Structure Contour Map on the Precambrian Unconformity Surface in Ohio and Related Basement Features

by
Mark T. Baranoski

Digital Map Series PG-23, Version 2.0

STATE OF OHIO
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL SURVEY
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Columbus 2013

DISCLAIMER

Data used in this report and map is subject to reporting errors, sample cutting lag times, borehole irregularities, faulty instrumentation, inadequate rathole, rounding errors, hearsay, and other factors beyond the control of the author.

RECOMMENDED BIBLIOGRAPHIC CITATION

Baranoksi, M.T., 2013, Structure contour map on the Precambrian unconformity surface in Ohio and related basement features (ver. 2.0): Columbus, Ohio Department of Natural Resources, Division of Geological Survey Map PG-23, scale 1:500,000, 17 p. text.

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INTRODUCTION

Additional deep well drilling to the Precambrian[1] basement in the Ohio region has necessitated revision of map PG-23 (Baranoski, 2002), to which the reader is referred for the history and methodology of the map's development. Table 1 herein lists structural features and bibliographic citations, replacing Appendix A from Baranoski (2002). Tables 2 and 3 list well data and seismic reflection lines, respectively, and replace Appendices B and C from Baranoski (2002). The updated map uses and identifies 79 additional wells for mapping Ohio, the surrounding states, and Ontario, Canada, and also 47 additional paleotopographic high areas and monadnocks. The new map uses insets to show detail where required and also indicates Class II oil-field waste injection wells in addition to Class I industrial-waste injection wells.

Since 2002, the major impetus for drilling deep wells has been an increased interest in oil-field brine disposal, research for CO_2 sequestration targets, and wildcats. Cambrian-age rocks cannot be properly evaluated for disposal zones, sequestration targets, or hydrocarbon potential unless a well is drilled into the Precambrian complex with sufficient depth (including a rathole[2]). Typically, 100 feet (ft) of rathole into the Precambrian will allow open-hole geophysical instruments to collect data along the uppermost Precambrian and the entire Cambrian interval for proper evaluation. Also since the 2002 map was released, new analyses of diamond bit core have revealed that Ohio's Precambrian rocks are significantly older than previously thought. While the details of age-dating results are not included in this report, these older rock ages will have far-reaching effects on our understanding of the Precambrian complex underpinning the Ohio region. Both deep well drilling and age-dating research will assist industry and academia in developing new tectonic models for the Ohio region.

For more than one half century there has been little change to Bass's (1960) original delineation of Ohio's Precambrian Provinces using geochronology: older, unmetamorphosed Granite-Rhyolite Province rocks west of a north–south boundary of younger, metamorphosed Grenville Province rocks (see Baranoski and others, 2009). Bass (1960) noted the presence of unmetamorphosed sedimentary rocks west of the Grenville Province boundary in the Mattinson well (API number 3402360004) in Clark County. It was not until the discovery of the Middle Run Formation (Shrake and others, 1990) followed by reexamination of older well data, new well drilling, and seismic reflection data that revealed extensive and thick, unmetamorphosed sedimentary rocks. Drahovzal and others (1992) interpreted these newly discovered rocks beneath the Paleozoic as deposits of the regional Precambrian East Continent Rift System. The generally accepted ages of these provinces are 1.3 to 1.4 billion years (Ga) for the Eastern Granite-Rhyolite Province of western Ohio (Van Schmus and others, 1996); 1.0 to 1.2 Ga for the Grenville Province (Culshaw and Dostal, 2002); and 1.0+ Ga for the East Continent Rift System (Santos and others, 2002). However, these well-established rubidium-strontium (Rb-Sr) radiometric age dates have likely been reset due to later tectonic events applied to older crustal rocks now known to exist in Ohio (Petersson and others, 2012).

Another significant and yet unexplained tectonic anomaly to Bass's (1960) original Ohio Precambrian Province delineation line is the gabbro in Seneca County, Ohio (API number 3414760840, DGS core no. 2580; see Wickstrom and others, 1985). This well was drilled approximately 30 miles east of the Grenville boundary into Lucius and von Frese's (1988) Seneca "geopotential" anomaly. The gabbro was analyzed for samarium-neodymium (Sm-Nd), yielding a radiometric age date of 1.3 Ga and a calculated (time of crystallization of depleted mantle [T_{DM}]) model age date of 1.6 Ga (Van Schmus and

[1]The informal term *Precambrian* has become obsolete with the advent of modern radiometric age dating of rocks. The preferred term for rocks beneath the Cambrian is *Proterozoic Eon* (Ohio Geological Survey, 1990; Palaeos, [n.d.]). The Proterozoic is subdivided into three eras, which in ascending order are Paleoproterozoic, Mesoproterozoic, and Neoproterozoic. However, this report will continue to use the informal term *Precambrian*.

[2]"Extra hole drilled at the end of the well (beyond the last zone of interest) to ensure that the zone of interest can be fully evaluated. The logging tool string may be as much as 120 ft (36.5 m) in length, so the rathole allows tools at the top of the logging string to reach and measure the deepest zone of interest." (Schlumberger, 2013)

others, 1996). Interestingly this gabbro did not exhibit deformation, metamorphism, or radiometric resetting even though located well within the Grenville Province. Van Schmus and others (1996, p. 23) explained this anomaly as a "block of crust that locally escaped penetrative deformation." Their calculated (T_{DM}) model age date of 1.6 Ga for the gabbro was the first indication, at least locally, of Ohio crust much older than the Eastern Granite-Rhyolite. These findings further added to the unexplained tectonic history of the region.

In 2002, uranium-lead (U-Pb) radiometric age-dating of zircon crystals was performed on six Ohio diamond drill core in Sweden by Dr. Jenny Andersson (Jenny Andersson, unpub. data, 2002; Baranoski and others, 2002). This work was later expanded upon by Petersson (2010) to show that Ohio's crustal complex is at least 1.6 Ga in age (Petersson and others, 2012). These new preliminary age dates are more than 200 million years older than previous dates for the Eastern Granite-Rhyolite Province and allow extension of the Van Schmus and others' (1996) older crust over most of Ohio. These findings will spur work to develop new crustal models for the Ohio region and will change the way we currently view the Granite-Rhyolite and Grenville Provinces and the East Continent Rift Basin. Such new tectonic models will likely change our view on the region's Paleozoic structural and stratigraphic history. Long-term implications of new models will affect future exploration and development of energy, mineral, and geothermal resources; industrial-waste and oil-field brine disposal; CO_2 sequestration; and seismicity research.

UPDATES TO MAP PG-23

The revised PG-23 map utilizes data from 335 wells drilled into Precambrian basement[3], including an additional 80 wells since the 2002 map was published. Of those additional wells, 43 are in Ohio and include new information for 13 older wells and 30 new wells drilled since 2002. Of the 30 new wells since 2002, 16 are permitted as oil-field waste injection wells into Cambrian-age reservoirs; 12 are rank wildcat; and 2 were drilled for CO_2 sequestration research. Eight Ohio counties have had drilling to the Precambrian for the first time since the 2002 map was published[4]. The remaining 37 additional wells include new wells drilled outside of Ohio and into an expanded map area, which added older wells. One well each in Indiana, Kentucky, and West Virginia was drilled to the Precambrian for CO_2 sequestration research since 2002. The updated map also shows wells drilled to the Precambrian that have been permitted (active and inactive) for Class I industrial-waste injection (20 wells) and Class II oil-field waste injection (26 wells). Table 2 lists all the wells on the map, with additional wells since 2002 footnoted. Sixteen Ohio counties have not yet had a well drilled into the Precambrian: Athens, Belmont, Darke, Champaign, Gallia, Geauga (see observation below), Hamilton, Jefferson, Meigs, Montgomery, Monroe, Morgan, Ottawa, Preble, Vinton, and Washington. A Geauga County well (API number 3405520096) reportedly had been drilled to a total depth of 7,077 ft with tools lost in the hole. This well was drilled along the Akron Magnetic Boundary trend and yields a subsea value of –5,877 ft, which lies proximal to contours interpreted for the revised map, suggesting the total depth of the well was close to the Precambrian. This well location was not used on the revised map without further documentation, electric well logs, and/or sample cuttings.

Seismic-reflection lines, fault codes, and fault positions remain unchanged from the 2002 map. However, one relative fault movement was changed to "Up" on the southwest for the Harlem Fault in southeastern Delaware County. This change suggests steep vertical northeast dip on the fault. The structural features table (table 1) now recognizes the Serpent Mound impact structure of southern Ohio and includes the Utica Mountain Structure and Fault in Licking and Knox Counties. The original 17 paleotopographic high areas or monadnocks on the 2002 map included only those wells where Janssens' (1973) Cambrian Mount Simon Sandstone was not present above the Precambrian. The updated 2013 map has 67 symbols for well locations drilled into paleotopographic high areas—50 more than on the 2002 map. The paleotopographic high areas on the updated map include both additional wells missing Janssens' (1973) Mount Simon and other wells with relatively thin basal Cambrian units (Baranoski, unpub. data, 2013). Two additional paleotopographic high areas outside of Ohio are located in Branch County, Michigan, and Erie County, Pennsylvania.

Contour lines were adjusted digitally/manually using Geographix® mapping software, following placement of new Precambrian well locations and subsea values. Finalized shape files were exported from Geographix® and reformatted in Esri ArcMAP 10®. The final version of the map includes brief text and updated data tables and is formatted as an Adobe PDF file. Also included with the revised map is a database of well data, seismic line locations, faults, contours, and metadata. Metadata is described in the digital DVD version of this report.

[3]A total of 25 wells have a question mark (?) associated with (1) formation name and total depth and (2) the subsea value on the PG-23 map. These wells have not been verified conclusively with sample cuttings or geophysical well logs. In most cases, samples were not available and in some instances samples were too fine in size to analyze without grain mounts and a high-power petrographic microscope. The David Hill Georgetown-Marine well in Belmont County is the deepest well drilled in the state at 13,727 ft. This well is interpreted as reaching near the base of the Cambrian Conasauga Formation and a few tens to a couple of hundred feet above the Precambrian basement, thus justifying this well location as an important control point in a sparsely drilled region.

[4]Belmont, Carroll, Fairfield, Greene, Mahoning, Stark, Trumbull, and Tuscarawas Counties.

