A new approach to measure the wettability of porous media under different saturation conditions by Temperature Sensitivity of Nuclear Magnetic Resonance Relaxation Time

Hyung T. Kwak *and Jun* Gao

Abstract. The wettability, specifically the wettability of the porous structure within rocks, is one of the key parameters that determine fluid flow, which determines the potential oil producibility from reservoirs. The oil wetting preference on the pore surface of reservoir rock influences the reservoir performance in various steps of oil production, such as waterflooding and enhanced oil recovery (EOR).

The surface relaxation times of nuclear magnetic resonance (NMR) are sensitive to the wettability of pore surface since they are mainly determined by the strength of fluid-rock interaction. Thus, the surface effective activation energy (DeltaE), which is determined by the properties of fluid and pore surface, is one of the key parameters determines the NMR relaxation times. Since the DeltaE is related to temperature by Arrhenius laws for the correlation time, the wettability of pore surface is directly related to the temperature sensitivity of NMR surface relaxation times.

A new approach to measure the wettability of reservoir rocks has been developed based on this temperature dependence of NMR relaxation time. The proposed method is also capable of measuring the wettability of porous media under any saturation level which conventional method cannot provide. The proof of the concept has been conducted with a set of model mono-porous glass bead packs of various wettability. Then, the developed method has been tested to measure the wettability of multi-porous reservoir rocks with various mineralogy.