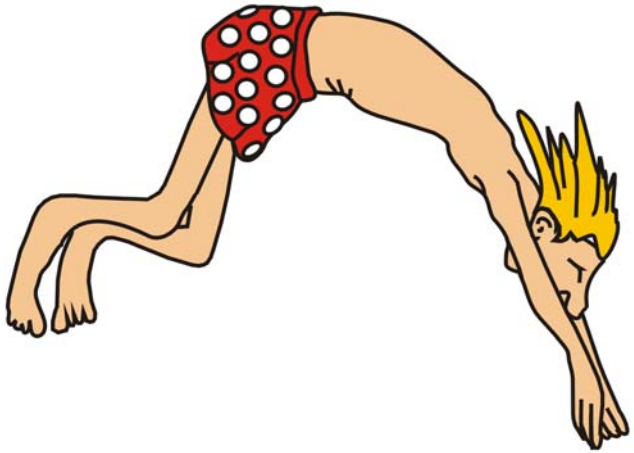
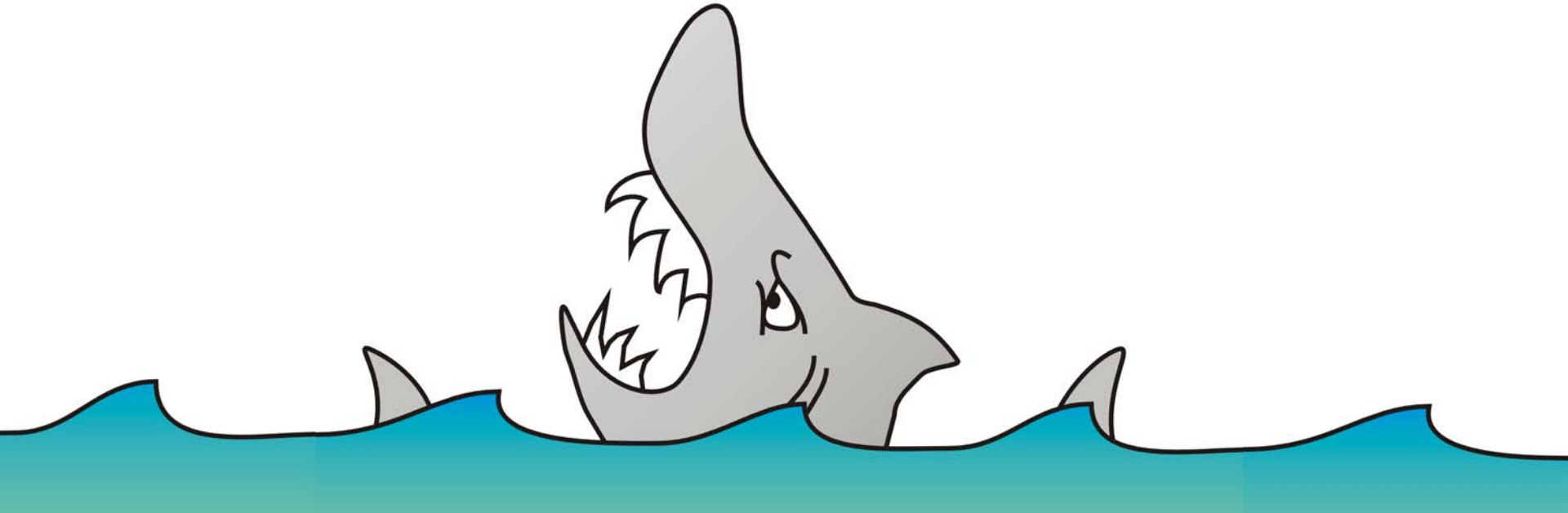
An Overview of Carbon Sequestration in Pennsylvania

John A. Harper
Pennsylvania Geological Survey

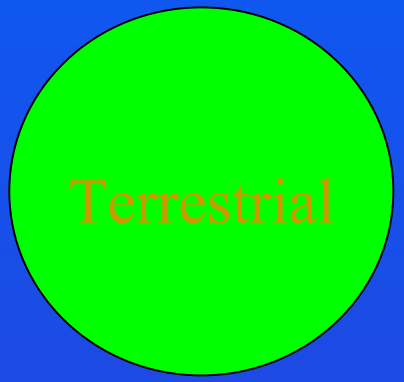

Are you sure you're comfortable?
Unger



Let's dive right in!



Principal Global CO2 Sequestration Targets



Forest lands

Agricultural lands

Biomass croplands

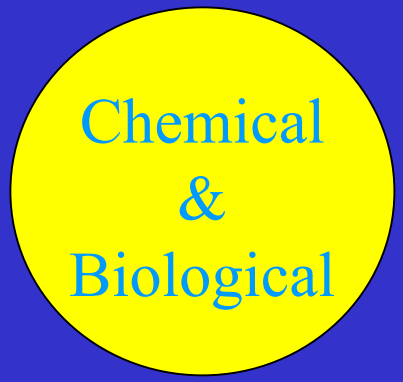
Deserts and degraded lands

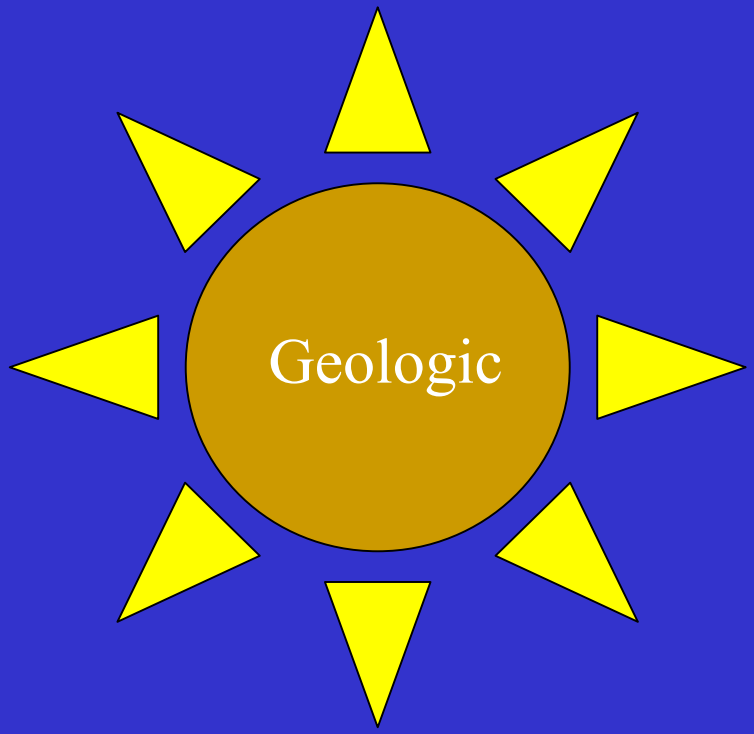
Boreal wetlands and peatlands

Enhancement of natural carbon sequestration in the ocean

Direct injection of CO2 in the deep ocean

Principal Global CO2 Sequestration Targets

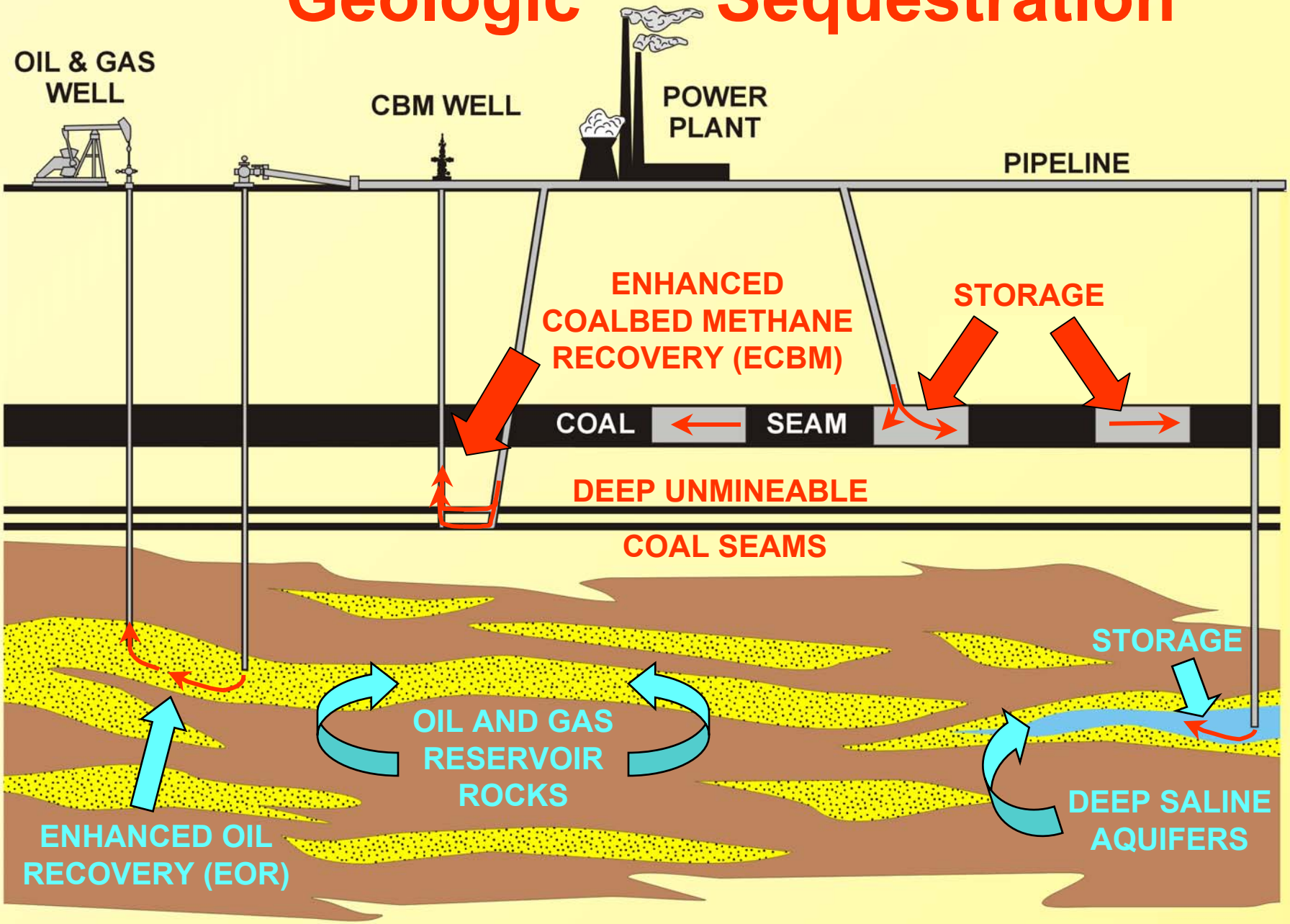




Converting CO_2 into stable solids such as magnesium carbonate

Utilizing microbes to convert CO_2 into useful products such as methane

Geologic Sequestration



MIDWEST REGIONAL CARBON SEQUESTRATION PARTNERSHIP

MRCSP Mission:

To be the premier resource in the Midwest Region for identifying the technical, economic, and social considerations associated with CO_2 sequestration and creating viable pathways for its deployment.

Snapshot of the MRCSP

Who:

- 38-member team led by Battelle Labs
- Leading research organizations in our Region
- Major energy and agricultural entities operating in our Region
- Key government and non-government organizations

What:

- Assessing carbon sequestration opportunities
- Technical and economic potential
- Public acceptance
- Regulatory Issues

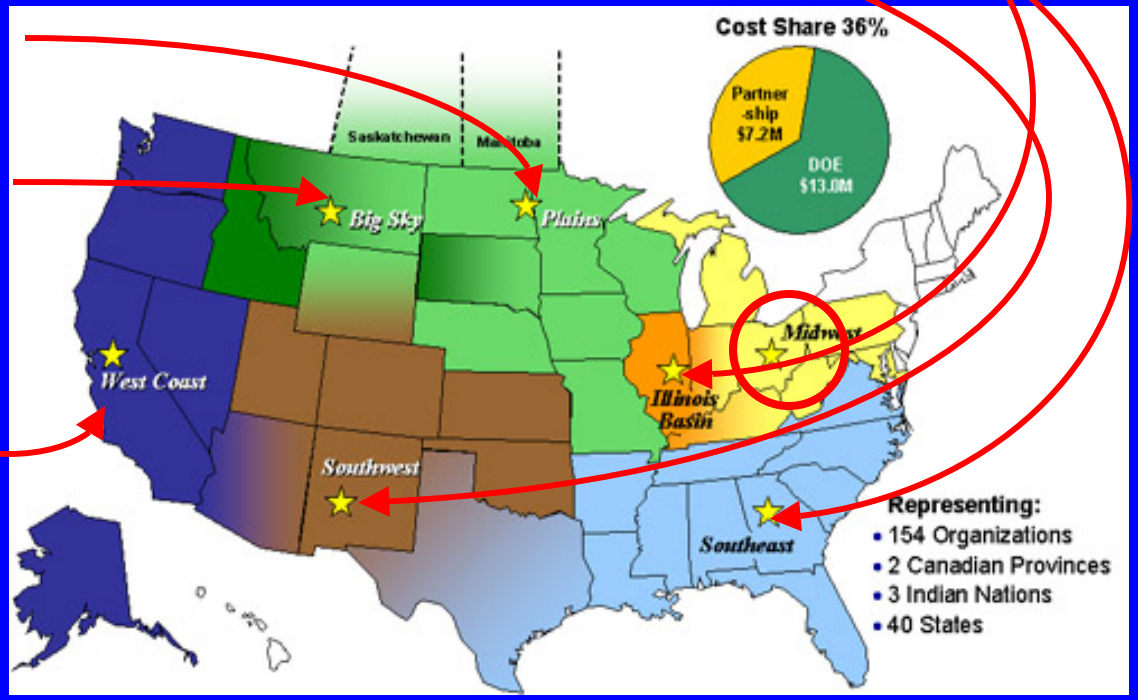
Where:

- Seven-State Region - IN, KY, MD, MI, OH, PA, WV

The MRCSP is One of Seven Regional Partnerships Across the U. S.

The other six are:

- Geological Carbon Sequestration Options in the **Illinois Basin**
- **Southeast** Regional Carbon Sequestration Partnership
- **Southwest** Regional Partnership for Carbon Sequestration
- **Plains** CO_2 Reduction Partnership
- **Big Sky** Regional Carbon Sequestration Partnership
- **West Coast** Regional Carbon Sequestration Partnership

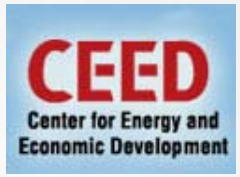


See http://www.netl.doe.gov/coal/Carbon%20Sequestration/partnerships/index.htm for more information from NETL on the seven partnerships.

