Evaluation of Sequestration Options for Deep Saline Formations and Oil and Gas Fields in Eastern Ohio

Ronald A. Riley (ron.riley@dnr.state.oh.us), Michael P. Solis (michael.solis@dnr.state.oh.us), and Matthew S. Erenpreiss (matt.erenpreiss@dnr.state.oh.us) • Ohio Department of Natural Resources, Division of Geological Survey, Columbus, OH

SUMMARY

Mapping of subsurface horizons with high data density was conducted to ascertain structural trends concurrent at multiple horizons in order to help evaluate geologic conditions favorable for CO_2 storage in eastern Ohio. Horizon elevations interpreted by Survey geologists are combined with driller-reported horizon elevations. The combined dataset is statistically evaluated; deference is given to geologists' interpretations. Once local outliers are removed, the dataset is contoured using kriging. Separate contour maps are created for areas where data density is low. These contours are then manually spliced together. Currently mapped, greater-detailed surfaces include the Wenlockian Dayton Formation, the Middle Devonian Onondaga Limestone, and the Upper Devonian Berea Sandstone.

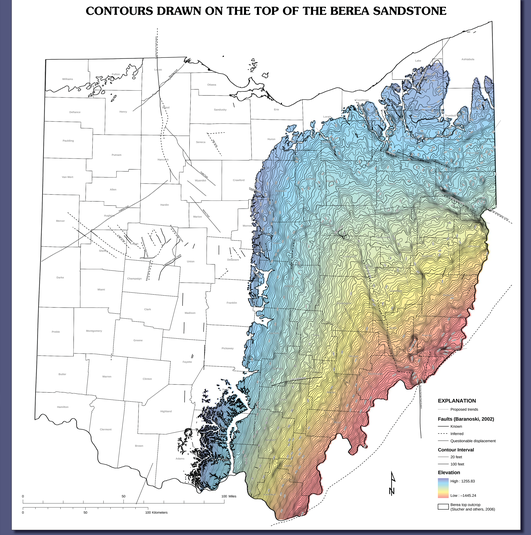
VERIFICATION OF THE MAHONING COUNTY LOW

A structural low is present in the vicinity of Boardman Township, Mahoning County. The structural low is described by drillers' tops but is statistically viable and also present in a draft Queenston Shale structure contour map. Therefore, the low was included on the Dayton Formation structure contour map until it could be verified.

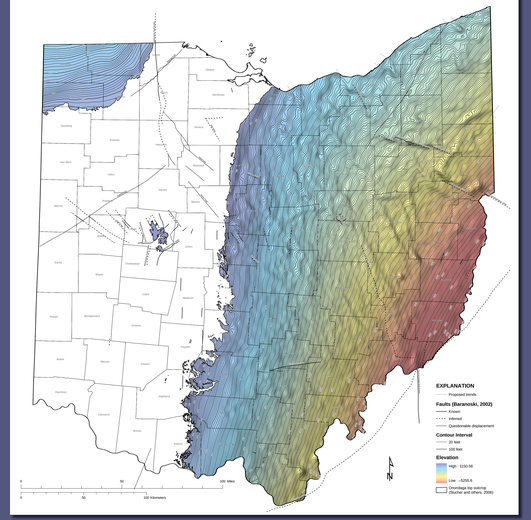
Location map

To verify the tops used in kriging, well locations were verified within the area of interest. Log images were then depth registered and drillers' tops were verified on each log. The driller-reported tops are fairly accurate and begin to describe a discontinuous Dayton surface, most noticeably on cross section B-B', between well 34099224950000 and well 34099224940000. Wells 34099224950000 and 34099224940000 are 91 ft apart with the Dayton surface ≈170 ft higher in the eastern well (34099224940000). A thickened Salina section in the western well (34099224950000), suggests a north-striking, east-dipping reverse fault.