TABLE 1. ***Regional structural features in the Precambrian basement of Ohio as depicted on map PG-23***

Type of structure	Map number	Named feature	References
anomaly	47	Seneca Anomaly	Lucius and von Frese, 1988
	50	Southwestern Ohio Anomaly	Lucius and von Frese, 1988
cross-strike structural discontinuity (CSSD)	3	Cambridge CSSD	Shumaker, 1986; Coogan and Reeve, 1985; Baranoski, 1989, 1990, 1993a, 1993b, 1993c; Riley and others, 1993; Root, 1996
	11	Pittsburgh-Washington CSSD	Harper and Laughrey, 1987; Riley and others, 1993
fault	27	Akron Fault	Gray and others, 1982; Root and MacWilliams, 1986; Shumaker, 1986; Coogan, 1991; Riley and others, 1993
	31	Anna-Champaign Fault	McGuire, 1975; Schwartz and Christensen, 1986; Wickstrom, 1990; Wickstrom and others, 1992
	33	Auglaize Fault	Schwartz and Christensen, 1986; Wickstrom, 1990; Wickstrom and others, 1992
	41	Bellefontaine Outlier Faults	Steck, 1997; portion of Union Fault from Wickstrom, 1990
	8	Bowling Green Fault System	Orton, 1888; Carman and Stout, 1934; Stout, 1941; Green, 1957; Worthing, 1965; Janssens, 1973; Shearrow, 1987; VanWagner, 1988; Wickstrom, 1990; Wickstrom and others, 1992; Onasch, 1995
	6	Burning Springs Fault System	Shumaker and others, 1982; Calvert, 1983; Shumaker, 1986; Baranoski, 1989
	34	Crawford Faults	Wickstrom, 1990; Wickstrom and others, 1992
	21	Harlem Fault	Wickstrom, 1990
	30	Highlandtown Fault	Gray and others, 1982; Root and MacWilliams, 1986; Shumaker, 1986; Coogan, 1991; Riley and others, 1993
	35	Kentucky River Fault System	McGuire and Howell, 1963; Rudman and others, 1965; Lidiak and Zietz, 1976; Ammerman and Keller, 1979; Webb, 1980; Black and others, 1981; Cable and Beardsley, 1984; Black, 1986; Harris and Drahovzal, 1996; Drahovzal and Noger, 1995; Stark, 1997
	36	Killbuck Dome	Wicks, 1996
	32	Logan Fault	McGuire, 1975
	37	Marion Fault	Wickstrom, 1990; Wickstrom and others, 1992; Shrake, 1997
	38	Maumee Fault	Wickstrom, 1990
	10	Middleburg Fault	Gray and others, 1982; Root and MacWilliams, 1986; Coogan, 1991
	7	Ohio River Fault	Calvert, 1974; Baranoski and Riley, 1988
	39	Outlet Fault	Wickstrom, 1990; Shrake, 1997
	40	Plum Run Quarry Fault	Schmidt and others, 1961; Reidel and Koucky, 1981; Reidel and others, 1982; Baranoski and others, 2003
	2	Rome Trough Fault System	Lockett, 1947; Thomas, 1960; Woodward, 1961; McGuire and Howell, 1963; Rudman and others, 1965; Webb, 1969, 1980; Silberman, 1972; Heyl, 1972; Harris, 1975; Wagner, 1976; Shumaker and others, 1982; Beardsley and Cable, 1983; Cable and Beardsley, 1984; Keller and others, 1983; Baranoski, 1993b; Kulander and Dean, 1986; Harper, 1989; Coogan and Peng, 1993; Riley and others, 1993; Harris and Drahovzal, 1996; Stark, 1997
	29	Smith Township Fault	Gray and others, 1982; Root and MacWilliams, 1986; Coogan, 1991; Riley and others, 1993; Shumaker, 1986
	24	Starr Fault System	Brannock, 1993
	28	Suffield Fault System	Gray and others, 1982; Root and MacWilliams, 1986; Coogan, 1991; Riley and others, 1993; Shumaker, 1986
	19	Tiffin Fault	Sitler and Wehmeyer, 1962; Shearrow, 1987
	52	Utica Mountain Fault	this report
	42	unnamed faults (Adams Co.)	Foerste and Lamborn, unpub. data, 1918, 1919; Harper, 1939; Bucher, 1921, 1933, 1935, 1936, 1963; Galbraith, 1968; Galbraith and Koucky, 1969; Reidel, 1972, 1975; Koucky, 1975; Reidel and Koucky, 1981; Reidel and others, 1982
	44	unnamed fault (Ashtabula Co.)	this report
	45	unnamed fault (Ashtabula Co.)	Seeber and Armbruster, 1993
	4	unnamed fault (Belmont Co.)	Berryhill, 1963
	9	unnamed faults (Delaware Co.)	Galey, unpub. data, 1964; Rudman and others, 1965; Swinford and Slucher, 1995
	22	unnamed faults (Fayette Co.)	Mayhew, 1969
	20	unnamed faults (Fayette, Ross, Pickaway Cos.)	Mayhew, 1969; Shearrow, 1987
	18	unnamed fault (Hancock Co.)	Shearrow, 1987
	26	unnamed fault (Highland Co.)	Shearrow, 1987

TABLE 1. ***Regional structural features in the Precambrian basement of Ohio as depicted on map PG-23 (cont.)***

Type of structure	Map number	Named feature	References
	1	unnamed fault (Lake Co.)	Nicholson and others, 1988
fault (cont.)	14	unnamed faults (Madison Co.)	Mayhew, 1969
	12	unnamed fault (Sandusky Co.)	this report
	15	unnamed fault (Scioto Co.)	this report
	23	unnamed fault (Seneca Co.)	Shearrow, 1987
	17	unnamed fault (Warren Co.)	Shrake and others, 1991
	13	unnamed faults (Washington Co.)	Baranoski, 1989; Deyling, 1993
	43	unnamed fault (Wyandot Co.)	this report
	25	unnamed faults along COCORP seismic lines	Dean and others, 1998; this report
	5	W. Hickman Creek-Bryan Station Fault	Harper, 1939; McGuire and Howell, 1963; Worthing, 1965; Galbraith, 1968; Lidiak and Zietz, 1976; Ammerman and Keller, 1979; Patterson, 1980; Webb, 1980; Black and others, 1981; Swinford, 1983; Harper, 1989; Black, 1986; Hinze and others, 1987
miscellaneous structure	46	Akron Magnetic Boundary	Aggarwal, 1987; Seeber and Armbruster, 1993
	16	Serpent Mound impact structure	Locke, 1838; Orton, 1871; Foerste and Lamborn, unpub. data, 1918, 1919; Harper, 1939; Bucher, 1921, 1933, 1935, 1936, 1963; Stout, 1941; Lockett, 1947; Schmidt and others, 1961; Sappenfield, 1950, 1951; Summerson and others, 1963; Worthing, 1965; Bull and others, 1967; Galbraith, 1968; Galbraith and Koucky, 1969; Reidel, 1972, 1975; Koucky, 1975; Reidel and Koucky, 1981; Reidel and others,1982; Langford, 1984; Koucky and Reidel, 1987; Baranoski, 1993c; Baranoski and others, 2003
	48	Coshocton Zone	Pratt and others, 1989; Culotta and others, 1990
	49	Fort Wayne Rift	Denison and others, 1984; Hinze and others, 1987; Lucius and von Frese, 1988; Coogan and Peng, 1993
	53	Utica Mountain Structure	this report
province		Granite-Rhyolite Province (Central Granite-Rhyolite Province/ Eastern Granite-Rhyolite Province)	Bass, 1960; Denison and others, 1984; Bickford and others, 1986; Lucius and von Frese, 1988; Pratt and others, 1989; Culotta and others, 1990; Drahovzal and others, 1992; Hauser, 1993
		Grenville Province	Bass, 1960; Rudman and others, 1965; Webb, 1980; Black and others, 1981; Keller and others, 1983; Beardsley and Cable, 1983; Bickford and others, 1986; Black, 1986; Lucius and von Frese, 1988; Green and others, 1988; Pratt and others, 1989; Culotta and others, 1990; Hoehn, 1991; Hoehn and Hinze, 1992; Coogan and Peng, 1993; Hauser, 1993; Riley and others, 1993; Carter and others, 1996
	51	Grenville Front Tectonic Zone	McGuire and Howell, 1963; Rudman and others, 1965; Bayley and Muehlberger, 1968; Mayhew, 1969; Lidiak and Zietz, 1976; Hinze and others, 1987; Lucius and von Frese, 1988; Pratt and others, 1989; Culotta and others, 1990; Hoehn, 1991; Hoehn and Hinze, 1992; Coogan and Peng, 1993; Hauser, 1993; Lidiak and Hinze, 1993; Wolfe and others,1993; Riley and others, 1993; Richard and Wolfe, 1995; Stark, 1997; Steck, 1997
		East Continent Rift Basin	Shrake and others, 1991; Drahovzal and others, 1992; Riley and others, 1993; Wolfe and others, 1993; Coogan and Peng, 1993
		East-central midcontinent rift system	McGuire and Howell, 1963; Lidiak and Zietz, 1976; Halls, 1978; Keller and others, 1982, 1983; Cable and Beardsley, 1984; Hinze and others, 1987; Hoehn, 1991; Hoehn and Hinze, 1992; Stark, 1997
		Kentucky-Ohio Trough	Black, 1986

TABLE 2. *Well data for control points on map PG-23*

Precambrian-top data source: C = core; D = driller; E = electric-log interpretation; N = no sample cuttings; S = sample-cuttings interpretation, by Baranoski unless otherwise noted