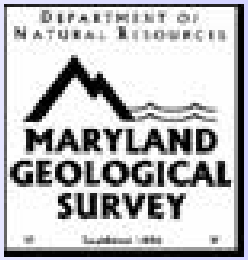
Industry Partners

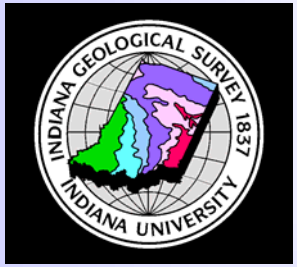
U.S. Department of Energy/NETL

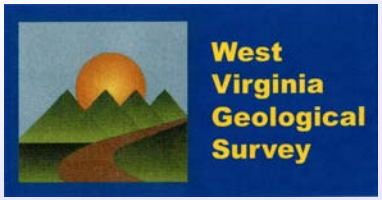
Ohio Coal Development Office



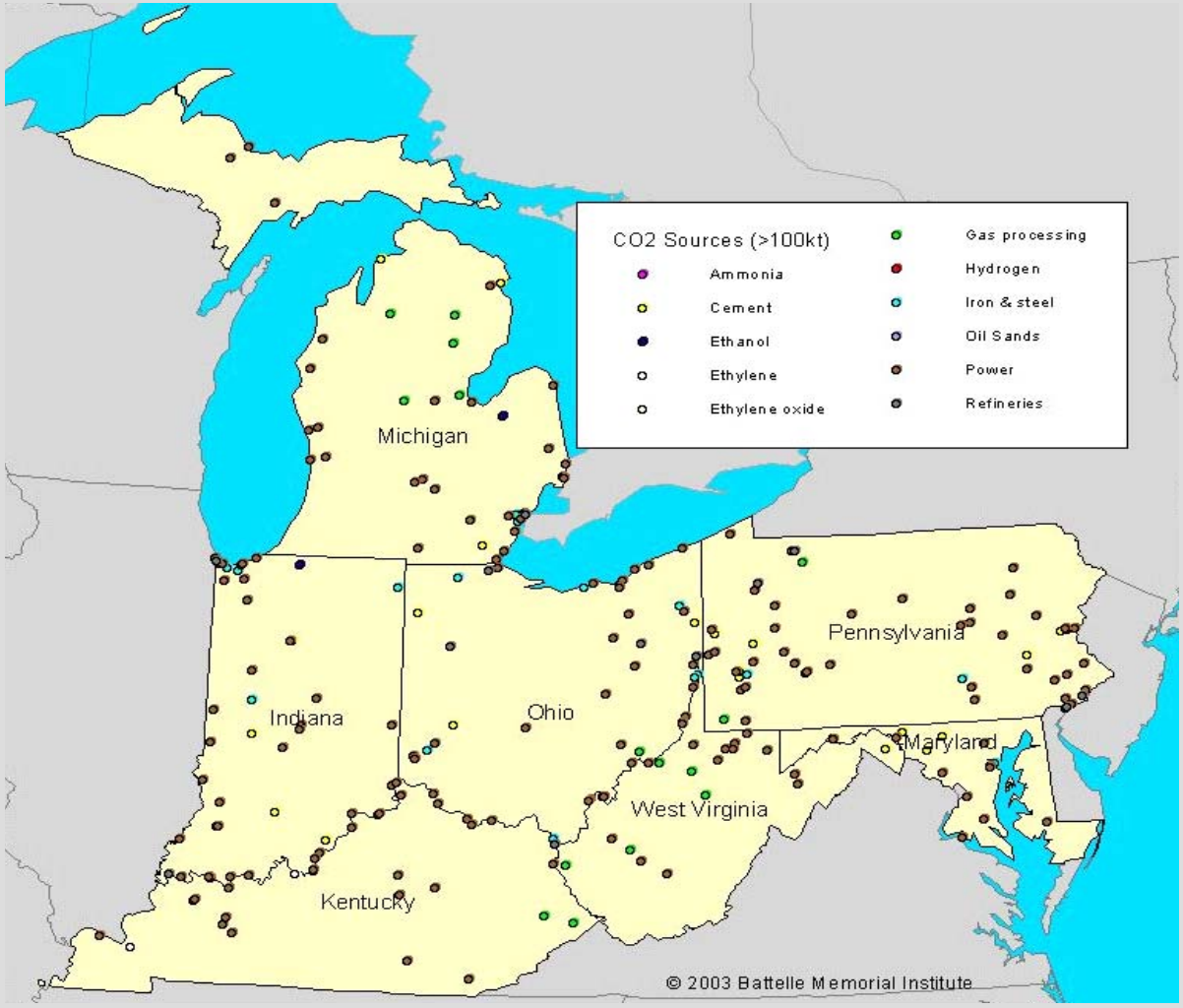
Research Partners







Snapshot of our Region



The Nation's Engine Room

Population: 50.8 million (one in six Americans)

Gross Regional Product: $1,534 billion (16% of U.S. economy)

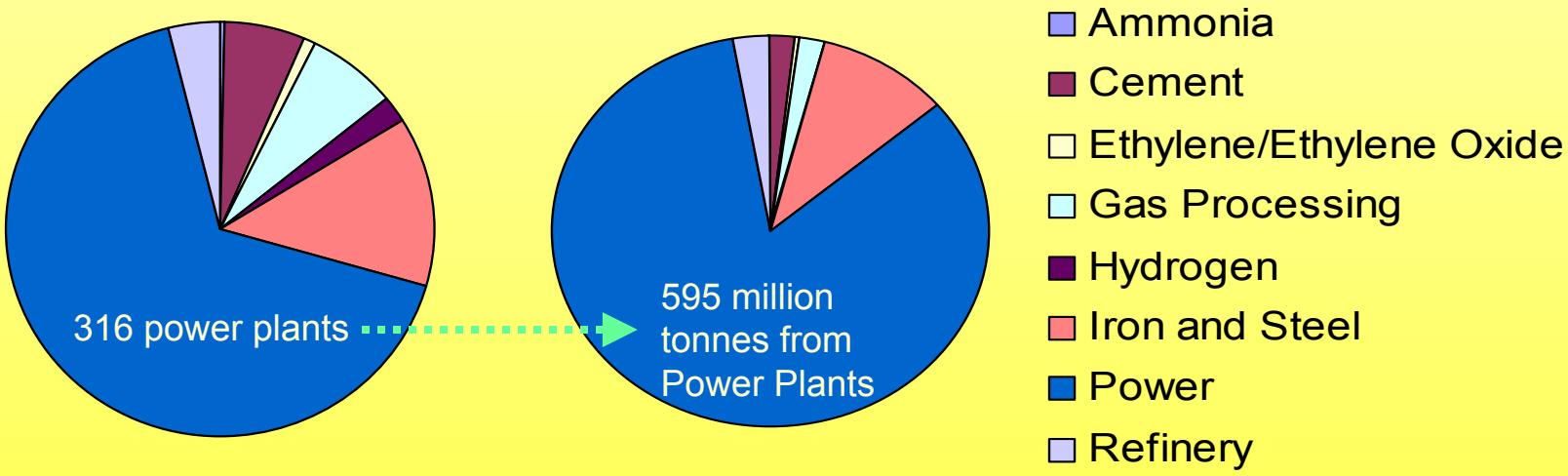
21.5 % of all the electricity generated in the U.S.

77% of the Region's electricity is generated from coal

CO_2 Emissions in the MRCSP Region

The focus is on large point sources (>100,000 tonnes CO_2/yr)

474 Point Sources ⇨ 715 Million Tonnes CO_2 annually

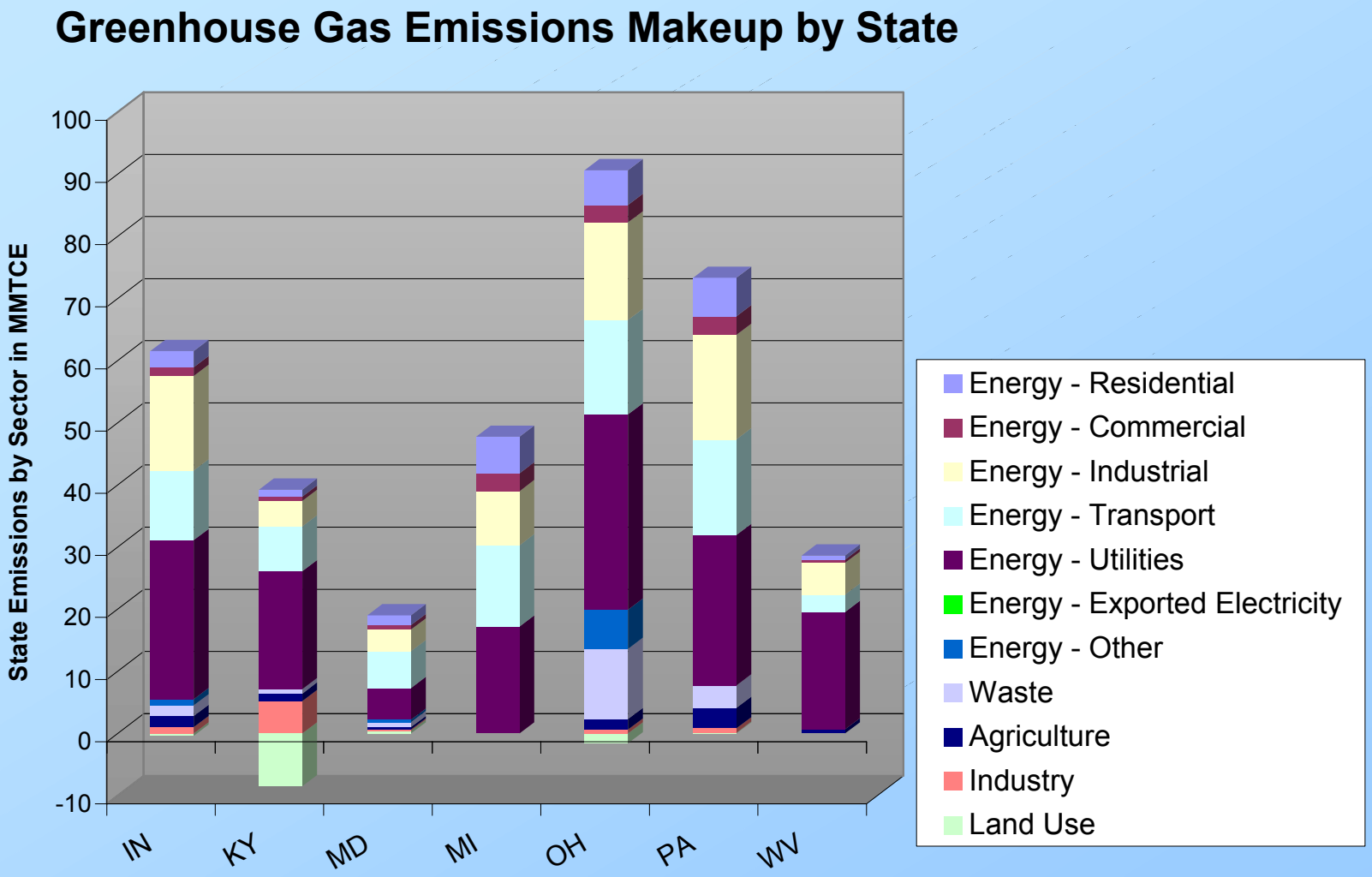


Over 26% of CO_2 emissions from power plants nationwide

SIGNIFICANCE

Point sources in the Midwest Region, including Pennsylvania, account for over 12% of total CO_2 emissions nationwide

CO_2 Emissions in our Region



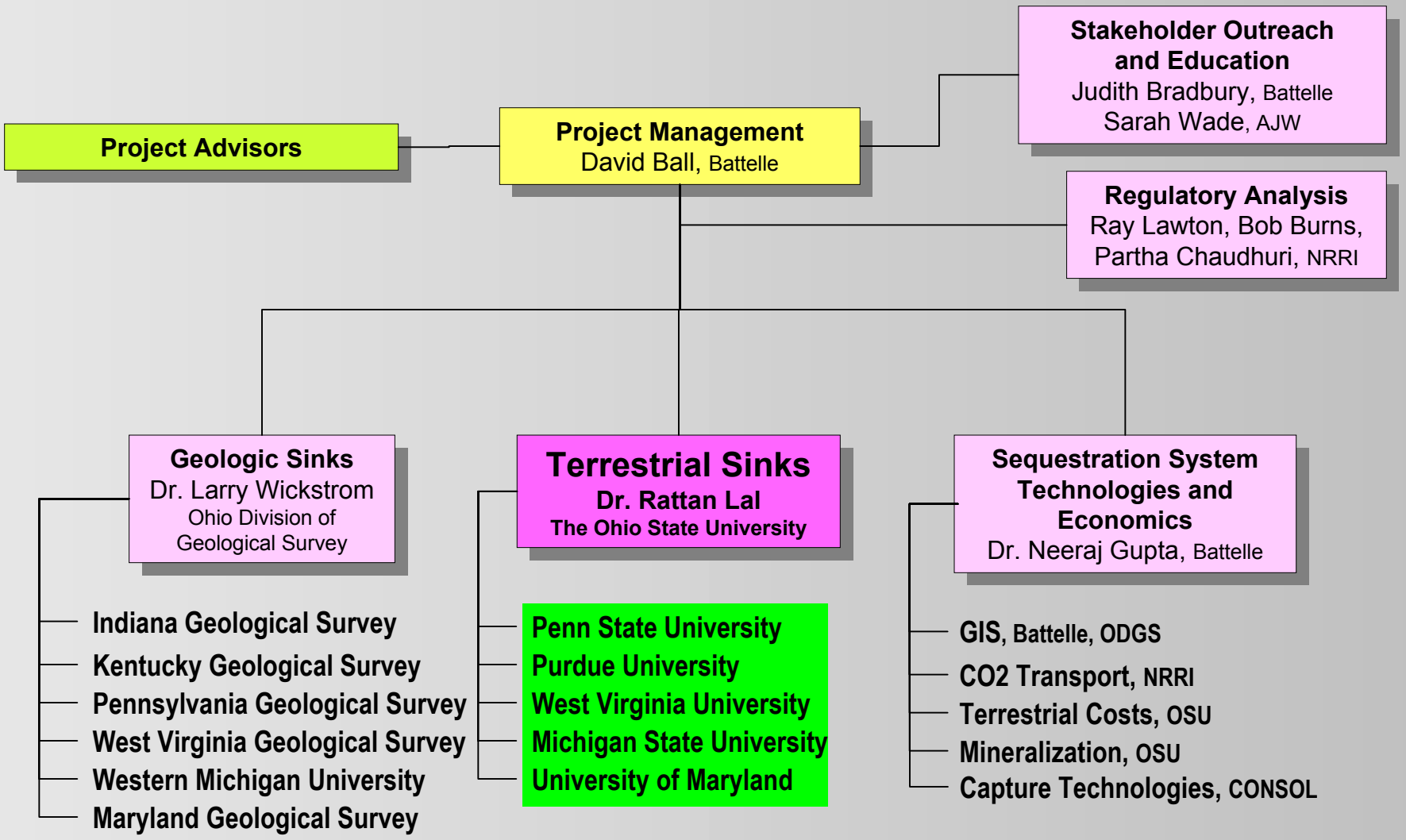
MRCSP GOALS

Assess the technical and economic potential, and the social impact, of carbon sequestration:

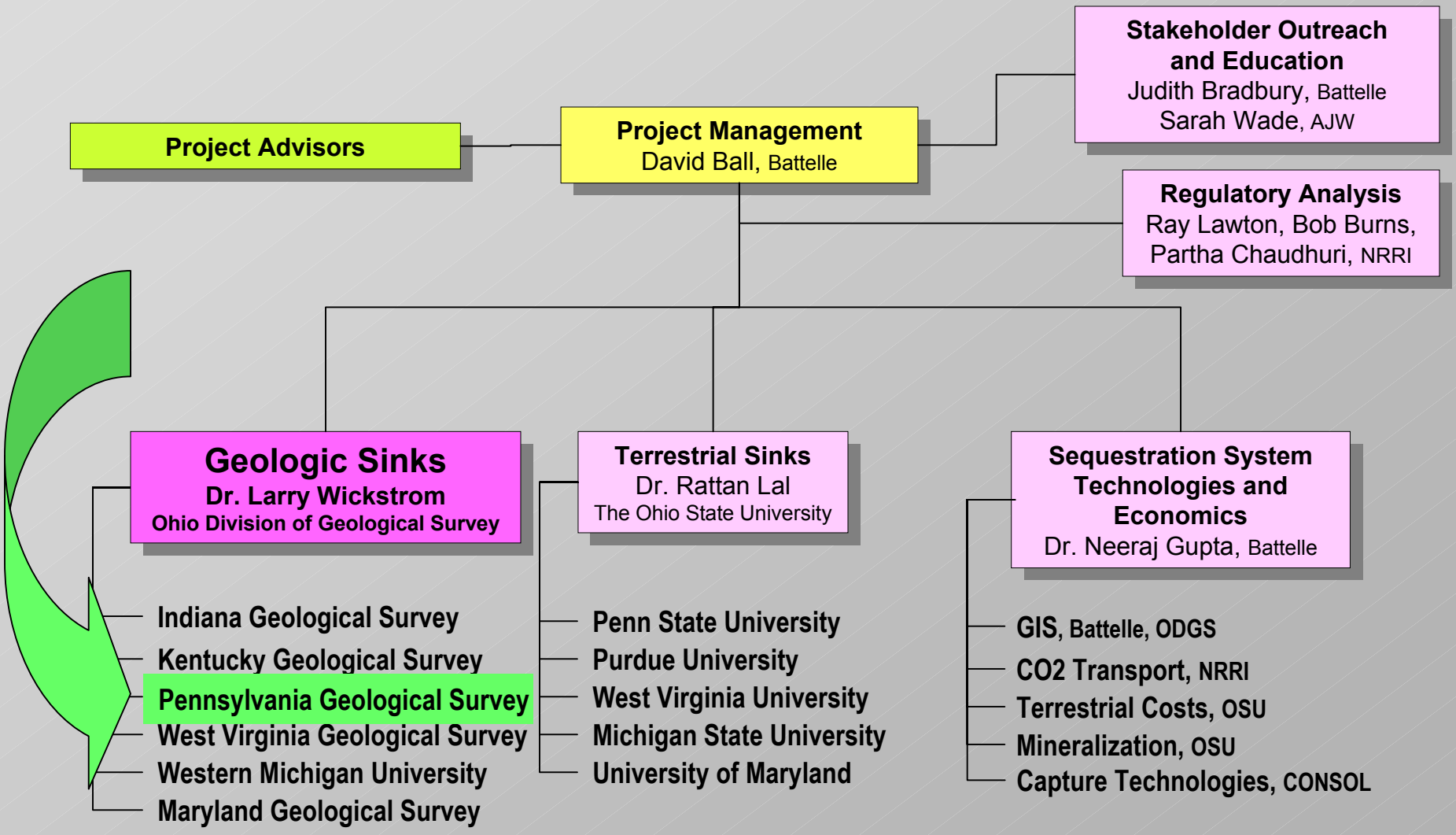
- Identify CO_2 sources in the region
- Assess the cost of capturing CO_2 from these sources
- Assess the region's deep geologic formations, forests, agricultural, and degraded land systems for their potential to sequester CO_2
- Engage the public and elected officials to communicate the potential value of geologic and terrestrial sequestration
- Examine barriers that would hinder cost-effective and timely deployment
- Identify strategies for overcoming these barriers via Phase II field demonstrations

Translate this theoretical knowledge into practical implementation strategies to assist the industries that rely on the region's abundant, reliable, and inexpensive energy sources.

