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A 1H NMR Study on Acidized and Non-acidized Carbonate Rock Cores to Explore Correlations Between Pore Geometry and Fluid-Solid Interactions

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SUMMARY

Carbonate reservoirs are heterogeneous systems at multiple length-scales, a characteristic that influences strongly their petrophysical properties and oil recovery procedures [1]. Wettability for example, capillary pressure as a function of water saturation, and partial permeability, are related with the pore structure (pore size and shape) and the rock mineralogy [2, 3]. Acid stimulation treatments are available, which can improve productivity [4, 5, 6]. It is expected that acid stimulation treatment, which opens rock porous channels known as wormholes, will influence strongly the pore structure and therefore petrophysical properties around the wormholes, decreasing wettability and thus increasing oil recovery.

In this work we study the role of the pore structure on the water and oil absorption in a number of acidized and non-acidized carbonate cores by employing 1H NMR.

Abstract

Carbonate reservoirs are heterogeneous systems at multiple length-scales, a characteristic that influences strongly their petrophysical properties and oil recovery procedures. Wettability for example, capillary pressure as a function of water saturation, and partial permeability, are related with the pore structure (pore size and shape) and the rock mineralogy. Acid stimulation treatments are available which can improve productivity.

It is expected that acid stimulation treatment, which opens rock porous channels known as wormholes, will influence strongly the pore structure and therefore petrophysical properties around the wormholes. In this work a systematic study of the role of the pore structure on the water and oil absorption in a number of acidized and non-acidized carbonate cores is reported, by employing 1H NMR (z-axis profiles, T2 and D distributions and two dimensional D-T2 spectroscopy). We study the role of the micro and macroporosity, as well as that of the induced vuggy porosity due to acidic dissolution, on the saturation state and spontaneous fluid displacement of a number of carbonate rocks (both acidized and non-acidized). Results indicate that acidized cores show increased oil wetting properties, and “resist” water imbibition.