Unique well number[1]	County	Lease name	Well no.	Company name	Well total depth (feet)	Formation at total depth	Datum well elevation above sea level (feet)	Along-hole depth to top of Precambrian (feet)	Precambrian-top data source	Precambrian subsea value (feet)
OHIO										
3400120004	Adams	Bailey	1-A	Cabot Corp.	3,790	Precambrian	714	3,778	E	-3,064
3400120005	Adams	Covert	1	Commonwealth Gas Corp.	3,829	Precambrian	624	3,807	E	-3,183
3400120011	Adams	Russell-Tener	1	Oxford Oil Co.	3,886	Precambrian	852	3,865	S, E	-3,013
3400320060	Allen	Pohlman	1	H. & H. Producing Co.	3,207	Middle Run Formation?	807	3,207	N, E (Warner, 1988)	-2,400?
3400320064	Allen	Pohlman et al. Unit	3	Alco Oil Co.	3,265	Precambrian	811	3,208	N, E (Warner, 1988)	-2,397
3400320067	Allen	BP Chemical	1	BP Chemical	3,133	Middle Run Formation	872	3,133	E (Warner, 1988)	-2,261
3400320071	Allen	BP Chemical	2	BP Chemical	3,170	Middle Run Formation	853	3,143	E (Warner, 1988)	-2,290
3400320084	Allen	BP Chemical	3	BP Chemical	3,170	Middle Run Formation	856	3,138	E	-2,282
3400363691	Allen	BP Chemical	4	BP Chemical	3,300	Middle Run Formation	874	3,153	C, E	-2,279
3400523938	Ashland	Fingulin	1	Bass Energy Co.	5,163	Precambrian	1,083	5,060	D	-3,977
3400720191	Ashtabula	Rhoa	1-H	Horizon Oil	6,750	Precambrian	983	6,740	S (Owens, 1967)	-5,757
3400720193	Ashtabula	Brayman	1	East Ohio Gas Co.	6,907	Precambrian	977	6,898	S, D (Gonterman, 1973)	-5,921
3400720286	Ashtabula	Roulston	1	U.S. Gas & Oil	6,659	Precambrian	861	6,606	S, D	-5,745
3400721847	Ashtabula	Rhoa	3	POI Energy	7,136	Precambrian	950	7,102	N, D	-6,152
3400722038	Ashtabula	Parobek	2	POI Energy	7,127	Precambrian	942	7,106	N, E (Warner, 1988)	-6,164
3400722272	Ashtabula	Lautanen	1	POI Energy	7,151	Precambrian	973	7,120	N, D	-6,147
3400723192	Ashtabula	Dietrich	1	Universal Energy	7,008	Precambrian	932	6,776	N, E (Riley and others, 1993)	-5,844
3400723948	Ashtabula	Bustamante	2	Bottom Line Prod.	7,074	Precambrian	969	6,920	N, D	-5,951
3400724113	Ashtabula	Krcal Unit	1-2954	CGAS Exploration	6,900	Precambrian	848	6,237	E	-5,389
3400724523[2]	Ashtabula	Monroe	1	Kastle Resources	7,016	Precambrian	990	6,856	N, E	-5,866
3400760010	Ashtabula	Reserve Environmental Services	1	Reserve Environmental Services	6,060	Precambrian	650	5,972	D	-5,322
3401120071	Auglaize	Hoelscher Comm.	1	West Ohio Oil & Gas	3,067	Precambrian	896	2,942	S (Janssens, 1973)	-2,046
3401120103[2]	Auglaize	Elshoff	2	Innex Oil and Gas, Inc.	3,075	Middle Run Formation	870	3,019	S, E	-2,149
3401320611[2,3]	Belmont	Georgetown Marine	1	David R. Hill Inc.	13,727	Cambrian Conasauga Formation	1,129	13,727	S, E, estimated	-12,598?
3401520006	Brown	Griffith	1	Spencer Petroleum	3,350	Middle Run Formation?	946	3,260	S, E	-2,314
3401720004	Butler	Armco Steel Corp.	1	Armco Steel Corp.	3,297	Middle Run Formation	666	3,239	E	-2,573
3401720005	Butler	Armco Steel Corp.	2	Armco Steel Corp.	3,285	Middle Run Formation	671	3,233	E	-2,562
3401922045[2]	Carroll	Lee Unit	1-D	Range Resources	8,922	Precambrian	964	8,805	S, E	-7,841
3402320002	Clark	Brown	1	Edmund Oil & Gas	3,649	Precambrian	1,249	3,624	S (Owens, 1967)	-2,375
3402320003	Clark	Elcamere Farms	1	Hodges Industries	3,578	Precambrian	1,167	3,550	E	-2,383
3402360004	Clark	Mattison	1	Friend	4,647	Precambrian?	1,087	3,385	S	-2,298?
3402520003	Clermont	Wikoff	1	Continental Oil Co.	3,436	Precambrian	817	3,328	S, E	-2,511
3402720002	Clinton	Adams	1	Kewanee Oil Co.	3,392	Precambrian	1,080	3,372	E	-2,292
3402720005	Clinton	Van Pelt	1	Kewanee Oil Co.	3,263	Precambrian	1,092	3,253	S, E	-2,161
3402720007	Clinton	McVey	1	Kewanee Oil Co.	3,473	Precambrian	1,087	3,460	S (Janssens, 1973)	-2,373
3402720010	Clinton	Coy	1	Stocker & Sitler	3,603	Precambrian	1,098	3,554	S, E	-2,456
3402920648	Columbiana	Murray	3	Management Control Corp.	10,242	Precambrian?	1,194	10,200	D	-9,006?
3403122053	Coshocton	Lee	1	Tatum	6,970	Precambrian	1,040	6,960	S	-5,920
3403123462	Coshocton	Columbus & Southern Ohio Electric	1C	Worthington Oil	7,585	Precambrian	879	7,550	N, D	-6,671
3403124118	Coshocton	Burrell	1	Pomstone	7,363	Precambrian	852	7,296	N, D	-6,444
3403127177[2]	Coshocton	Adams	1	Preferred Fluids Mgt., LLC	7,305	Precambrian	787	7,290	S, E	-6,503
3403320044	Crawford	Spitler-Brown Unit	1	Piggott	3,415	Precambrian	977	3,410	N, E (Owens, 1967)	-2,433
3403320050	Crawford	Leonhardt	1	Luling Oil & Gas Co.	3,774	Precambrian	1,008	3,770	S (Owens, 1967)	-2,762

[1]American Petroleum Institute 10-digit numbers are used for wells in the following states: Ohio, Kentucky, Michigan, Pennsylvania, and West Virginia.
[2]Well added after 2002.
[3]Well did not penetrate the Precambrian.

TABLE 2. *Well data for control points on map PG-23 (cont.)*

Precambrian-top data source: C = core; D = driller; E = electric-log interpretation; N = no sample cuttings; S = sample-cuttings interpretation, by Baranoski unless otherwise noted

Unique well number[1]	County	Lease name	Well no.	Company name	Well total depth (feet)	Formation at total depth	Datum well elevation above sea level (feet)	Along-hole depth to top of Precambrian (feet)	Precambrian-top data source	Precambrian subsea value (feet)
3403520821[2]	Cuyahoga	Jones & Laughlin Steel Corp.	1	Jones & Laughlin Steel	5,801	Precambrian	603	5,770	S, E	-5,167
3403521625	Cuyahoga	Marconi Medical Systems	1	Bass Energy Co.	6,550	Precambrian	974	6,540	S	-5,566
3403920028	Defiance	Haver	1	Brown	3,610	Precambrian?	702	3,602	E	-2,900?
3404120001	Delaware	Vance	1	Chester Wise et al.	4,291	Precambrian	920	3,845	S (Owens, 1967)	-2,925
3404120009	Delaware	Sprain	1	Wehmeyer	4,006	Precambrian	988	4,010	E	-3,022
3404120022	Delaware	Jones	1	Southern Triangle	3,426	Precambrian	945	3,420	D (Janssens, 1973)	-2,475
3404120242	Delaware	Smith	1	McClure Oil Co.	4,035	Precambrian	992	3,990	S (Owens, 1967)	-2,998
3404120269	Delaware	Lindsey	1	Minnesota-Ohio Oil Co.	4,071	Precambrian	919	4,058	E	-3,139
3404120270	Delaware	Gregory	1	Minnesota-Ohio Oil Co.	4,685	Precambrian	1,205	4,685	S (Owens, 1967)	-3,480
3404120322	Delaware	Jolliff	1	Funk Exploration	3,382	Precambrian	933	3,352	N, E	-2,419
3404120329	Delaware	Case	1	Funk Exploration	3,569	Precambrian?	919	3,554	S, D	-2,635?
3404120339[2]	Delaware	Morrison	J-4	Sunbury-Trenton Inc.	4,610	Precambrian	1,090	4,600	S	-3,510
3404120354	Delaware	Cockrell-Godshall Unit	1	Poling Co.	4,873	Precambrian	1,118	4,450	S, E	-3,332
3404120356	Delaware	Sheets	1	NGO Development Corp.	4,013	Precambrian	987	3,956	E	-2,969
3404120358	Delaware	Longshore et al. Unit	1	Poling Co.	4,272	Precambrian	1,071	4,166	E	-3,095
3404320007	Erie	Sayler et al.	1	Ohio Fuel Gas Co.	4,417	Precambrian	817	4,400	S (Summerson, 1962)	-3,583
3404320011	Erie	Krysik-Wakefield et al. Unit	1	Sun Oil Co.	4,463	Precambrian	828	4,455	S (Owens, 1967)	-3,627
3404320019	Erie	Herman et al.	1	Sun Oil Co.	4,466	Precambrian	829	4,449	E (Janssens, 1973)	-3,620
3404320111[2]	Erie	Nixon Unit	1	Bartlo Oil and Gas	3,650	Precambrian	725	3,614	N, E	-2,889
3404320171	Erie	Kellstone	1	Kellstone	3,436	Precambrian	625	3,375	S, E	-2,750
3404521266[2]	Fairfield	Harden Unit	1	MFC Drilling, Inc.	5,080	Precambrian?	1,097	5,056	E	-3,959?
3404720001	Fayette	Hopkins	1	Kewanee Oil Co.	4,708	Precambrian	965	3,545	S (Summerson, 1962)	-2,580
3404720002	Fayette	Wilson	1	Kewanee Oil Co.	3,494	Precambrian	1,017	3,342	S (Summerson, 1962)	-2,325
3404720004	Fayette	Barnes	1	Kewanee Oil Co.	3,410	Precambrian	1,044	3,332	S, E (Janssens, 1973)	-2,288
3404720007[2]	Fayette	Cockrill	1	Barnwell Producing	3,640	Precambrian	1,002	3,636	E	-2,634
3404720009	Fayette	Hanawalt	1	Oxford Oil Co.	3,375	Precambrian?	907	3,542	E	-2,635?
3404720010	Fayette	Braun	1	Oxford Oil Co.	3,750	Precambrian	980	3,732	E (Riley and others, 1993)	-2,752
3404720011	Fayette	Duff	1	Stocker & Sitler	3,352	Precambrian	946	3,230	D	-2,284
3404920014	Franklin	Marble Cliff Quarries	1	Marble Cliff Quarries	3,622	Precambrian	697	3,607	S (Owens, 1967)	-2,910
3405120049	Fulton	Storeholder	1	Liberty Petroleum Corp.	3,700	Precambrian	689	3,555	S	-2,866
3405720004[2]	Greene	Greene	1	Tatum Petroleum Co., LLC	3,343	Precambrian	1,079	2,948	S	-1,869
3405920782	Guernsey	Marshall Comm.	1	Lake Shore Pipeline Co.	8,622	Precambrian	1,007	8,355	E (Riley and others, 1993)	-7,348
3405924067[2]	Guernsey	Devco Unit	1	David R. Hill Inc.	8,910	Precambrian	1,080	8,810	S, E	-7,730
3405924188[2]	Guernsey	Mitchell	1	David R. Hill Inc.	8,856	Precambrian	1,040	8,820	D	-7,780
3405924202[2]	Guernsey	SOS-D	1	Silcor Oilfield Services, Inc.	8,900	Precambrian	809	8,890	S, E	-8,081
3406320139	Hancock	Frazier	1	Dever	3,017	Middle Run Formation	824	3,008	S (Janssens, 1973)	-2,184
3406320140	Hancock	Harris	1	Cowen	2,799	Precambrian	833	2,795	S (Janssens, 1973)	-1,962
3406320152	Hancock	Drummelsmith	1	Kin-Ark Oil Co.	2,807	Precambrian	809	2,795	S (Janssens, 1973)	-1,986
3406367158	Hancock	Norris	1	Fennerty et al.	2,980	Precambrian	830	2,770	S (Summerson,1962)	-1,940
3406520074	Hardin	Jones	1	Edmund	2,834	Precambrian	941	2,840	S (Janssens, 1973) estimated	-1,899
3406520079	Hardin	Wolf	1	McMahon-Bullington Drilling	2,992	Precambrian?	971	2,960	E (Warner, 1988)	-1,989?
3406520133	Hardin	Fewell	1-25	Ensign Operating Co.	2,928	Precambrian	934	2,867	E	-1,932
3406720737	Harrison	Zechman Unit	1	Red Hill Development	10,625	Precambrian	898	10,474	N, E	-9,576
3406920036	Henry	Hall	1	Callander & Kimbrel	3,475	Precambrian	683	3,425	E	-2,742
3406920139[2]	Henry	Shidler	3-4SWD	Aurora Energy, Ltd.	3,375	Precambrian	692	3,355	S, E	-2,663
3407120001	Highland	Pavey	1	Kewanee Oil Co.	3,512	Precambrian?	1,043	3,515	S (Janssens, 1973) estimated	-2,472?
3407120007	Highland	Courtney	1	Ohio Valley Oil & Gas Co.	3,610	Precambrian?	957	3,582	E (Gonterman, 1973)	-2,625?

