pennsylvania
DEPARTMENT OF CONSERVATION
AND NATURAL RESOURCES

The History of the Aggregates Industry in Pennsylvania & the Work of the Pennsylvania Geological Survey

Dr. Gale Blackmer, Director and State Geologist
Pennsylvania Geological Survey

PACA Young Leaders Development Group Conference
October 12, 2023

Nonfuel Raw Mineral Production in Pennsylvania

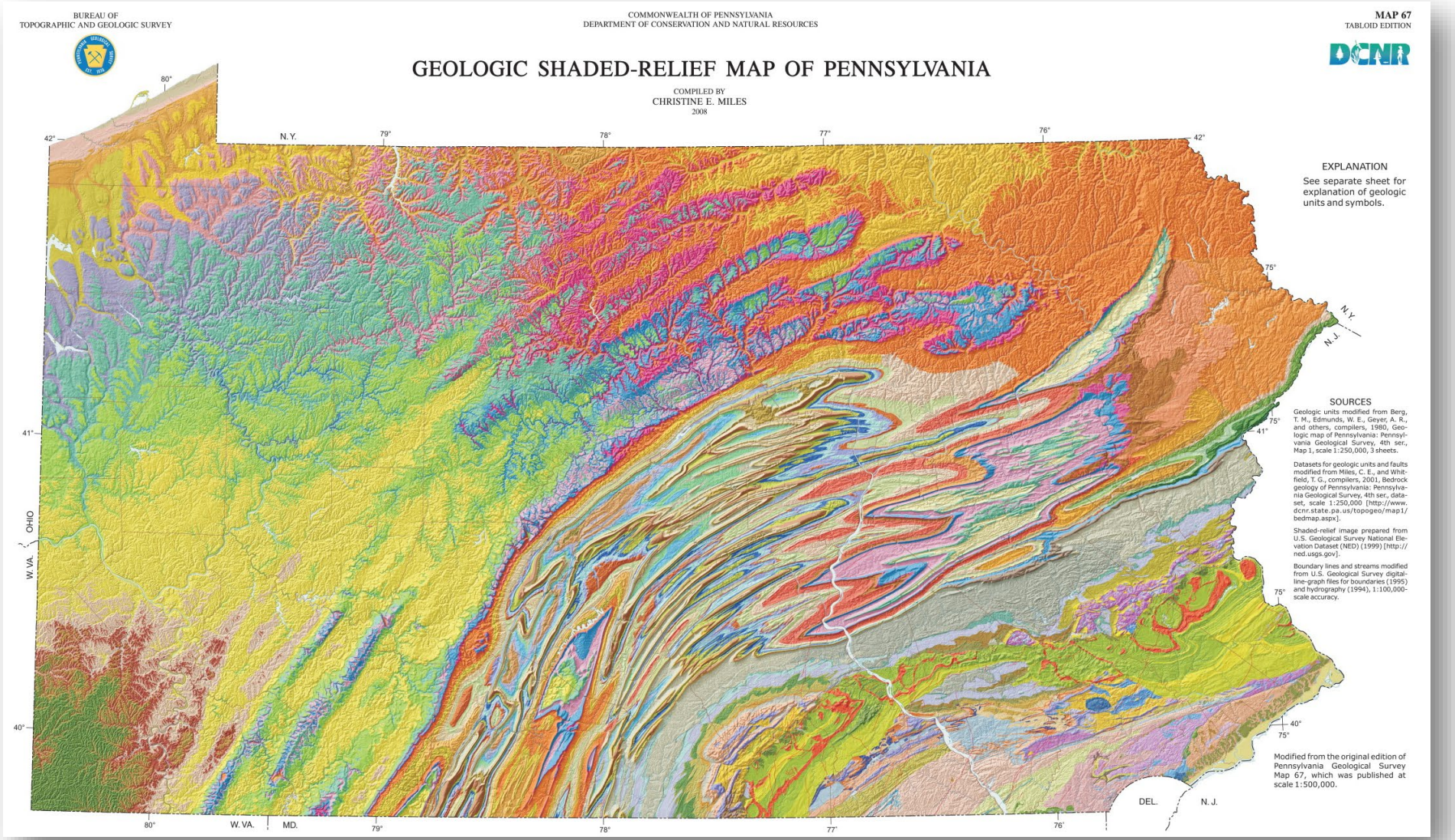
Mineral Commodity	2018 Quantity (1000 metric t)	2018 Value (1000 $)	2019 Quantity (1000 metric t)	2018 Value (1000 $)
Cement, masonry	143	19,800	146 20,400	
Cement, Portland	3,370	356,000	3,770	390,000
Clay, common	281	1,870	272	1,840
Lime	854	176,000	937	184,000
Sand and gravel, construction	9,950	94,600	11,100	116,000
Stone, crushed	87,200	1,160,000	94,600	1,380,000
Stone, dimension	48	7,340	38	
TOTAL		**1,810,000**		**2,100,000**

