Relations Between Lithofacies and Porosity, Permeability, Capillary Pressure, and Relative Permeability in the Chase and Council Grove groups, Hugoton Embayment, Kansas.

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Fundamental to reservoir geomodel construction is the population of cells with basic lithofacies and their associated porosity, permeability, and fluid saturation. Petrophysical properties vary between ten major lithofacies classified. Mean and maximum porosities increase from mudstones to grainstones. In situ porosities (?i) correlated with routine porosity ($?_{routine}$) using: ?i = 1 x $?_{routine}$-0.68. Equations developed to predict permeability and water saturation use porosity as the independent variable because porosity data are the most economic and abundant, and are well correlated with other variables for a given lithofacies. In situ Klinkenberg (high-pressure gas or liquid-equivalent) gas permeability (k) exhibits a power-law relationship with porosity though the relationship changes in some facies at porosities below ~6%. Each lithofacies exhibits a relatively unique coefficient and exponent in k-? relationships?of the form:

$k = 10\ B\ ?i^{A}$

At ?i > 6% permeability in grainstone/ bafflestones can be 30X greater than mudstones and >100X greater than marine siltstones of similar porosity. Differences in permeabilities between nonmarine silt/sandstones and shaly siltstones range from 3.3X at 12% porosity to 7X at 18%. Full-diameter cores frequently exhibit permeabilities as great as 50X plug permeabilities due to stress relief fracturing.

Capillary pressures and corresponding water saturations (Sw) vary between facies, and with porosity/permeability and gas column height. Threshold entry pressures and corresponding heights above free water level are well correlated with permeability. Differences in Sw between facies increase with decreasing porosity and decreasing height above free water. For rocks with k > 0.1 md, relative permeabilities exhibit consistent exponents.