The Central Appalachian Partnership (CAP) for Carbon Sequestration

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Outline

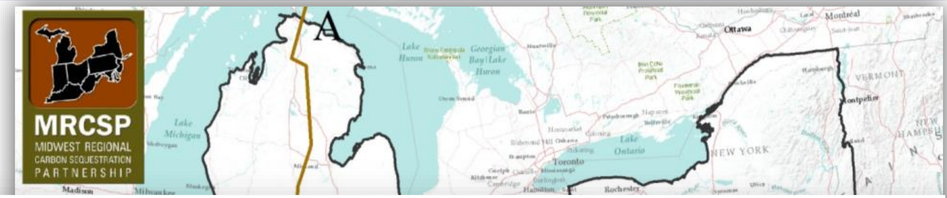
- Project goals
- Current state of knowledge
- Project scope of work
- Project leadership
- Tentative schedule and next steps

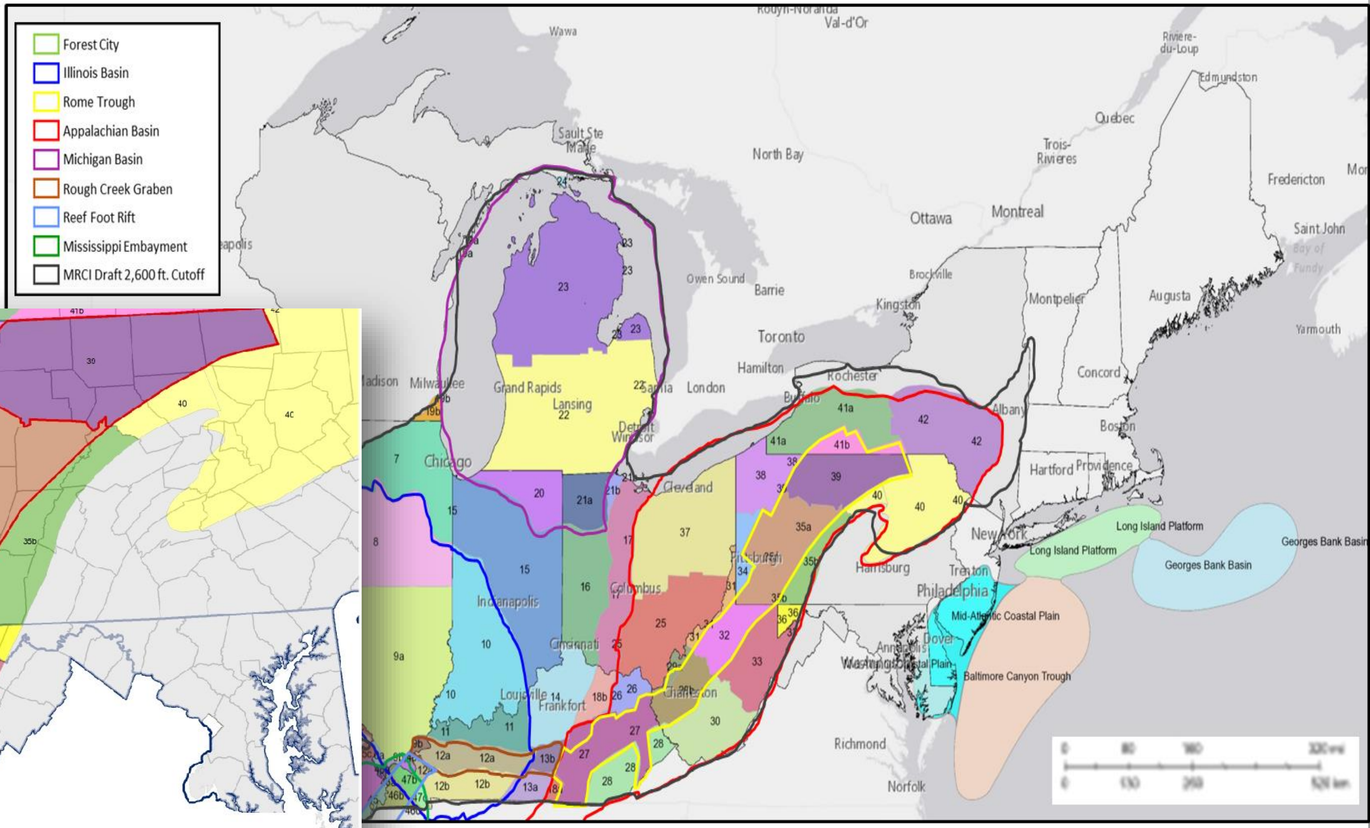
CAP Project Goals

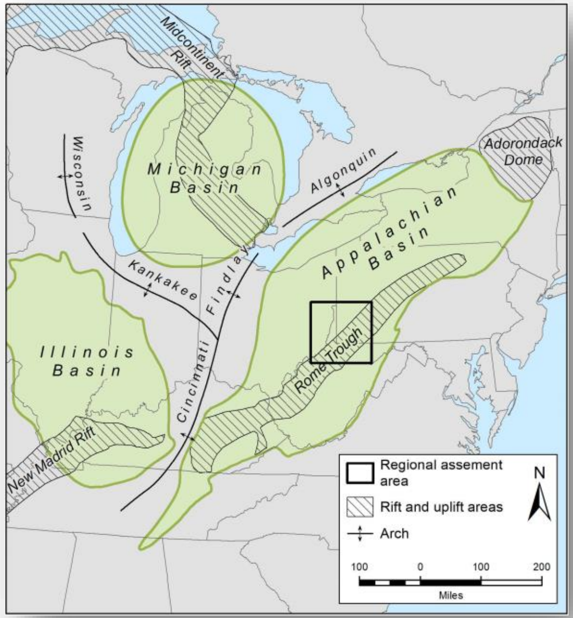
- Apply the existing expertise of PAGS and WVGES with respect to oil, gas and subsurface geology conditions in the Appalachian basin
- Build on current collaborative relationships and the regional knowledge base from two decades of regional characterization efforts
- Frame and focus efforts to address data needs not currently being tackled through other proposed efforts for the greater Appalachian region
- Aggregate the most pertinent geologic and geospatial datasets to construct a free, public-facing Web-Based Tool with information needed to inform UIC injection permitting efforts

