How Artificial Fractures and Bedding Planes Influence the Fluid Movement in the Fracture-Matrix Dual-Connectivity System in Barnett Shale

Qiming Wang[1], Xiaoming Zhang[2], Qinhong Hu[1], Xiang Lin[2]
[1]University of Texas at Arlington; [2]China University of Geosciences (Wuhan)

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Abstract

Hydraulic fracturing in horizontal wells increases hydrocarbon production in tight shale formations. However, it also creates additional space and pathway for fluid leak-off. In this study, outcrop samples of Barnett Shale with two different lithofacies were used to study the influence of artificial fractures and bedding plane on fluid movement in fractured shale systems. Capable of demonstrating water movement behavior in shale matrix, the 1-D spontaneous imbibition (SP) tests are used to determine the pore connectivity and the capability of liquid-uptake in porous media. X-ray diffraction, TOC, liquid immersion porosimetry, and mercury intrusion porosimetry were employed to characterize basic sample properties such as mineral composition, organic richness, porosity, and pore structure. The imbibition tests of Barnett Shale of two lithofacies were conducted under the following situations: (1) parallel to the bedding plane; (2) perpendicular to the bedding plane, (3) parallel to the bedding plane with artificial fractures from Brazillian test; and (4) perpendicular to the bedding plane with artificial fractures. Our results indicate that the imbibition flow direction relative to the bedding plane influences the pore connectivity in a relative small manner, but the artificial fractures dramatically improve the pore connectivity and capability of liquid-uptake in the Barnett Shale.