Influence of Multi-Scale Fractures on Tight Oil Production in Tight Oil Sandstones of the Upper Triassic Yanchang Formation in the Southwest Ordos Basin, China

Wenya Lyu, Lianbo Zeng, Hui Chen, Ruiqi Li
State Key Laboratory of Petroleum Resources and Prospecting, College of Geosciences, China University of Petroleum, Beijing

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

Abstract

Tight sandstones of the Upper Triassic Yanchang Formation in the southwest Ordos Basin, China are characterized by multi-scale fractures, which range from several micrometers to hundreds of meters. Production practice shows that fractures at different scales have obviously different influences on the production of tight oil. According to the mechanical stratigraphy interfaces, which constrain fracture propagation, and fracture sizes, natural fractures within the tight sandstone reservoir are divided into micro-scale, small-scale, meso-scale and macro-scale ones. Micro-scale fractures are developed with a single sandbody and observed by microscopes. Small-scale fractures are mainly developed within a single sandbody and constrained by thin mudstone interlayers. Meso-scale fractures are mainly developed within multiple sandstones and constrained by mudstone barriers. Macro-scale fractures (small faults) cut through mudstone barriers. Multi-scale fractures in the study area were characterized by integrating outcrops, cores, well logs, 3D seismic data and microscope analysis. Combined with multi-scale fracture distribution and production data, micro-scale fractures have low permeability and mainly serve as storage spaces in the tight sandstones and have little influence on the productivity of tight oil. Small-scale fractures serve as primary storage spaces and seepage channels in the tight sandstones. Meso-scale fractures provide important seepage channels for tight sandstones. The greater the intensities of small-scale and meso-scale fractures are, the initial production of tight oil

could be greater. Macro-scale fractures provide migration pathways for tight oil. The initial production of horizontal wells are influenced by the sizes and different parts of macro-scale fractures. Macro-scale fractures (small faults), with the length of 1500~2500m, are favorable for the initial production of horizontal wells. In addition, the linkage zones and tips of macro-scale fractures are also favorable targets. Under the present-day stress field, northeast-southwest (NE-SW) small-scale fractures and east-northeast-west-southwest (NEE-SWW) macro-scale and meso-scale fractures are instructive to tight-oil production improvement. This study provides an example of natural fracture characterization and unravels fracture impact on the tight oil production, which could provide a geological basis for oil exploration and development in tight sandstones.