3407120015	Highland	Carl-Roberts Unit	J-1	Oxford Oil Co.	3,442	Precambrian	1,041	3,380	D, E	-2,339
3407120016	Highland	Heyob-Coyne-West Unit	J-1	Oxford Oil Co.	3,299	Precambrian	1,015	3,145	E	-2,130
3407321222	Hocking	Hockman	1	Dunigan	6,495	Precambrian	970	6,469	S (Owens, 1967)	-5,499
3407524527[2]	Holmes	Killbuck Test Well	1	OOGC Disposal Co.	6,532	Precambrian	810	6,512	E	-5,702
3407525070	Holmes	Snyder	1	Bakerwell, Inc.	5,988	Precambrian	875	5,930	N, D	-5,055
3407525231[2]	Holmes	Hawkins Unit	1-H10	Bakerwell, Inc.	6,686	Precambrian	810	6,662	N, E	-5,852
3407525275[2]	Holmes	Snyder Unit	2-59	Bakerwell, Inc.	6,396	Precambrian	808	6,394	E	-5,586
3407525393[2]	Holmes	Kaser-Rohr Unit	1-238	Bakerwell, Inc.	6,324	Precambrian	810	6,320	N, E	-5,510
3407720011	Huron	Arting	1	White	4,270	Precambrian	749	3,901	S (Summerson, 1962)	-3,152
3407720103	Huron	Wolf Unit	1	Appalachian Exploration	4,574	Precambrian	856	4,554	N, D	-3,698
3407720233	Huron	Walcher-Gray	2	NGO Development Corp.	4,445	Precambrian	970	4,340	N, D	-3,370
3407920076	Jackson	Wood	1	Worthington Oil	6,320	Precambrian	816	6,218	S (Owens, 1967)	-5,402
3407920078	Jackson	Slavens	1	Halbert	5,681	Precambrian	665	5,575	S (Owens, 1967)	-4,982
3407920079	Jackson	Brown	1	Halbert	5,991	Precambrian	841	5,990	D (Owens, 1967)	-5,149
3407920102	Jackson	Trepanier	1	Nucorp Energy Corp.	6,050	Precambrian	834	5,965	S, E	-5,152
3408321413	Knox	Cunningham	1	KST Oil & Gas	5,745	Precambrian	1,239	5,740	E	-4,501
3408321468	Knox	Larimore	1	Ohio Fuel Gas Co.	5,376	Precambrian	1,204	5,364	S (Janssens, 1973)	-4,160
3408321604	Knox	Huffman	1	Kin-Ark Oil Co.	4,907	Precambrian	1,183	4,773	S (Janssens, 1973)	-3,590
3408323915	Knox	Donaldson	1	Edco Drilling & Producing	5,354	Precambrian	1,086	5,235	N, E	-4,149
3408323931	Knox	Carter	1 G-M	B. & J. Drilling Co.	5,084	Precambrian	1,032	4,918	E	-3,886
3408323944	Knox	White	1	Cobra Oil & Gas Co.	5,023	Precambrian	1,212	4,990	N, D	-3,778
3408323955	Knox	Parkinson	4	Michigan Geosearch	4,920	Precambrian	1,060	4,920	N, E	-3,860
3408323976	Knox	Parkinson	6	Michigan Geosearch	4,886	Precambrian	1,028	4,853	N, E	-3,825
3408324000[2]	Knox	McCoy	1	Knox Energy, Inc.	5,216	Precambrian	1,200	5,200	S, E	-4,000
3408324064	Knox	Ernest	2	Redman Oil Co.	5,234	Precambrian	1,010	5,166	N, E	-4,156
3408520142	Lake	Calhio Chemicals	1	Calhio Chemicals	6,072	Precambrian	701	6,060	D	-5,359
3408520280	Lake	Calhio Chemicals	2	Calhio Chemicals	6,110	Precambrian	712	6,096	N, D	-5,384
3408520661	Lake	Diamond Alkali Co.	LM 1	Environmental Brine Services	5,975	Precambrian	623	5,923	D	-5,300
3408521094[2]	Lake	Vrooman	1	Great Plains Exploration	6,355	Precambrian	808	6,318	S, E	-5,510
3408521278[2]	Lake	Dickey	13	Great Plains Exploration	6,310	Precambrian	794	6,295	E	-5,501
3408720174	Lawrence	Payne	1	Goldberg	7,002	Precambrian	609	6,950	N, E	-6,371
3408921826	Licking	Crowley	1	Lake Shore Pipeline Co.	5,991	Precambrian	1,060	5,978	S (Owens, 1967)	-4,918
3408922057	Licking	Roberts	1	Atha	4,952	Precambrian	1,179	4,910	S (Owens, 1967)	-3,731
3408922252	Licking	Schmelzer	1	Ashland Oil & Refining Co.	4,802	Precambrian	1,090	4,785	S (Owens, 1967)	-3,695
3408924792	Licking	Moran	1	Moran	6,237	Precambrian?	806	6,215	N, D	-5,409?
3408925416[2]	Licking	Dispennette	1	Dalton & Hanna Co.	5,500	Precambrian	1,119	4,800	E, S	-3,681
3408925489	Licking	Uhde	3-9	Michigan Geosearch	4,922	Precambrian	1,100	4,838	E	-3,738
3408925542	Licking	Ellas Unit	1	Clinton Oil Co.	5,626	Precambrian	1,222	5,620	S, E	-4,398
3408925817[2]	Licking	Dager	1	Knox Energy, Inc.	4,962	Precambrian	960	4,905	S, E	-3,945
3409120018	Logan	Johns et al. Unit	1	Ohio Oil Co.	3,361	Precambrian	1,190	3,255	S (Summerson, 1962)	-2,065
3409120096	Logan	Prinkey Unit	1	Ashtola Exploration Co.	3,260	Precambrian	1,125	3,140	S, E,	-2,015
3409320794	Lorain	Born	1	East Ohio Gas Co.	4,590	Precambrian	850	4,573	S (Owens, 1967)	-3,723
3409520060	Lucas	Ketring Unit	1	Liberty Petroleum Corp.	3,914	Precambrian?	674	3,624	D	-2,950?
3409720003	Madison	Hume	1	Amerada Petroleum Corp.	3,631	Precambrian	995	3,610	S (Janssens, 1973)	-2,615
3409720007	Madison	Immell	1	Columbia Natural Resources	3,476	Precambrian?	1,016	3,476	Estimated	-2,470?
3409923127[2]	Mahoning	Northstar	1	D & L Energy, Inc.	9,192	Precambrian	877	8,992	S, E	-8,115
3409923157[2]	Mahoning	Northstar Khalil	3	Northstar #3, LLC	9,580	Precambrian	1,052	9,500	E	-8,448
3409923158[2]	Mahoning	Northstar Lucky	4	D & L Energy, Inc.	10,088	Precambrian	1,126	9,990	E	-8,864
3409923171[2]	Mahoning	Northstar Collins	6	D & L Energy, Inc.	9,840	Precambrian	1,149	9,764	E	-8,615
3410120008	Marion	Mitchell	1	United Producing	3,675	Precambrian	1,001	3,665	S (Owens, 1967)	-2,664
3410120085	Marion	Parrish	1	Stadler & Mattix	2,984	Precambrian?	980	2,985	N, D	-2,005?
3410120165	Marion	McNamara	6	X-Alpha International	3,657	Precambrian	965	3,603	N, D	-2,638
3410120167	Marion	Herr	1	Delray Oil	2,934	Precambrian	905	2,924	D	-2,019

TABLE 2. *Well data for control points on map PG-23 (cont.)*

Precambrian-top data source: C = core; D = driller; E = electric-log interpretation; N = no sample cuttings; S = sample-cuttings interpretation, by Baranoski unless otherwise noted