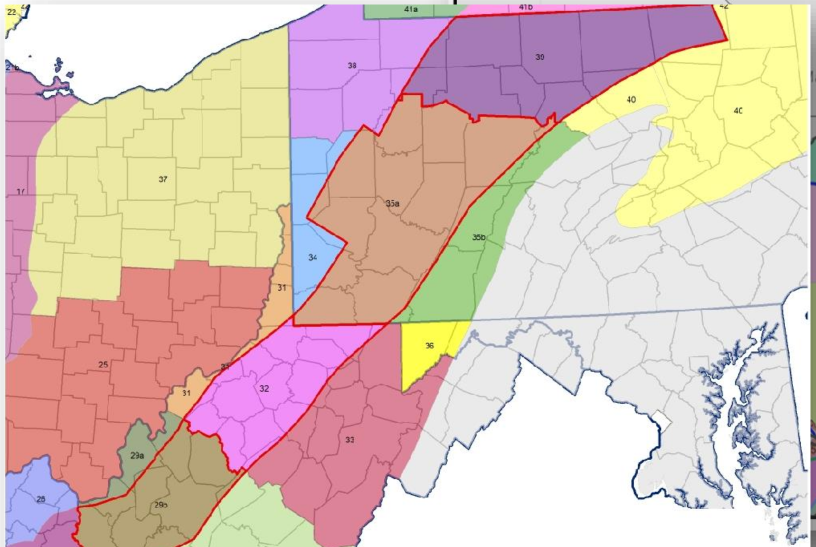
Current State of Knowledge

- MRCSP (2003-2019)
- MRCI (2019-present)
- 21CPP (2021-present)









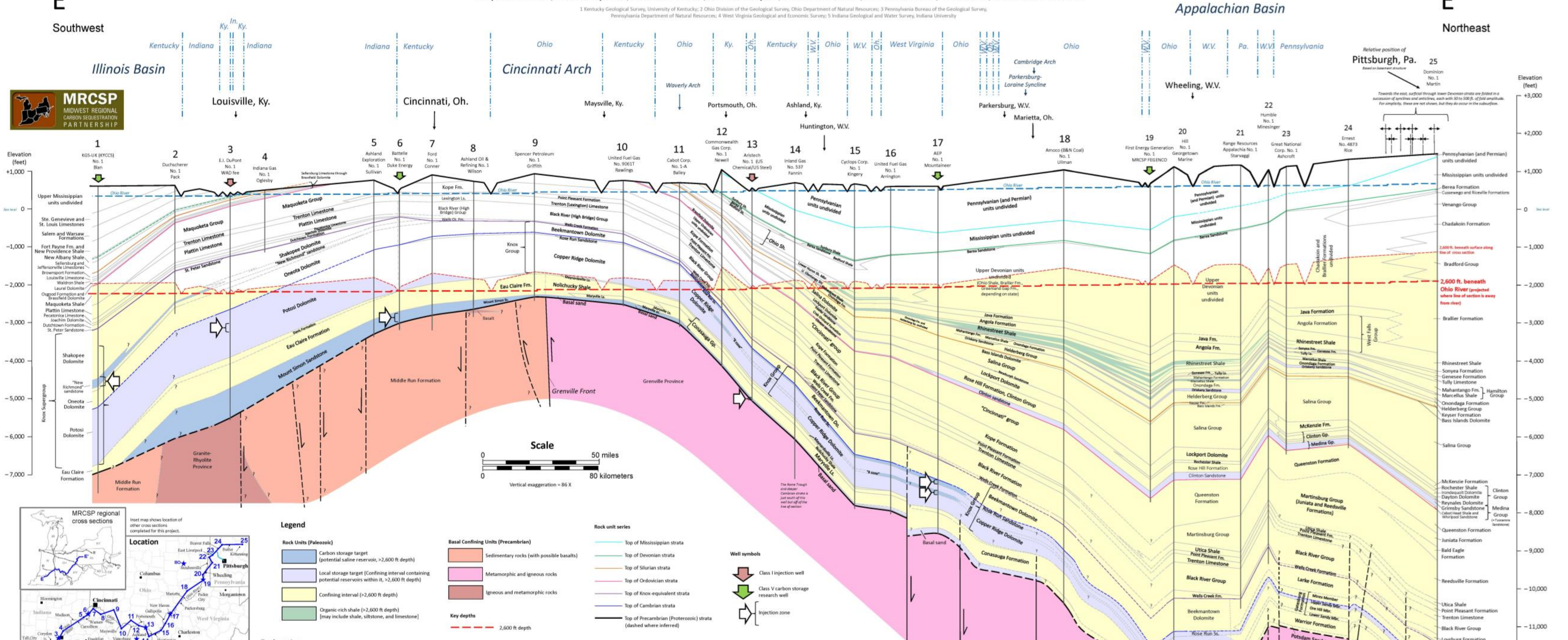
Portion of MRCI Region
Showing Lithostratigraphic Sub-Regions

Subsurface geology for carbon storage along the Ohio River in part of the Midwest Regional Carbon Sequestration Partnership region

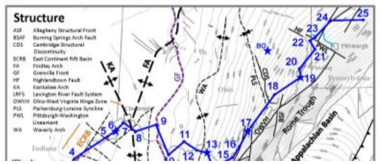
From Dinterman et al. (2020)

Stephen F. Greb[1], Thomas Sparks[1], Michael P. Solis[2], John A. Harper[3], Kristin M. Carter[3], Phil Dinterman[4], Eric Lewis[4], and Cristian Medina[5]

1 Kentucky Geological Survey, University of Kentucky; 2 Ohio Division of the Geological Survey, Ohio Department of Natural Resources; 3 Pennsylvania Bureau of the Geological Survey, Pennsylvania Department of Natural Resources; 4 West Virginia Geological and Economic Survey; 5 Indiana Geological and Water Survey, Indiana University



Location of wells in cross section along the Ohio River. Blue stars represent cored stratigraphic tests or wells drilled for carbon storage research which are mentioned in the text or in other cross sections (BO=Battelle-Ohio Geological Survey, KH=KGS No. 1 Hanson Aggregates).