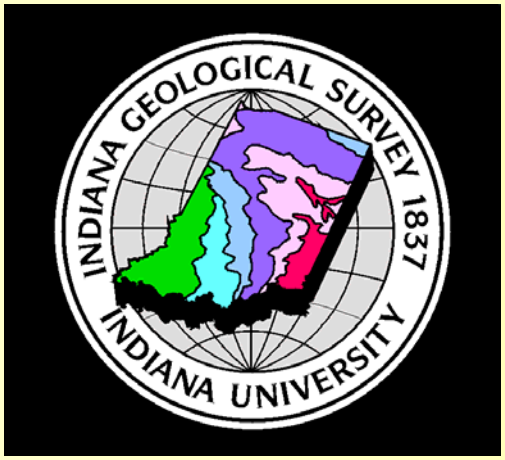
Phase I Project Organization

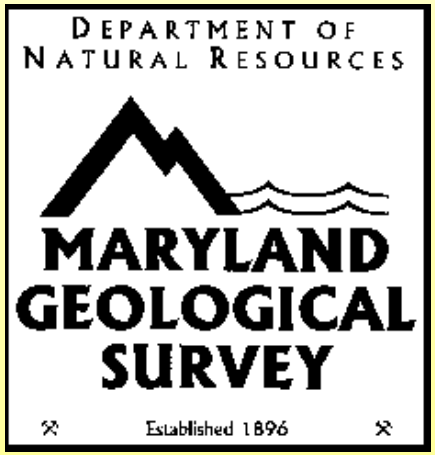


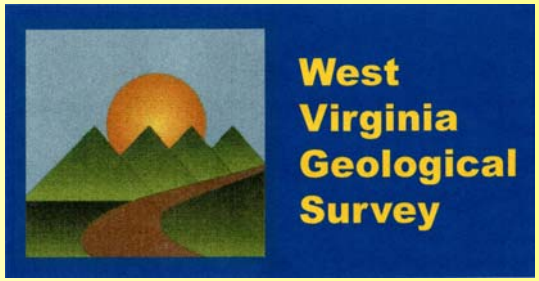
Phase I Project Organization



Team Partners are the Major Geologic Data Sources in this Region







A partnership of regional expertise

MRCSP Geologic Characterization

Four major types of potential CO_2 injection reservoirs

- **Deep saline reservoirs**
- **Oil and gas fields (active and depleted)**
- **Coal seams and organic-rich shales**
- **Salt solution mines and cavities**

At least nine regional potential injection reservoirs

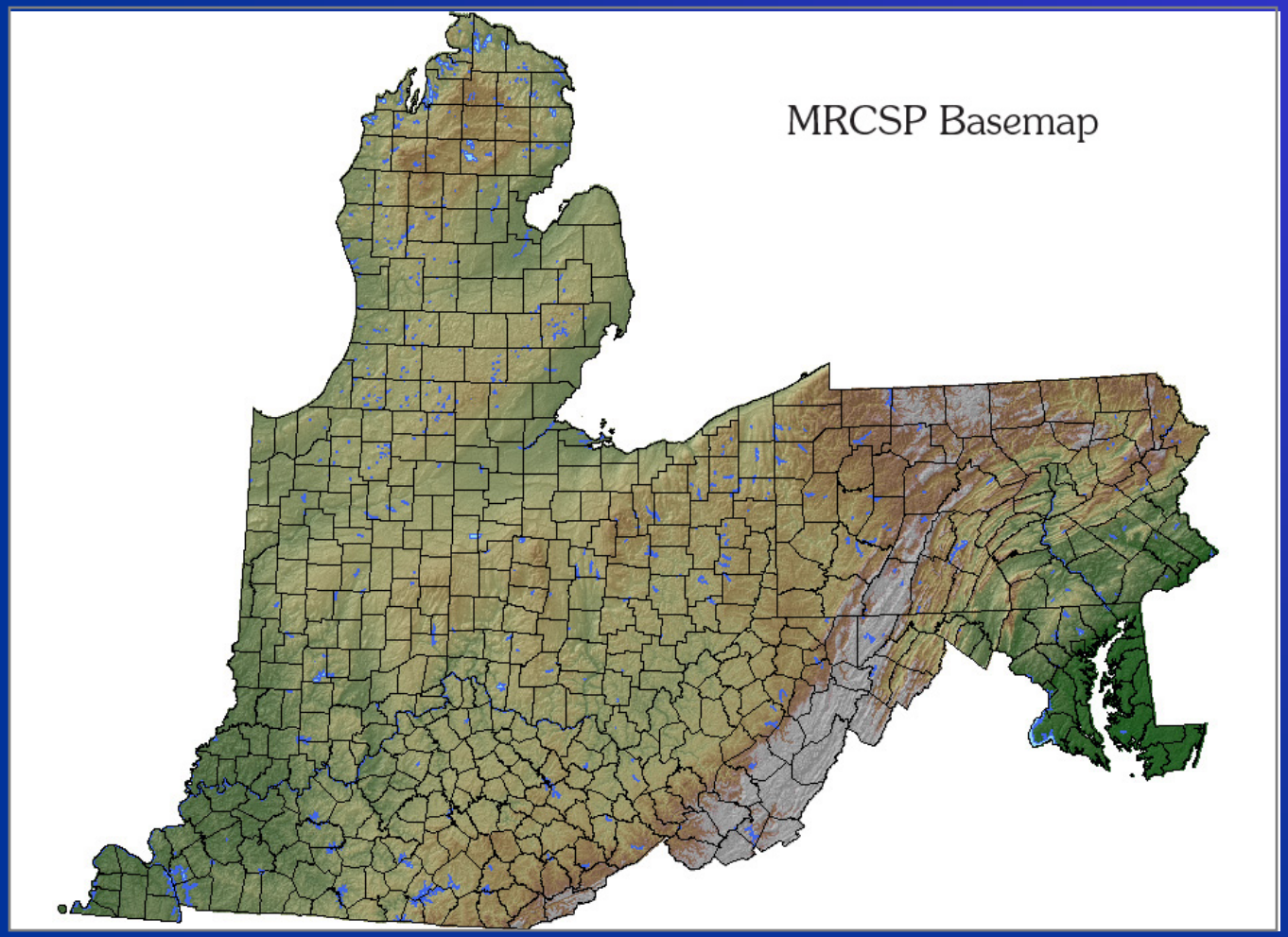
Several reservoirs of local importance

Ultimate Objective:

Evaluate the potential capacity for geologic sequestration of CO_2 in the member states.

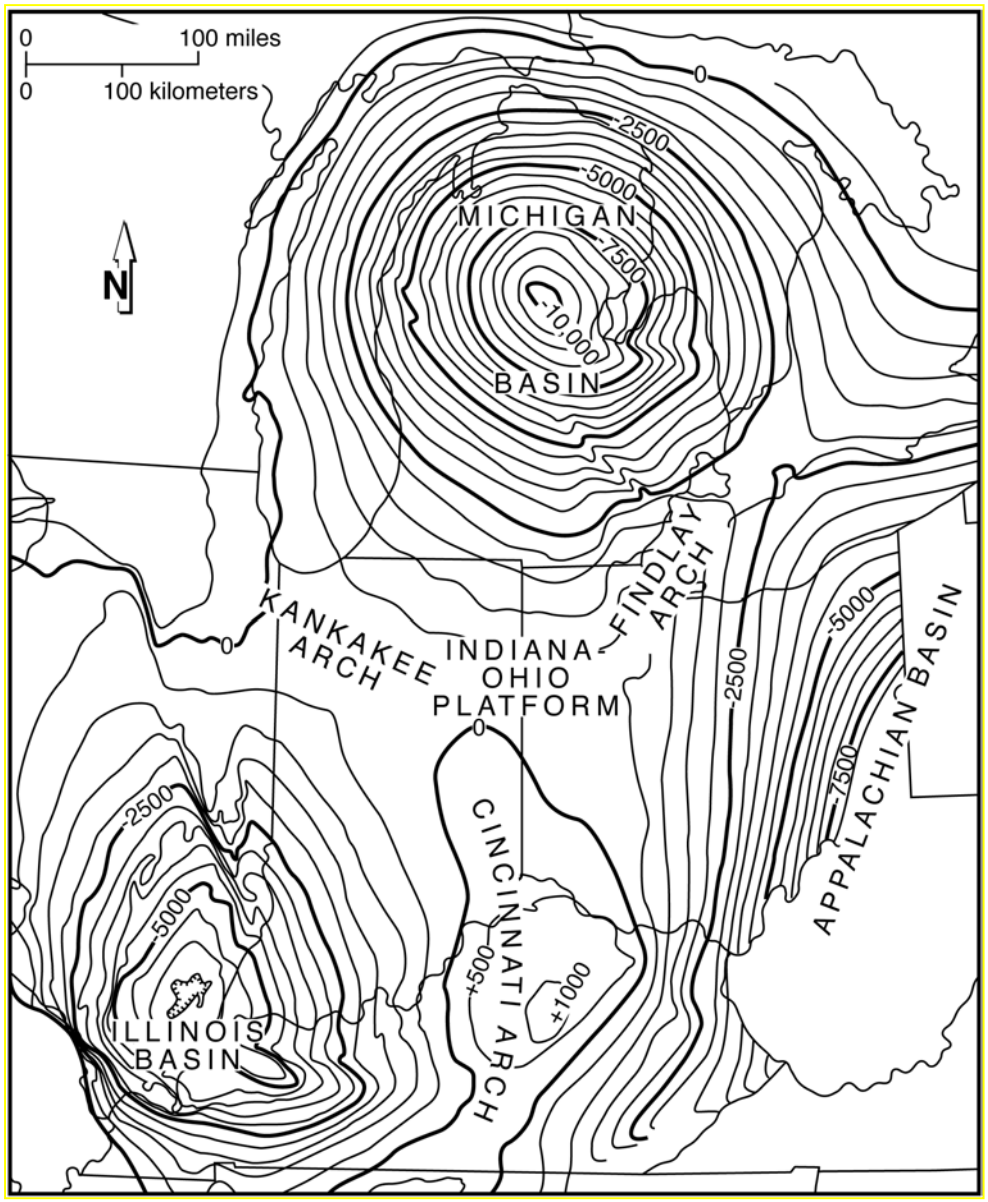
- Determine potential reservoir capacities
- Determine, within the scope of the project, the potential for enhanced recovery of coalbed methane, shale gas, and “conventional” oil and gas
- Identify promising locations for sequestration potential

MRCSP Area of Interest

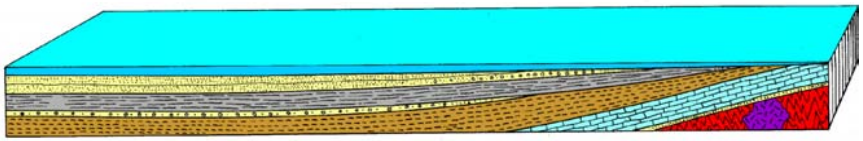


- *An area of diverse geology*
- *An area in which CO_2 sequestration will be environmentally and economically important*
- *Diverse geology leads to diverse geologic sequestration options*

