Laboratory measurements to explore the link between surface area, surface relaxivity, and NMR relaxation time in partially-saturated porous media.

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The interpretation of near-surface nuclear magnetic resonance (NMR) measurements typically assumes that the measured volume is fully saturated. This assumption ignores an important part of the subsurface: the vadose zone. As the use of NMR to explore near-surface environments increases, an improved understanding of NMR measurements of partially-saturated porous media is needed. A limited number of recent studies have shown that the NMR relaxation time (T_2) is a function of the water content (θ) of partially-saturated geologic material. Our research expands on these previous studies and focuses on understanding how surface properties of materials, i.e. the surface-area-to-volume ratio (S/V) and the surface relaxivity (ρ_2), affect T_2.

Nine sand sample with varying S/V and ρ_2 values were used in this study. Sands with different particle size fractions were used to vary S/V and sands with different surface

concentrations of hematite were used to vary ρ_2. NMR measurements were collected as water was pumped into dry samples until they were saturated. Our results confirm the findings from previous studies and show that T_2 is a function of θ. We find that that the values of both S/V and ρ_2 affect the shape and magnitude of the T_2-θ curve. The results from this study provide important insight that will help to improve the interpretation of NMR measurements in the vadose zone.