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Prediction of Porosity and Permeability of Heterogeneous Shaly Gas Sand Reservoirs Using Neural Network Algorithm

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Analysis of shaly gas sand reservoirs is one of the most difficult problems. These reservoirs usually produce from multiple layers with different permeability and complex formation, which is often enhanced by natural fracturing. Therefore, using new well logging techniques like NMR or a combination of NMR and conventional openhole logs, as well as developing new interpretation methodologies are essential for improved reservoir characterization. Nuclear magnetic resonance (NMR) logs differ from conventional neutron, density, sonic and resistivity logs because the NMR measurements provide mainly lithology independent detailed porosity and offer a good evaluation of the hydrocarbon potential. NMR logs can also be used to determine formation permeability and capillary pressure.

The developed NN models use the NMR T2 pin values, and density and resistivity logs to predict porosity, and permeability for two test wells. The NN trained models displayed good correlation with core porosity and permeability values, and with the NMR derived porosity and permeability in the test wells. This work concentrates on determination of porosity (ϕ_{DMR}) from combination of density porosity and NMR porosity and permeability from NMR logs using Bulk Gas Magnetic Resonance Permeability (K_{BGMR}) and then using the neural network (NN) technique to predict formation porosity and permeability using NMR and conventional logging data. The NN technique has been developed and applied in several field cases and the predicted porosity and permeability values were validated from the proposed NN algorithm. Predicted porosity and permeability have shown a good correlation with core porosity and permeability in the studied shaly gas sand reservoir.

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