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Capillary Pressure, Hg Withdrawal Efficiency, Pore Throat Diameter, and Pore Geometry as "Quality Indicators" in Carbonate Reservoirs

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High poroperm combined values sometimes indicate high connectivity and low resistance to fluid transmissivity in carbonate reservoirs. These zones, or "flow units", may have pore systems that include any combination of 3 genetic pore classes; therefore, the geological model of the reservoir may reflect structural, depositional, diagenetic, or hybrid genetic characteristics. Pore classes within flow units can be ranked for high, intermediate, and low "quality" (ease of extracting hydrocarbons) based mainly on how reservoir rocks behave in capillary pressure runs. Extrapolating the results of the MICP runs and attendant Hg withdrawal efficiency calculations to field scale depends on finding "tags" that link MICP behavior to objective rock properties such as pore geometry, pore aperture size, and pore genesis. Those rock properties can be placed in a geo-history model of depositional properties, burial diagenesis, and tectonism. A test case has been studied at Happy Spraberry field, Garza County, TX, where about 100 feet of oolitic-peloidal grainstones, oolitic-peloidal packstones, and skeletal rudstones, bindstones, and floatstones compose the reservoir. Each rock type has relatively distinctive pore properties that reflect their geological history; e.g., leached depositional porosity on probable, subtle paleotopographic highs and matrix or cement-reduced pores off topography. Principal pore types in this field are grain-molds, vugs, solution-enlarged intergranular pores, and matrix or cement-reduced pores. Flow unit boundaries are loosely facies-selective and were defined by comparing poroperm values from core analyses with pore properties from thin section petrography. The results define correspondences between genetic pore classes and poroperm values ("pore facies"). Pore facies are ranked for "quality" on their capillary pressure character, median pore throat size, and mercury withdrawal efficiency. Pore facies map overlays on facies maps identified spatial distribution of quality ranked pore facies within flow units.