Investigation of Heterogeneous Carbonate Reservoir Quality Using Low Field NMR

Mohammad Ebrahim Shafiee and Apostolos Kantzas,
Department of Chemical and Petroleum Engineering
University of Calgary

Abstract

There are significant oil and gas in carbonate reservoirs in the world. Depositional environments, lithofication and diagenesis construct different range of carbonate rock classes. These complex processes provide multifaceted pore systems, complicated interconnectivity and reservoir quality. To study the complicated interconnectivity in carbonate reservoirs we conducted core analysis and nuclear magnetic resonance (NMR) measurements in an Iranian reservoir.

The organization of interconnectivity and reservoir quality are related to carbonate facies and the carbonate facies are controlled by salinity, temperature, pH and the amount of calcium carbonate (organic and inorganic) of water. As a result of different types of carbonate facies, there are different rock properties and wide range of rock interconnectivity. Because of the nature of carbonate reservoirs, they are more complicated to siliciclastic sandstones.

New research has documented the role of dissolution in carbonate facies particularly in the course of diagenesis. The different fluid pH levels in the carbonate rocks achieve various dissolution scenarios, and they can produce a vide range of complex interconnectivity. There are not enough works published in the literature in comparison to sandstones.

Core materials were provided from the Ab-Teymur carbonate oil reservoir. 50 cores were cut to a length and diameter of 50 mm and 38 mm, respectively. Then we measured gas expansion porosity and helium permeability. Through NMR we also measured the porosity, permeability and interconnectivity distribution.

NMR is a novel experimental technology in special core analysis. The NMR T_2 relaxation times were measured on brine-saturated samples. The relaxation time reflects the distribution of pore and interconnectivity where they are measured.

The results of the different methods were used to show the individual reservoir data processing by NMR technique. Core data provide the complexity of permeability variation and interconnectivity distribution. NMR was used to determine the heterogeneity of petroleum carbonate reservoirs and to perform a series of characterization on the porous media.