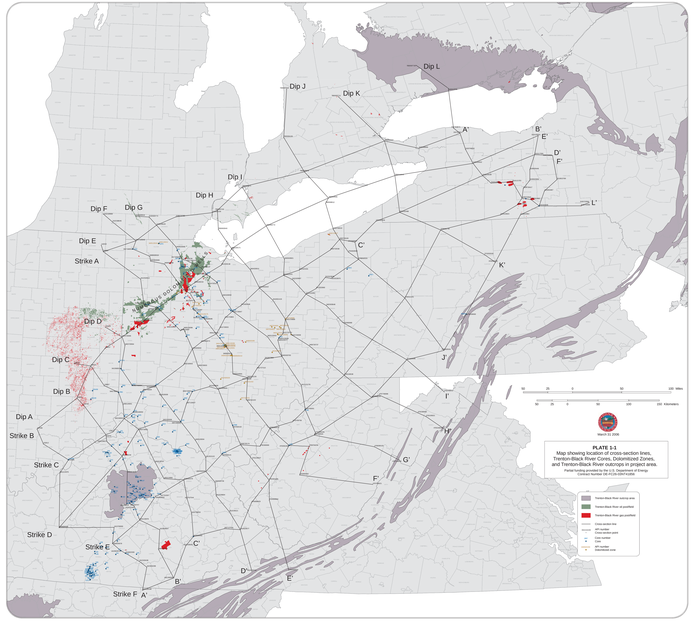

Regional Cross Sections Illustrating the Middle and Upper Ordovician Stratigraphic Framework in the Appalachian Basin

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Abstract

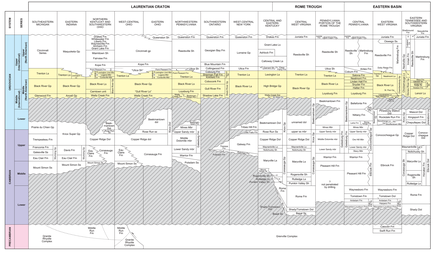
The Ohio Division of Geological Survey (ODGS), in conjunction with the State geological surveys in Kentucky, Pennsylvania and West Virginia, and the New York State Museum Institute recently completed a regional study of the Ordovician Trenton-Black River interval in the Appalachian Basin. This industry-government partnership was partially co-funded by the U.S. Department of Energy and a consortium of oil and gas companies.

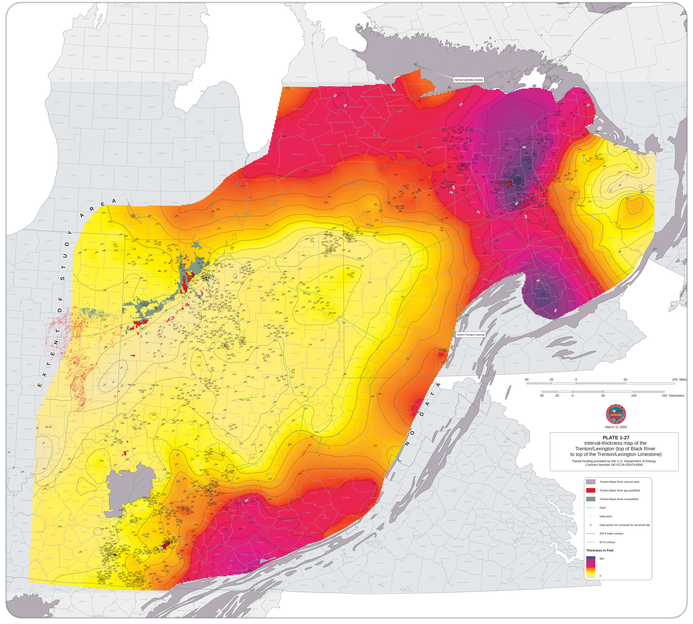
A network of regional cross sections across the Appalachian Basin was generated by the ODGS to unravel the regional Trenton-Black River stratigraphy and facies relationships, which are necessary for understanding the exploration potential of these productive reservoirs. Cross sections were tied to open-file and published reports, continuously cored Trenton-Black River wells, geophysical well logs, and Geolog sample descriptions. Six geophysical log cross-section lines oriented parallel to strike, and 12 cross-section lines oriented perpendicular to strike were constructed.

