Carbonate Porosity Families and Their Reservoir Potential

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Variations in carbonate porosity abundance and types are important contributors toward the creation of heterogeneous carbonate reservoirs. To assess reservoir potential and quantify the role of porosity variations, and to refine existing classification schemes of carbonate porosity, a pragmatic scheme is proposed wherein four porosity families are defined: 1) micro-porosity; 2) meso-porosity; 3) macro-porosity; and 4) mega-porosity defined by a combination of pore type, pore size, pore throat radii size, and crystal-particle size. They are determined by detailed core/outcrop description, reflected light petrography, thin section transmitted light petrography, scanning-electron microscopy (SEM), and high pressure mercury (Hg) porosimetry (MICP). Porosity families tend to overlap, with one or two porosity families typically most common and others subordinate to non-existent. Rarely are pure end members represented by only one porosity family.

Micro-porosity is defined as intercrystal pores that are <4µ, between micrite crystals <4µ and connected by pore throat radii <0.5µ (if defining an oil reservoir) and <0.1µ (if defining a gas reservoir). Micro-porosity is non-productive. Meso-porosity is defined as intercrystal and micro-moldic pores between microspar crystals that are >4µ to <30µ, with pore throat radii that range from >0.5µ (oil reservoir) or >0.1µ (gas reservoir) up to <2.5µ. Meso-pores form in mud-rich matrix or within particles. To be productive, meso-porosity requires extensive reservoir contact utilizing a horizontal wellbore. Macro-porosity is the standard classification of carbonate porosity, with interparticle pores most common, that are >30µ and larger that are petrographically distinquishable and connected by pore throat radii that are >2.5µ to <10µ; particle size is >30µ and much larger. Macro-porosity is productive in vertical wells. Mega-porosity contains dissolution-related pores, such as moldic, vugular and cavernous pores, connected by pore throat radii >10µ and much larger. Particle size is >30µ to much larger. Mega-porosity is highly productive and often characterized by "drill bit drops" through caves.