Integrated Investigation of the Pore Structure of Middle-Upper Cretaceous Carbonates in Central and Southern Iraq

Hangyu Liu[1], Bo Liu[1], Kaibo Shi[1], Zhongyuan Tian[1], Rui Guo[2]
[1]School of Earth & Space Sciences, Peking University; [2]PetroChina Research Institute of Petroleum Exploration and Development

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

Carbonates in Iraq are characterized by complex pore systems resulting in strong reservoir quality heterogeneity. The integration of CT scans, cast thin section observations, 2D digital image analyses, SEM observations, porosity, permeability, MICP and NMR measurements, and well log analyses were conducted on carbonates from various strata in the mid-Upper Cretaceous formations of four oilfields in central and southeast Iraq to investigate the microscopic pore structures and their control on reservoir quality. Seven matrix-related, three non-matrix pore types and five pore throat types were identified. Pore sizes vary greatly both in the same pore type and in different pore types. Pore shapes vary little in the same pore type but vary greatly in different pore types. Carbonates have an extensive range of pore throat sizes, ranging from 0.003 μm to 124 μm with six distribution patterns. Although there are positive correlations between pore distributions and pore throat distributions, there is no apparent correlation between pore size and pore throat size except for the interparticle pore system, which is significantly different from that of common clastic rocks. This is partly because isolated pores developed to different degrees in pore types other than interparticle pores that lack throats to connect them and partly because of the throat types. The controls of pore structure on reservoir quality were clarified. Porosity is controlled by pore sizes and pore abundance, not by pore throat size. Permeability is controlled by pore throat sizes rather than pore sizes, and R40 shows the best correlation with permeability. Distribution patterns of pore throat sizes determine the differential contributions of different-sized pore throat subsystems to

permeability. This not only leads to the differentiation of the φ-k relationship in different patterns of pore throat distributions but also has implications in microscopic residual oil distributions and water flooding. The well logging identification model of four pore structure types, classified based on the newly proposed pore and pore throat assemblage modes, was constructed to guide pore structure type prediction in uncored wells. The results above may be useful for improving the understanding of pore structure and to predict the reservoir quality in carbonates with complex matrix-dominated pore systems.

AAPG Datapages/Search and Discovery Article # 91200 © 2020 AAPG Annual Convention & Exhibition Online, Sept. 29- Oct. 1.