The stratigraphic framework developed by these cross sections established regionally consistent formation/interval boundaries that were used for development of structure, isopach, and facies maps. These cross sections also were critical in understanding the Trenton-Black River depositional environment, basin architecture and facies distribution, which has important implications for Trenton-Black River exploration. The relationship of the deeper-water Utica/Point Pleasant Sub-basin to the thick Trenton/Lexington carbonate platforms that rim much of this sub-basin is illustrated and defines a potential exploration trend. Regional correlations also indicate a clean carbonate in the upper portion of the Trenton in portions of western New York, which may have exploration potential for hydrothermal dolomite reservoirs and is yet untested.

Methods

1. Created a stratigraphic correlation chart for Cambrian-Ordovician units.
2. Constructed a core location and outcrop map for the Trenton-Black River interval.
3. Examined numerous cores with focus on dolomitized zones, porous zones, oil shows, and marker beds (i.e., bentonite beds) to assist in refining the regional correlations and analyzing zones with reservoir potential.
4. Compiled a basin-wide Trenton-Black River oil and gas field's map.
5. Generated a network of 18 regional stratigraphic cross sections (six cross-section lines oriented parallel to strike, and 12 cross-section lines oriented perpendicular to strike). All 225 wells used in these cross sections were converted to LAS (Log ASCII Standard) format.
6. Interpreted geophysical logs for the regional mapping that were tied into regional cross sections. Geophysical-log data was integrated with core and sample descriptions, and published work. A total of 2,031 wells were used for regional mapping across the project area.
7. Generated regional interval thickness maps for selected Cambrian-Ordovician units:
   - preKnox (the top of the Precambrian to the base of the Cambrian-Ordovician Knox)
   - basal Cambrian sandstone (includes the Cambrian Mt. Simon, unnamed Conasauga sandstone, Potsdam, and Rome Trough basal sandstone)
   - Knox (Cambrian-Ordovician base of Knox to top of Knox)
   - Rose Run sandstone (top of Cambrian Copper Ridge to top of Rose Run; includes the Upper Sandy member of the Gatesburg Formation in Pennsylvania and Theresa sandstone equivalent in New York)
   - Black River and Wells Creek (top of Knox to top of Black River)
   - Black River (top of Ordovician "Wells Creek" to top of Black River)
   - Trenton/Curdsville (top of Ordovician Black River to top of Trenton/Curdsville)
   - Trenton/Lexington (top of Ordovician Black River to top of Trenton/Lexington)
   - "Utica" (top of Ordovician Trenton/Lexington to top of "Utica," includes the "Point Pleasant" and Antes Shale)
   - "Kope" (top of Ordovician Trenton/Lexington to top of "Kope" and equivalents; includes the "Utica" and "Point Pleasant")
   - upper Ordovician undifferentiated (top of "Kope" and equivalents to top of Ordovician undifferentiated)
8. Created generalized maps showing the major tectonic features and basin architecture during Middle Cambrian through Late Ordovician time.
9. Constructed generalized facies maps for the Black River and Trenton/Point Pleasant equivalent strata.
10. Developed type logs illustrating the major Trenton facies.



Conclusions

1. Exploration potential exists along the platform margin. Grainstones in skeletal shoals along platform margin that wraps around from IN-OH-ONT-PA appear to have some of the best reservoir quality (Lake Erie region has great potential).
2. Best facies for hydrothermal reservoirs appear to be in clean Trenton and Black River carbonates.
3. Area of western NY that contains a clean upper Trenton carbonate may have potential for hydrothermal reservoir facies and is an undeveloped play.
4. Localized areas of clean carbonate buildups deeper in the basin and off the platform region are present and are potential targets.
5. Shallow mapping of the Silurian-Devonian "Big Lime" (top of Onondaga to base of Lockport) interval is a useful exploration tool for identifying potential deeper, faulted, HTD TRNN-BKRV reservoirs.
6. Basal Cambrian sandstones are present throughout most of known TRNN-BKRV HTD producing fields and are, in part, probable migration pathways for hydrothermal fluids.