever there is a need for that.