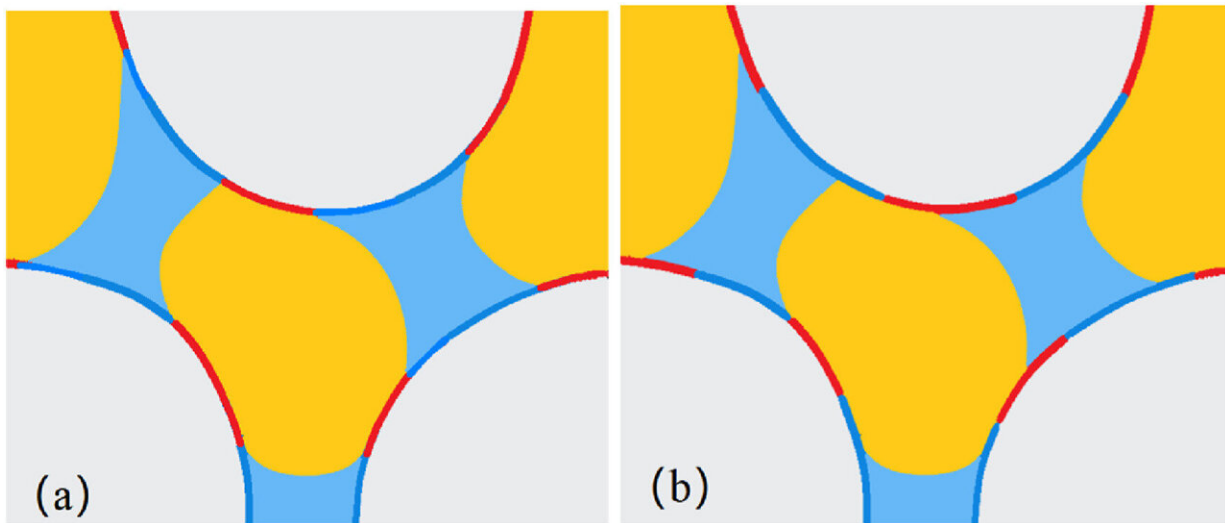


Potential NMR-based wettability index for rocks proposed

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Fluid distributions in heterogeneous-wet rocks with (a) strongly-wet and (b) intermediate-wet conditions. Oil-wet surfaces are depicted as red and water-wet surfaces are dark blue. Oil is orange and water is blue. Credit: *Magnetic Resonance Letters* (2023). DOI: 10.1016/j.mrl.2023.03.010

Reservoir wettability plays a crucial role in determining how oil and water are distributed and affects the success of enhanced oil recovery methods in oil exploration and development. However, as more complex wettability formations, like tight oil and shale oil formations, emerge, accurately estimating wettability has become a challenge. To that end, researchers have discovered that nuclear magnetic resonance (NMR) can

be a powerful tool for characterizing wettability.

In a recent study published in the journal *Magnetic Resonance Letters*, a team of researchers in China proposed a new NMR method for evaluating rock wettability. Their approach utilizes the magnetic susceptibility contrast between the rock skeleton and saturated fluids. This method enables petrophysical analysis of rocks with varying wettability due to mineral differences, particularly in cases of heterogeneous wettability.

"Wettability knowledge and understanding has always been a challenge for unconventional reservoirs, which drives the development of an applicable characterization method for quantitative description," explains lead author Lizhi Xiao, professor at China University of Petroleum-Beijing. "The transverse relaxation time (T_2) measurement has been accepted as a rapid method for determining wettability."

The development of NMR- T_2 based wettability indices stemmed from the observation that T_2 surface relaxation of the water phase indicates water-wet areas, while T_2 surface relaxation of the oil phase indicates oil-wet areas. However, when it comes to intermediate wettability, where both water and oil can interact with surfaces displaying water-wet and oil-wet characteristics, relying solely on T_2 -based methods may lead to inaccurate assessments of wettability and predictions of fluid distribution in reservoirs.

The researchers observed distinct internal gradients for water and oil, which were influenced by variations in magnetic susceptibility contrasts within artificial sandstone samples exhibiting heterogeneous wettability. This finding implies that utilizing the contrast in [magnetic susceptibility](#) and the resulting internal magnetic field gradients could serve as an alternative approach for characterizing wettability.

"In previous studies, we used one-dimensional T_2 , two-dimensional diffusion and T_2 , two-dimensional T_1 and T_2 in previous publications, as well as internal gradient and T_2 mentioned in this study to characterize rock wettability. These approaches can be selected based on lithology and usage conditions," says the first author Can Liang, lecturer at Changzhou Institute of Technology. "In this study, we are conducting additional experiments to test the effectiveness of the method for generalization."

The team hopes that their innovative method will help in advancing the understanding of [wettability](#) features in oil shale and tight oil formations.

More information: Can Liang et al, A potential NMR-based wettability index using free induction decay for rocks, *Magnetic Resonance Letters* (2023). [DOI: 10.1016/j.mrl.2023.03.010](https://doi.org/10.1016/j.mrl.2023.03.010)

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