Source: USGS 2019 Minerals Yearbook

Pennsylvania: Crushed Stone Sold or Used, by kind

Kind	# of quarries 2005	Quantity (1000 met. tons)	Value (1000 $)	# of quarries 2006	Quantity (1000 met. tons)	Value (1000 $)
Limestone	109	61,300	413,000	104	64,600	460,000
Dolomite	13	12,400	79,700	11	11,800	82,200
Marble	1			1		
Sandstone/ quartzite	41	10,800	73,500	42	12,700	91,600
Traprock	7	4,700	33,000	7	6,480	46,800
Granite	7	6,450	40,700	6	4,280	30,600
Slate	11			11		
Misc. Stone	18	9,530	62,400	17	9,320	65,300
Total		**107,000**	**713,000**		**111,000**	**788,000**

Source: USGS Minerals Yearbook 2006, volume II


BUREAU OF
TOPOGRAPHIC AND GEOLOGIC SURVEY
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
MAP 67
TABLOID EDITION
GEOLOGIC SHADED-RELIEF MAP OF PENNSYLVANIA
COMPILED BY
CHRISTINE E. MILES
2008
DCNR
EXPLANATION
See separate sheet for explanation of geologic units and symbols.
SOURCES
Geologic units modified from Berg, T. M., Edmunds, W. E., Geyer, A. R., and others, compilers, 1980, Geologic map of Pennsylvania: Pennsylvania Geological Survey, 4th ser., Map 1, scale 1:250,000, 3 sheets.
Datasets for geologic units and faults modified from Miles, C. E., and Whitfield, T. G., compilers, 2001, Bedrock geology of Pennsylvania: Pennsylvania Geological Survey, 4th ser., dataset, scale 1:250,000 [http://www.dcnr.state.pa.us/topogeo/map1/bedmap.aspx].