Explanation

The Ohio River is an important industrial and electrical generation corridor, and an area with significant CO_2 emissions. Future regulations may limit carbon emissions, so it is important to understand the potential for safe geologic storage of CO_2 in the subsurface and for CO_2 use in enhanced oil and gas recovery. Geologic storage involves the capture of carbon emissions and the injection of captured CO_2 under pressure into reservoirs with sufficient seals and confining zones deep underground to prevent migration of injected CO_2 into shallower strata (e.g., NETL, 2015). This cross section was constructed to help industry, policy makers, and the general public visualize the geology of rock units relative to geologic carbon storage as part of the research efforts of the Midwest Regional Carbon Sequestration Partnership (MRCSP). Subsurface units in the cross section are color-coded based on a unit's potential as a (1) storage interval (regional saline reservoir), (2) confining interval with local potential reservoirs, (3) confining zone, or (4) organic-rich shale. Units are color-coded at depths greater than 2,600 ft, which is a conservative estimate of the depth needed for CO_2 to be in a dense super-critical phase (with variation). Below this depth, natural pressures beneath the surface should be great enough to cause CO_2 to dramatically decrease in volume allowing for maximum storage capacity. This depth should also allow CO_2 to be miscible

carbonates were the test horizons in the Kentucky Geological Survey No. 1 Blan well (no. 1 on section). A total of 323 short tons of CO_2 was injected into Knox reservoirs. This was the first demonstration of CO_2 injection in the Knox in the United States (Greb et al., 2012; Bowersox et al., 2013; Bowersox and Williams, 2014). The Copper Ridge Dolomite, Knox Group, was the reservoir for the DuPont No. 1 waste acid disposal well (no. 3 on section) near Louisville, Kentucky (Clark et al., 2005; Greb et al., 2009; 2012). Significant testing was done on the Basal sand, Knox carbonates, and the Rose Run Sandstone in the Aristech No. 1 Chemicals well (no. 13 on section), an industrial waste disposal well (Ohio Division of the Geological Survey data). These units were also cored and tested in the KGS No. 1 Hanson Aggregates stratigraphic test well (Bowersox et al., 2018; KH south of well 12 on the section). The Copper Ridge B zone and Rose Run Sandstone were the primary reservoirs tested in the AEP No. 1 well (no. 17 on the section) at the Mountaineer power plant (Bacon et al., 2007; 2009). An extensive, testing program was conducted and 40,785 short tons of CO_2 were injected as part of an integrated carbon capture and storage project (Gupta et al., 2013).

Eastward in the Appalachian Basin, where Cambrian and Ordovician horizons are more than 10,000 ft beneath the surface, shallower reservoirs in Silurian and younger

Structure symbols

Anticline (details not shown)

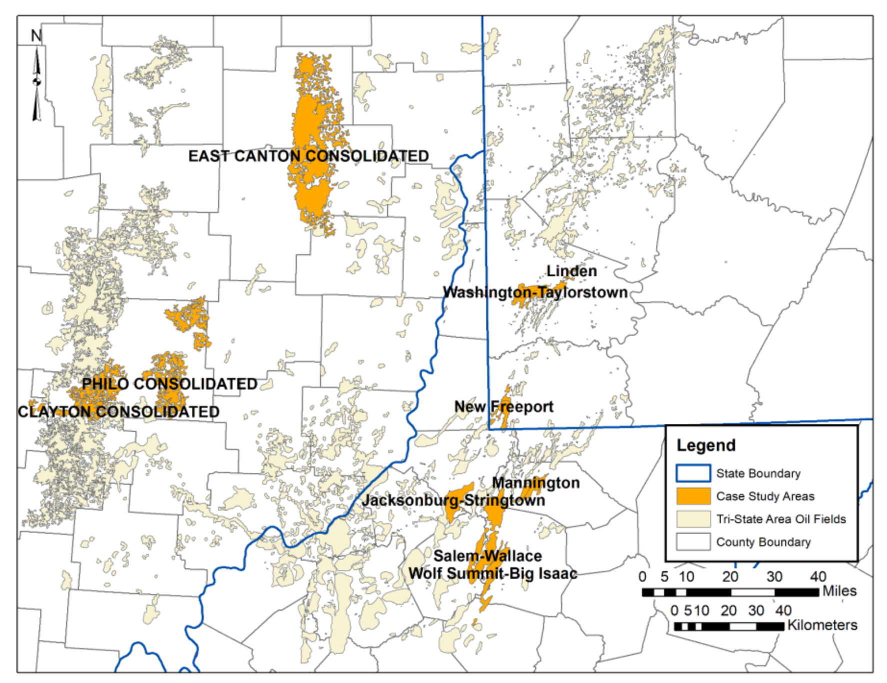
Syncline (details not shown)