Unique well number[1]	County	Lease name	Well no.	Company name	Well total depth (feet)	Formation at total depth	Datum well elevation above sea level (feet)	Along-hole depth to top of Precambrian (feet)	Precambrian-top data source	Precambrian subsea value (feet)
3410120168	Marion	Gracely Farms	1	Anschutz Corp.	3,074	Precambrian	926	3,060	E	-2,134
3410120173	Marion	Oehler	1	Texas Gas Exploration Corp.	2,990	Precambrian	974	2,938	D, E	-1,964
3410120174	Marion	Gracely Farms	1	Texas Gas Exploration Corp.	3,198	Precambrian	916	3,120	E	-2,204
3410120175	Marion	Wenig et al.	1	Delray Oil	2,935	Precambrian	909	2,909	N, E	-2,000
3410120176	Marion	Gracely Farms	1	Texas Gas Exploration Corp.	3,075	Precambrian	924	3,062	E	-2,138
3410120207	Marion	Forry et al.	OH-377	Equitable Resources	3,142	Precambrian	913	3,092	N, E	-2,179
3410321143	Medina	Smith	1-A	Wiser Oil Co.	7,040	Precambrian	1,200	6,580	S (Janssens, 1973)	-5,380
3410321201	Medina	Warner	1	Wiser Oil Co.	6,731	Precambrian	1,116	6,662	S, E (Janssens, 1973)	-5,546
3410321819	Medina	Wandel Unit	1	Moore	5,667	Precambrian	1,092	5,650	E (Warner, 1988)	-4,558
3410720141	Mercer	Yewey	2	Harner Union Oil	3,135	Middle Run Formation?	837	3,102	S (Janssens, 1973)	-2,265
3410920001	Miami	Levering	1	Sun Oil Co.	3,412	Middle Run Formation?	994	3,282	S (Summerson, 1962)	-2,288
3410920003	Miami	Walker	1	National Associated Petroleum	3,510	Precambrian	1,035	3,255	S (Summerson, 1962)	-2,220
3411720012	Morrow	Myers	3	Ashland Oil & Refining Co.	4,090	Precambrian	1,016	4,002	S (Owens, 1967)	-2,986
3411720033	Morrow	Henry	1	Wehmeyer	4,044	Precambrian	995	4,009	S (Janssens, 1973)	-3,014
3411720047	Morrow	Windbigler	1	Poston	4,888	Precambrian	1,398	4,870	S (Janssens, 1973)	-3,472
3411721388	Morrow	McBee	1	Wray	4,411	Precambrian	1,140	4,445	S (Janssens, 1973)	-3,305
3411721681	Morrow	Shaver-Neff Unit	5	Kin-Ark Oil Co.	4,195	Precambrian	1,007	4,195	E	-3,188
3411721935[2]	Morrow	Bush	1-C	Comanche Oil Co.	3,867	Precambrian?	999	3,867	E	-2,868?
3411722550	Morrow	Irey	1	Otter Creek Exploration	3,876	Precambrian	1,004	3,875	S (Janssens, 1973)	-2,871
3411723737	Morrow	Brewer	1	Star Exploration Corp.	5,000	Precambrian?	1,399	4,938	N, D, E	-3,539?
3411724012	Morrow	Morris	7	Ohio Production Corp.	5,258	Precambrian	1,331	4,792	N, E	-3,461
3411724043	Morrow	Hickok	1-14	EEI	4,707	Precambrian	1,398	4,682	N, D	-3,284
3411724190[2]	Morrow	Lee Family Trust	1-3264	Knox Energy, Inc.	4,200	Precambrian	1,028	4,030	E	-3,002
3411927076	Muskingum	Consolidation Coal	CR 400	Carless Resources	7,381	Precambrian	928	7,373	E (Riley and others, 1993)	-6,445
3411928776[2]	Muskingum	Goff	1	Well Services, LLC	8,010	Precambrian	984	7,995	S	-7,101
3412121278	Noble	Ullman	1	Amoco Corp.	11,442	Precambrian	1,035	11,410	S (Janssens, 1973)	-10,375
3412124349[2]	Noble	FREC Noble Olive	A-1	Anadarko E & P Co.	10,620	Precambrian	917	10,158	D, S	-9,241
3412520013	Paulding	Arend	1	Mt. Pleasant Mines	3,100	Precambrian?	725	3,392	D	-2,667?
3412726595	Perry	Rush Creek Partners et al.	1	Poling Co.	6,395	Precambrian	828	6,302	E (Riley and others, 1993)	-5,474
3412920002	Pickaway	Long	1A	Kewanee Oil Co.	3,257	Precambrian	857	3,245	S (Summerson, 1962)	-2,388
3412920004	Pickaway	Croman	1	McMahon-Bullington Drilling	3,731	Precambrian	797	3,691	S (Janssens, 1973)	-2,894
3412920006	Pickaway	Miller	1	Midwest Oil & Gas Co.	4,179	Precambrian	693	4,148	S (Owens, 1967)	-3,455
3412920020	Pickaway	Higgy	1	Minuteman Exploration Co.	3,816	Precambrian	799	3,803	N, D	-3,004
3412920024	Pickaway	Kerns	1	Ramco Oil & Gas Corp.	4,446	Precambrian	770	4,310	E (Riley and others, 1993)	-3,540
3413120089	Pike	Hurless	1	Hill Drilling	4,011	Precambrian	578	3,972	N, D, E	-3,394
3413322860	Portage	Viking Resources	1	Viking Resources	8,797	Precambrian	1,061	8,720	N, D	-7,659
3413720031	Putnam	Barlage	1	Ohio Oil Co.	3,377	Precambrian	740	3,350	S (Summerson, 1962)	-2,610
3413920431	Richland	Scott	2	Tri-State Producing	5,503	Precambrian	1,458	5,497	S (Janssens, 1973)	-4,039
3413920448	Richland	Empire Reeves Steel Division	D-1	Empire Reeves Steel Division	5,085	Precambrian	1,176	5,061	S (Janssens, 1973)	-3,885
3414120009	Ross	Clark	1	Crest Oil Co.	3,863	Precambrian	1,033	3,845	S (Janssens, 1973)	-2,812
3414120021	Ross	Irvine	1	Oxford Oil Co.	3,880	Precambrian	985	3,870	E (Riley and others, 1993)	-2,885
3414360158[4]	Sandusky	Bruns	1	Ohio Oil Co.	2,822	Precambrian	650	2,667	S (Janssens, 1973)	-2,017
3414320001	Sandusky	Hetrick	1	Montgomery	2,796	Precambrian	590	2,701	D (Summerson, 1962)	-2,111
3414320077	Sandusky	Haff	1	East Ohio Gas Co.	3,123	Precambrian	644	3,092	S (Janssens, 1973)	-2,448
3414320117	Sandusky	Ayers	1	Dunigan	2,716	Precambrian	633	2,706	S (Janssens, 1973)	-2,073
3414320126	Sandusky	Recker	1	C. & E. Oil Co.	2,675	Precambrian?	673	2,632	N, D	-1,957?
3414320146	Sandusky	Aleshire	1	Maguire	2,759	Precambrian	706	2,756	N, E (Owens, 1967)	-2,050

3414320147	Sandusky	Kerbel	1	Maguire	2,785	Precambrian	647	2,760	S, E (Janssens, 1973)	-2,113
3414320210	Sandusky	Vickery Environmental	1	Vickery Environmental	2,932	Precambrian	620	2,927	D (Janssens, 1973)	-2,307
3414320224	Sandusky	Vickery Environmental	2	Vickery Environmental	2,960	Precambrian	616	2,930	D	-2,314
3414320225	Sandusky	Vickery Environmental	3	Vickery Environmental	2,902	Precambrian	618	2,890	D	-2,272
3414320226[2]	Sandusky	Vickery Environmental	4	Vickery Environmental	2,905	Precambrian	618	2,905	D	-2,287
3414320235	Sandusky	Vickery Environmental	1A	Vickery Environmental	2,980	Precambrian	616	2,936	N, D	-2,320
3414320237[2]	Sandusky	Vickery Environmental	5	Vickery Environmental	2,943	Precambrian	618	2,934	N, E	-2,316
3414320238	Sandusky	Vickery Environmental	6	Vickery Environmental	2,955	Precambrian	614	2,939	N, D	-2,326
3414320312[2]	Sandusky	Weickert Unit	1	M & M Royalty, Ltd.	2,773	Precambrian	593	2,760	N, D	-2,167
3414520212	Scioto	Aristech Chemical Corp.	1	Aristech Chemical Corp.	5,617	Precambrian	557	5,595	E	-5,036
3414520252	Scioto	Aristech Chemical Corp.	2	Aristech Chemical Corp.	6,024	Precambrian	NA	NA	directional well	NA
3414520257	Scioto	Smith	1	Adobe Oil & Gas Corp.	4,432	Precambrian	1,213	4,382	E	-3,193
3414560033	Scioto	Aristech Chemical Corp.	3	Aristech Chemical Corp.	6,109	Precambrian	NA	NA	directional well	NA
3414720128	Seneca	Stigamire	1	Ashland Oil & Refining Co.	3,170	Precambrian	796	3,147	S (Owens, 1967)	-2,351
3414720211	Seneca	Shults	1	American Standard Energy	2,847	Precambrian	720	2,800	E	-2,080
3414720212	Seneca	Watson	1	American Standard Energy	2,960	Precambrian?	741	2,844	D	-2,103?
3414720213[2]	Seneca	Sendelbach	1	American Standard Energy	2,617	Precambrian	769	2,612	E	-1,843
3414720214	Seneca	Hoover	1	American Standard Energy	2,600	Precambrian	766	2,493	E	-1,727
3414720216	Seneca	Watson	2	American Standard Energy	2,796	Precambrian	759	2,762	D	-2,003
3414720244	Seneca	Watson	4	American Standard Energy	2,830	Precambrian?	751	2,804	D	-2,053?
3414760840	Seneca	M & B Asphalt	GB-4	ODNR Division of Geological Survey	2,870	Precambrian	697	2,811	C, E (Wickstrom and others, 1985)	-2,114
3414760890	Seneca	Watson Heirs	2	Sun Oil Co.	2,935	Precambrian	710	2,780	S	-2,070
3414920012	Shelby	Nelson	1	Sun Oil Co.	3,275	Precambrian	1,050	3,180	E	-2,130
3414920013	Shelby	Fogt	1	Gump Oil Co.	3,360	Precambrian	1,037	3,280	E	-2,243
3414920103	Shelby	Borland	1	Funk Exploration	3,227	Precambrian	1,074	3,213	D	-2,139
3415125237[2]	Stark	Gibbs Unit	1-K	Range Resources	8,620	Precambrian	1,155	8,610	S, E	-7,455
3415320907	Summit	Northampton Board of Trustees	2	KST Oil & Gas	7,199	Precambrian	1,006	7,150	D	-6,144
3415321591	Summit	KST Oil & Gas	5	KST Oil & Gas	7,225	Precambrian	1,005	7,168	D	-6,163
3415524043[2]	Trumbull	Northstar United	2	D & L Energy, Inc.	9,038	Precambrian	901	8,925	E	-8,024
3415725334[2]	Tuscarawas	Belden Brick Unit	9 (1)	ODNR Division of Geological Survey	8,700	Precambrian	917	8,632	S, E	-7,715
3415725465[2]	Tuscarawas	General Clay	1	Red Hill Development	8,720	Precambrian	1,033	8,590	S, E	-7,557
3415920002	Union	Zenith Holding & Trading Corp.	1	H. H. & R. Operating	3,348	Precambrian	1,001	3,350	S (Janssens, 1973)	-2,349
3415920013	Union	Lane	1	T. & W. Oil Co.	2,990	Precambrian?	996	2,985	N, D (Owens, 1967)	-1,989?
3415920067	Union	Graver	1	Funk Exploration	3,435	Precambrian	966	3,430	E (Warner, 1988)	-2,464
3415920069	Union	Yoder	1	Funk Exploration	3,500	Precambrian	971	3,450	E (Warner, 1988)	-2,479
3415920070	Union	Kindig	1	Funk Exploration	3,340	Precambrian	962	3,340	E	-2,378
3415920071	Union	Black	1	Funk Exploration	3,395	Precambrian	987	3,390	E (Warner, 1988)	-2,403
3415920074	Union	Low	1	Funk Exploration	3,438	Precambrian	974	3,419	D	-2,445
3415920083	Union	Inskeep	1	Titan Energy	3,115	Precambrian?	971	3,059	N, D	-2,088
3416120044	Van Wert	Miller	5	West Ohio Oil & Gas	3,240	Precambrian	820	3,214	D	-2,394
3416560005	Warren	American Aggregates	DS-2	ODNR Division of Geological Survey	5,380	Middle Run Formation	1,025	3,458	C, E (Shrake and others, 1990)	-2,433
3416920071	Wayne	Steiner	2	East Ohio Gas Co.	6,919	Precambrian	960	6,904	D (Summerson, 1962)	-5,944
3416921419	Wayne	Drake	1	Waldron	6,897	Precambrian	1,151	6,728	S (Janssens, 1973)	-5,577
3416925676[2]	Wayne	CRC Discovery	1	Hard Rock Drilling & Prod., LLC	6,429	Precambrian	1,142	6,286	D	-5,144
3417120034	Williams	Kennerk	1	Beglinger	4,167	Precambrian	842	3,922	S (Janssens, 1973)	-3,080
3417120046[2]	Williams	Cook	1	Columbia Gas Trans. Co.	4,490	Precambrian?	915	4,489	S, E	-3,574?
3417320229	Wood	Knauss	1	Southern Triangle Oil Co.	2,764	Precambrian	694	2,720	S (Owens, 1967)	-2,026
3417320231	Wood	Peek	1	O'Neill	2,770	Precambrian	698	2,760	N, E (Owens, 1967)	-2,062
3417320236	Wood	Smith	1	Kin-Ark Oil Co.	2,785	Precambrian	677	2,775	E	-2,098
3417320237	Wood	Carter	1	Kin-Ark Oil Co.	2,821	Precambrian	673	2,825	D (Janssens, 1973)	-2,152