Shaded-relief image prepared from U.S. Geological Survey National Elevation Dataset (NED) (1999) [http://ned.usgs.gov].
Boundary lines and streams modified from U.S. Geological Survey digital-line-graph files for boundaries (1995) and hydrography (1994), 1:100,000-scale accuracy.
Modified from the original edition of Pennsylvania Geological Survey Map 67, which was published at scale 1:500,000.
N.Y.
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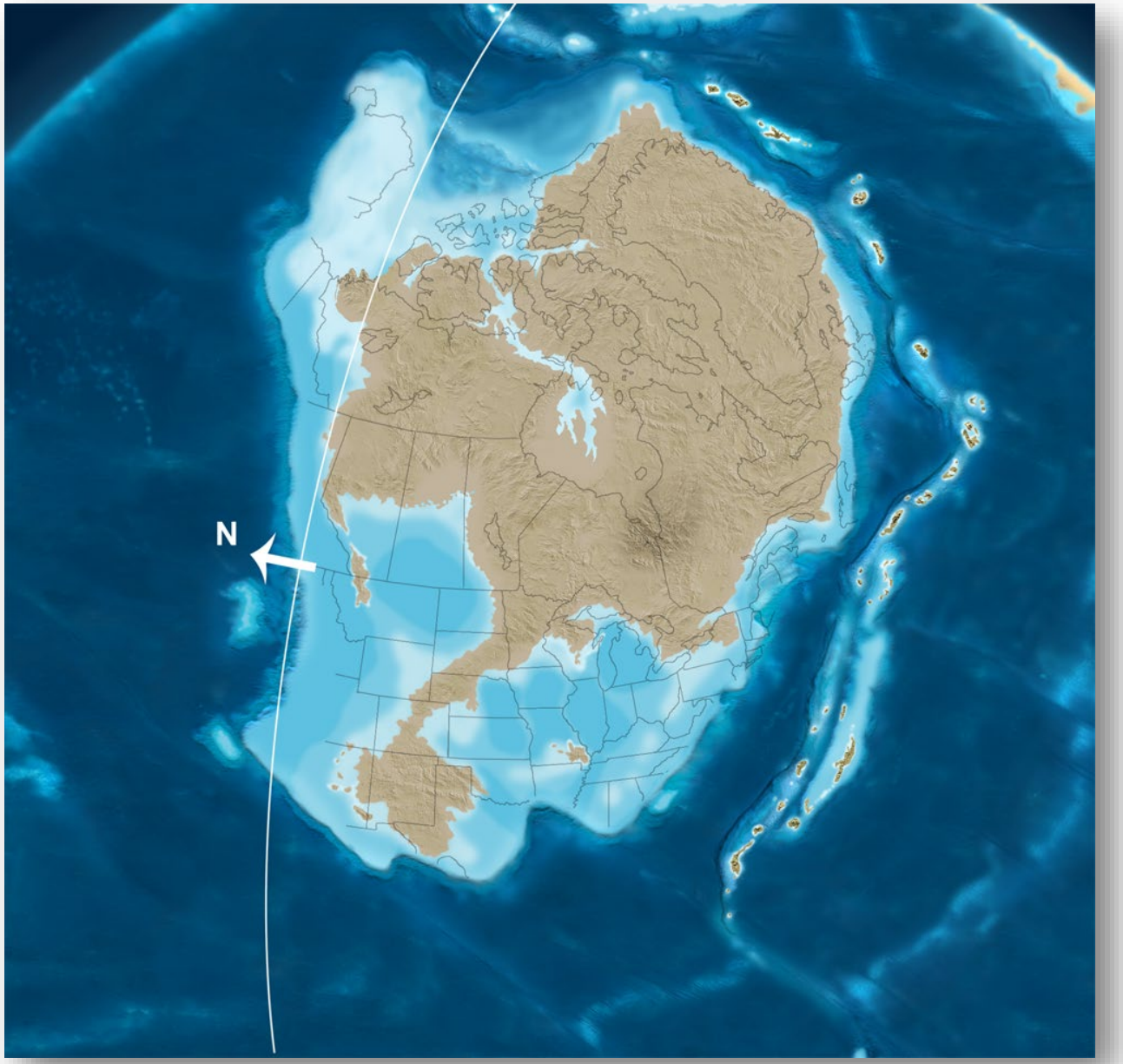
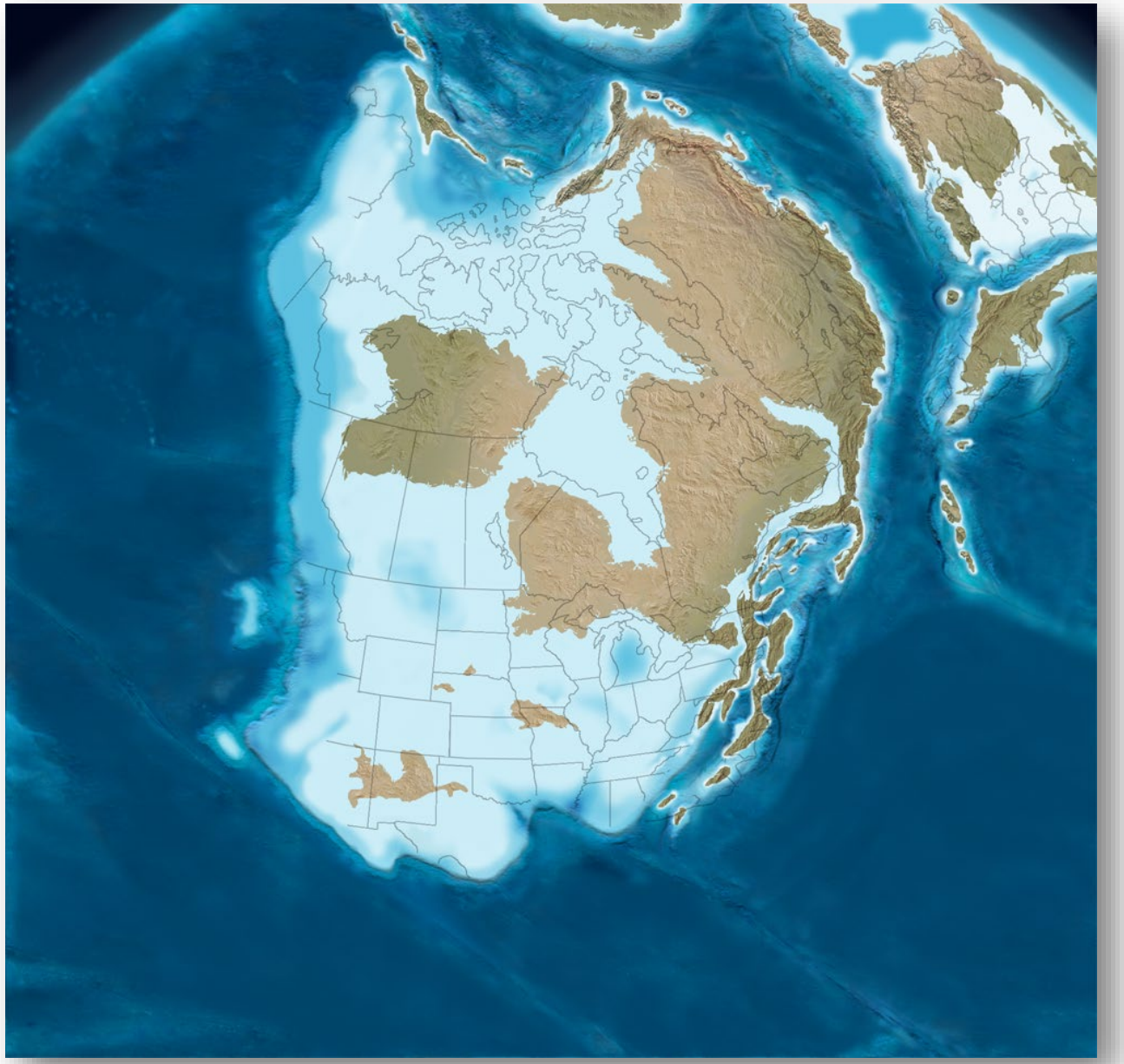
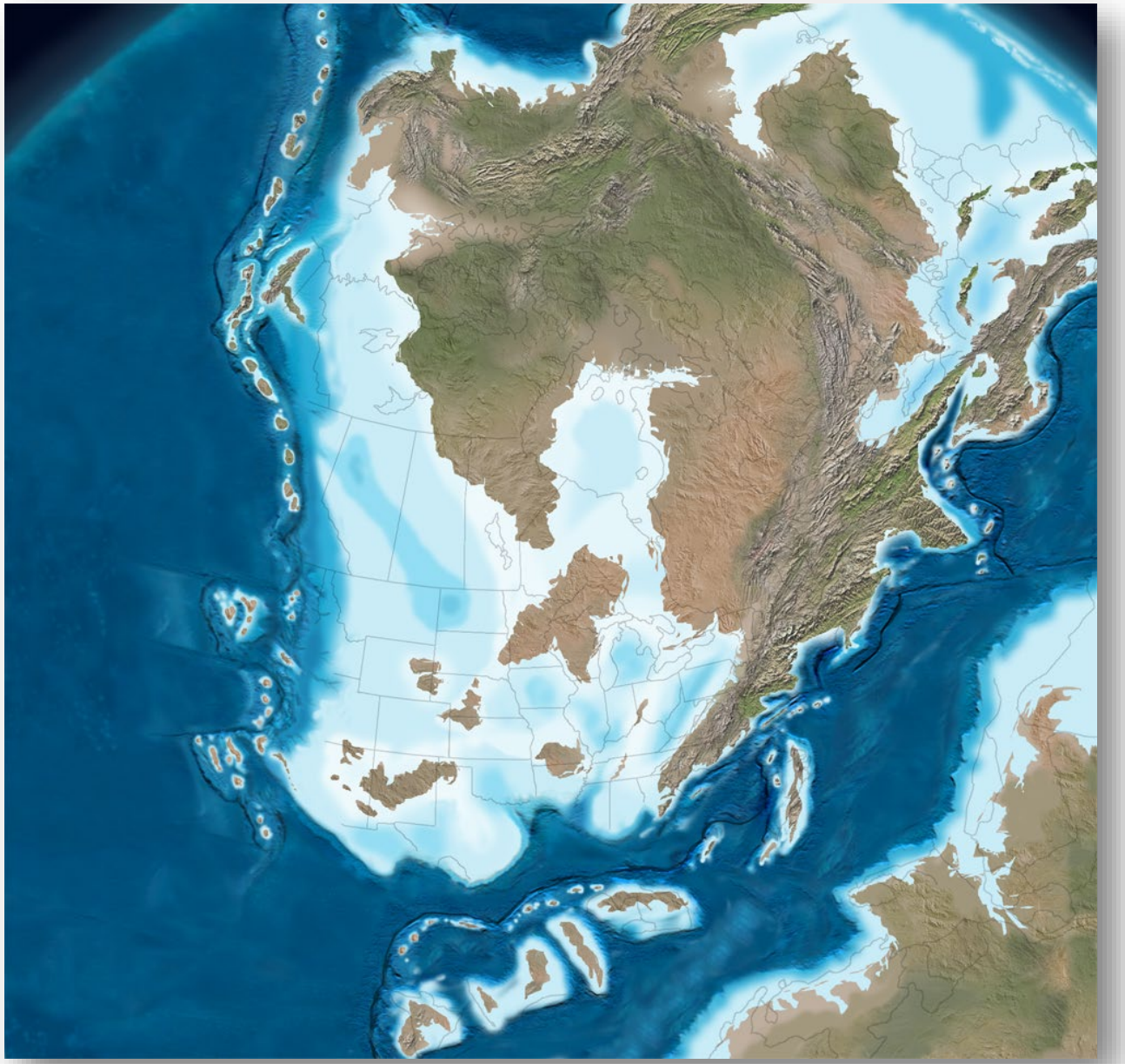
North America @ 500 Ma, Late Cambrian