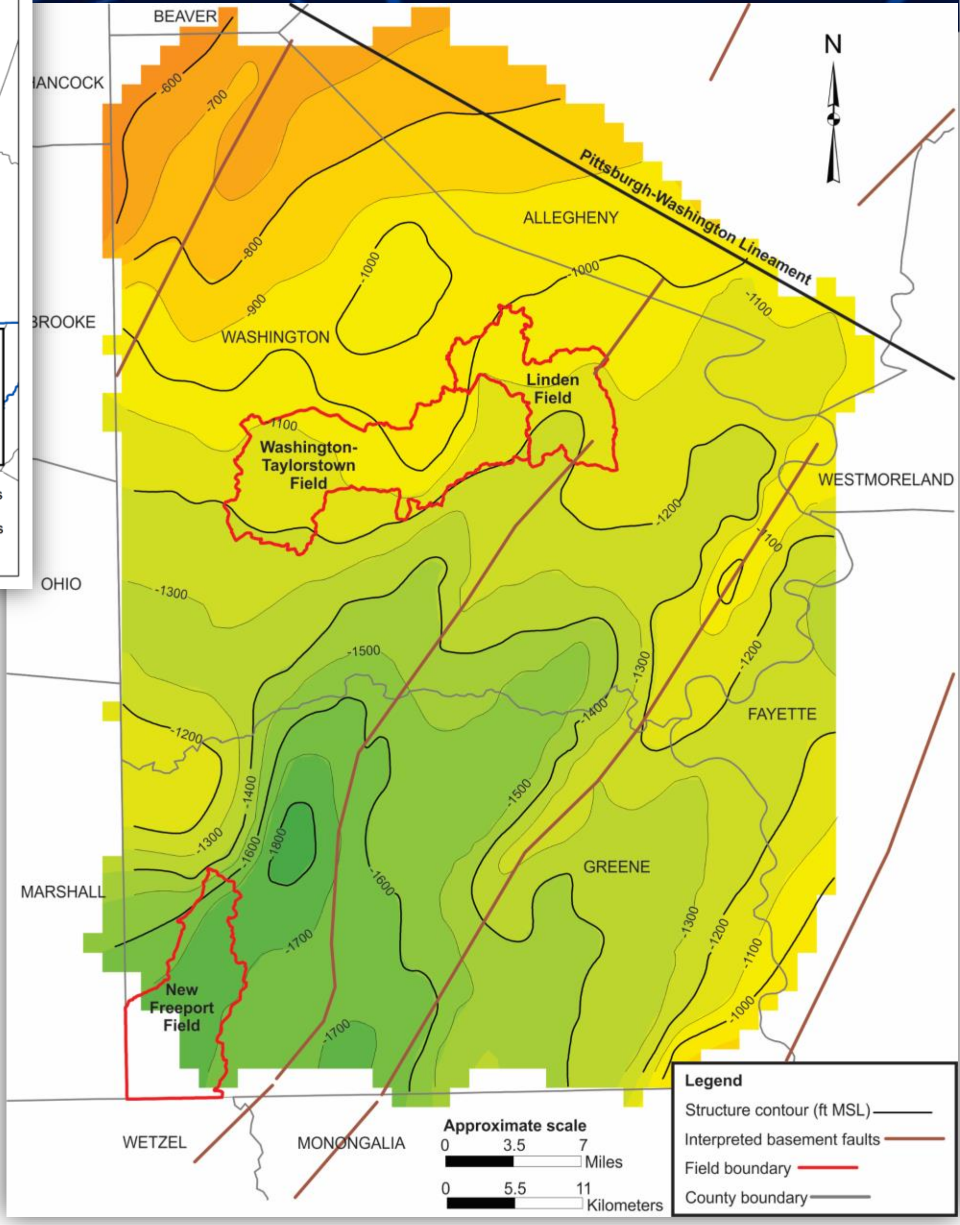
Fault (arrow shows relative direction of movement)

(Boswell et al., 1996a), Bradford (Boswell et al., 1996b), and Elk (Donaldson et al., 1996). In the future, CO_2 could be used for secondary recovery in some of these fields

Bowersox, R.J., Hickman, J., and Leetaru, H., 2013, An evaluation of the carbon sequestration potential of the Cambro-Ordovician strata of the Illinois and Michigan Basins. Part 1. Evaluation of Phase 2 CO_2 injection testing in the deep saline Gunter Sandstone reservoir (Cambro-Ordovician Knox Group), Marvin Blan No. 1 Hancock County, Kentucky and Part 2: Time-lapse three-dimensional vertical seismic profile (3D-VSP) of sequestration target interval with injected fluids: U.S. Department of Energy, Topical report DOE/FE0002068-3, 90 p., plus