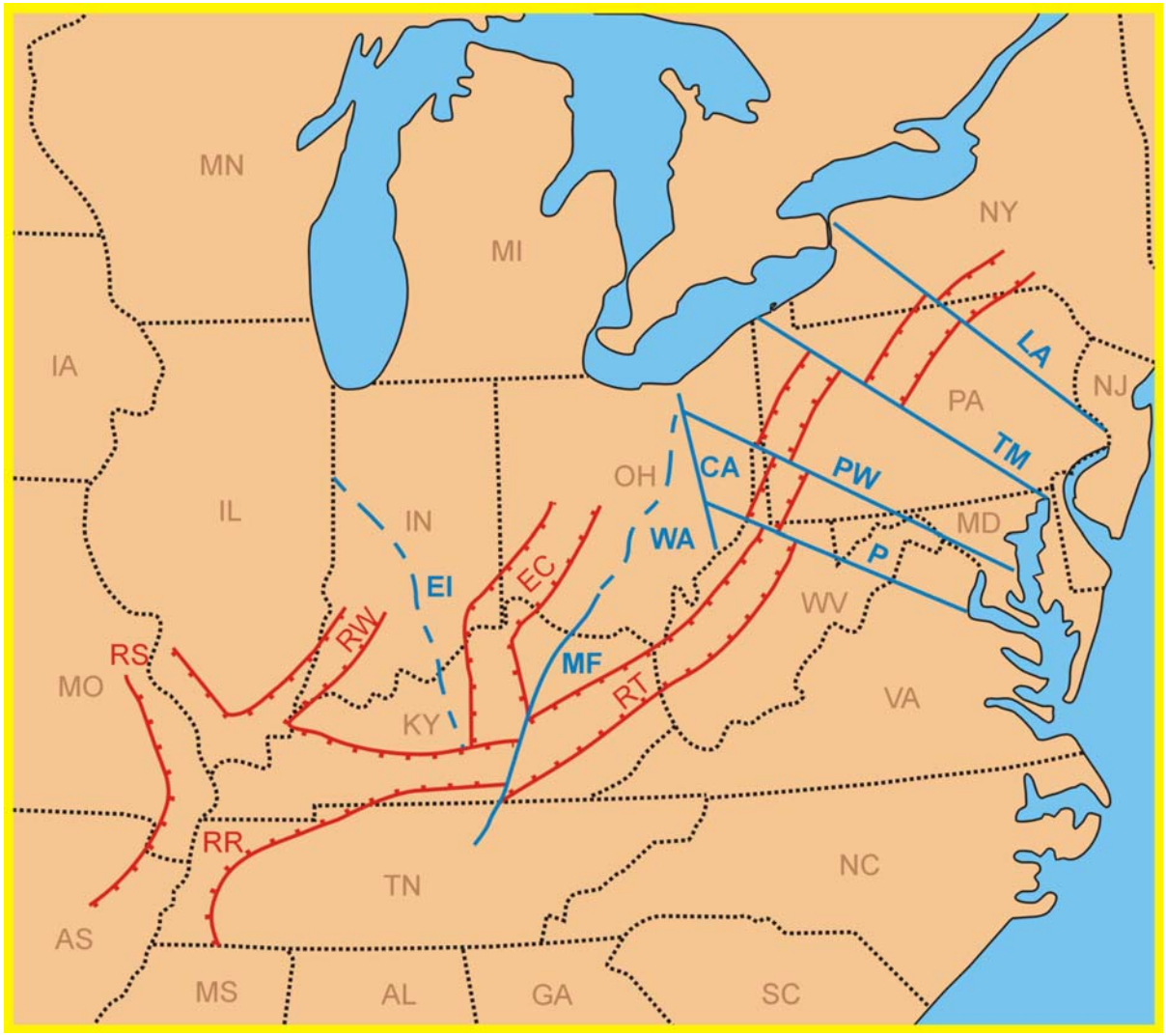
Regional Geology



All or parts of three large sedimentary basins

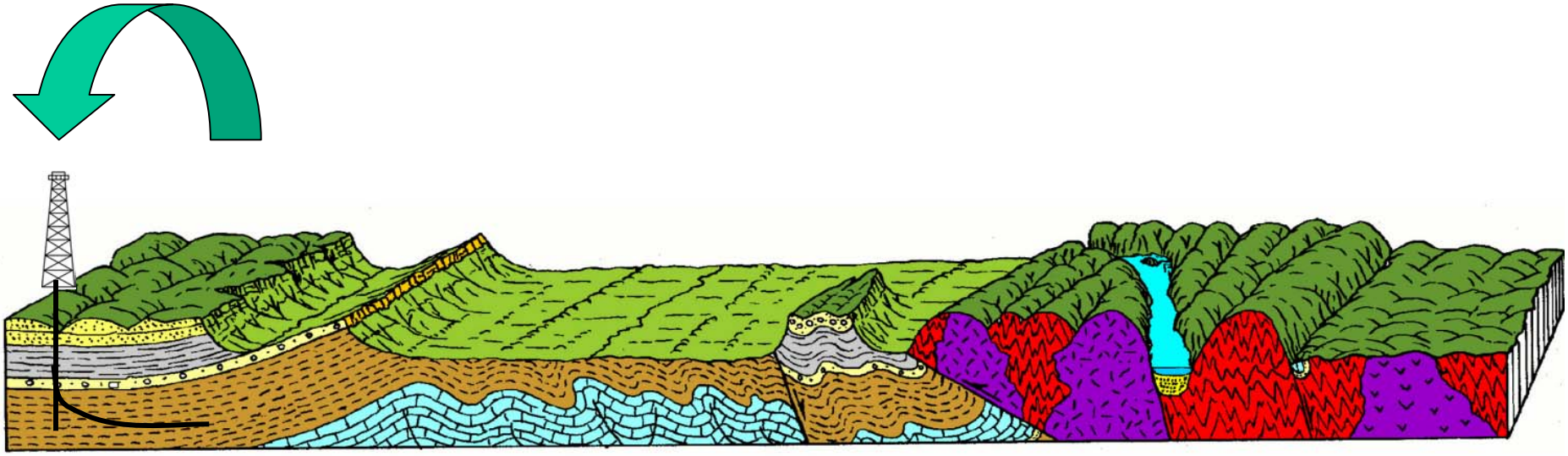


Regional Geology



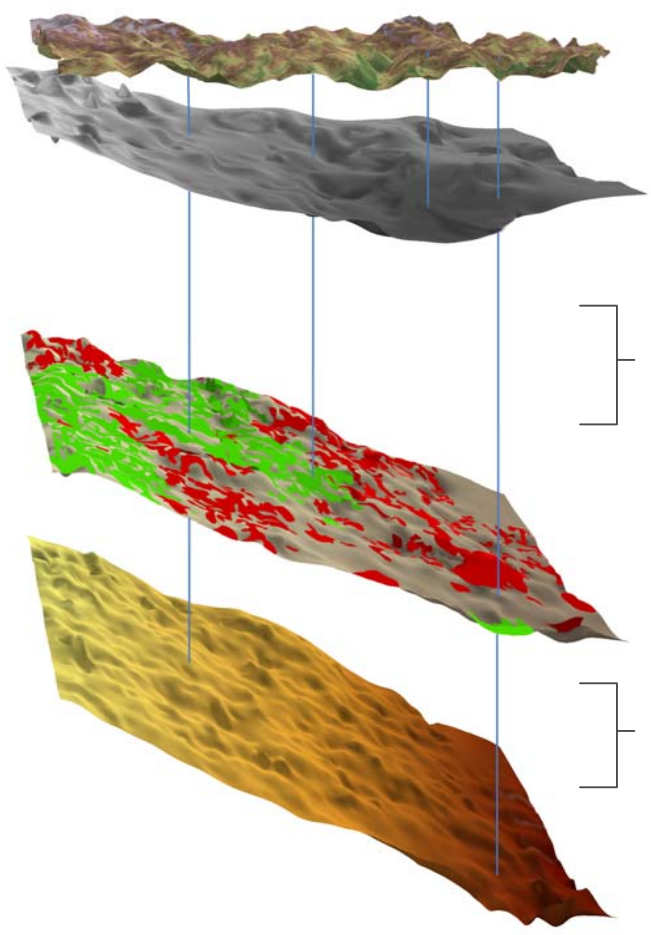
Deeply buried rift systems in the crystalline "basement" rocks (< 570 million year old igneous and metamorphic rocks)

Regional Geology



Significant potential for large-volume sedimentary reservoirs in which CO_2 could be injected with good containment at depth

What We are Looking At



Surficial elevation model

Prospective coal beds and organic shales ("sinks" & reservoirs)

Caprocks ("seals")

Oil and gas fields & prospective horizons ("sinks" & reservoirs)

Caprocks ("seals")

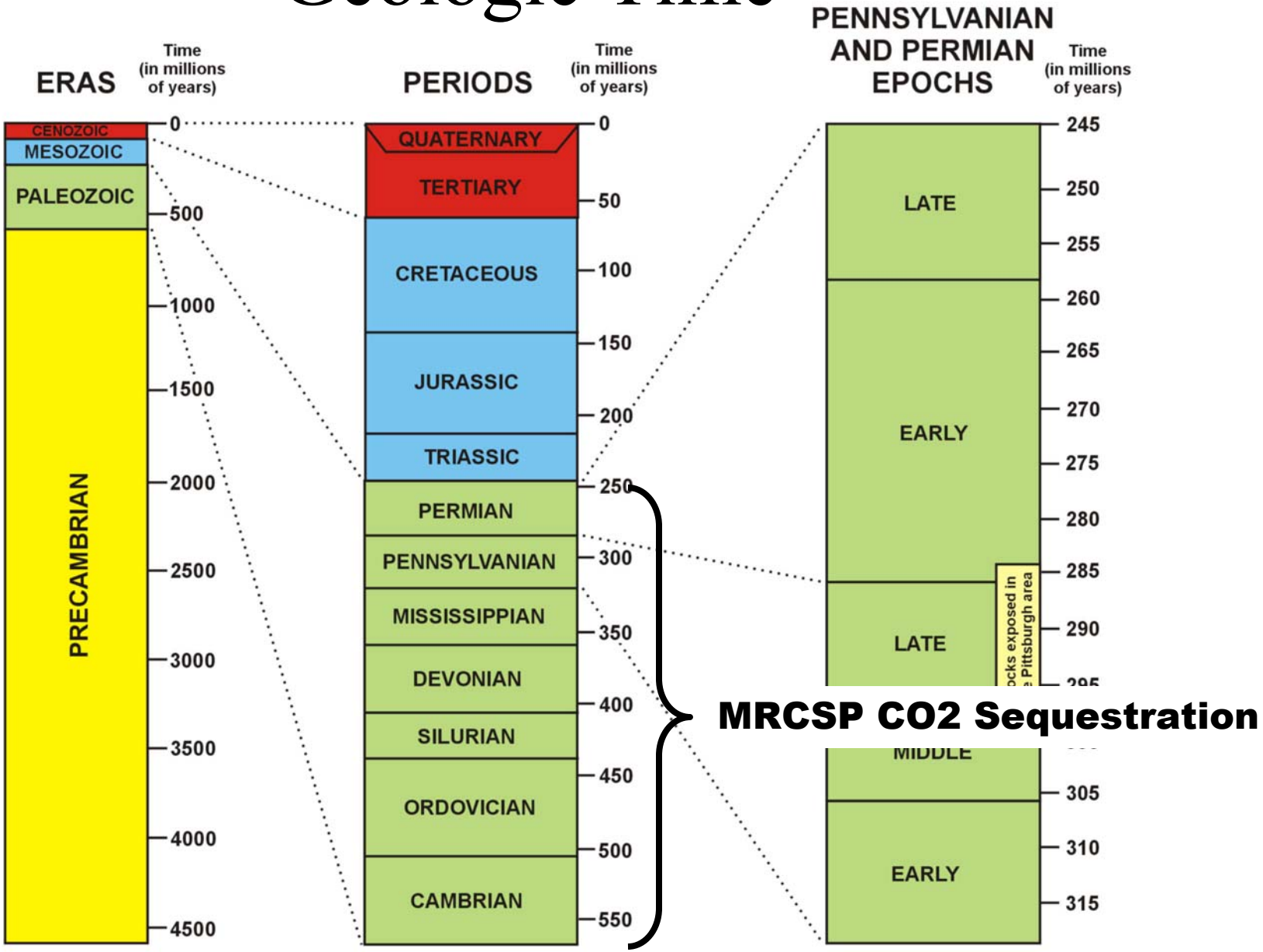
Prospective deep saline aquifers ("sinks")

At any one location, multiple horizons can be analyzed

Different types of potential reservoirs

Results eventually will be compared to emissions sources

Geologic Time



Prospective Storage Units, Caprocks, and Other Features

Storage

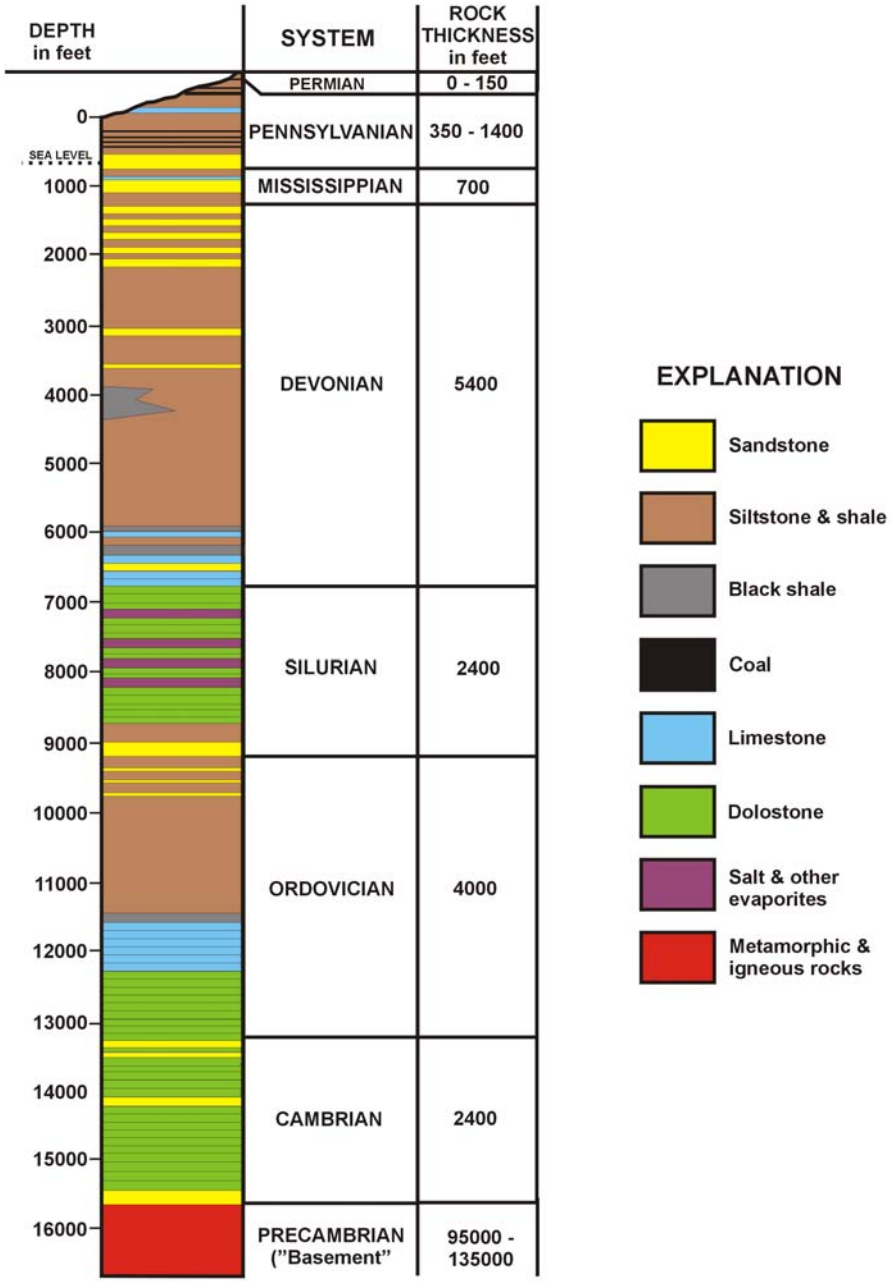
- Basal Sandstone
- Rose Run/Theresa Sandstones
- St. Peter Sandstone *(in some areas)*
- Medina/"Clinton"/ Tuscarora Sandstones
- Lockport Dolomite *(in some areas)*
- Oriskany Sandstone
- Devonian shales *(in some areas)*
- Upper Devonian sandstones
- Wastegate (MD)

Caprock/seals

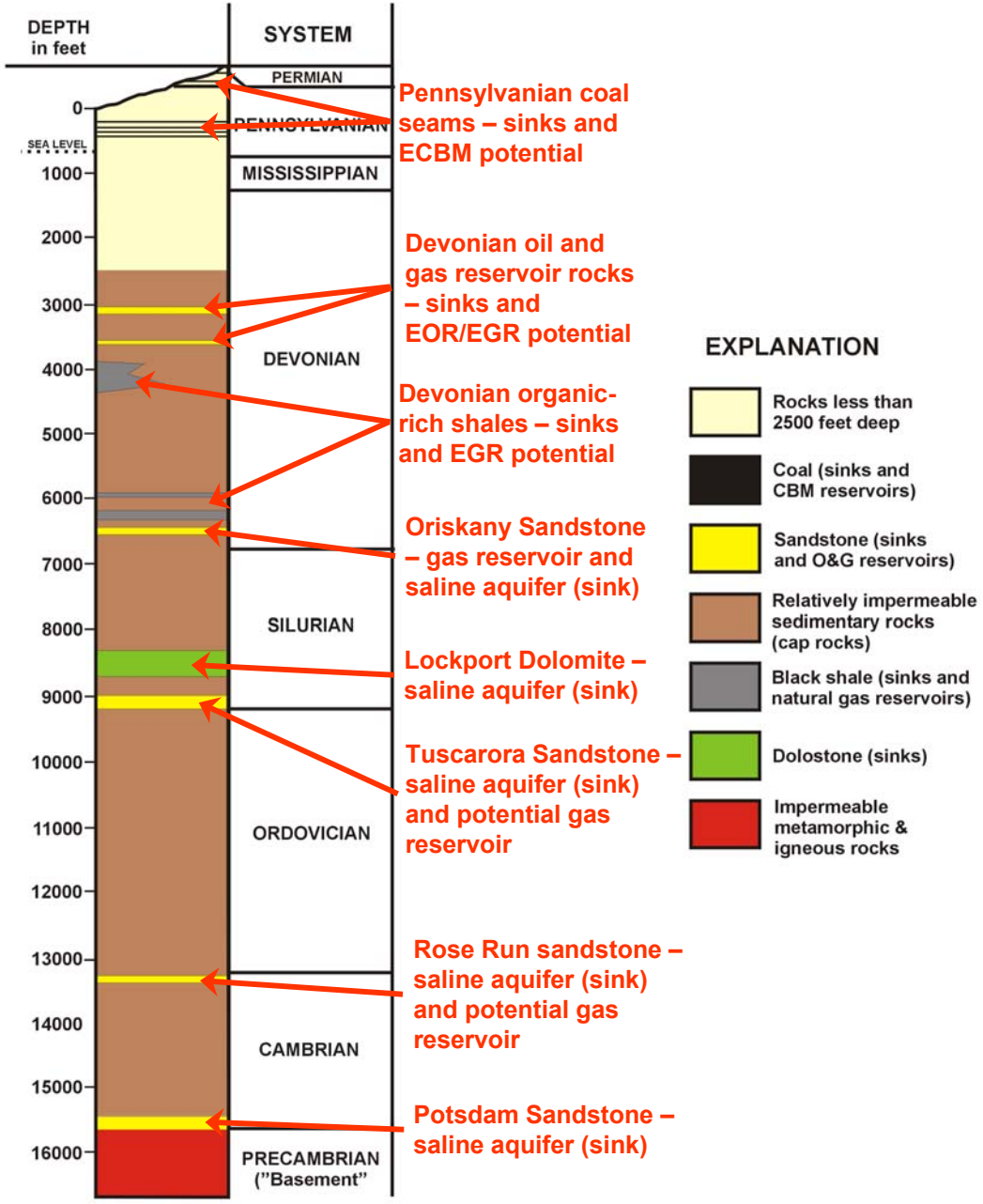
- "Basement" structure
- Top basal sand to top of Knox
- Knox to base Silurian
- Lockport to top Onondaga *(in some areas)*
- Devonian shales *(in some areas)*

Other

- Oil and gas fields
- Gas storage fields
- Salt mines/solution mines
- Coal beds (deep, unmineable)
- Hazardous and non-hazardous waste injection wells
- Abandoned coal mines
- Major structural features/faults