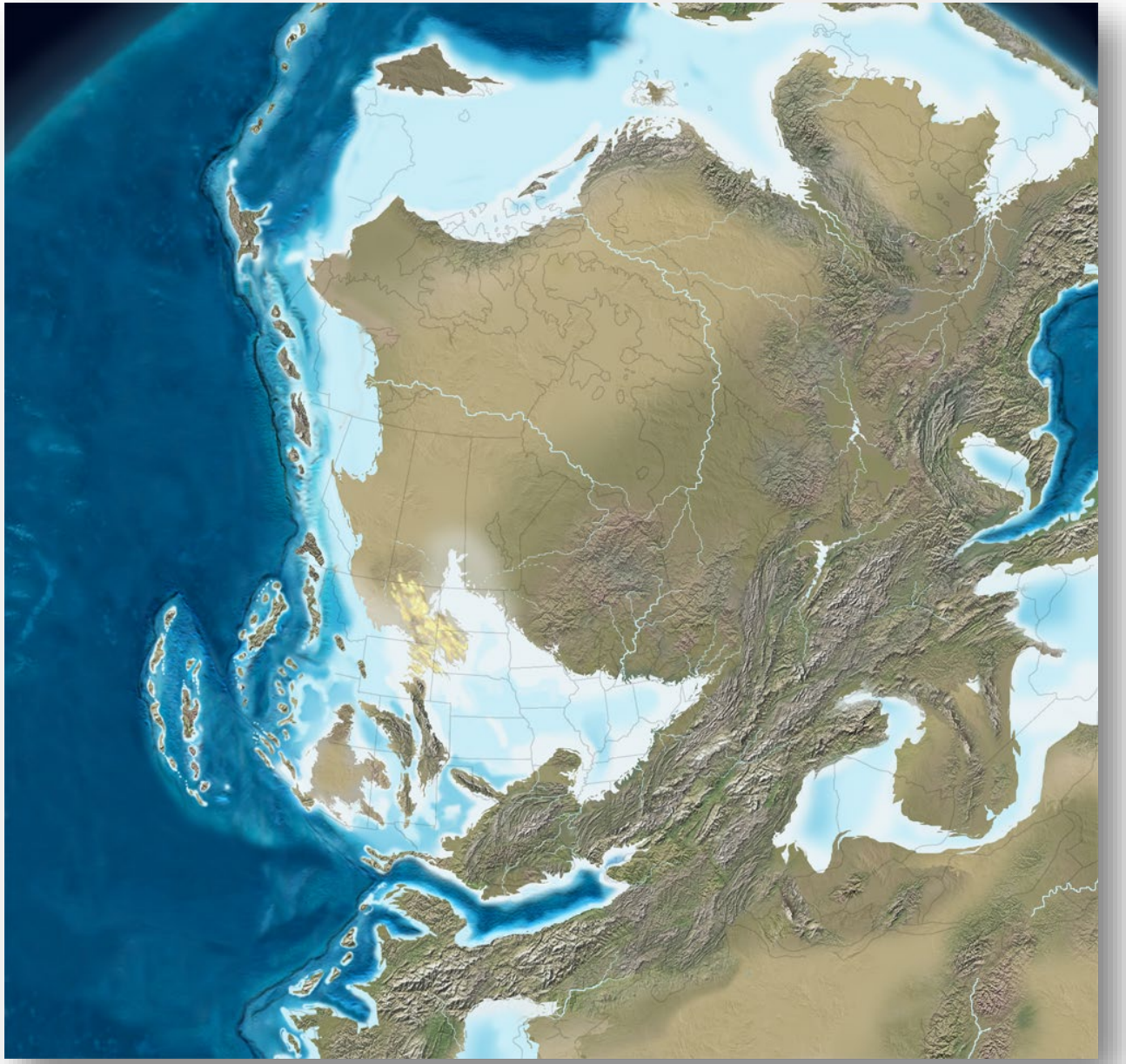
North America @ 450 Ma, Late Ordovician



North America @ 360 