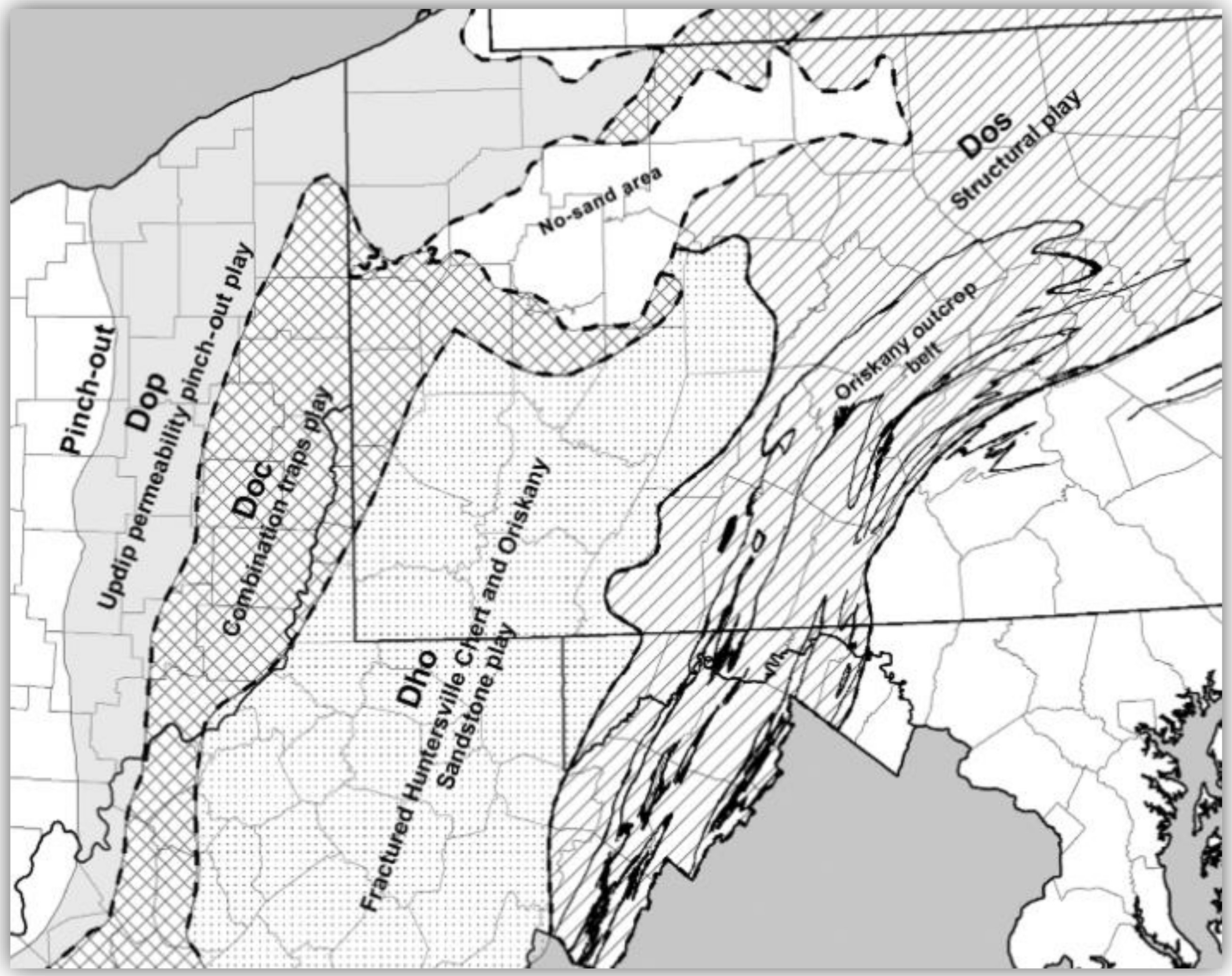
Oil Field Case Studies (2019)

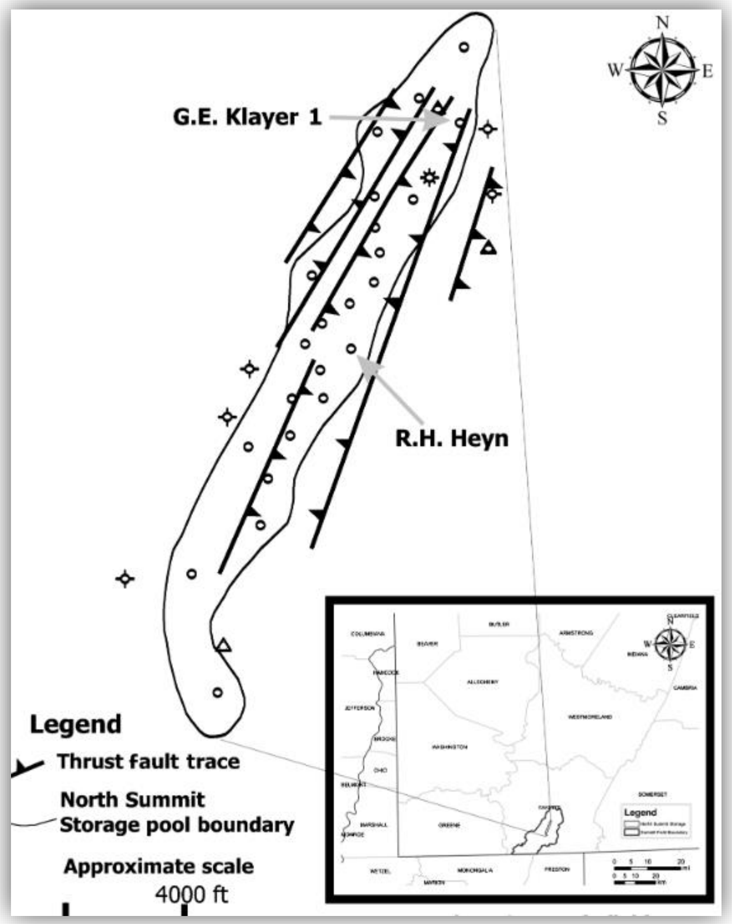




Drillers' Sand Name	Top Formation (ft)			Thickness (ft)		Porosity (%)		
	Min	Max	Avg	Gross	Net	Density	Neutron	Average
Hundred-Foot	1813	3306	2563	81	55	11	6	9
Gantz	1813	3306	2633	18	11	14	6	10
Fifty-Foot	1839	3342	2591	60	48	7	6	7
Nineveh	1968	3395	2708	39	23	12	7	10
Gordon Stray	2018	3451	2745	13	7	9	9	9
Gordon	2050	3482	2792	43	30	11	7	9
Fourth	2116	3555	2896	26	16	8	6	7
Fifth	2175	3611	2979	40	29	11	6	9

