The Late Middle Ordovician Trenton Limestone is a highly productive carbonate hydrocarbon reservoir across the eastern United States. Enhanced porosity and permeability within the Trenton Limestone generated by hydrothermal dolomitization (HTD) in Michigan and New York have allowed for extensive hydrocarbon reservoirs to be developed. In these areas, carbonate facies associations have been shown to significantly control the development of diagenetic alteration and influence the porosity and lateral continuity of reservoirs. Herein, we report on outcrop study and core analysis to document HTD in the Trenton Limestone of Kentucky. We show that HTD is prevalent large, isolated vugs of saddle dolomite yielding poorly developed secondary permeabilities and tests the hypothesis that HTD has influenced historically productive fields of south-central Kentucky.

Results from outcrop analysis indicate that HTD within post-Trenton strata is linked to stratigraphic setting and that dolomite precipitation is controlled by various factors including: (1) energy carbonate ramp during the deposition of the Lexington Limestone, (2) depositional environments such as the Upper Ordovician energy carbonate ramp, and (3) the presence of Mn2+ that promotes optical luminescence caused by reactions in the presence of Mn2+.

This study tests the hypothesis that HTD within the Trenton Limestone of Kentucky may be more extensive in facies that exhibit high primary permeability and low energy carbonate ramp. This hypothesis is supported by the occurrence of HTD in hydrocarbon reservoirs across the eastern United States. Determination of HTD extent through matrix-replaced dolomite on outcrop and in core samples has led to fault reactivation and determined the nature and extent of HTD occurrences. Comparisons to previous studies allow for development of a better understanding of HTD reservoirs.

Determine extent of hydrothermal dolomitization through the determination of HTD extent through matrix-replaced dolomite on outcrop and in core samples. Observed outcrop displays developed matrix-replaced HTD hydrocarbon reservoirs that provide large, isolated vugs of saddle dolomite yielding poorly developed secondary permeability. Investigation of fluid inclusion fabrics from these and saddle dolomite samples allow for the determination of the origin and nature of HTD reservoirs. Comparisons to previous investigations of fluid inclusions from throughout the northern part of the Appalachian Basin allow for development of a better understanding of HTD reservoirs.

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Core Analysis: determine extent of hydrothermal dolomitization through the subsurface of south-central Kentucky.

 Petrographic Analysis: utilize Alizarin red S, Potassium-Ferricyanide, and blue-dyed epoxy to generate detailed facies descriptions and to document paragenetic sequences.

 Fluid Inclusion Microthermometry: determine temperature and salinity of post-depositional dolomite emplacement providing geochemical data that may be compared to dolomite bodies in the Northern Appalachian Basin and determine if geochemical controls are linked to reservoir-grade permeability.

 Stable Isotope Analysis: δ18O in dolomites can be compared to sea-level curves to grade porosity development.

 Cathodoluminescence Microscopy: observe stages of dolomite development through optical luminescence caused by the presence of Mn2+.

 Subsurface Mapping: utilize public well logs to develop isopach and structure contour maps of the Trenton interval to help correlate outcrop and subsurface samples and to locate zones where potential faulting and dolomitization may have occurred.

• Solution collapse associated with Mg2+ replacement of Ca2+.
• Seismic recognition through increased travel times associated with seismic "sags".
• Basement fault reactivation.
• Regional Mg2+ rich fluid flow.
• Vertical migration halted by low porosity/permeability aquifers.