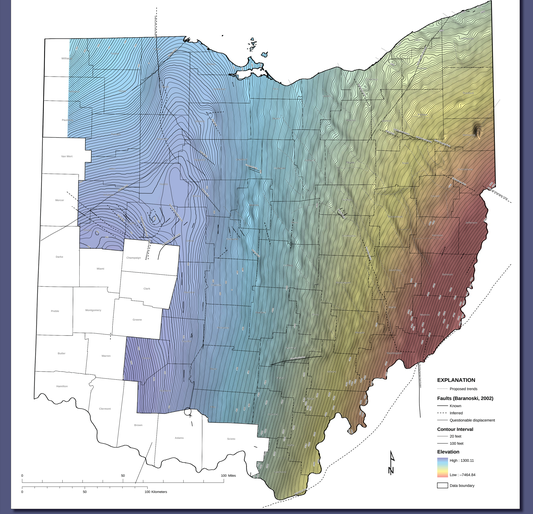
CONTOURS DRAWN ON THE TOP OF THE BEREA SANDSTONE



CONTOURS DRAWN ON THE TOP OF THE ONONDAGA LIMESTONE ("BIG LIME")



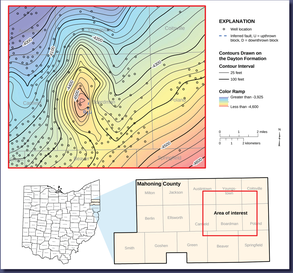
CONTOURS DRAWN ON THE TOP OF THE DAYTON FORMATION ("PACKER SHELL")



Formation	$n_{Position}$ / n_{Total}	Kriging Type	Trend Removal	Lag (ft)	Model	Anisotrophy	Neighborhood	Axis (ft)	RMS Error (ft)	Regression Function
Berea Sandstone	Geo = 17,856 Drill = 111,761 Tot = 129,626 / Geo = 16,781 Drill = 83,545 Tot = 100,326	Ordinary	Second Order	1,061	Stable	FALSE	Standard	50,000	22.34	0.998479639611502 * x + -0.271908063411118
Onondaga Limestone ("Big Lime")	Geo = 16,001 Drill = 56,081 Tot = 72,082 / Geo = 15,357 Drill = 52,288 Tot = 67,645	Ordinary	Second Order	1,414	Stable	FALSE	Standard	50,000	18.59	0.999810247426246 * x + -0.301320980876199
Dayton Limestone ("Packer Shell") (central)	Geo = 10,109 Drill = 56,107 Tot = 66,216 / Geo = 9,663 Drill = 52,125 Tot = 61,788	Ordinary	Second Order	1,439	Stable	FALSE	Standard	50,000	29.17	0.999551878295574 * x + -1.25178635477005
Dayton Limestone ("Packer Shell") (east/west)	Geo = 10,109 Drill = 56,107 Tot = 66,216 / Geo = 9,663 Drill = 52,125 Tot = 61,788	Ordinary	Second Order	3,648	Stable	FALSE	Standard	100,000	22.78	0.999649622227872 * x + -0.968977815089602

Geologists' top picks are from a number of sources: Gray and others, 1982; Baranoski and others, 1988; Riley, 2001; Ohio Division of Geological Survey, 2003; Patchen and others, 2006; and Carter and others, 2010; M. T. Baranoski, Table of formation tops, written commun., 2011. For wells with multiple geologist picks, the most recent pick was used. A number of older geologist picks were dropped because of poor elevation data, missing coordinates, or improper database entry. Because of changes in data density, the Dayton Formation ("Packer Shell") was kriged in three portions and compiled manually. The Onondaga Limestone ("Big Lime") was hand-edited where data density decreased. The Berea Sandstone required no editing after kriging.

Trends from structure contour maps. Consistent deflections in strike were used to delineate trends on each structure contour map. Many of the trends are incident to the different mapped horizons, suggesting a plane present through approximately 7,000 ft through the Paleozoic section.