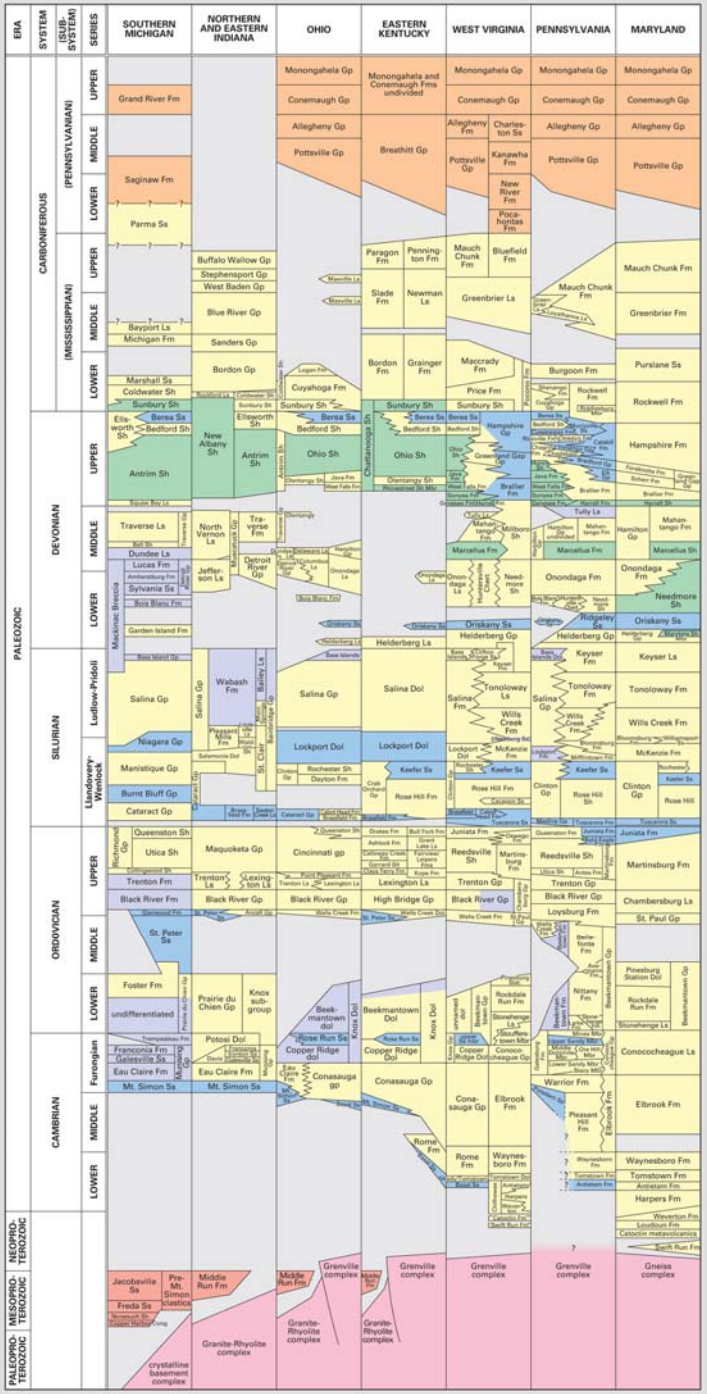


Geologic Column of Rocks in the Pittsburgh area



Geologic Column of Rocks in the Pittsburgh area

- Local target
- Regional target
- Confining unit
- Organic-rich shale
- Coal-bearing unit
- Precambrian sandstone
- Basement rocks
- Unconformity (rocks missing by erosion or non-deposition)



Sequestration Potential of Rocks in the MRCSP Project Area

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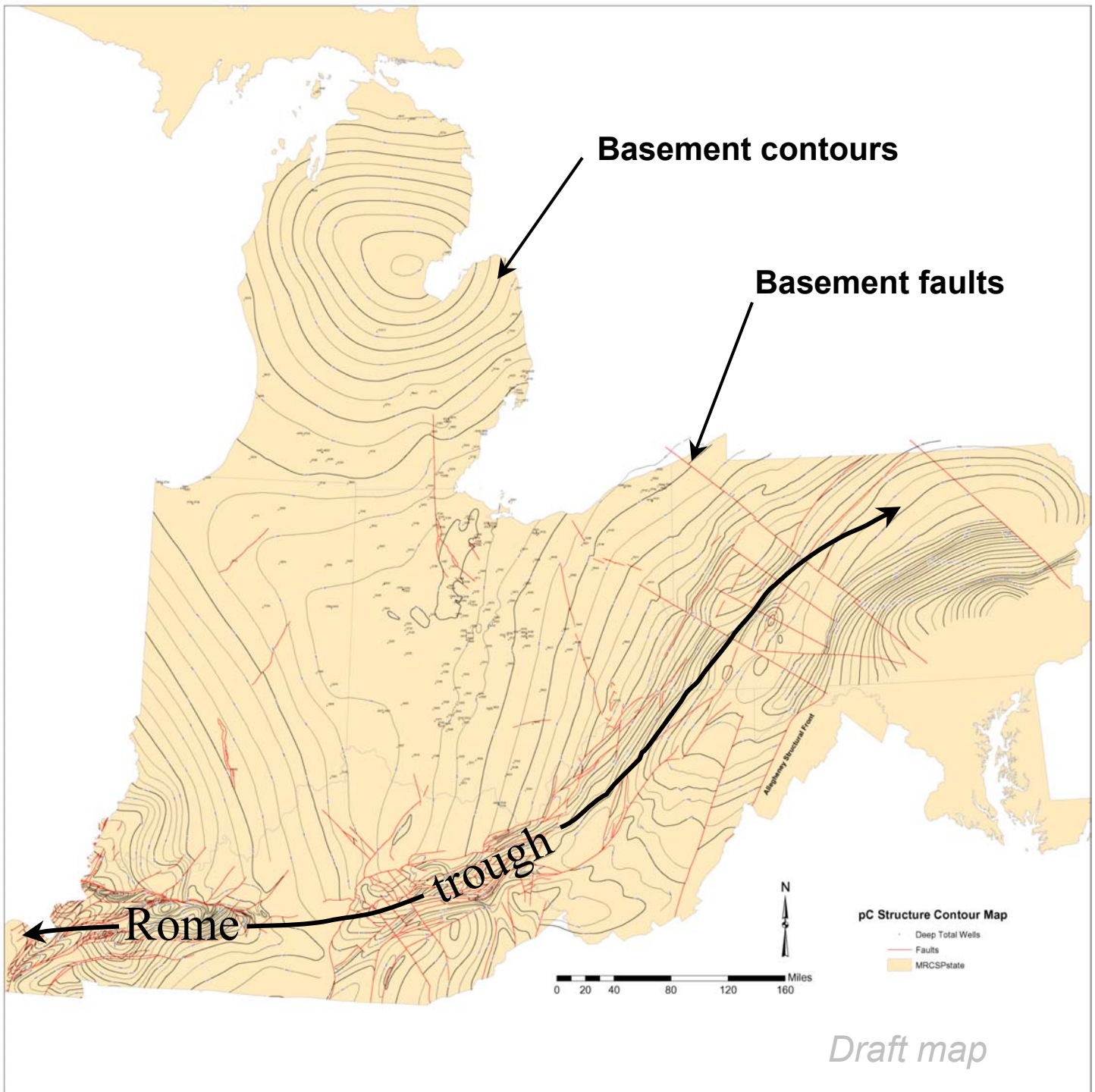
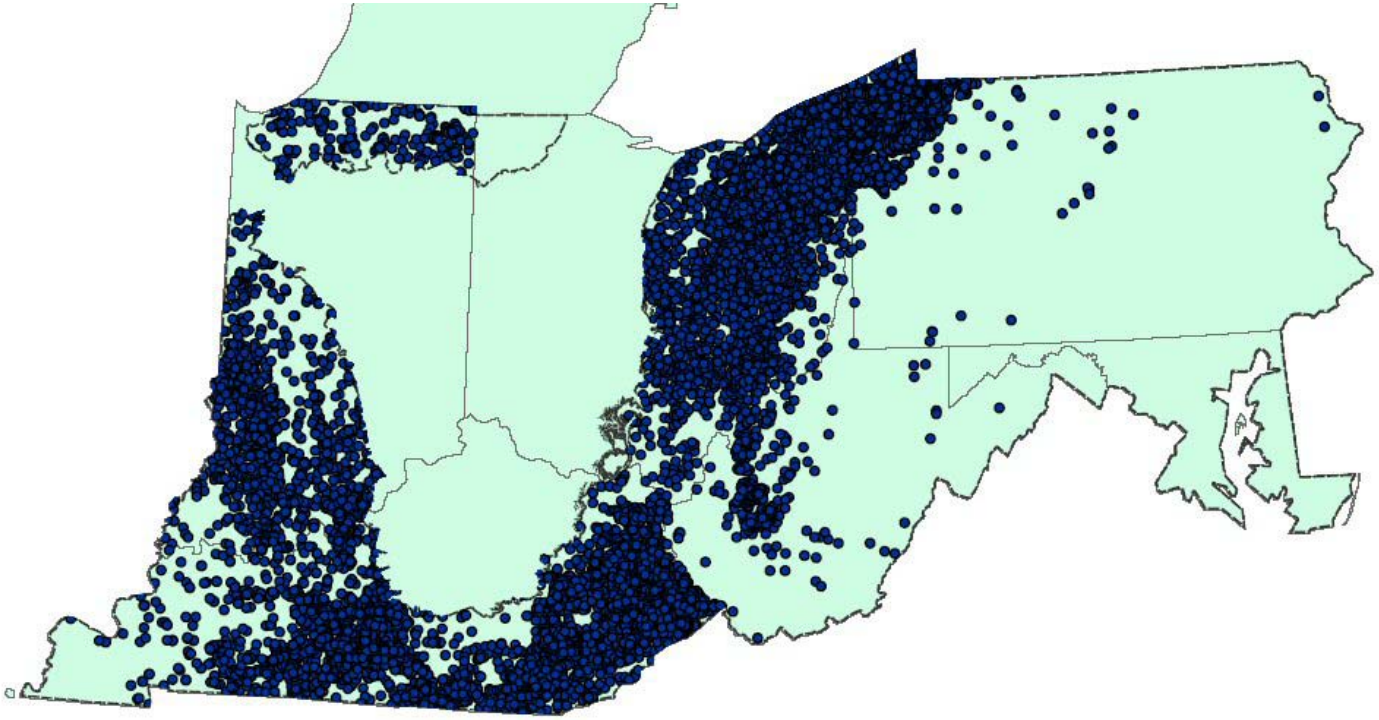


Basement Map of the MRCSP Area

Large Amounts of Data, but Density Varies



Draft map

Distribution of wells used to construct the thickness and structure maps for the Onondaga-to-Lockport confining unit

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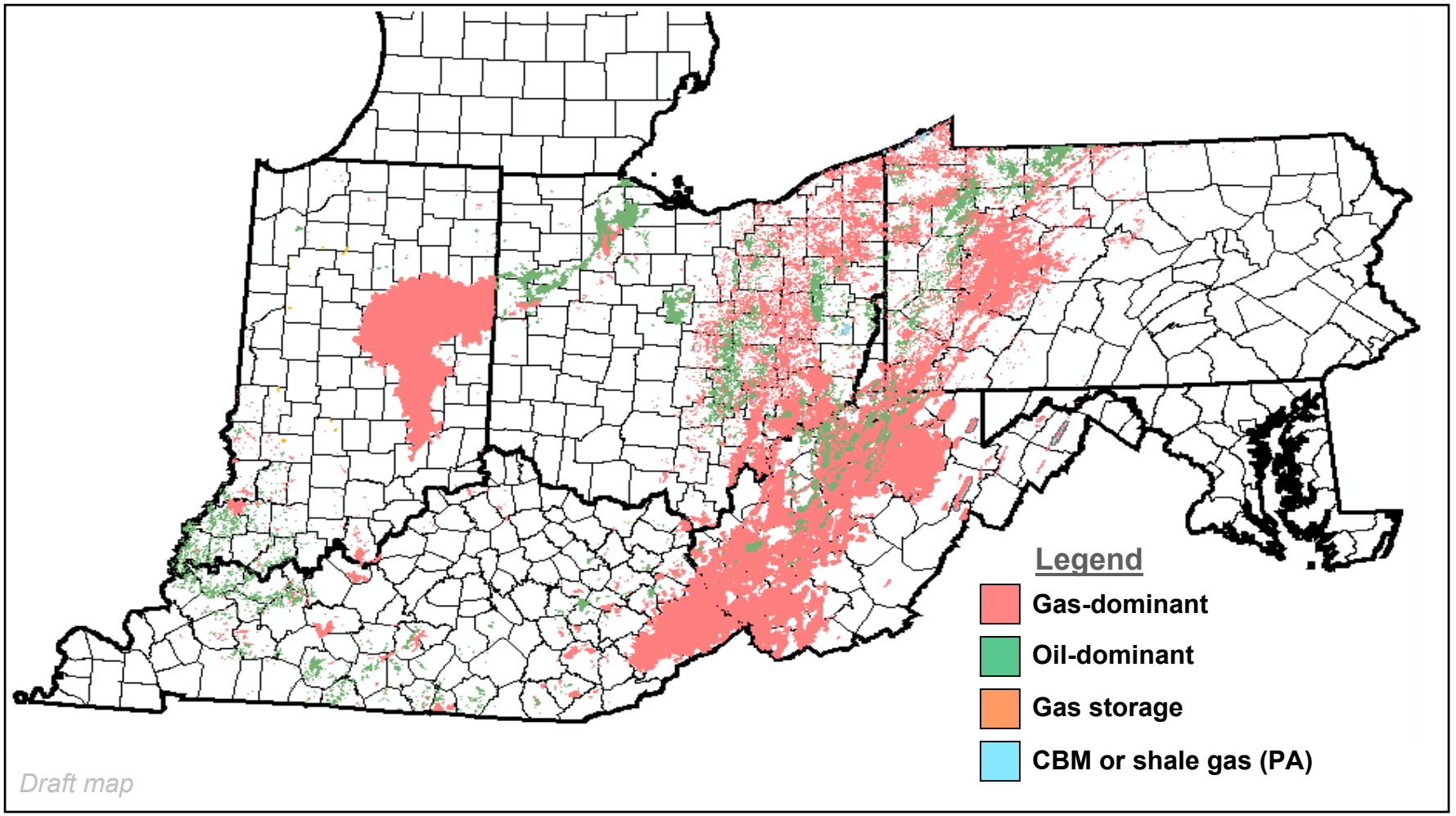
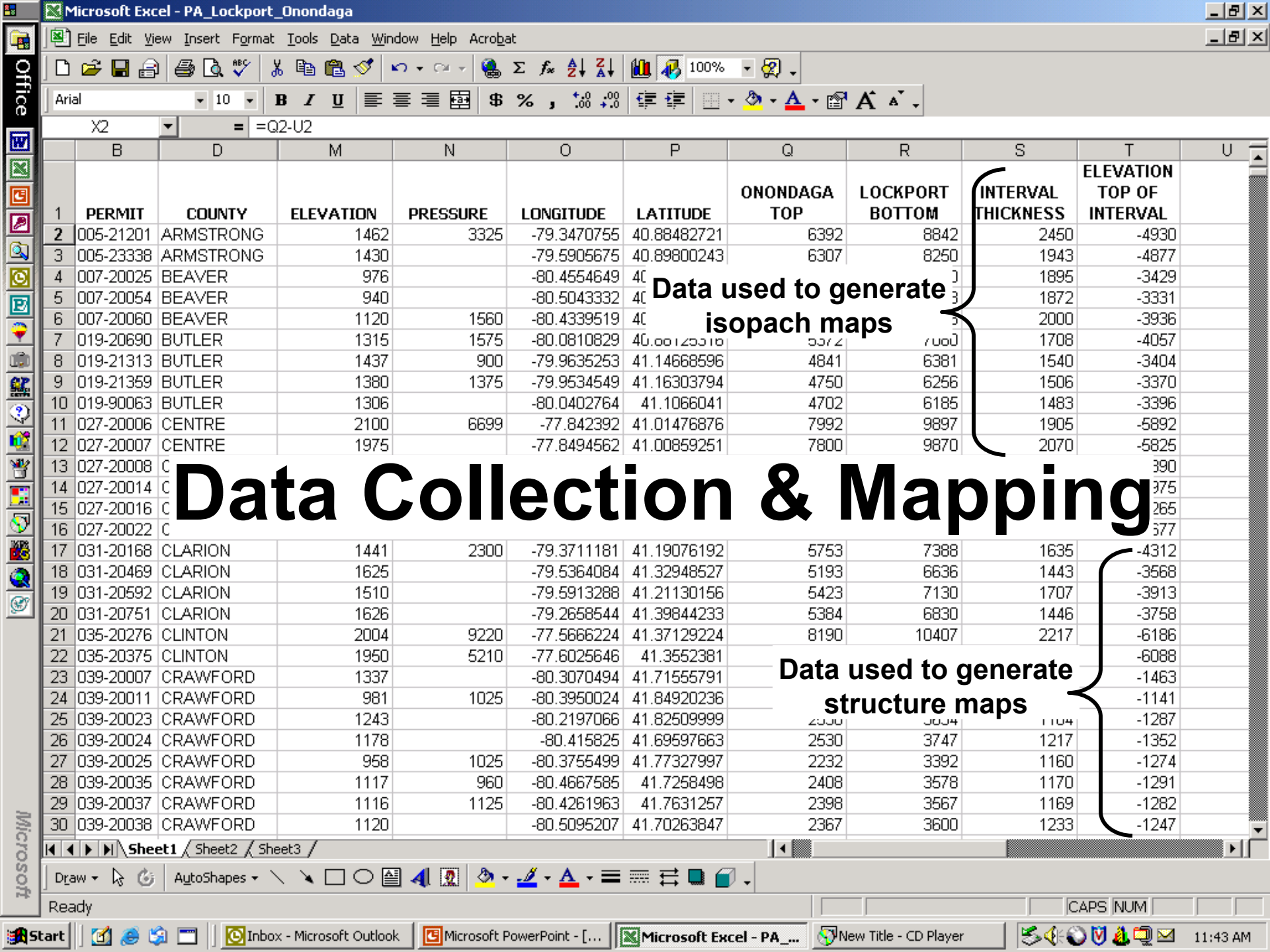
Oil and Gas Fields in the MRCSP Area



