

The Liard Basin Manetoe Dolomite: An Arctic Frontier Deep Gas Play

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Recent discoveries in the Manetoe Dolomite of Liard Basin (Northwest Territories) had very high initial absolute open flow (AOF) rates. These were similar to the older Beaver River, Pointed Mountain and Kotaneelee Gas Fields, which also had high initial production rates but which declined rapidly.

This was attributed to water invasion of a “two-porosity” system in which vuggy carbonates contain vertical and horizontal fractures. Gas produced from the more open fracture system was accompanied by water influx from an underlying aquifer that sealed gas in the less connected vuggy porosity.

The rapidity of this differential water influx is due primarily two factors, variations in the pressure drive of the aquifer, and variations in the magnitudes and spatial distributions of reservoir porosity-permeability. Large variations in the differences between the elevations of the gas-water contacts and the aquifer potentiometric surfaces at these fields indicate that there are large variations in water drive pressure.

Kotaneelee Field is a structural trap within a faulted structural dome. Core from the Kotaneelee Field (H-38) exhibits porosity-permeability and reservoir fabrics similar to most Liard gas fields. The finely to medium crystalline replacement matrix of dolomite in the Kotaneelee Field is fabric destructive. Bioclasts are preserved as white dolospar-cemented molds, or as open vugs. Many cemented vugs contain geopetal internal sediments emplaced during high temperature dolomitization. Depositional textures are discernible and finely comminuted skeletal material is preserved. Mesoscale fabrics include white dolospar-cemented mosaic and rubble breccias and poorly sorted internal, silt to gravel-sized, carbonate sediment. White dolospar “saddle” dolomite lines vugs. Porosity-occluding reservoir bitumen coats vug linings. Blocky, equant calcite, and/or quartz tend to fill remaining porosity in vugs. Well-developed stylolites cross-cut dolomitization fabrics throughout.

Porosities in the H-38 core range from 0.5% to 12%. There is a weak correlation between measured porosity and horizontal permeability, which can be as much as 30 darcies, but more typically about 10-100 millidarcies. Subvertical open fractures are uncommon in the Kotaneelee Field and may be a factor that enabled a relatively long production history in spite of a high reservoir aquifer water pressure.