Diagenetic Factors Influencing Quality of Mesaverde Tight-Gas Sandstone Reservoirs, Colorado, Utah and Wyoming, USA

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Grain size and degree of sorting, specifically shaliness and distribution of detrital clay are the primary depositional factors determining reservoir quality of tight-gas sandstones. Following deposition, processes of diagenesis reduce initial porosity and permeability by mechanical compaction and chemical alteration. Mesaverde sandstones consist of quartz arenite, sublitharenite, lithic arenite and feldspathic litharenite. Quartzarenite and sublitharenite lose porosity by pressure solution and precipitation of quartz overgrowths. Carbonate cement is locally prominent. Dissolution of chert or carbonate rock fragments creates poorly connected moldic and intragranular micropores. Secondary intergranular porosity is extremely rare. Porosity in quartzarenites is dominated by severely reduced intergranular pores with tabular geometries and slot-like pore throats.

Litharenites and shaly sandstones are extremely sensitive to compaction, resulting in severe loss of porosity and closure of surrounding pore throats. The presence of chemically unstable grains (volcanic rock fragments or small amounts of feldspar) contributes to the formation of clay cements. Porosity is composed of microporosity within rock fragments and clay cement and sparse intergranular or moldic pores. Feldspathic litharenites are also susceptible to compaction, but due to the lower proportion of detrital quartz, they respond differently. Feldspar grains undergo brittle deformation resulting in a loss of intergranular porosity, but the surrounding pore throats are not occluded by quartz overgrowths that are attendant with pressure solution. Clay cements derived from feldspars and volcanic rock fragments occlude pore throats, while inhibiting quartz overgrowths on neighboring grains, thus preserving intergranular porosity. Pore networks are comprised of a mixture of compaction-modified primary intergranular, secondary intergranular and moldic mesopores, and clay-filled intergranular microporosity.