The Oriskany Sandstone Natural Gas Plays





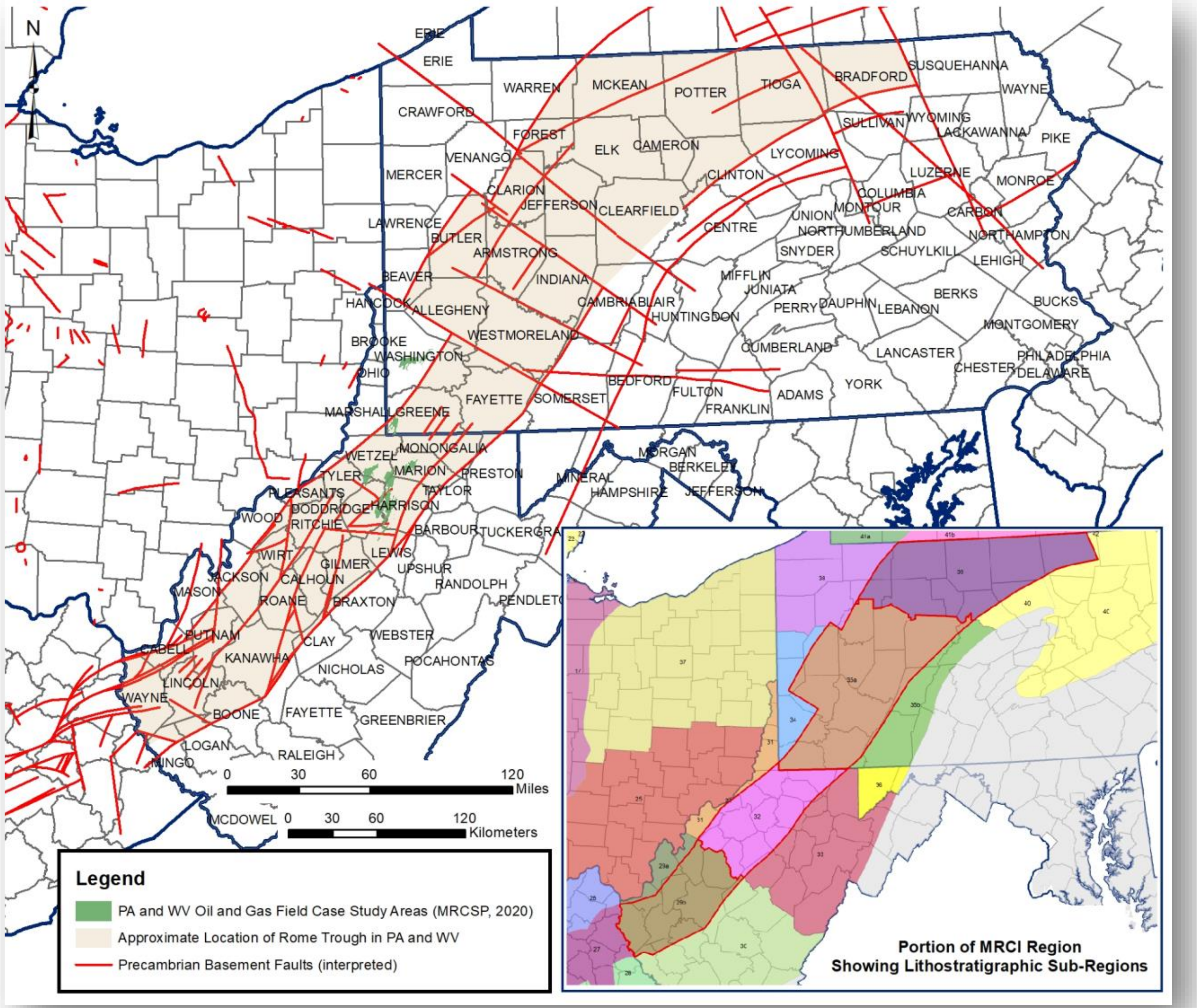
Kostelnik and Carter (2009)

Summary of Existing Data/Knowledge

	Penetrations (with records)						Sample Studies
	Allegheny	Beaver	Fayette	Greene	Washington	Westmoreland	Statewide
Devonian Sands							
Venango	1,222	117	3,358	2,425	3,866	6,792	15
Bradford	259	99	1,401	1,460	1,548	2,125	153
Brallier	56	97	314	667	943	290	21
Marcellus	5	60	269	100	121	259	2
Huntersville	3	59	229	61	77	204	0
Oriskany	3	59	195	42	62	196	0
Medina	0	28	6	10	6	4	1
Trenton/BR	0	0	0	1	3	0	0
Gatesburg/RR	0	0	0	0	0	0	1