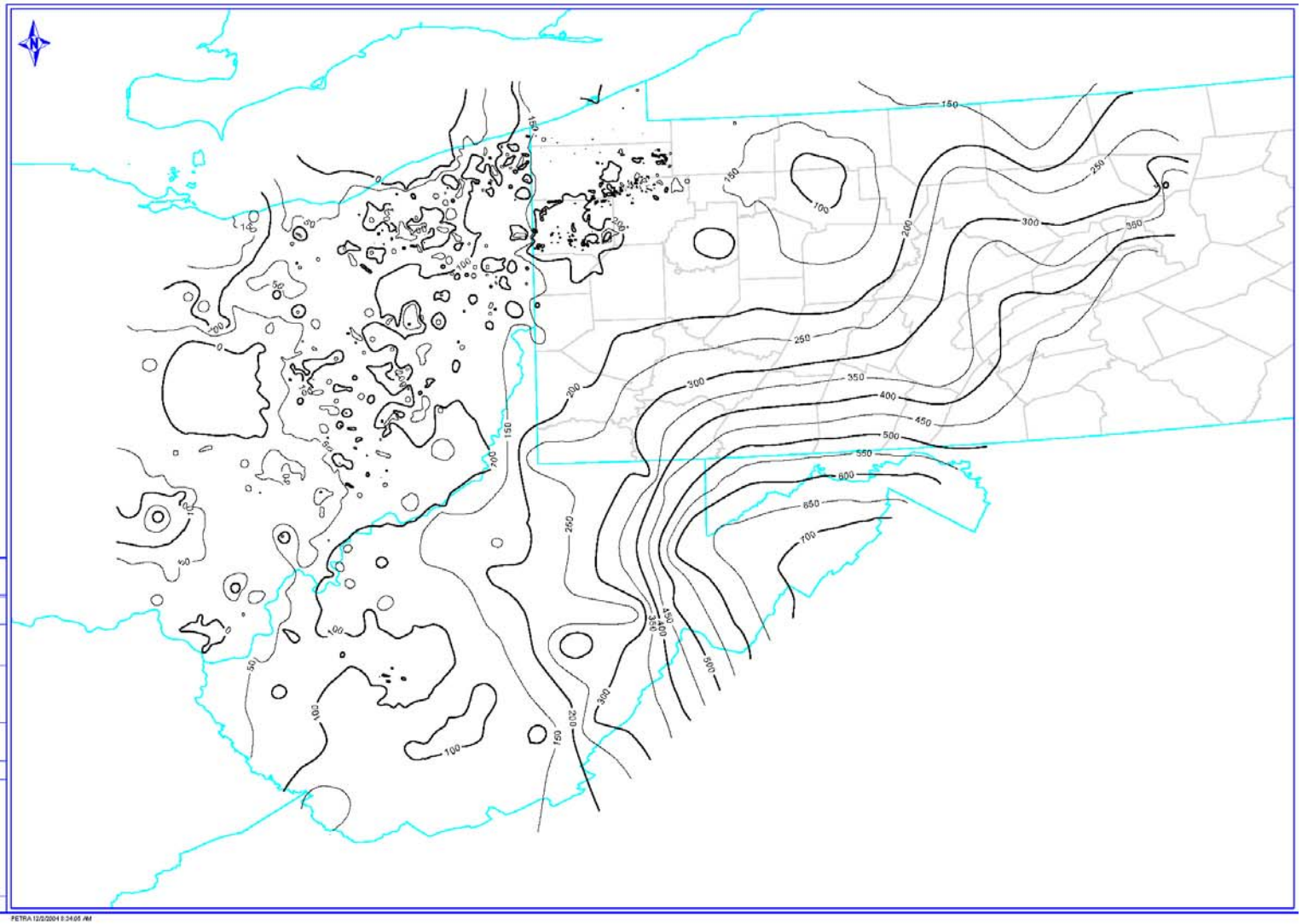
✦ ***First time this data will be available to the public in a GIS database across the region***



	B	D	M	N	O	P	Q	R	S	T	U
1	PERMIT	COUNTY	ELEVATION	PRESSURE	LONGITUDE	LATITUDE	ONONDAGA TOP	LOCKPORT BOTTOM	INTERVAL THICKNESS	ELEVATION TOP OF INTERVAL	
2	005-21201	ARMSTRONG	1462	3325	-79.3470755	40.88482721	6392	8842	2450	-4930	
3	005-23338	ARMSTRONG	1430		-79.5905675	40.89800243	6307	8250	1943	-4877	
4	007-20025	BEAVER	976		-80.4554649	40			1895	-3429	
5	007-20054	BEAVER	940		-80.5043332	40			1872	-3331	
6	007-20060	BEAVER	1120	1560	-80.4339519	40			2000	-3936	
7	019-20690	BUTLER	1315	1575	-80.0810829	40.661253516	5372	7080	1708	-4057	
8	019-21313	BUTLER	1437	900	-79.9635253	41.14668596	4841	6381	1540	-3404	
9	019-21359	BUTLER	1380	1375	-79.9534549	41.16303794	4750	6256	1506	-3370	
10	019-90063	BUTLER	1306		-80.0402764	41.1066041	4702	6185	1483	-3396	
11	027-20006	CENTRE	2100	6699	-77.842392	41.01476876	7992	9897	1905	-5892	
12	027-20007	CENTRE	1975		-77.8494562	41.00859251	7800	9870	2070	-5825	
13	027-20008	C								390	
14	027-20014	C								375	
15	027-20016	C								265	
16	027-20022	C								577	
17	031-20168	CLARION	1441	2300	-79.3711181	41.19076192	5753	7388	1635	-4312	
18	031-20469	CLARION	1625		-79.5364084	41.32948527	5193	6636	1443	-3568	
19	031-20592	CLARION	1510		-79.5913288	41.21130156	5423	7130	1707	-3913	
20	031-20751	CLARION	1626		-79.2658544	41.39844233	5384	6830	1446	-3758	
21	035-20276	CLINTON	2004	9220	-77.5666224	41.37129224	8190	10407	2217	-6186	
22	035-20375	CLINTON	1950	5210	-77.6025646	41.3552381				-6088	
23	039-20007	CRAWFORD	1337		-80.3070494	41.71555791				-1463	
24	039-20011	CRAWFORD	981	1025	-80.3950024	41.84920236				-1141	
25	039-20023	CRAWFORD	1243		-80.2197066	41.82509999	2530	3654	1104	-1287	
26	039-20024	CRAWFORD	1178		-80.415825	41.69597663	2530	3747	1217	-1352	
27	039-20025	CRAWFORD	958	1025	-80.3755499	41.77327997	2232	3392	1160	-1274	
28	039-20035	CRAWFORD	1117	960	-80.4667585	41.7258498	2408	3578	1170	-1291	
29	039-20037	CRAWFORD	1116	1125	-80.4261963	41.7631257	2398	3567	1169	-1282	
30	039-20038	CRAWFORD	1120		-80.5095207	41.70263847	2367	3600	1233	-1247	

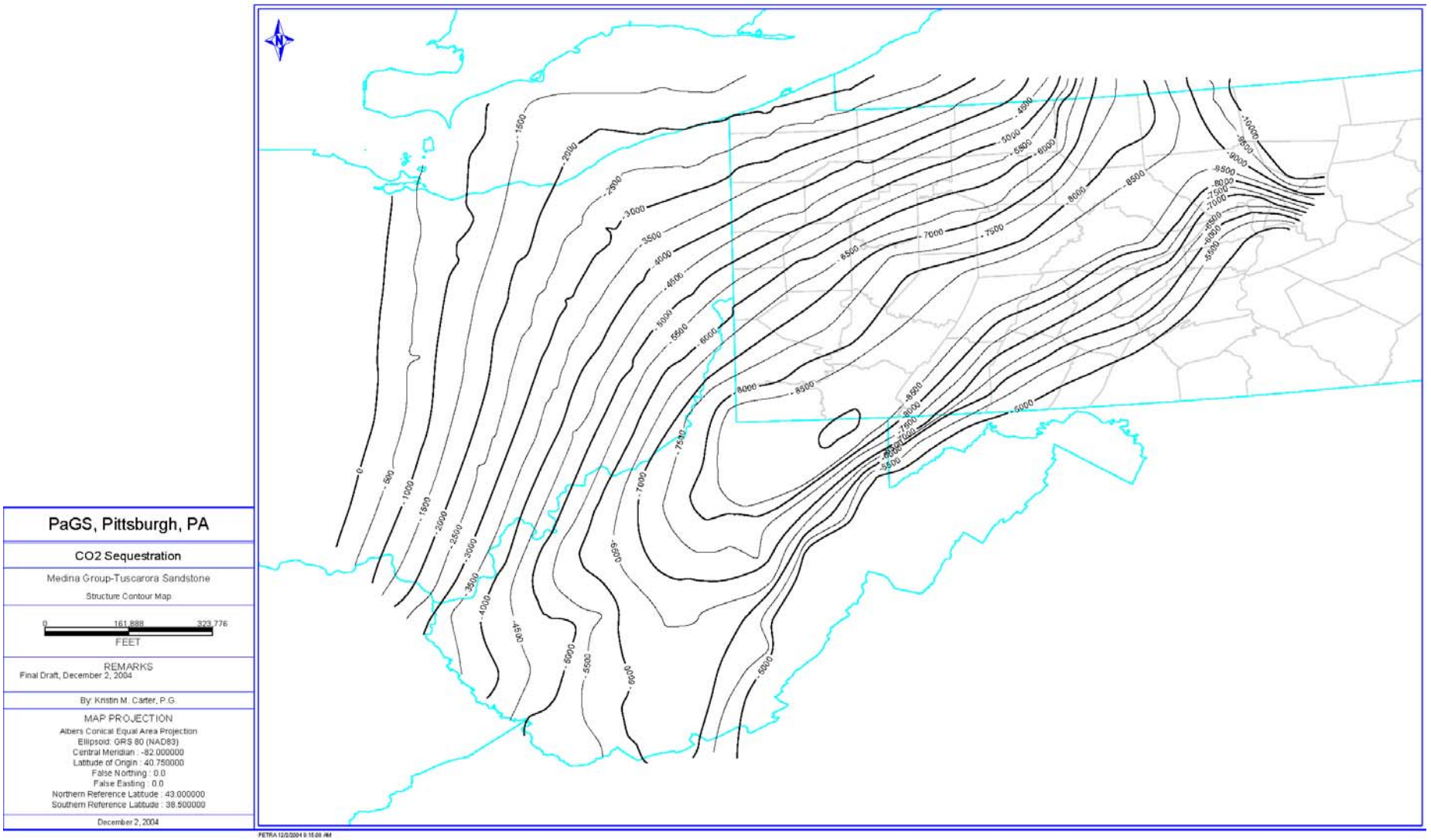
Isopach Maps

Thickness Map of the Medina Group/Tuscarora Sandstone



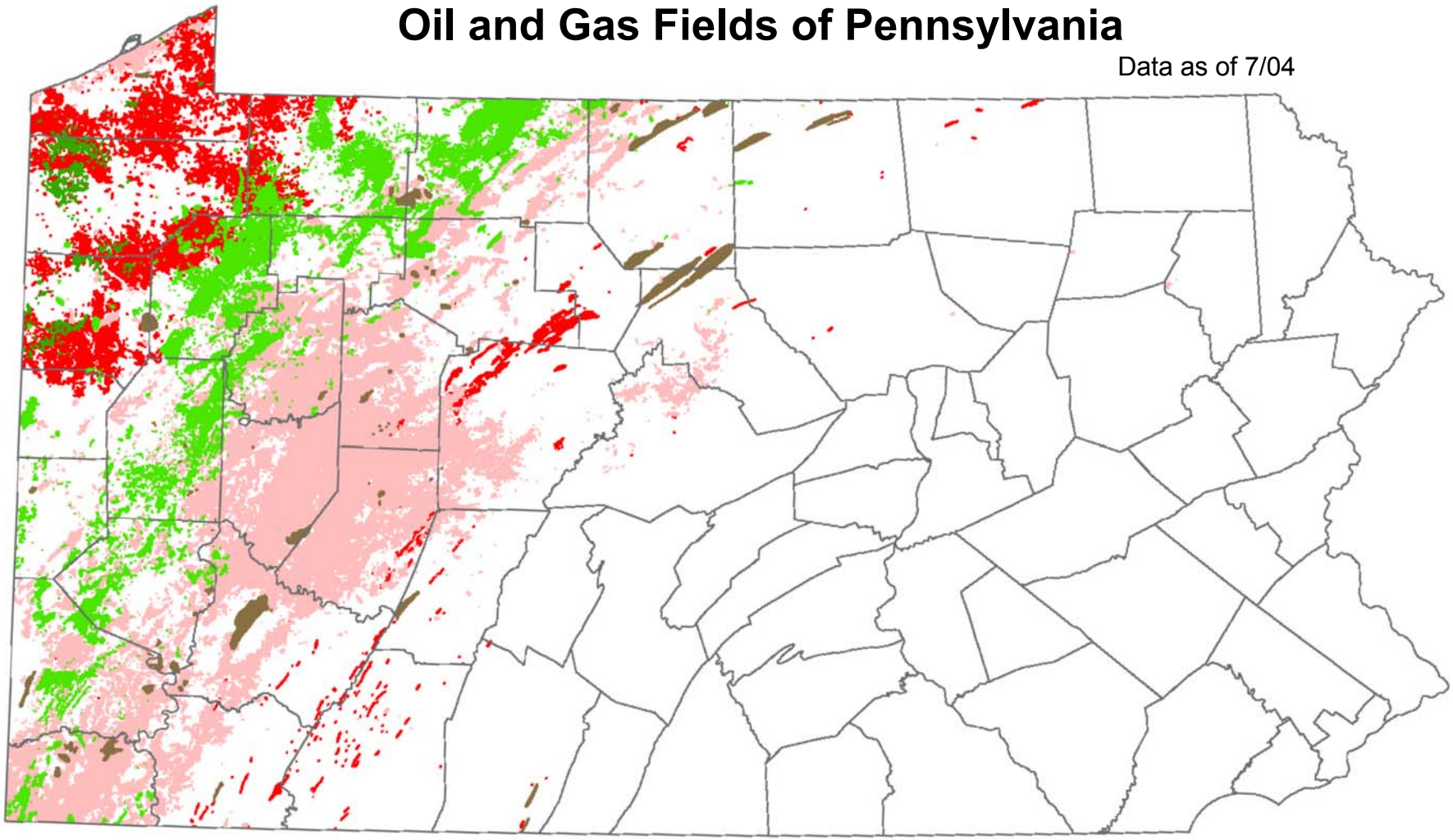
Structure Maps

Contour Map on Top of the Medina Group/Tuscarora Sandstone



Oil and Gas Fields of Pennsylvania

Data as of 7/04



Microsoft Excel - Fields Deep

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	F	G	H	I	J	K	L	M	N	O	P	Q	R
1			RESERVOIR										
2	FIELD NAME	POOL NAME	AVGERAGE PRODUCING DEPTH	NET THICKNESS	TEMPERATURE	PRESSURE	POROSITY	DISCOVERY YEAR	WATER SATURATION	#WELLS	ACREAGE	SALINITY	
3	AKELEY	SHERMAN	4700	30	102	1250	5.17	1992	11.02	22			
4	ALDER RUN	UNNAMED	4000	126		919		1974	1975				
5	ARTEMAS	BIG MOUNTAIN	5500	7	98	1871	7.02	1964	37			231,000	
6	ARTEMAS	PENNLAND	4800	23	106	1400	7			1		201,600	
7	ATHENS	BRIMSTONE	4700	125	105	1350	6			63		178,600	
8	ATHENS	DUTCH HILL	4550	113	103	1250	6			46		172,900	
9	ATHENS	LINCOLNVILLE	4500	96	108	1350	6			8		171,000	
10	ATHENS	POTASH RUN	4600	139	105	1168	3			13		174,800	
11	ATHENS	ROME	4950	145	108	1320	7			80		188,100	
12	ATHENS	STEUBEN	5050	74	112	1330	13			3		191,900	
13	ATHENS	UNNAMED	4700	115	106	1325	5			31		178,600	
14	ATLANTIC	ADAMSVILLE	4500	43		1375				25		171,000	
15	BAKERSVILLE	LAVANSVILLE	9000	43	159	3520	4.65	1986	8.54	1		225,000	
16	B												
17	B												
18	B												
19	B												
20	B												
21	B												
22	B												
23	BIG RUN	REED-DEEMER	7450	11	162	3850	5.90	1953	38.6	18		275,650	
24	BIG RUN	STRAIGHT RUN	7550	24	162	3850	5.90	2002	38.6	1		279,350	
25	BLACK ASH	MOTTER	5250	71	110	1375		1986		14		199,500	
26	BLACK MOSHANNON	UNNAMED	11250	322	167	5952		1982		1		270,000	
27	BLAIRSVILLE	KAHL	7750			4372		1962					
28	BLOOMING VALLEY	UNNAMED	4550	55	107	750	16.07	1982	41.63	4		172,900	
29	BLUE HOLE	UNNAMED	8250	105	147	3211	8.84	1989	2.49	1		206,250	
30	BOONE MOUNTAIN	MOSHANNON	6400	12	142	2850	13.92	1976	12.2	1		204,800	
31	BOSWELL	EDIE	8700	250	154	3465	7.09	1968	23.1	1		200,100	
32	BOSWELL	PILLTOWN	8900	10		2950		1997		1		204,700	
33	BOSWELL	QUEMAHONING	8550	106	180	2912	4.26	1980	6.73	1		196,650	
34	BOSWELL	SNYDER	8550	137	160	3050	7.09	1958	23.1	8		196,650	
35	BOSWELL	UNNAMED	8650	31		3590		1958		8		196,650	
36	BRADFORD	CYCLONE	5200	86	103	2841	7.60	1974	11.54	3			
37	BRADFORD	MINARD RUN	10010	220	172	3000	10.00	1975		1		440,440	
38	BREEDTOWN	GRESHAM	5350	49		1475	4.42	1985	33.2	101			
39	BRIER KNOB	UNNAMED	9100	18	144	4546	7.52	1980	8.2	1		227,500	
40	BROKENSTRAW	STROUP	4300	133	104	1205	5.57	1980	47.2	13			

