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Evaluation of saturation of tight sandstones using dielectric logs: Ordos Basin, China

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Due to shallow mud invasion in unconventional reservoirs such as tight sandstone, shale, the dielectric dispersion logs have advantage in the saturation evaluation of unconventional reservoirs. Dielectric dispersion logs had been applied in the evaluation of unconventional reservoirs in North America with good results. A large number of unconventional reservoirs are found in the basins in China that are a huge source of oil production. However, the applicability of dielectric dispersion logs in those basins are rarely studied. Ordos Basin is one of the largest petroliferous basins in China. In this paper, we mainly investigate the applicability of interpretation models for dielectric logs in the tight sandstone of the Yanchang Formation of Triassic. The conventional sandstone of Yan'an Formation of Jurassic is taken as comparative example. This study could help identify for the oil and water layers in the Ordos Basin.

Firstly, the core samples were drilled from the two formations are measured with the dielectric dispersion in laboratory to get the permittivity of the matrix. The samples are measured with two states that are dry and saturating salty water. The matrix permittivity of conventional sandstone are calculated as 4.5 while the tight sandstone is high at about 6.2. Then, we applied these values to investigate the interpretation models in the real formations. The commonly used Complex Refractive Index (CRIM), Stroud-Milton-De (SMD) and shaly sandstone (SHSD) model are selected. In the conventional sandstone, the CRIM model used for permittivity and conductivity measured at 1GHz and SMD model is used for permittivity and conductivity in 20MHz-500MHz frequency band. In tight sandstone, the CRIM and SHSD models are used to construct the misfit function due to that the shale content is higher. Next, the particle swarm optimization (PSO) algorithm is used to optimize the objective functions, and examples are constructed to test the algorithm. Finally, the method is applied to the target reservoir to obtain saturation, tortuosity index of water phase, salinity of flushing zone.

The results show that the relative error between the synthetic log response and the measured log is less than 20% in the two formations, indicating that the combination of the interpretation models are rational and effective. Furthermore, the calculated oil saturation is in good agreement with the core analysis and oil test data, which verifies the accuracy of the proposed method.

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References

Time Block Preference

Time Block B (14:00-17:00 CET)

Participation

Online

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