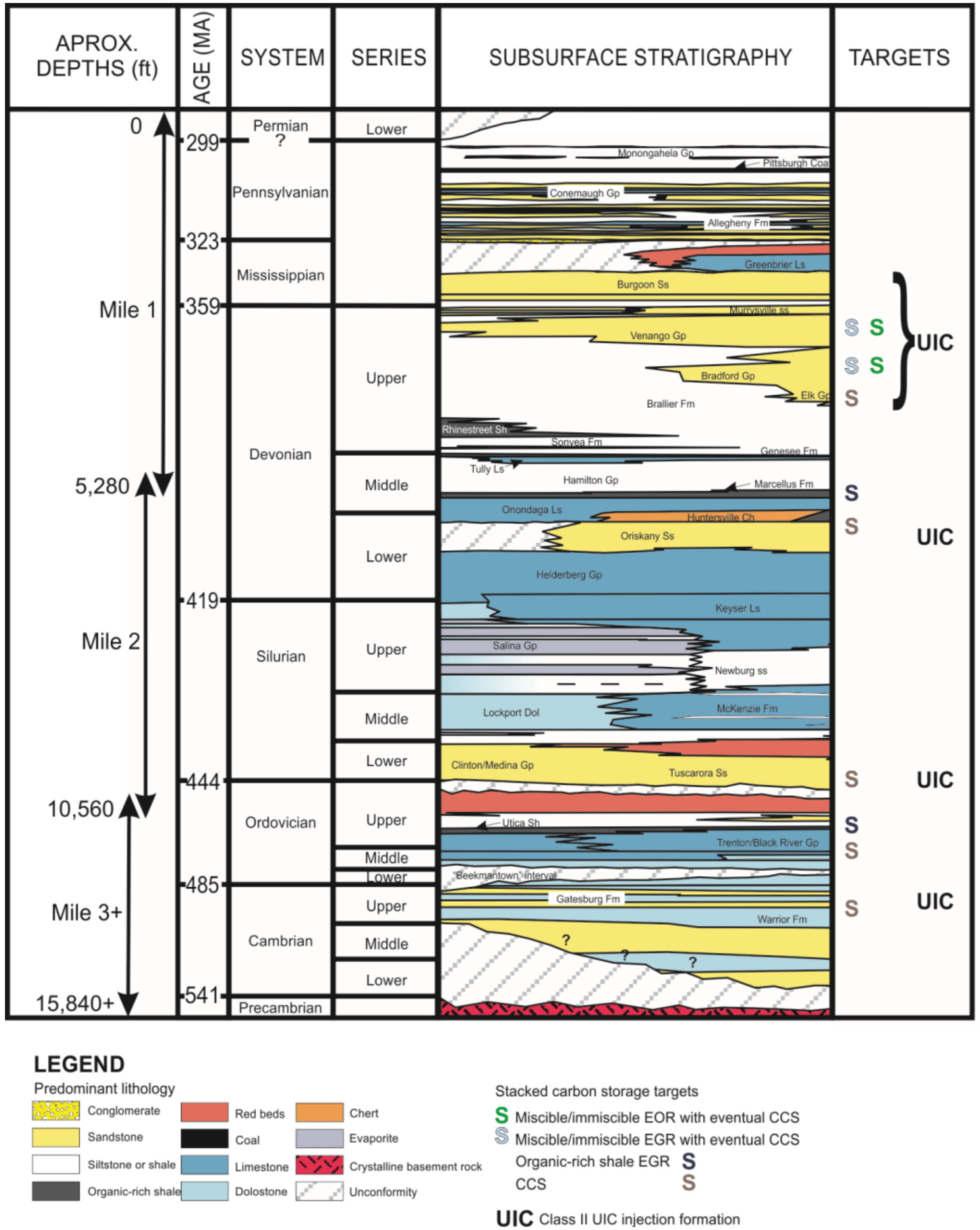
Project Scope of Work

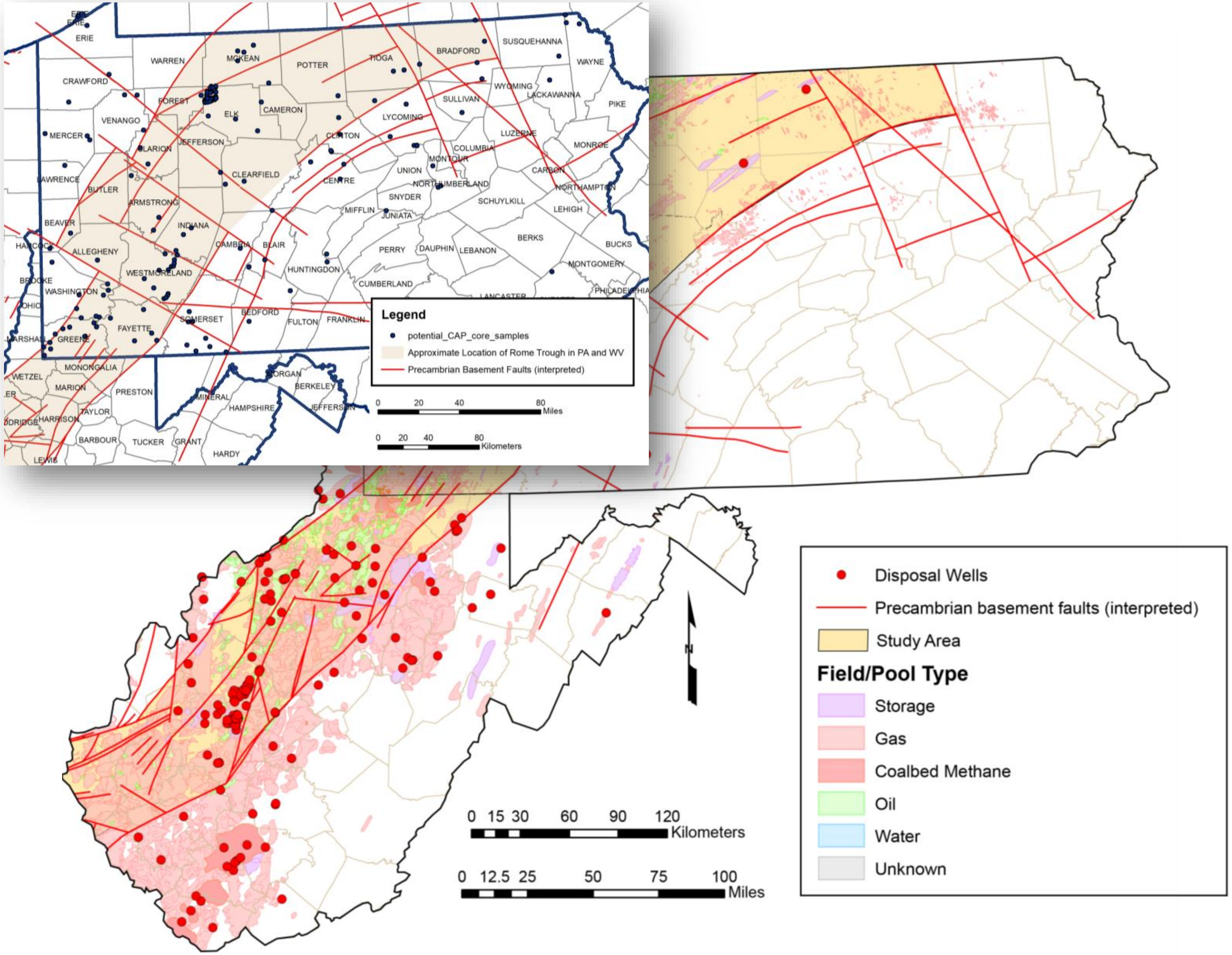
- 1.0 – Project management and planning
- 2.0 – Societal consideration and impacts (SCI) assessment and community benefits portfolio plans
- 3.0 – Data crosswalk and conceptual geologic model development
- 4.0 – Strategic data acquisition for key geologic samples
- 5.0 – Web-based tool for geologic resource visualization and data dissemination
- 6.0 – Technology transfer and public outreach