Acreage calculated by GIS

Porosity, salinity, temperature, and other data

CO2 database

Draw AutoShapes

Ready NUM

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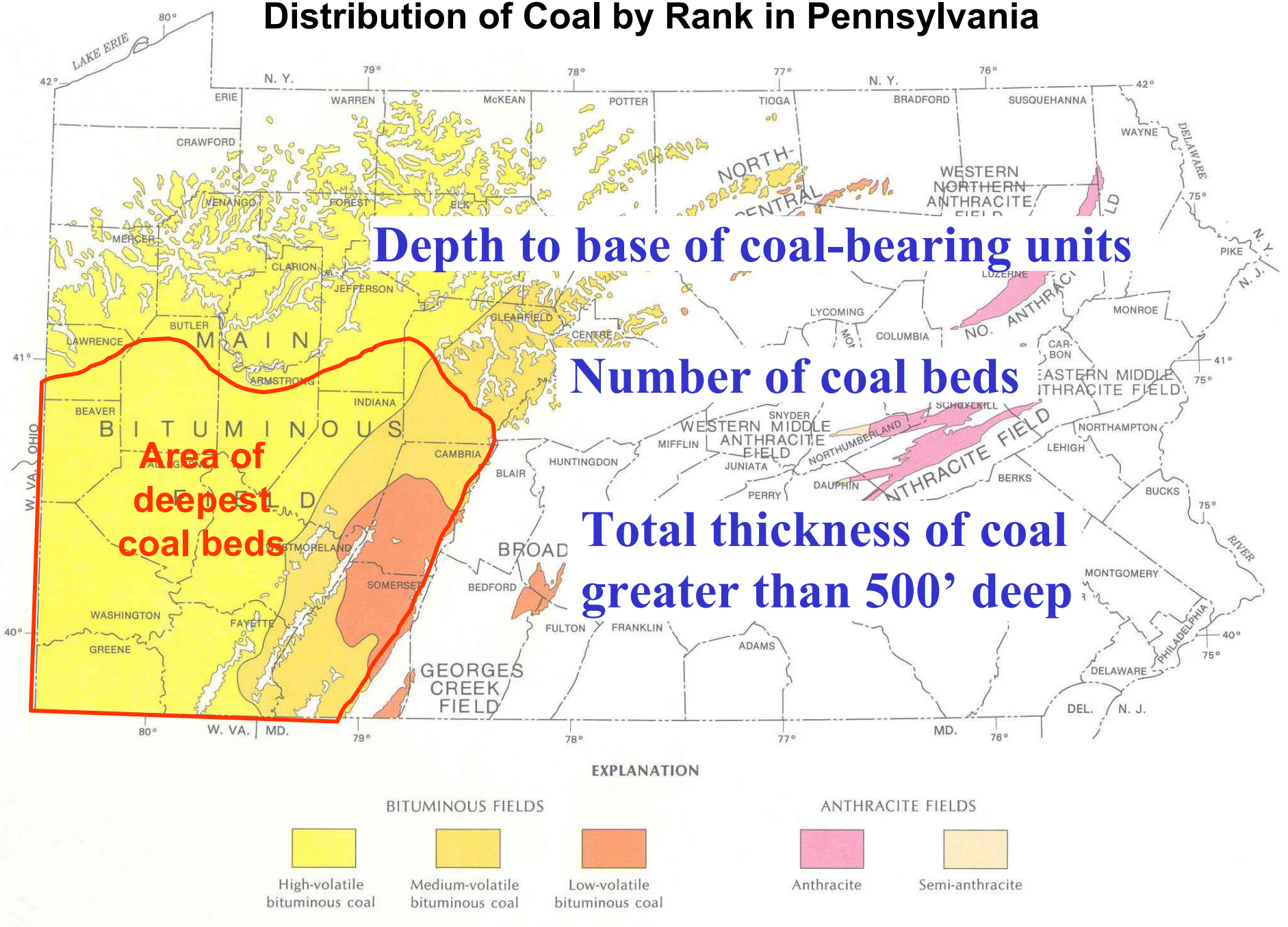
Distribution of Coal by Rank in Pennsylvania



Microsoft Excel - CBMReservoirs2

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M1 =

	A	B	C	D	E	F	G	H	I	J	K
1	FIELD NAME	POOL	PERMIT NUMBER/ DRILLHOLE	LATITUDE	LONGITUDE	# COAL BEDS PER WELL	NET THICKNESS	DEPTH TO BASE OF COAL INTERVAL	ELEVATION	ELEVATION AT BASE OF COAL INTERVAL	
2	ASHTREE	FISH CREEK	059-23108	39.7801534	-80.40966081	13	42	2081	1429	-652	
3	ASHTREE	FISH CREEK	059-23109	39.7691354	-80.40448296	9	38	2305	1426	-879	
4	ASHTREE	FISH CREEK	059-23110	39.7730318	-80.40059982	9	33	2305	1416	-889	
5	ASHTREE	FISH CREEK	059-23111	39.7771352	-80.41340913	12	39	2225	1336	-889	
6	ASHTREE	FISH CREEK	059-23112	39.7742297	-80.40802135	12	36	2250	1374	-876	
7	ASHTREE	FISH CREEK	059-23165	39.7809056	-80.35730299	2	16	799	1055	256	
8	ASHTREE	FISH CREEK	059-23166	39.7811142	-80.35752721	2	16	799	1055	256	
9	ASHTREE	FISH CREEK	059-23204	39.7749066	-80.34271118	2	10	737	1046	309	
10	ASHTREE	FISH CREEK	059-23205	39.7749340	-80.34266493	2	10	737	1046	309	
11	ASHTREE	UNNAMED	059-23085	39.7597932	-80.34933905	4	26	905	1100	195	
12	ASHTREE	UNNAMED	059-23086	39.7604246	-80.34912578	3	10	815	1114	299	
13	ASHTREE	UNNAMED	059-23087	39.7600952	-80.34923241	3	10	1060	1122	62	
14			Pittsburgh Coal Co. Drillhole W-6	39.8719444	-80.33416667	7	15	903	1127	224	
15		Coal cores	Pittsburgh Coal & Finley Co. Drillhole W-13	39.8716667	-80.28722222	3	8	760	1121	361	
16			Christopher Coal Co. Drillhole CC-448	39.7836111	-80.28444444	5	16	748	1060	312	
17			Consolidation Coal Co. Drillhole BL-82-14	39.7883333	-80.35944444	6	22	1000	1240	240	
18	BLAIRSVILLE	CAMPBELLS MILL	063-30389	40.4678823	-79.23088509	7	19	1131	997	-134	
19	BLAIRSVILLE	CAMPBELLS MILL	063-30448	40.4643704	-79.22051604	8	30	975	1027	52	
20	BLAIRSVILLE	CAMPBELLS MILL	063-30449	40.4447405	-79.24372115	5	16	1130	1123	-7	
21	BLAIRSVILLE	CAMPBELLS MILL	063-30455	40.4588199	-79.24696262	6	20	1065	1065	0	
22	BLAIRSVILLE	CAMPBELLS MILL	063-30467	40.4651367	-79.23420839	4	16	975	1039	64	
23	BLAIRSVILLE	CAMPBELLS MILL	063-30484	40.4637898	-79.24175462	5	19	1065	1143	78	
24	BLAIRSVILLE	CAMPBELLS MILL	063-30546	40.4578941	-79.25449172	6	22	1090	1115	25	
25	BLAIRSVILLE	CAMPBELLS MILL	063-30614	40.4615012	-79.26787798	6	14	808	1085	277	
26	BLAIRSVILLE	CAMPBELLS MILL	063-30615	40.4539398	-79.26958273	8	22	1200	1210	10	
27	BLAIRSVILLE	CAMPBELLS MILL	063-30616	40.4620483	-79.23591416	6	25	1297	1262	-35	
28	BLAIRSVILLE	CAMPBELLS MILL	063-30618	40.4502306	-79.24309526	10	29	1170	1178	8	
29	BLAIRSVILLE	CAMPBELLS MILL	063-30619	40.4585514	-79.26015138	5	22	1158	1187	29	

Sheet1 Sheet2 Sheet3

Draw AutoShapes

Ready NUM

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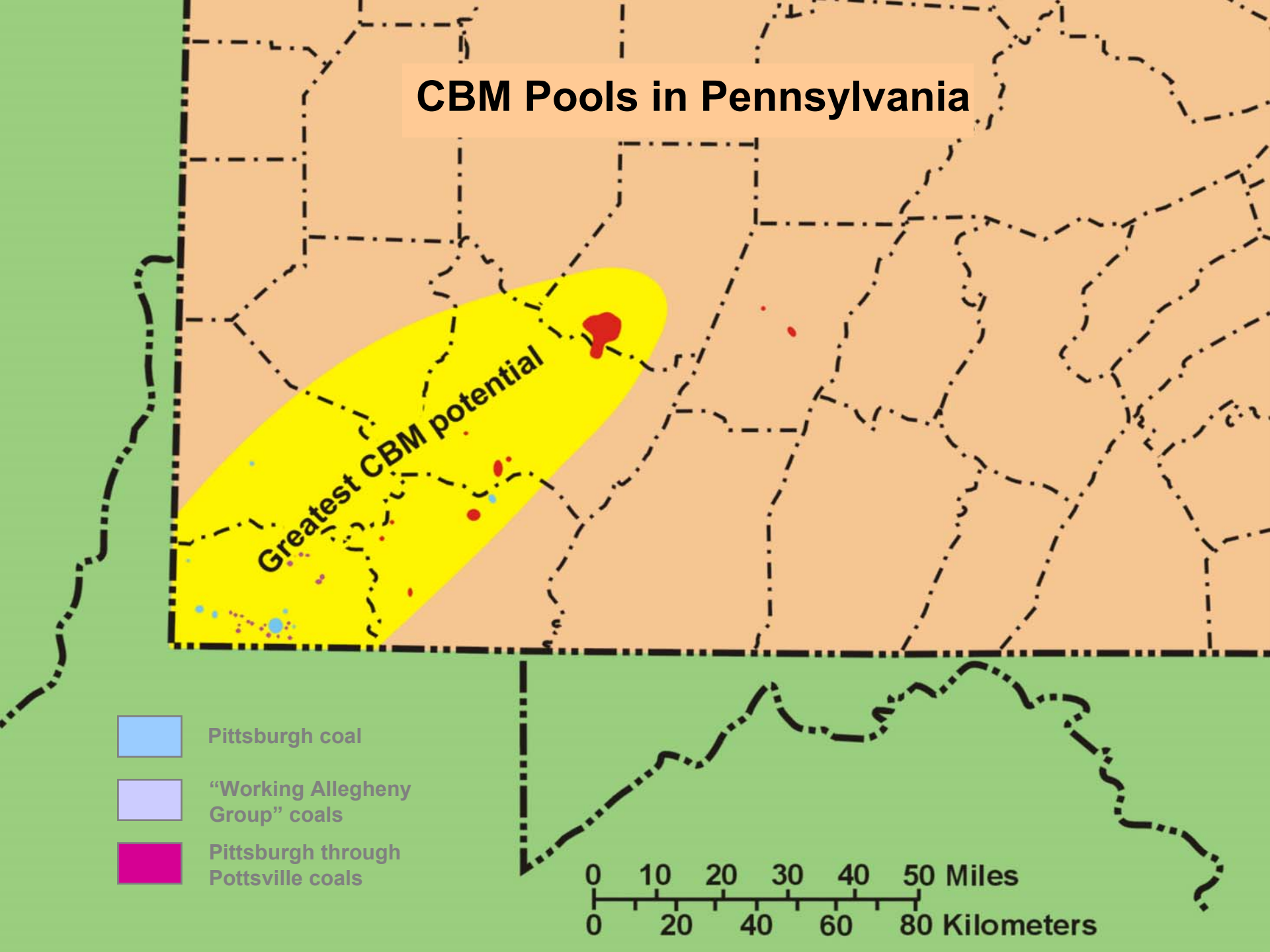
CBM Pools in Pennsylvania



From Data to Products

Each state organization compiled geologic data for each given layer

That layer was transmitted to the state organization responsible for the regional mapping (for example, PA was responsible for Medina/Tuscarora).

The review process allowed each state organization input on the final maps

All finalized maps will be turned over to the Ohio Division of Geological Survey (ODGS)

ODGS will prepare all calculations and web-enable all map products, queries, calculations, etc. in the MRCSP GIS

CALCULATING CO_2 SEQUESTRATION VOLUMES FOR SALINE AQUIFERS

$$Q = ((7758 * (\Phi * a * h)) * CO_2s)/(1000 * 18.75)$$

Where: Q = sequestration volume (metric tonnes)

Φ = porosity (percent)

a = area (acres)

h = net thickness (feet)

CO_2s = CO2 solubility (scf/bbl water))

Assumptions: Temp (deg F) = 61 + 0.007 * depth (ft)

Pressure (psia) = 0.433 (psi) * depth (ft)

CALCULATING CO_2 SEQUESTRATION VOLUMES FOR COAL

$$Q = C_{CO2CH4} * (\rho_{coal} * a * 0.3048 * h * G_{coal}) / 18950$$

Where: Q = sequestration volume (metric tonnes)

C_{CO2CH4} = CO_2:CH_4

ρ_{coal} = coal density (g/cc or T/m^3)

a = area (acres)

h = net thickness (feet)

G_{coal} = coalbed gas desorption value (scf/sT)

CALCULATING CO_2 SEQUESTRATION VOLUMES FOR OIL AND GAS RESERVOIRS

$$Q = \rho_{co2} * h * a * \Phi * (1-Sw)/2200$$

Where: Q = sequestration volume (metric tonnes)

ρ_{co2} = CO2 density (lbs/acre-ft)

h = net thickness (feet)

a = area (acres)

Φ = porosity (percent)

Sw = Water saturation (percent)

2200 (lbs) = 1 metric tonne

Example Calculations: Ohio's Deep Oil-and-Gas Reservoirs

Oil and Gas Reservoirs

Depth greater than 2500'

Formation or play	Dominant Lithology	Average Poro	Average Thickness	Average Depth	Reservoir	CO2 Sequestration Potential		
	SS/LS/DOL/SH	percentage	ft, inches	feet	acres	metric tons		
						80%	50%	20%
Berea	SS/LS/DOL/SH	9	13' 9"	3910	264,650	172,532,801	107,833,001	43,133,200
Chagrin	SH	7	123' 6"	3140	9,143	37,434,610	23,396,632	9,358,653
Devonian Shale	SH	7	191' 9"	2908	9,143	19,965,404	12,478,378	4,991,351
Ohio Shale	SH	7	234'	2913	741	1,421,392	888,370	355,348
Big Lime	SS/DOL	8	15' 8"	2724	148,016	69,664,626	43,540,391	17,416,156
Clinton	SS	8	20' 2"	3484	3,020,369	2,141,391,364	1,338,369,603	535,347,841
Trenton	LS	10	16' 4"	3813	3,212	684,664	427,915	171,166
Knox	DOL/SS	9	23'	5304	420,079	400,012,042	250,007,527	100,003,011
TOTALS						**2,843,106,903**	**1,776,941,815**	**710,776,726**

Calculations made at different capacities

Multiple query options:

Sequestration potential will be able to be calculated by state, county, unit, user-defined areas, etc.