[4]American Petroleum Institute well number changed from 2002 map.

TABLE 2. ***Well data for control points on map PG-23 (cont.)***

Precambrian-top data source: C = core; D = driller; E = electric-log interpretation; N = no sample cuttings; S = sample-cuttings interpretation, by Baranoski unless otherwise noted

Unique well number[1]	County	Lease name	Well no.	Company name	Well total depth (feet)	Formation at total depth	Datum well elevation above sea level (feet)	Along-hole depth to top of Precambrian (feet)	Precambrian-top data source	Precambrian subsea value (feet)
3417320239	Wood	Asmus et al.	1	J.R.S.	2,825	Precambrian	670	2,805	S (Janssens, 1973)	-2,135
3417320423	Wood	Kramer	1-A	Anschutz Corp.	2,880	Precambrian?	691	2,860	E	-2,169?
3417320432	Wood	Freehan	1	Texas Gas Exploration Corp.	2,867	Precambrian?	690	2,862	D	-2,172?
3417360438	Wood	Killian	1	Brailey	2,927	Precambrian	688	2,884	S (Summerson, 1962)	-2,196
3417520072	Wyandot	Heck	1	Ohio Oil Co.	2,801	Precambrian	860	2,800	S (Owens, 1967)	-1,940
3417520173	Wyandot	Frey	1	Comanche Oil Co.	2,875	Precambrian	868	2,860	S (Janssens, 1973)	-1,992
3417520174	Wyandot	Bowen	1	Texaco	2,900	Precambrian	846	2,850	S (Owens, 1967)	-2,004
3417520211	Wyandot	Eyestone	1	Minnesota-Ohio Oil Co.	3,260	Precambrian	942	3,250	S (Janssens, 1973)	-2,308
3417520259	Wyandot	Kuenzli	1	Berea Oil & Gas Corp.	3,149	Precambrian	893	3,091	E	-2,198
3417520336[2]	Wyandot	Hansel	1	Ramah Oil	2,833	Precambrian	918	2,820	S, E	-1,902
3417560610	Wyandot	Parsell	1	Dibble & Miller	5,632	Precambrian	910	3,040	S (Summerson, 1962)	-2,130
INDIANA										
133529[2]	Allen	Gibson	1	Tecumseh Oil & Gas Co.	3,517	Precambrian	822	3,497	Indiana Geological Survey	-2,675
133540	Allen	Leuenberger	1	Northern Indiana Public Service	3,672	Precambrian	797	3,484	S, E (Rudman and Rupp, 1993)	-2,687
135957	Fayette	Scott	1	Gulf Oil	3,955	Precambrian	959	3,942	S, E (Rudman and Rupp, 1993)	-2,984
158450[2]	Henry	May	1	Ohio Oil Co.	3,664	Precambrian	1,060	3,649	Indiana Geological Survey	-2,589
141771	Jay	Binegar	1	Petroleum Development	3,404	Precambrian	948	3,351	S (Summerson, 1962)	-2,403
146918[2]	Steuben	Swager	1	Swager	6,866	Precambrian	1,046	4,930	Indiana Geological Survey	-3,884
126873[2]	Switzerland	Collins	1	Ashland	4,000	Precambrian	880	3,974	Indiana Geological Survey	-3,094
159292[2]	Switzerland	Sullivan	1	Ashland	4,151	Precambrian	794	4,040	Indiana Geological Survey	-3,246
147781	Wayne	Doddridge	1	Porter Gordon	3,907	Precambrian	857	3,435	Indiana Geological Survey (Owens, 1967)	-2,578
KENTUCKY										
1601500000	Boone	Conner	1	Ford	4,089	Middle Run Formation	908	3,695	Kentucky Geological Survey	-2,784
1601500005[2]	Boone	Duke East Bend Power	1	Battelle	3,712	Middle Run Formatiom	526	3,532	Kentucky Geological Survey	-3,006
1601920459	Boyd	Inland Gas	533	Inland Gas Co.	9,595	Precambrian	862	8,505	Kentucky Geological Survey	-7,643
1601920876	Boyd	McKeand	535	Inland Gas Co.	9,449	Precambrian	868	9,385	Kentucky Geological Survey	-8,517
1601921652	Boyd	Fannin	537	Inland Gas Co.	7,828	Precambrian	709	6,757	Kentucky Geological Survey	-6,048
1603718051	Campbell	Wilson	R-1	Ashland Oil & Refining Co.	3,604	Precambrian	757	3,390	Kentucky Geological Survey	-2,633
1604316235	Carter	Stapleton	11-1	Ashland Oil & Refining Co.	5,251	Precambrian	956	5,220	Kentucky Geological Survey	-4,264
1604322935	Carter	Inland Gas	538	Inland Gas Co.	7,272	Precambrian	796	7,176	Kentucky Geological Survey	-6,380
1604326995	Carter	Duncan	547	Inland Gas Co.	5,062	Precambrian	985	5,042	Kentucky Geological Survey	-4,057
1604300000[3]	Carter	Stamper	8807T	United Fuel Gas Co.	5,085	Precambrian	857	5,048	Kentucky Geological Survey	-4,191
16043109910[2]	Carter	Hansen Aggregates	1	Kentucky Geological Survey	4,835	Precambrian	753	4,721	Kentucky Geological Survey	-3,968
1606367748[2]	Elliot	Kazee	1	Ashland Exploration	11,091	Precambrian	727	10,967	Kentucky Geological Survey	-10,240
1608921256	Greenup	Newell	1	Commonwealth Gas Corp.	5,193	Precambrian	1,053	5,159	Kentucky Geological Survey	-4,106
1612724502	Lawrence	Young	542	Inland Gas Co.	12,712	Precambrian	884	12,544	Kentucky Geological Survey	-11,660
1613500000	Lewis	Adams	1	Thomas	4,190	Precambrian	560	4,177	Kentucky Geological Survey	-3,617
1613502579	Lewis	Shephard	9060	United Fuel Gas Co.	4,550	Precambrian	908	4,529	Kentucky Geological Survey	-3,621
1613521132	Lewis	Wolfe, Dewey et al.	1	Ashland Oil & Refining Co.	5,082	Precambrian	1,113	5,024	Kentucky Geological Survey	-3,911
1616103990	Mason	Rawlings	9061T	United Fuel Gas Co.	3,314	Precambrian	769	3,290	Kentucky Geological Survey	-2,521
1618130197[2]	Nicholas	Mynear	1	Union Light	2,958	Precambrian	710	2,922	Kentucky Geological Survey	-2,212
1620514647[2]	Rowan	Jones	1	Pennzoil Co.	4,991	Precambrian	1,199	4,967	Kentucky Geological Survey	-3,768
1620522478[2]	Rowan	Bailey	1	Peter Henderson Oil	3,802	Precambrian	737	3,790	Kentucky Geological Survey	-3,053
MICHIGAN										
2102329779[2]	Branch	Lindsey-Hostetler	1	Consumers	5,439	Precambrian	890	5,375	Michigan Geological Survey	-4,485
2102329969[2]	Branch	Clark	1	Consumers	5,475	Precambrian	887	5,416	Michigan Geological Survey	-4,529
2102337569	Branch	Atlantic Richfield Co. & Johnson	1-3	Atlantic Richfield Co.	5,252	Precambrian	911	5,210	Michigan Geological Survey	-4,299