WVGES GEOLOGY UNDERLIES IT ALL

BATTELLE


APROX. DEPTHS (ft)
AGE (MA)
SYSTEM
SERIES
SUBSURFACE STRATIGRAPHY
TARGETS
0
Mile 1
5,280
Mile 2
10,560
Mile 3+
15,840+
299
323
359
419
444
485
541
Permian
Pennsylvanian
Mississippian
Devonian
Silurian
Ordovician
Cambrian
Precambrian
Lower
Upper
Middle
Lower
Upper
Middle
Lower
Upper
Middle
Lower
Upper
Middle
Lower
Monongahela Gp
Pittsburgh Coal
Conemaugh Gp
Allegheny Fm
Greenbrier Ls
Burgoon Ss
Murrysville ss
Venango Gp
Bradford Gp
Elk Gp
Brallier Fm
Rhinestreet Sh
Sonyea Fm
Genesee Fm
Tully Ls
Hamilton Gp
Marcellus Fm
Onondaga Ls
Huntersville Ch
Oriskany Ss
Helderberg Gp
Keyser Ls
Salina Gp
Newburg ss
Lockport Dol
McKenzie Fm
Clinton/Medina Gp
Tuscarora Ss
Utica Sh
Trenton/Black River Gp
Beekmantown interval
Gatesburg Fm
Warrior Fm
UIC
UIC
UIC
UIC
LEGEND
Predominant lithology
Conglomerate
Sandstone
Siltstone or shale
Organic-rich shale
Red beds
Coal
Limestone
Dolostone
Chert
Evaporite
Crystalline basement rock
Unconformity
Stacked carbon storage targets
S Miscible/immiscible EOR with eventual CCS
S Miscible/immiscible EGR with eventual CCS
Organic-rich shale EGR S
CCS S
UIC Class II UIC injection formation


Legend
potential_CAP_core_samples
Approximate Location of Rome Trough in PA and WV
Precambrian Basement Faults (interpreted)
0 20 40 80 Miles
0 20 40 80 Kilometers
Disposal Wells
Precambrian basement faults (interpreted)
Study Area
Field/Pool Type
Storage
Gas
Coalbed Methane
Oil
Water
Unknown
0 15 30 60 90 120 Kilometers
0 12.5 25 50 75 100 Miles

Project Leadership

Task 1: Project Management & Planning
PI: Michele Cooney (PAGS)
PA Project Manager: Kristin Carter (PAGS)
WV Project Manager: Jessica Moore (WVGES)

Task 2: Societal Considerations and Impacts (SCI)

Joy Frank-Collins (Battelle) - Outreach Lead
Jared Hawkins (Battelle) - SCI Lead

Task 3: Data Crosswalk and Conceptual Geologic Model Development

Michele Cooney - PAGS Lead
Jessica Moore - WVGES Lead

Task 4: Strategic Data Aquistion for Key Geologic Samples

John Neubaum - PAGS Lead
Bethany Royce - WVGES Lead

Task 5: Web-based Tool Development

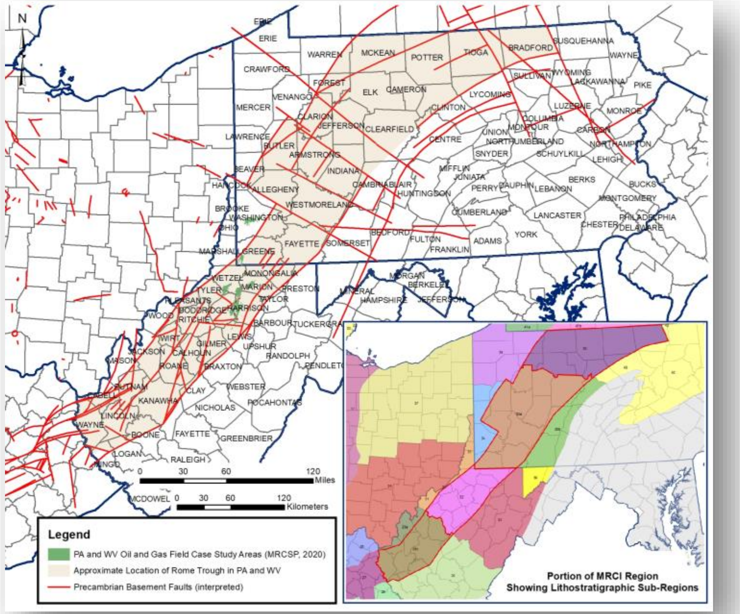
Al Guiseppe - PAGS Lead
Richard Binns - WVGES Lead

Task 6: Technology Transfer & Public Outreach

Lead: Joy Frank-Collins (Battelle)

Tentative Schedule and Next Steps

- Contract documents, subcontracts, legal review and fiscal processing
- Updated Project Management Plan (within 30 days)
- SCI and Community Benefits Package (within 90 days)
- Student internship logistics
- Rock core and cuttings storage facility (funded by DCNR)



1. Data Crosswalk
2. Community Benefits Plan Development

→

1. Targeted Core Analysis
2. Community Advisory Council
3. Internships

→

1. Web-Based Tool Deliverable
2. Continued Community and Stakeholder Outreach

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Thank you!

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