Interactive base map available via Web - soon

MRCSP Sequestration Planning - Microsoft Internet Explorer

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Address http://nr729intradev/website/geosurvey/MRCSPIMAGE/viewer.htm Go Links

MRCSP Sequestration Planning

TOC/Legend
OV Toggle
Zoom In
Zoom Out
Full Extent
Zoom Active
Last Extent
Pan
Pan to North
Pan to South
Pan to West
Pan to East
Identify
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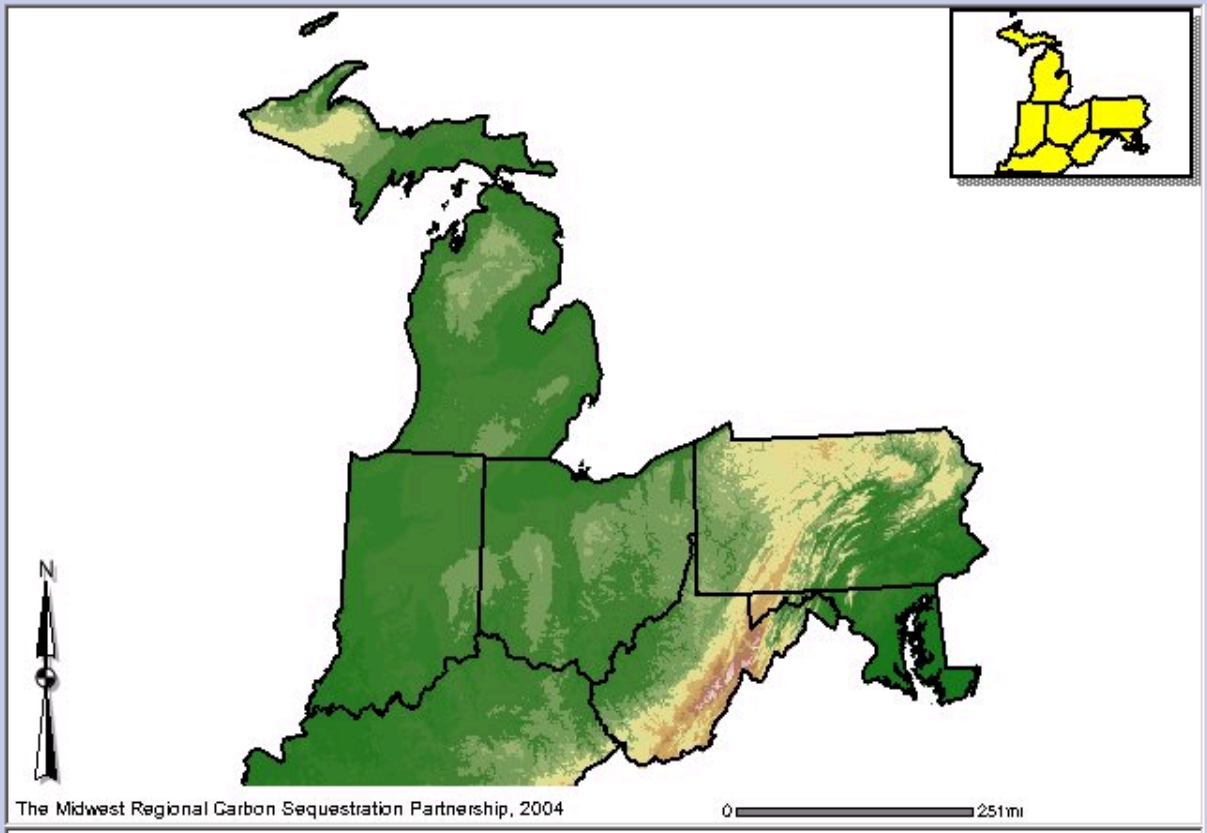
Find
Measure
Set Units
Buffer
Select Rect.
Select Line/Poly
Clear Selection
Print
Help



Digital Elevation Model

Layers

Visible Active

☑	MRCSP States	Info
☐	Mine Reclamation	Info
☐	Estimated_Pools	Info
☐	Portion_Landuse	Info
☐	Primeclass_Landuse	Info
☐	Faults	Info
☐	PC_Contours	Info
☐	Basal Sand	Info
☐	PC Basement	Info
☑	Elevation	Info

Refresh Map

More Information

Zoom In

Map: 3176931.02 , -515534.25 -- Image: 632 , 317 -- ScaleFactor: 10427.555333031998

Local intranet

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- Full Extent
- Zoom Active
- Last Extent
- Pan
- Pan to North
- Pan to South
- Pan to West
- Pan to East
- Identify
- Query
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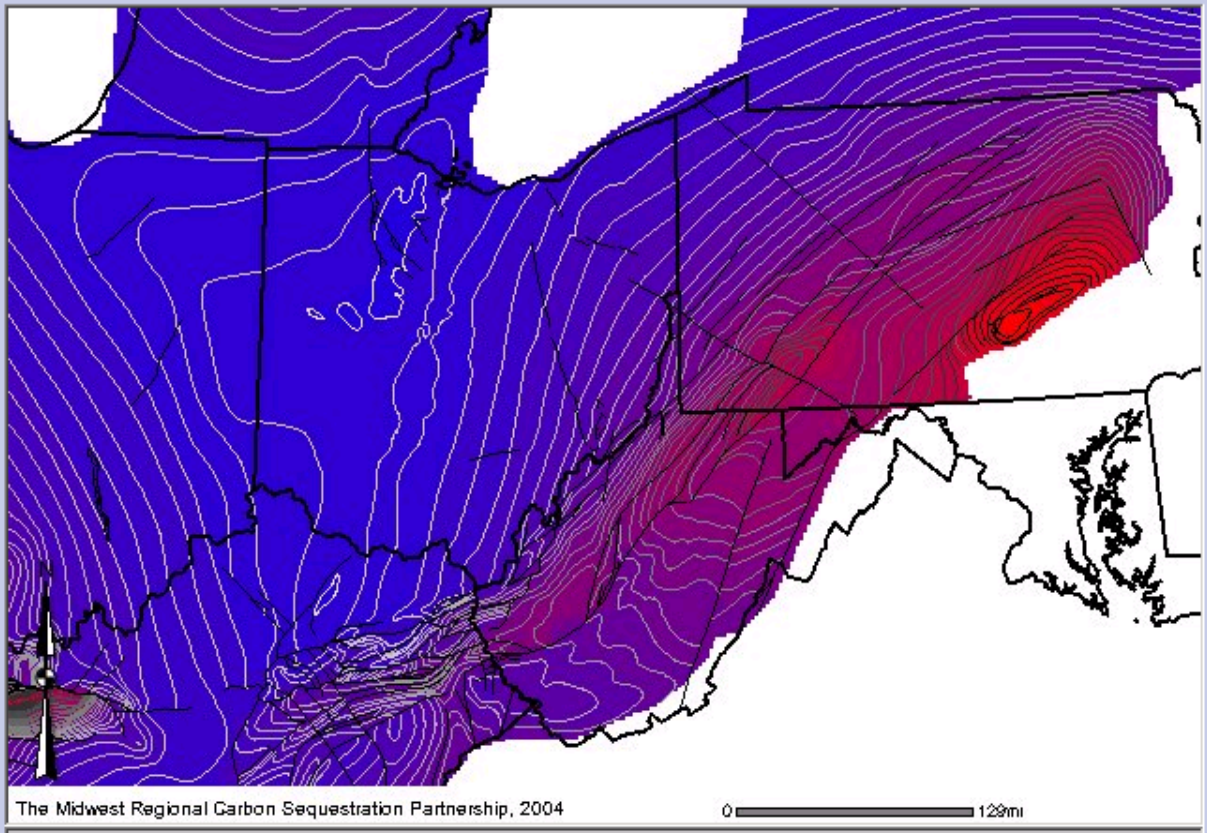
- Find
- Measure
- Set Units
- Buffer
- Select Rect.
- Select Line/Poly
- Clear Selection
- Print
- Help



PC Basement

Value=-26242.369140625

Layers

Visible Active

☑	◉ MRCSP States	Info
☐	○ Mine Reclamation	Info
☐	○ Estimated_Pools	Info
☐	○ Portion_Landuse	Info
☐	○ Primeclass_Landuse	Info
☑	○ Faults	Info
☑	○ PC_Contours	Info
☐	○ Basal Sand	Info
☑	◉ PC Basement	Info
☐	○ Elevation	Info

Refresh Map

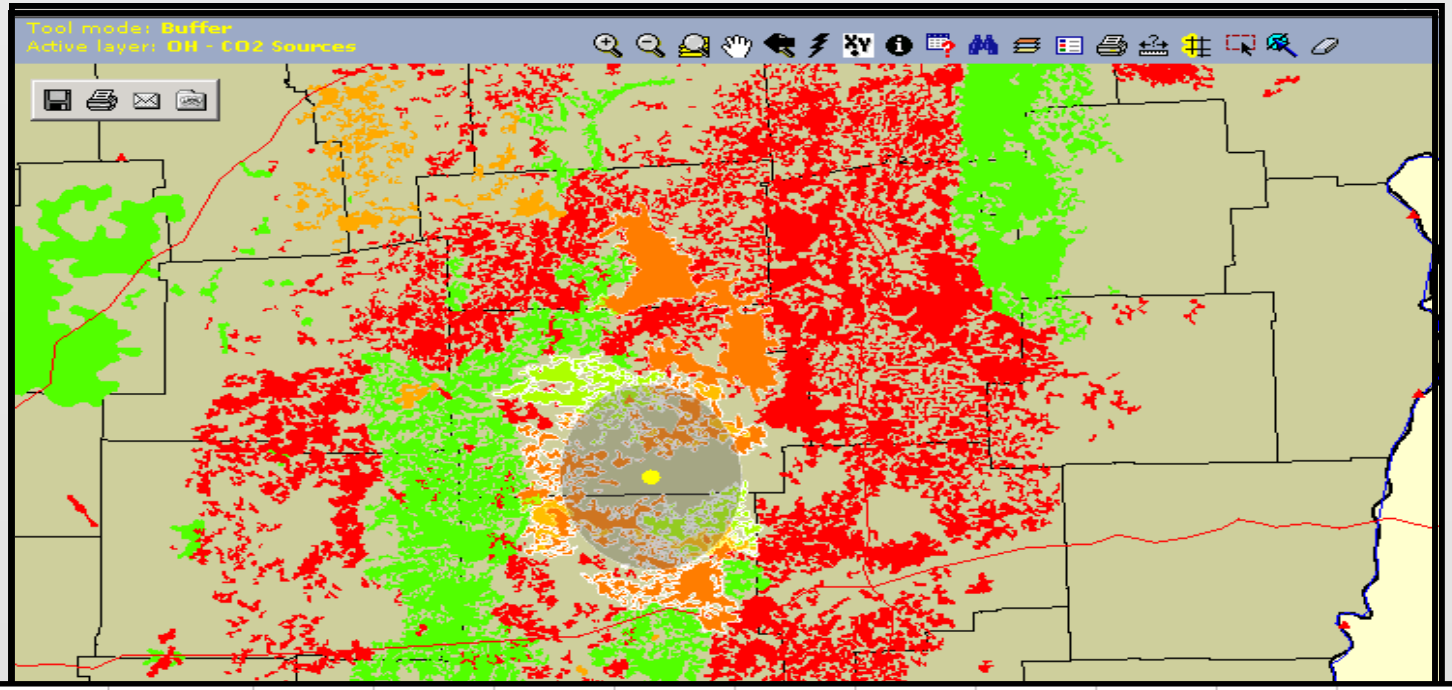
More Information

Raster Identify

Map: 648645.15 , -329695.9 -- Image: 402 , 201 -- ScaleFactor: 5350.004636424922

Local intranet

Example Application from GIS



Oil-and-gas fields within a 10 mile radius of a coal-fired utility in Ohio

FMTN_CODE	FIELD_NAME	AVGPRODEPT	NETTHICK	TEMP_	PRES	POROSITY	DISCOVERY_YEAR	WATER_SATURATION	NUMBER_OF_WELLS	RESERVOIR_ACRES	CO2_DENSITY	SEQUESTRATION_VOLUME	PRODUCTION_TYPE
CLNN	MONROE-COSHOCTON CON	3338	12	100	1600	0.055	1917	40	3444	117511	1939291.2	41019848.68	OIL
CLNN	MORGAN RUN	4017	25	100	1200	0.08	1972	27	53	3720	1009720.8	2492725.277	OIL
CLNN	PHILO CONSOLIDATED	4650	18	100	1400	0.065	1928	30	1869	164960	1763308.8	108284985.8	OIL
											Total	151,797,560	
										20% volume		30,359,512	Metric tons

CO_2 sequestration available in 3 oil fields near the plant = 30 Mmt @ 20%

Phase I Findings

- The MRCSP has an abundance of the 3 primary reservoir types
  - **Deep saline formations**
  - **Oil and gas fields (active and depleted)**
  - **Coal seams and organic shales**
- Mapping their distribution is the primary key to existing and future geological sequestration from large CO_2 sources in the region.
- We have established our mapping and calculations methodologies, collected large volumes of data.
- We are still mapping the data and developing the IMS service.

MRCSP is also doing other stuff:

- Evaluating other important issues:
  - **What impact will federal state and local regulations play in implementing sequestration projects**
    - National Regulatory Research Institute, lead
  - **What capture and transport technologies will be important to implementation and what will they cost**
    - CONSOL Energy, lead (BP & B&W review)
- Public Outreach and Education
  - **Helping the public in our region to make informed decisions about sequestration and getting their feedback to help us plan for implementation**
- Economic analysis and selection of Phase II project recommendations

MRCSP PHASE II PROPOSAL

Geological assessment of candidate project sites

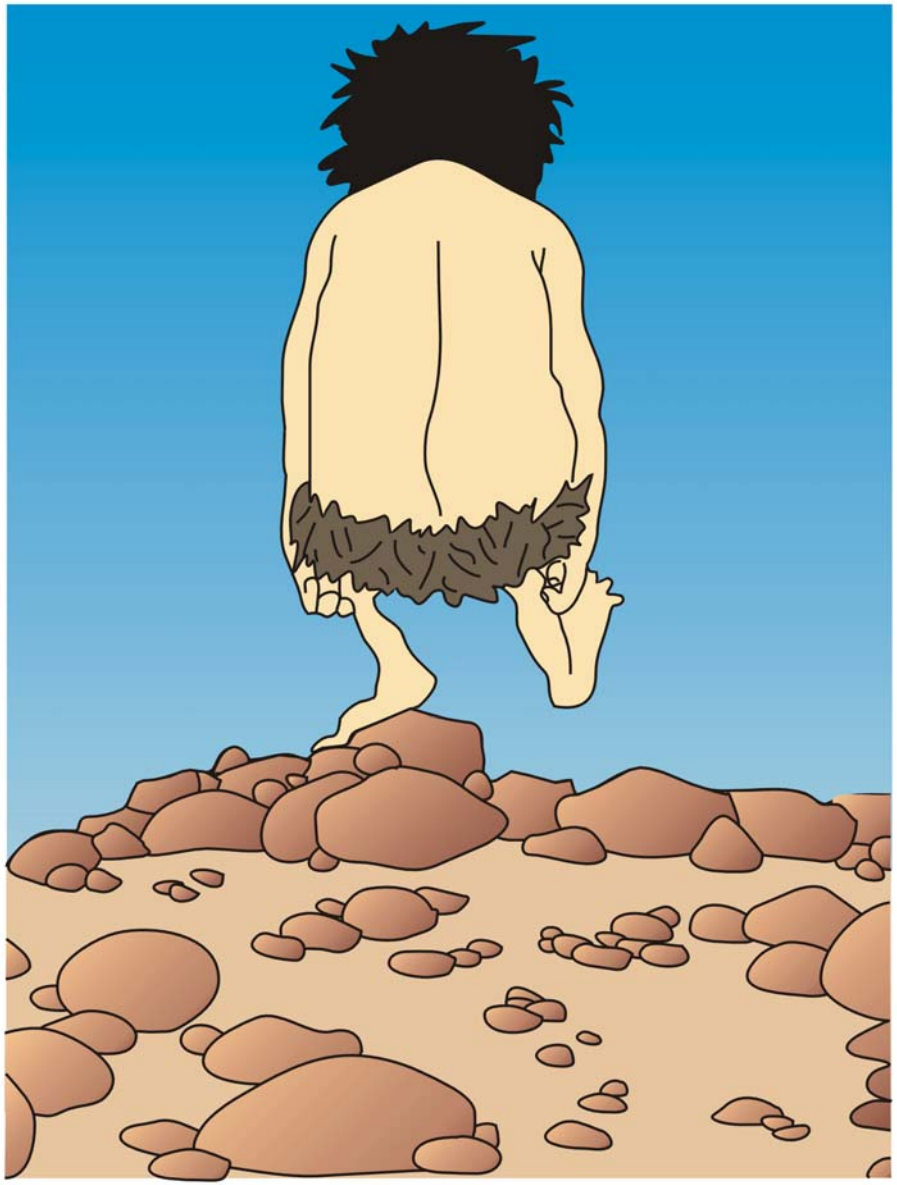
Implementation of field test projects

Fill data gaps in the regional geologic framework through piggyback drilling

Refine the mapping of potential reservoirs and seals

Evaluate CO_2 storage potential in depleted oil and gas fields through EOR

Refine geostatistical modeling and GIS



The End