2102338045	Branch	Atlantic Richfield Co.	1-13	Atlantic Richfield Co. & Gaglio	5,377	Precambrian	918	5,207	Michigan Geological Survey	-4,289
2105940414[2]	Hillsdale	Rowe	1	Marathon Oil Co.	5,917	Precambrian	1,107	5,866	Michigan Geological Survey	-4,759
2109110448	Lenawee	Taylor	1	Eckert	3,902	Precambrian	715	3,865	Michigan Geological Survey	-3,150
2111507702	Monroe	Sancrant	1	Beck	5,465	Precambrian	669	3,595	Michigan Geological Survey	-2,926
2111511221	Monroe	Chapman	1	Sturman	3,377	Precambrian	597	3,343	Michigan Geological Survey	-2,745
2111525494	Monroe	Shimp	1	Ferguson & Garrison	3,671	Precambrian	686	3,640	S (Janssens, 1973)	-2,954
2111535948	Monroe	Cousino	1-1	Reef Petroleum	3,512	Precambrian	646	3,470	Michigan Geological Survey	-2,824
PENNSYLVANIA										
3700720283[2]	Beaver	DBC	1	Ergon	12,450	Precambrian	1,192	11,800	Pennsylvania Geological Survey	-10,608
3703920007	Crawford	Kardosh	1	Benedum & Ark-La Gas	8,031	Precambrian	1,337	7,924	Pennsylvania Geological Survey	-6,587
3703923539[2]	Crawford	Ewig	1	Kastle Resources	7,168	Precambrian	1,030	7,108	Pennsylvania Geological Survey	-6,078
3704923768[2]	Erie	Eastern American Energy	1	Reemsnyder	7,345	Precambrian	1,240	7,338	Pennsylvania Geological Survey	-6,098
3704924388[2]	Erie	Great Lakes Energy	2	Cross	8,035	Precambrian	1,450	7,359	S, E	-5,909
3708520036	Mercer	Temple	1	Peoples Natural Gas	9,919	Precambrian	1,344	9,820	Pennsylvania Geological Survey	-8,476
3708520116	Mercer	Fleck	1	Peoples Natural Gas	9,246	Precambrian	1,325	9,138	Pennsylvania Geological Survey	-7,813
WEST VIRGINIA										
4701100537[4]	Cabell	Kingery	1	Cyclops	8,552	Precambrian	667	8,516	West Virginia Geological and Economic Survey	-7,849
4703501366[4]	Jackson	McCoy	1	Exxon USA	17,675	Precambrian	943	17,626	West Virginia Geological and Economic Survey	-16,683
4704301469[4]	Lincoln	McCormick	1	Exxon USA	19,124	Precambrian	772	19,074	West Virginia Geological and Economic Survey	-18,302
4705300069[4]	Mason	Arrington	1	United Fuel Gas Co.	8,635	Precambrian	609	8,558	West Virginia Geological and Economic Survey	-7,950
4705300297[4]	Mason	Jividen	1	Union Drilling	10,598	Precambrian	646	10,564	West Virginia Geological and Economic Survey	-9,922
4705300423[2]	Mason	Appalachian Power Co.	1	Appalachian Power Co.	9,190	Precambrian	608	9,104	S, C, E	-8,496
4709901572[4]	Wayne	Smith	1	Exxon USA	14,625	Precambrian	622	14,548	West Virginia Geological and Economic Survey	-13,968
4710700351[4]	Wood	Power Oil	1	Hope Natural Gas	13,331	Precambrian	1,065	13,272	West Virginia Geological and Economic Survey	-12,207
4710700756[4]	Wood	Deem	1	Exxon USA	13,266	Precambrian	726	13,254	West Virginia Geological and Economic Survey	-12,528
ONTARIO, CANADA										
T000183[2]	Essex	Klie	1	Imperial Oil	3,222	Precambrian	629	3,220	Ontario Ministry of Natural Resources	-2,591
T000185[2]	Essex	Field	1	Consolidated West Petroleum	3,345	Precambrian	604	3,341	Ontario Ministry of Natural Resources	-2,737
T000196[2]	Essex	Wilkinson	1	Imperial Oil	3,439	Precambrian	607	3,431	Ontario Ministry of Natural Resources	-2,824
T000534	Essex	Lewis	23	Lewis	3,223	Precambrian	581	3,190	Ontario Ministry of Natural Resources	-2,609
T002843	Essex	Government of Ontario	2	Amerada Hess	3,072	Precambrian	630	3,022	Janssens (1973)	-2,392
T006369	Essex	Mersea 8-15-B	33683	Consumers et al.	3,471	Precambrian	585	3,466	Ontario Ministry of Natural Resources	-2,881
T006389[2]	Essex	Mersea 8-14-A	33684	Consumers et al.	3,503	Precambrian	586	3,451	Ontario Ministry of Natural Resources	-2,865
T006536[2]	Essex	Mersea 5-12-A	1	Consumers et al.	3,476	Precambrian	585	3,413	Ontario Ministry of Natural Resources	-2,828
T006538[2]	Essex	Mersea 7-12-I	33775	Consumers et al.	3,503	Precambrian	587	3,439	Ontario Ministry of Natural Resources	-2,852
T006539[4]	Essex	Mersea 3-13-A	33817	Consumers et al.	3,484	Precambrian	587	3,414	Ontario Ministry of Natural Resources	-2,827
T006540[4]	Essex	Mersea 5-12-I	33818	Consumers et al.	3,504	Precambrian	592	3,446	Ontario Ministry of Natural Resources	-2,854
T006897[4]	Essex	Mersea 1-11-I	34102	Consumers et al.	3,478	Precambrian	594	3,423	Ontario Ministry of Natural Resources	-2,829
T006942[2]	Essex	Mersea 6-15-B	1	Domego Terron	3,471	Precambrian	585	3,428	Ontario Ministry of Natural Resources	-2,843
T007051[2]	Essex	Gosfield South 8-B-III	34212	Consumers	3,412	Precambrian	637	3,361	Ontario Ministry of Natural Resources	-2,724
T007201[4]	Essex	Mersea 3-15-I	34335	Consumers et al.	3,514	Precambrian	601	3,461	Ontario Ministry of Natural Resources	-2,860
T007361[2]	Essex	Gosfield South 2-4	34311	Consumers	3,400	Precambrian	633	3,323	Ontario Ministry of Natural Resources	-2,690
T007495[2]	Essex	BP	10	Ram	3,353	Precambrian	618	3,330	Ontario Ministry of Natural Resources	-2,712
T007504[2]	Essex	Mersea 1-241	34369	Telesis et al.	3,474	Precambrian	625	3,418	Ontario Ministry of Natural Resources	-2,793
T007575[4]	Essex	BP	14	Ram	3,535	Precambrian	579	3,488	Ontario Ministry of Natural Resources	-2,909
T007831[2]	Essex	Gosfield South 4-4-III	34623	Telesis	3,451	Precambrian	671	3,398	Ontario Ministry of Natural Resources	-2,727
T008536[2]	Essex	Gosfield South 1-I-III	34312	Consumers/Paladin	3,444	Precambrian	651	3,397	Ontario Ministry of Natural Resources	-2,746
T008790[2]	Essex	Colchester South 7-16-V	12	Canenerco/CNR	3,362	Precambrian	619	3,328	Ontario Ministry of Natural Resources	-2,709
T008809[2]	Essex	Gosfield South 7-259	18	Canenerco/CNR	3,379	Precambrian	664	3,361	Ontario Ministry of Natural Resources	-2,697
T012024[2]	Essex	Colchester South 8-81	23	Algonquin	3,170	Precambrian	593	3,143	Ontario Ministry of Natural Resources	-2,550
T004772[4]	Kent	Government of Ontario	13501	Consumers	4,365	Precambrian	594	4,300	Ontario Ministry of Natural Resources	-3,706
T005353[4]	Kent	Government of Ontario	13730	Consumers	4,357	Precambrian	595	4,290	Ontario Ministry of Natural Resources	-3,695
T004754[2]	Kent	Government Of Ontario	13502	Consumers	4,180	Precambrian	594	4,107	Ontario Ministry of Natural Resources	-3,513
T006815[2]	Kent	Lake Erie 240-V	1	Diamond Shamrock	4,711	Precambrian	590	4,627	Ontario Ministry of Natural Resources	-4,037

TABLE 3. ***Seismic reflection profiles on map PG-23***

Map reference	Availability	Company	Number of lines	Total miles
COCORP OH-1	Public domain/Restricted	Consortium for Continental Reflection Profiling	1	172.0
COCORP OH-2	Public domain/Restricted	Consortium for Continental Reflection Profiling	1	81.0
A	Public domain	ODNR Division of Geological Survey	1	3.6
B	Public domain	Columbia Natural Resources	1	5.2
C	Public domain	BP Chemical (formerly Vistron Corp.)	11	72.0
D	Public domain	Reserve Environmental Services	7	25.8
E	Public domain	AK Steel Corp. (formerly Armco Steel Corp.)	4	15.0
F	Restricted	NGO Development Corp.	1	6.5
G	Public domain/Restricted	CGAS Exploration, Inc.	1	7.5
H	Public domain	Tomen Agro Inc. (formerly Calhio Chemicals)	3	5.3
I	Restricted	Excalibur Exploration	4	11.3
J	Public domain	Waste Management of Ohio (formerly Vickery Environmental)	8	62.0
K	Public domain	Aristech Chemical Corp. (formerly U.S. Steel)	7	80.7
L	Public domain	ODNR Division of Geological Survey	1	7.8

ACKNOWLEDGMENTS

This work was supported, in part, by funding from the Injection Well Review Fund and was performed in cooperation with the Ohio Environmental Protection Agency, Division of Drinking and Ground Waters.

Richard Ostrowski with the Ontario Oil, Gas & Salt Resources Library in London, Ontario, provided additional Ontario data.

Staff from the Ohio Geological Survey provided additional support. Michael Solis reviewed an early revised version of the map. Dean Martin formatted the digital map data and set up the map layout. Lisa Van Doren updated tables and formatted the map into the final PDF file. Chuck Salmons edited final copy.

