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Machine Learning for low-field NMR to improve pore fluid characterization

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The level and type of saturation of the petroleum reservoirs is an essential parameter in reserve estimation because it determines the effective volume of the hydrocarbon that is being stored. At the same time, rock wettability influences the displacement of oil by water from oil-producing reservoirs, especially during water-flooding processes. Low-field Nuclear Magnetic Resonance (NMR) spectrometry evaluates the pore size distribution and has proved a powerful tool in determining the type of saturation and assessing the solid-fluid affinity (Katika et al., 2017).

However, assessing the pore-fluid distribution of rocks with complex mineral composition at laboratory conditions, such as chalk and argillaceous sandstones, that are commonly found in the North Sea oil reservoirs, often requires further investigation. NMR data are combined with a visual inspection or with traditional techniques, such as MICP, to evaluate the microtexture of rocks (Katika et al., 2018, Faÿ-Gomord et al., 2016). Considering that laboratory low-field NMR can be used as a guide to interpreting logging data, improving the evaluation of lab measurements has a profound influence on the field.

Deep Learning (DL), as an artificial intelligence technique utilizing neural networks, has the potential to transform low-field NMR into a more efficient and powerful tool in reservoir characterization.

The various peaks in NMR T_2 relaxation spectra differ in rocks with multiple types and levels of saturation, rock-fluid affinity, or pore size distribution. In the present study, we aim to improve the interpretation of the T_2 spectra and automate peak picking. Using laboratory data for reservoir rocks from the literature (Katika et al., 2017), a Deep Neural Network (DNN) was trained to optimize the internal network parameters and successfully evaluate the type of peaks existing in T_2 spectra. The successful evaluation is confirmed with visual inspection and correlated with geophysical data derived from the same literature.

References

Katika, K., Saidian, M., Prasad, M. and Fabricius, I.L., 2017. Low-Field NMR Spectrometry of Chalk and Argillaceous Sandstones: Rock-Fluid Affinity Assessed from T1/T2 Ratio. Petrophysics-The SPWLA Journal of Formation Evaluation and Reservoir Description, 58(02), pp.126-140.

SPWLA-2017-v58n2a4

Faÿ-Gomord, O., Soete, J., Katika, K., Galaup, S., Caline, B., Descamps, F., Lasseur, E., Fabricius, I.L., Saïag, J., Swennen, R. and Vandycke, S., 2016. New insight into the microtexture of chalks from NMR analysis. Marine and Petroleum Geology, 75, pp.252-271. https://doi.org/10.1016/j.marpetgeo.2016.04.019

Katika, K., Alam, M.M., Alexeev, A., Chakravarty, K.H., Fosbøl, P.L., Revil, A., Stenby, E., Xiarchos, I., Yousefi, A. and Fabricius, I.L., 2018. Elasticity and electrical resistivity of chalk and greensand during water flooding with selective ions. Journal of Petroleum Science and Engineering, 161, pp.204-218. https://doi.org/10.1016/j.petrol.2017.11.045