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TITLE: Characterization and Modeling of the Mississippian Lodgepole Carbonate Mound Complex in Stark County, North Dakota, Using Macrofacies and Microfacies Indicators

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ABSTRACT BODY: The Stark County Lodgepole mound complex in North Dakota is part of the Lower Mississippian Lodgepole Formation and is a fractured vuggy carbonate sequence with a sharp macrofacies transition zone separating the shaly lower Lodgepole carbonate and the mound complex clean carbonate. The Lower Lodgepole mounds, sometimes referred to as Waulsortian or Waulsortian-like mounds, range from 250 to 320 ft thick, and contain a heterogeneous internal structure, facies, and diagenetic alterations. The mounds in Stark County have undergone multistage fracturing, assumed to be greatest along the flanks of the mounds due to their steep nature and differential compaction rates. Major fracturing along the base of the mounds may be due to differential stresses and other tectonic controls that would also be a source for fracturing throughout the rest of the mound complex. Traditional drill stem tests indicate the mounds have permeability ranging from 200–2000 mD, and wells two to three miles apart within the same pool show a pressure response within just a few minutes, indicating a high degree of transmissivity within the complex. This may explain the initial high hydrocarbon production rates and effectiveness of the secondary waterflood in many of the pools.

Three-dimensional sequential indicator simulation proved to be more effective than traditional surface modeling in delineating the mound surface and shape. Log indicator values were formed representing either mound macrofacies or shaly Lodgepole macrofacies, and sequential indicator simulations were performed to find the most probable volumetric structure of the mound. This provided the active domain for the mound reservoir porosity and permeability model.

Upon the development of a classic porosity and permeability transform for the mounds, it appeared that either compartmentalization or major facies changes were occurring in the mounds. Viewing of the cores suggests that there are at least three microfacies rock fabrics within the mounds: debris flank deposits, bryozoan–crinoid buildup, and a dominant stromatactis algal buildup. Different high-, mid-, and low-case porosity and permeability transforms were produced for each microfacies. By using a combination of macrofacies mound delineation, mound microfacies rock fabric classification, and a dual porosity and permeability system, a more representative reservoir model was produced.

KEYWORDS: Waulsortian-like, Microfacies.

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