Pore Structure and Petrophysical Characterization of Carbonate Rocks from Southern Lebanon

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Carbonate rocks are common in many parts of the world including the Eastern Mediterranean where they host significant groundwater supplies and are used widely in engineering as building and ornamental stones. Porosity of carbonate rocks plays a critical role in fluid storage and retrieval. The pore structure connectivity, in particular, controls many properties of rocks, and the relationships between the characteristics of individual minerals and the gross behavior of the rock. To study the relationships between porosity, rock properties, pore structure, pore size, and their impact on reservoir characteristics, several carbonate rock samples were collected from four stratigraphic sections exposed near Sidon, south Lebanon. The studied carbonate rocks are related to marine deposits of different ages (e.g., Upper Cretaceous, Eocene and Upper Miocene). In order to understand the pore connectivity, the MICP (mercury injection capillary pressure) is conducted on ten representative samples. Results from the SEM analysis indicate the dominance of very fine and fine pore sizes with various categories ranging in diameter from 0.1 to 10 µm. The MICP data revealed that the pore throat radii vary widely from 0.001 to 1.4 µm, and that all samples are dominated by micropore throats. The grain size analysis indicated that the studied rocks have significant amounts of silt- and clay-size grains with respect to the coarser sand-size particles; suggesting a high proportion of microporosity. Obtained results such as the poorly-sorted nature of grains, high microporosity, and the high percentage of micropore throats justify the observed low mean hydraulic radius, the high entry pressure, and the very low permeability of the studied samples. These results suggest that the carbonate rocks near Sidon (south of Lebanon) are possibly classified as non-reservoir facies.