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[PS]Petrophysical Properties from Quantitative Multiscale Pore-Structure Characterization in Unconventional Carbonate Reservoir: An Example from the Mid-Continent Mississippian Limestones*

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Abstract

The Mid-Continent Mississippian Limestone is an unconventional carbonate reservoir with moderate to ultra-low permeability (< 0.0001 to 80.2 mD). A complex depositional and diagenetic history of the Mississippian Limestone has resulted in a variety of pore types with different shapes, pore sizes, and pore-size distribution. These heterogeneous pore-system properties play a significant role in controlling fluid storage, connectivity of the pores, and fluid flow in a reservoir. Although pore characterization is essential in carbonate petrophysical analysis, little quantitative information on the pore-structure parameters and their fundamental relationships in an unconventional carbonate reservoir are currently available. This study focuses on image-analysis approaches for the multiscale pore characterization of the unconventional Mississippian Limestone reservoir based on thin sections and scanning electron microscope (SEM) images. The pore sizes are classified into macropores, mesopores, micropores, and nanopores. The relationships among porosity, pore shapes, predominant pore sizes (< 62 micrometer), pore-size distribution, and fluid saturation are investigated and related to core-based lithofacies such as brecciated chert, skeletal packstone-grainstone, peloidal mudstone-wackestone, bioturbated peloidal packstone-grainstone, nodular peloidal packstone-grainstone, bedded peloidal packstone-grainstone, and bioturbated mudstone-wackestone. These relationships are also explored for permeability prediction in the Mississippian unconventional carbonate reservoir.

References Cited

Anselmetti, F.S., S.M. Luthi, and G.P. Eberli, 1998, Quantitative Characterization of Carbonate Pore Systems by Digital Image Analysis: American Association of Petroleum Geologists Bulletin, v. 82, p. 1815-1836.

Birch, C.B., 2015, Reservoir-Scale Stratigraphy, Sedimentology, and Porosity Characteristics of Mississippian Reservoirs, Northeastern Anadarko Shelf, Oklahoma: Master's Thesis, University of Oklahoma, Norman, Oklahoma. 81 p.

Blakey, 2013, Paleography Map of North America During Early Mississippian (Kinderhookian): Colorado Plateau Geosystems, Phoenix, AZ.

Campbell, J.A., C.J. Mankin, A.B. Schwarzkopf, and J.J. Raymer, 1988, Habitat of Petroleum in Permian Rocks of the Midcontinent Region, *in* W.A. Morgan and J.A. Babcock (eds.), Permian Rocks of the Midcontinent: Midcontinent Society of Economic Paleontologists and Mineralogists, Special Publication No. 1, p. 13-35.

Dutton, S.P., 1984, Fan-Delta Granite Wash of the Texas Panhandle: Oklahoma City Geological Society, Short Course Notes, p. 1-44.

Gutschick, R.C. and C.A. Sandberg, 1983, Mississippian Continental Margins of the Conterminous United States, *in* D.J. Stanley and G.T. Moore (eds.), The Shelfbreak: Critical Interface on Continental Margins: SEPM Special Publication, v. 33, p. 79-96.

Johnson, K.S. and K.V. Luza, 2008, Earth Sciences and Mineral Resources of Oklahoma: Educational Publication 9, Oklahoma Geological Survey, 22 p.

LoCricchio, E., 2012, Granite Wash Play Overview, Anadarko Basin: Stratigraphic Framework and Controls on Pennsylvanian Granite Wash Production, Anadarko Basin, Texas and Oklahoma: AAPG Annual Convention and Exhibition, Long Beach, California, USA, April 22-25, 2012, Search and Discovery Article #110163 (2012). Website accessed May 2017.

McConnell, D.A., 1989, Determination of Offset Across the Northern Margin of the Wichita Uplift, Southwest Oklahoma: Geological Society of America Bulletin, v. 101, p. 1317-1332.

Mazzullo, S. J., 2011, Mississippian Oil Reservoirs in the Southern Midcontinent: New Exploration Concepts for a Mature Reservoir Objective: Tulsa Geological Society luncheon, October 11, 2011, Search and Discovery Article 10373 (2011). Website accessed May 2017.

Mazzullo, S.J., B.W. Wilhite, D.R. Boardman, B.T. Morris, and C.J. Godwin, 2016, Stratigraphic Architecture and Petroleum Reservoirs in Lower to Middle Mississippian Strata (Kinderhookian to Basal Meramecian) in Subsurface Central to Southern Kansas and Northern Oklahoma: Shale Shaker, v. 67, p. 20-49.

Mazzullo, S.J., B. Wilhite, and D.R. Boardman, II, 2011, Lithostratigraphic Architecture of the Mississippian Reeds Spring Formation (Middle Osagean) in Southwest Missouri, Northwest Arkansas, and Northeast Oklahoma Outcrop Analog of Subsurface Petroleum Reservoirs: Shale Shaker, v. 61/5, p. 254-269.

Mazzullo, S.J., B.W. Wilhite, and I.W. Woolsey, 2009, Petroleum Reservoirs within a Spiculite-Dominated Depositional Sequence: Cowley Formation (Mississippian: Lower Carboniferous), South-Central Kansas, American Association of Petroleum Geologists Bulletin, v. 93/12, p. 1649-1689.

Nissen, S.E., K.J. Marfurt, and T.R. Carr, 2004, Identifying Subtle Fracture Trends in the Mississippian Saline Aquifer Unit Using New 3-D Seismic Attributes: Kansas Geological Survey Open File Report, no. 56.

Northcutt, R.A. and J.A. Campbell., 1995, Geologic Provinces of Oklahoma: Oklahoma Geological Survey Open-File Report 5-95, 1 sheet, scale 1:750,000, 6-page explanation and bibliography.

Website Cited

http://jan.ucc.nau.edu/rcb7/nam.html. Website accessed May 2017.