Integrating 3D Seismic and Petrophysics to Characterize Hydrogen Storage Capacity in the Michigan Basin Pinnacle Reef Reservoirs

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ABSTRACT

Hydrogen storage in stacked reservoirs in the subsurface provides a great opportunity to transition into a low-carbon economy due to the larger capacity and more abundant opportunities and often existing geologic knowledge and surface infrastructure. This study analyzes the potential for hydrogen storage in the Niagaran reef carbonates in the Michigan Basin. The study focuses on the A–1 Carbonate and Guelph formations and utilizes 3D seismic, well logs, and engineering data from an active gas storage field in Southeast Michigan. The average single-well deliverability (natural gas injection or withdrawal) in these storage fields varies between 5 to 150 MCF of gas per day or more, which is tied to the reservoir quality and type of development (horizontal versus vertical wells). Seismic attribute-assisted interpretations show the geometry of the potential hydrogen storage system in the stacked reservoirs. Reef geometry provides a closed structure for hydrogen storage. The stacked reservoir system is ~250 ft thick, overlain by >300 ft thick caprock (mostly halite). The Niagaran carbonates are primarily comprised of reef boundstone and wackestone facies, which have heterogeneities between the windward and leeward sides of the reef. Based on previous in-depth core studies, the windward sides of the reefs are comprised of conglomerates dominated by touching vuggy porosity, with porosity values ~15%. Whereas the leeward side of the reef is comprised of fine-grained carbonate mud-wackestone facies dominated by separate vug porosity, resulting in much lower average porosities <6% on average. Preliminary analysis shows that the field has a working hydrogen capacity of 40,110 MMCF, with a potential maximum delivery of 1776 MMCFD of hydrogen due to existing infrastructure. Deliverability of hydrogen is a function of the reservoir pressure and it may drop to 292 MMCFD by the end of reproduction cycle. Further analysis is underway to define the integrity of the stacked hydrogen storage system. For example, the presence of anhydrite at places raises concerns about microbial reactions.

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