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2D-NMR a potential method to determine the in-situ fluid content in shale oil reservoirs

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Determining the in-situ hydrocarbon content and occurrence characteristics of shale oil reservoirs is critical to their reserves prediction and development. Although many scholars have studied the fluid saturation of conventional coring shale by solvent and thermal extraction methods, however, with time-consuming and only amounts of oil and water given, which cannot reveal the occurrence characteristics of oil and water. In this study, 2D-NMR T1-T2 mapping was proposed to systematically evaluate the in-situ water and oil saturations, distributions, and their dispersion law of preserved shales. 60 preserved shales with different depths were selected from the 1st member of Qingshankou Formation of six wells in the northern Songliao Basin, China. Each preserved sample was divided into 2 parts and analyzed by a high frequency (22MHz) NMR and Dean-Stark extraction respectively. One preserved shale was subjected to NMR T1-T2 map analysis with different exposure times. Results showed that NMR T1-T2 mapping can be used to distinguish and quantify the water and oil hydrogens of preserved shale core samples. Shale oil content evaluated by T1-T2 mapping is consistent with that measured by Dean-Stark extraction, with a correlation coefficient (R2) high to 90% when using the NMR calibration of crude oil. There may be errors for the water content of preserved shale in NMR test due to the effect of sample temperature. The regional location of oils on the T1-T2 map of preserved shale is controlled by their maturity/mobility, T2 relaxation time of oil is generally higher than that of water. During the exposure process of preserved shale, the evaporation rate of oil is higher than that of water, and the evaporation rate of fluids in macropores is fast. The loss of free oil is more serious, while the adsorbed oil is basically unchanged. As a non-destructive, rapid, minimal sample preparation method, 2D NMR can efficiently evaluate fluids content and distribution characteristics of preserved shales within 5 minutes and has great advantages and applications in in-situ fluid evaluation.

References:

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