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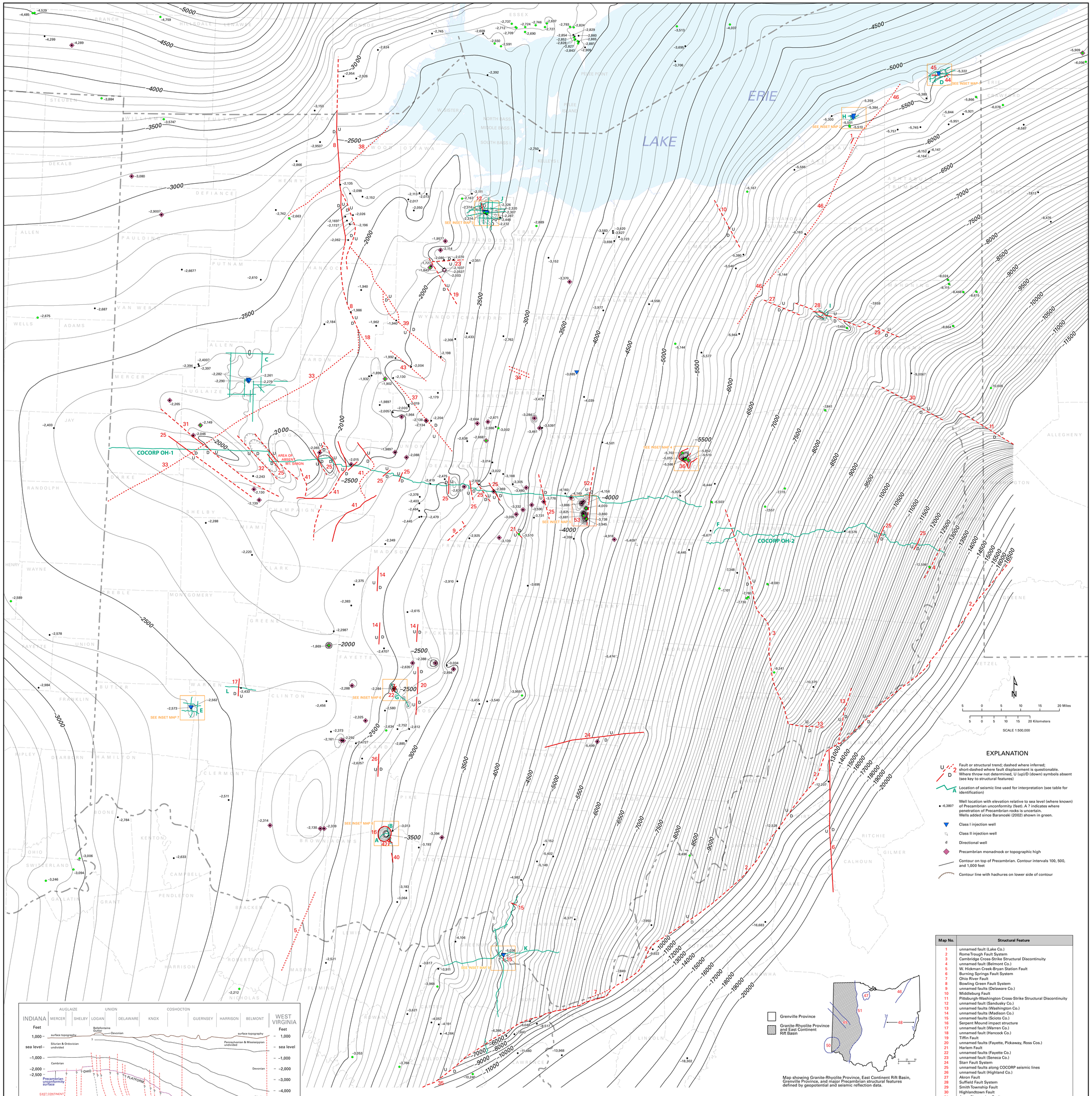
STATE OF OHIO
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL SURVEY
Thomas J. Serenko, Chief

STRUCTURE CONTOUR MAP ON THE PRECAMBRIAN UNCONFORMITY SURFACE IN OHIO AND RELATED BASEMENT FEATURES

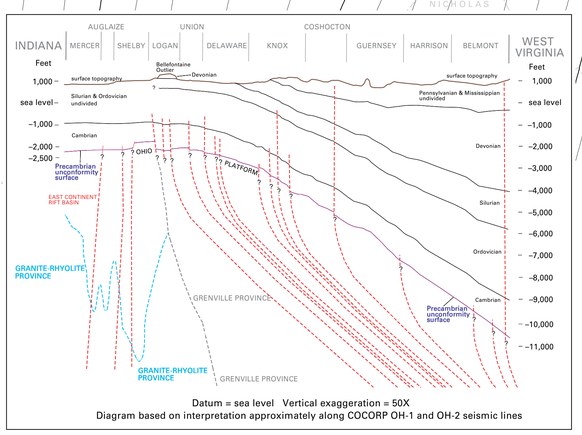
by
Mark T. Baranoski
GIS Cartography by Dean R. Martin

MAP PG-23
VERSION 2.0
6/2013



EXPLANATION

- Fault or structural trend; dashed where inferred; short-dashed where fault displacement is questionable. Where throw not determined, U (up)/D (down) symbols absent (see key to structural features)
- Location of seismic line used for interpretation (see table for identification)
- Well location with elevation relative to sea level (where known) of Precambrian unconformity (feet). A ? indicates where penetration of Precambrian rocks is uncertain. Wells added since Baranoski (2002) shown in green.
- Class I injection well
- Class II injection well
- d Directional well
- Precambrian monadnock or topographic high
- Contour on top of Precambrian. Contour intervals 100, 500, and 1,000 feet
- Contour line with hachures on lower side of contour



Datum = sea level Vertical exaggeration = 50X
Diagram based on interpretation approximately along COCORP OH-1 and OH-2 seismic lines

Map showing Granite-Rhyolite Province, East Continent Rift Basin, Grenville Province, and major Precambrian structural features defined by geopotential and seismic reflection data.

Map No.	Structural Feature
1	unnamed fault (Lake Co.)
2	RomeTrough Fault System
3	Cambridge Cross-Strike Structural Discontinuity
4	unnamed fault (Belmont Co.)
5	W. Hickman Creek-Bryan Station Fault
6	Burning Springs Fault System
7	Ohio River Fault
8	Bowling Green Fault System
9	unnamed faults (Delaware Co.)
10	Middleburg Fault
11	Pittsburgh-Washington Cross-Strike Structural Discontinuity
12	unnamed fault (Sandusky Co.)
13	unnamed faults (Washington Co.)
14	unnamed faults (Madison Co.)
15	unnamed faults (Scioto Co.)
16	Serpent Mound impact structure
17	unnamed fault (Warren Co.)
18	unnamed fault (Hancock Co.)
19	Tiffin Fault
20	unnamed faults (Fayette, Pickaway, Ross Cos.)
21	Harlem Fault
22	unnamed faults (Fayette Co.)
23	unnamed fault (Seneca Co.)
24	Starr Fault System
25	unnamed faults along COCORP seismic lines
26	unnamed fault (Highland Co.)
27	Akron Fault
28	Suffield Fault System
29	Smith Township Fault
30	Highlandtown Fault
31	Anna-Champaign Fault
32	Logan Fault
33	Auglaize Fault
34	Crawford Faults
35	Kentucky River Fault System
36	Killbuck Dome
37	Marion Fault
38	Maumee Fault
39	Outlet Fault
40	Plum Run Quarry Fault
41	Bellefontaine Outlier Faults
42	unnamed faults (Adams Co.)
43	unnamed fault (Wyandot Co.)
44	unnamed fault (Ashtabula Co.)
45	unnamed fault (Ashtabula Co.)
46	Akron Magnetic Boundary
47	Seneca Anomaly
48	Coshocton Zone
49	Fort Wayne Rift
50	Southwestern Ohio Anomaly
51	Grenville Front Tectonic Zone
52	Utica Mountain Fault
53	Utica Mountain Structure

SEISMIC REFLECTION PROFILES

Map reference	Availability[1]	Company	Number of lines	Total miles
COCORP OH-1	PD/R	Consortium for Continental Reflection Profiling	1	172.0
COCORP OH-2	PD/R	Consortium for Continental Reflection Profiling	1	81.0
A	PD	ODNR Division of Geological Survey	1	3.6
B	PD	Columbia Natural Resources	1	5.2
C	PD	BP Chemical (formerly Vistron Corp.)	11	72.0
D	PD	Reserve Environmental Services	7	25.8
E	PD	AK Steel Corp. (formerly Armco Steel Corp.)	4	15.0
F	R	NGO Development Corp.	1	6.5
G	PD/R	CGAS Exploration, Inc.	1	7.5
H	PD	Tomen Agro, Inc. (formerly Calhio Chemicals)	3	5.3
I	R	Excalibur Exploration	4	11.3
J	PD	Waste Management of Ohio (formerly Vickery Environmental)	8	62.0
K	PD	Aristech Chemical Corp. (formerly U.S. Steel)	7	80.7
L	PD	ODNR Division of Geological Survey	1	7.8

[1]PD = public domain; R = restricted.

Projection of map data is NAD83 UTM zone 17N.

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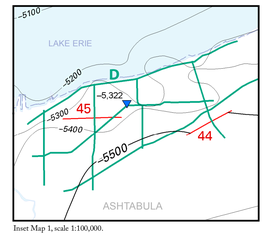
Inset Map 1, scale 1:100,000.



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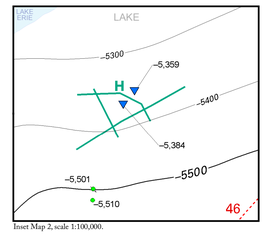

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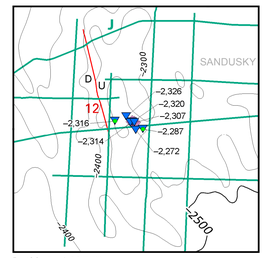

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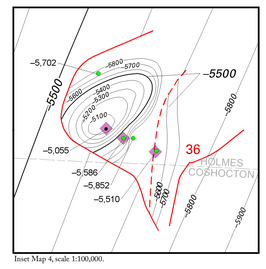

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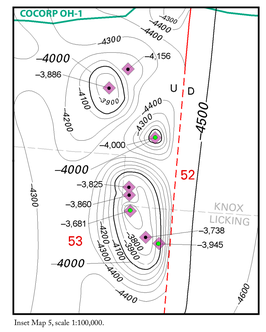

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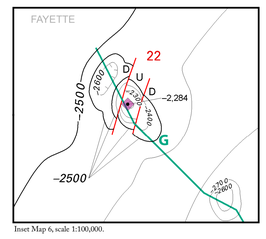

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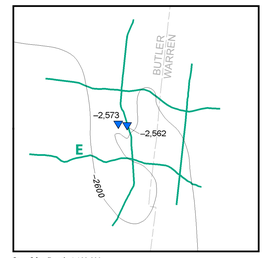

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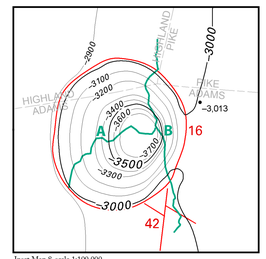

Inset Map 9, scale 1:100,000.