AAPG Search and Discovery Article #90020©2003 AAPG Mid-Continent Section Meeting, Tulsa, Oklahoma, October 12-14, 2003

The Role of Moldic Porosity in Paleozoic Kansas Reservoirs and the Association of Original Depositional Facies and Early Diagenesis with Reservoir Properties

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Multi-scale carbonate-dominated sequences were deposited in subtidal to supratidal environments on the broad shallow Kansas shelf throughout the Paleozoic. A repeating association of original depositional facies and early diagenesis for these rocks produced lithofacies ranging from mudstones to grainstones with abundant moldic porosity. As illustrated by three representative cores, the nature of the molds varies through time reflecting the change in primary carbonate grain constituents including Upper Cambrian- Lower Ordovician Arbuckle peloid and ooid molds, Mississippian carbonate/siliceous sponge spicule and echinoderm/ brachipod molds, and Pennsylvanian ooid, pelloid, and bioclast molds.

Reservoir properties for each system, including porosity and permeability, are strongly correlated with original depositional facies, with reservoir quality increasing from mudstone through grainstone. Most of these rocks have undergone extensive diagenetic overprinting. However, despite significant transformation, and even reversal of solid and pore space, the nature of the post-diagenetic fabric still correlates with, and reflects original textures. The final moldic rocks exhibit petrophysical-lithofacies trends that parallel those of original primary porosity carbonates as presented by Lucia (1995).

The cores from these three reservoir systems, which have produced over 4 billion barrels, played a critical role in defining reservoir performance. Integration of core petrophysical and geologic analysis provides understanding of the role of original facies and moldic porosity and definition of reservoir properties distribution. Data from core also reveal significant vertical changes in properties, such as permeability and Archie cementation exponent, which control reservoir performance or interpretation of fluid saturations, but are not fully evident in wireline logs.