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Characterization of Pore-Throat Structure and Prediction of Sweet Spot of the Eocene Low Permeability-Tight Beach-Bar Sandstone Reservoirs in the Dongying Depression, Bohai Bay Basin, China

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Pore-throat structure is one of the dominant factors controlling the reservoir quality and development benefit of low permeability-tight sandstone reservoirs [1]. The characteristics, distribution and its control on reservoir quality of pore-throat structure of the Eocene low permeability-tight sandstone reservoirs were carefully studied based on the systematically analyses of thin sections, porosity and permeability, high pressure mercury, and constant velocity mercury. The low permeability-tight reservoirs consist of micron-nano scale pore-throats. With the decreasing permeability the content of nano scale pore-throats increases gradually and the sensitive pore-throat radius of permeability decrease gradually. A small amount of large scale pore-throats control the permeability, while the majority small scale pore-throats contribute the permeability less but control the porosity more. Normal low-permeability reservoirs (10-50mD) consist of micron scale pore-throats, which is contributed by pore-throats with radius more than 3 μm . Ultra low-permeability reservoirs (1-10mD) consist of micron-nano scale pore-throats, which is contributed by pore-throats with radius between 1-3 μm . Tight reservoirs (<1mD) consist of nano scale pore-throats, which is contributed by pore-throats with radius less than 1 μm . The reservoir quality index (RQI) was employed to characterize the pore-throat structures based on the analysis of applicability of macro petrophysical parameters. The larger the number of RQI, the better the pore-throat structure. Affected by the compaction and cooperative diagenesis of sandstone-mudstone interlayers the RQI generally increases gradually with the increase of distance to the sandstone-mudstone contacts in sandstones in the same depth ranges. For a fixed distance to the sandstone-mudstone contact the RQI decreases gradually with the increasing depth. According to these varied characteristics the plate of RQI verified with depth and distance to the sandstone-mudstone contact was determined. The RQI=0.25 is the lower cutoff of the petrophysical-oiliness sweet sport based on the correlation of RQI and reservoir oiliness. Reservoir spaces of sweet sport are dominated by intergranular pores. The maximum connective pore-throat radius range from 1.47 to 10.5 μm with average of 4.92 μm . The average pore-throat radius are between 0.17-4.41 μm with average of 1.1 μm . With the increase of burial depth the thickness of developing sweet spot increase gradually.

References:

[1] Ziarani AS and Aguilera R (2012) J Appl Geophys 83: 65-73

