Secondary Porosity Development in the Galena (Trenton) Dolomite of Northern Illinois: Implications for Regional Fluid Flow and Hydrocarbon Accumulation,

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Secondary porosity in the Galena (Trenton) dolomite can be subdivided into three types: matrix, fracture, and conduit. All three types of secondary porosity have been enhanced by karst processes, either meteoric or hydrothermal. Meteoric karstification occurred along with subaerial exposure during post-Galena (mid-Ordovician) time. Hydrothermal karstification subsequently occurred in middle to late Paleozoic, with sulphur-rich hydrothermal fluids rising up through fracture conduits in the Galena dolomite until reaching the relatively impermeable overlying Maquoketa shale. Maximum dissolution occurred directly beneath the Maquoketa as well as along the vertical and horizontal conduits and fractures. Increased matrix porosity also resulted from shrinkage due to hydrothermal dolomitization.

Karst features such as caves, sinkholes, and springs are concentrated near synclinal axes as well as major faults and fractures. Sulphide mineralization is also coincident with synclines, faults, and fractures. Karst is evidenced by bit drops on drillers' logs as well as vugs and cavities in rock cores. Triple porosity pump drawdown curve analysis and spring hydrograph recession curve analysis also indicates karst. Horizontal karst conduits are found primarily at the junctions of vertical fractures and bedding plane fractures. Vertical conduits are found at the junctions of the northwest and northeast vertical fracture sets.

Hydrocarbon accumulation in the Trenton in both the Michigan and Illinois Basins occurs primarily in the top 50 feet, directly beneath the Maquoketa shale seal. Oil and gas occurrence is also associated with synclines and fractures that have resulted from solutional collapse and/or structural compression.