

Analysis of Pore Architecture within a Sequence Stratigraphic Framework and Correlation to Sonic Velocity Values in Silurian (Niagaran) Reefs of the Michigan Basin

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The relationship between porosity and permeability in carbonate rocks is complex due to variability in pore type and architecture. Porosity/permeability transforms are of limited value when evaluating carbonate reservoirs because permeability is controlled by pore type. Middle Silurian (Niagaran) Reef reservoirs of the Michigan Basin are being evaluated to better understand pore types and related permeabilities. In addition, pore types and associated geometries are thought to have direct correlation with sonic velocity values. As a result, Niagaran reef wells with both core and sonic logs were evaluated. Petrophysically significant facies and related pore types were identified through core analysis. Key facies were made into thin sections and photomicrographs were imported into an image analysis program where pore abundance and geometries were determined. Facies and related pore geometries were compared to sonic velocity values to identify the relationship of velocity and pore architecture. Facies with greater rigidity contain more rounded pores and have higher velocities whereas facies with less rigidity contain more irregular shaped pores and have slower velocities. To confirm the relationship between pore architecture, permeability, and acoustic impedance, x-ray computerized tomography will be used on key facies to visualize three-dimensional pore networks. Creating an integrated study that incorporates evaluation of the relationship of pore types, facies, and recognizing the affect of pore geometry and connectivity on rock acoustics, makes it possible to determine permeability. As a result, understanding rock and well log data relationships allows for better prediction of reservoir quality with logs in the absence of rock data.