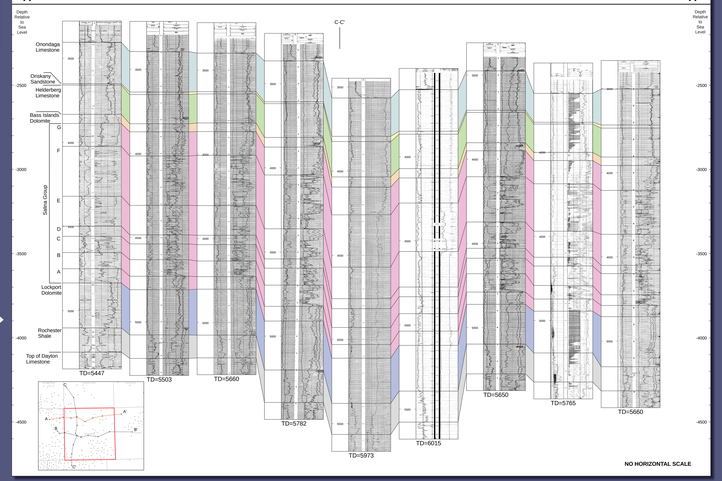


Contours drawn on the surface of the Dayton Formation in the area of interest in Mahoning County, Ohio.

CONTINUING WORK

Initial verification of the tops used to create the regional Dayton map suggests the Dayton Formation is a broken surface in Mahoning County. Addition of the dropped wells in Mahoning County and selection of Dayton tops would help define structural trends. Evaluation of available seismic data also would enhance the location of structural trends evident on the Dayton Formation, Onondaga Limestone, and Berea Formation.

Structural Cross Section of the Middle Silurian-Middle Devonian Interval Trending East-West, Mahoning County



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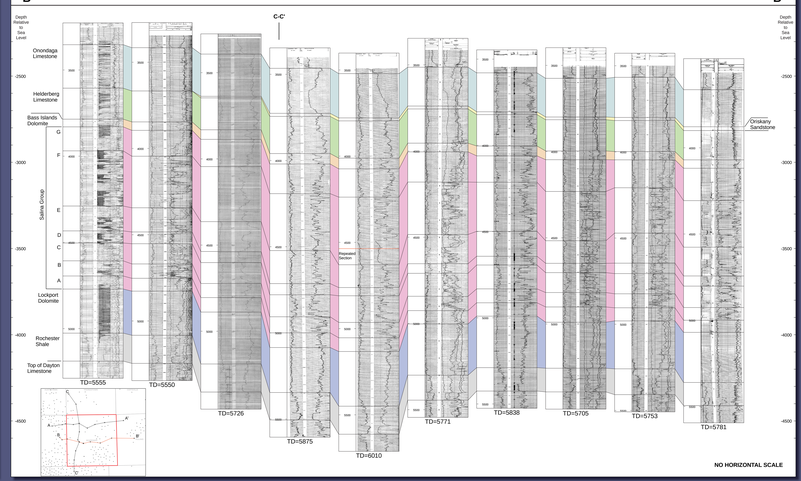
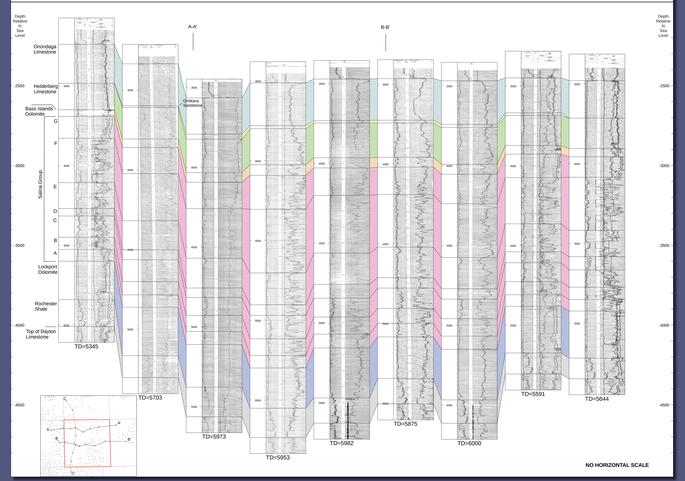


Structural Cross Section of the Middle Silurian-Middle Devonian Interval Trending North-South, Mahoning County



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