Ma, Late Devonian

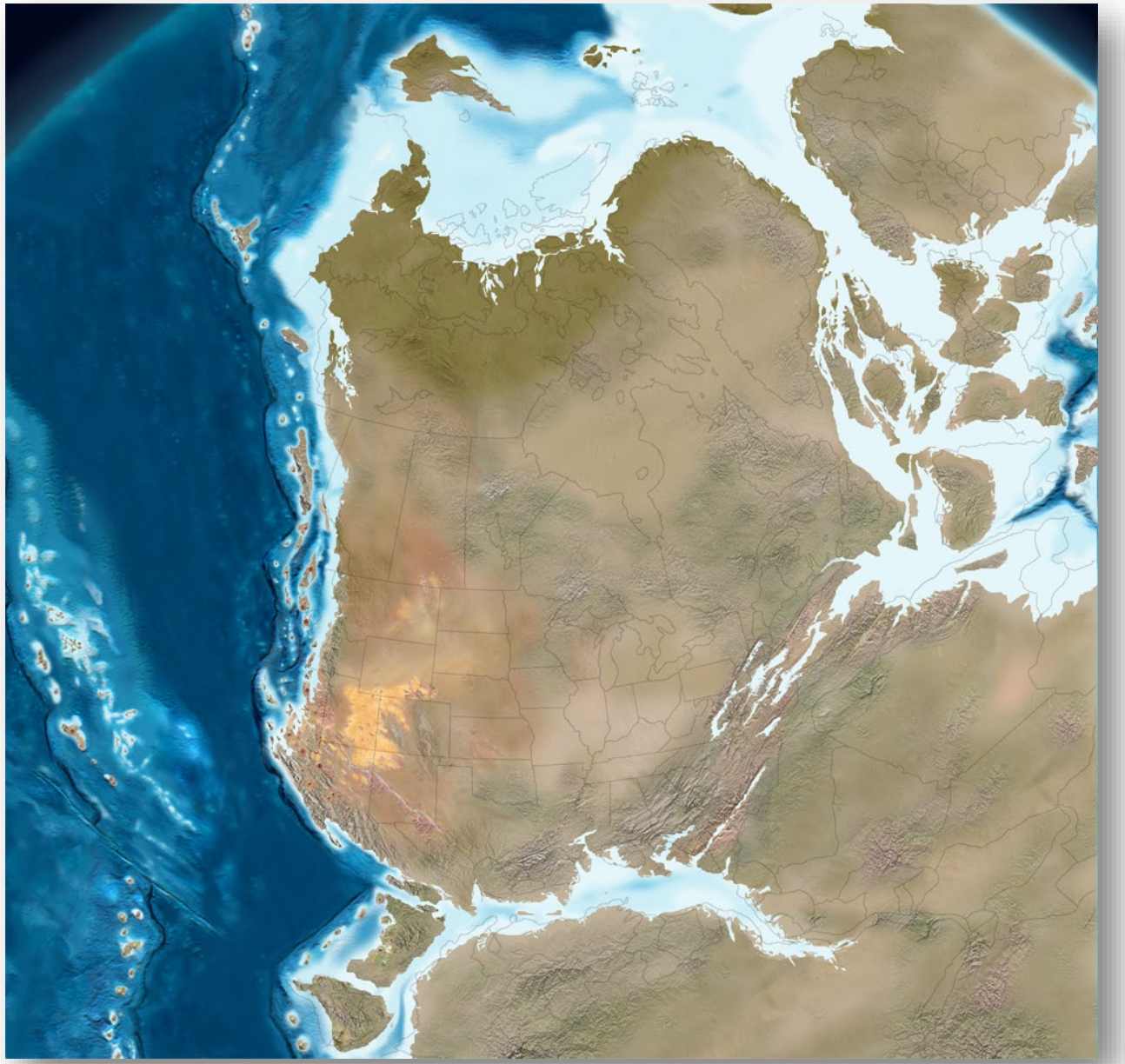


North America @ 300 Ma, Late Pennsylvanian

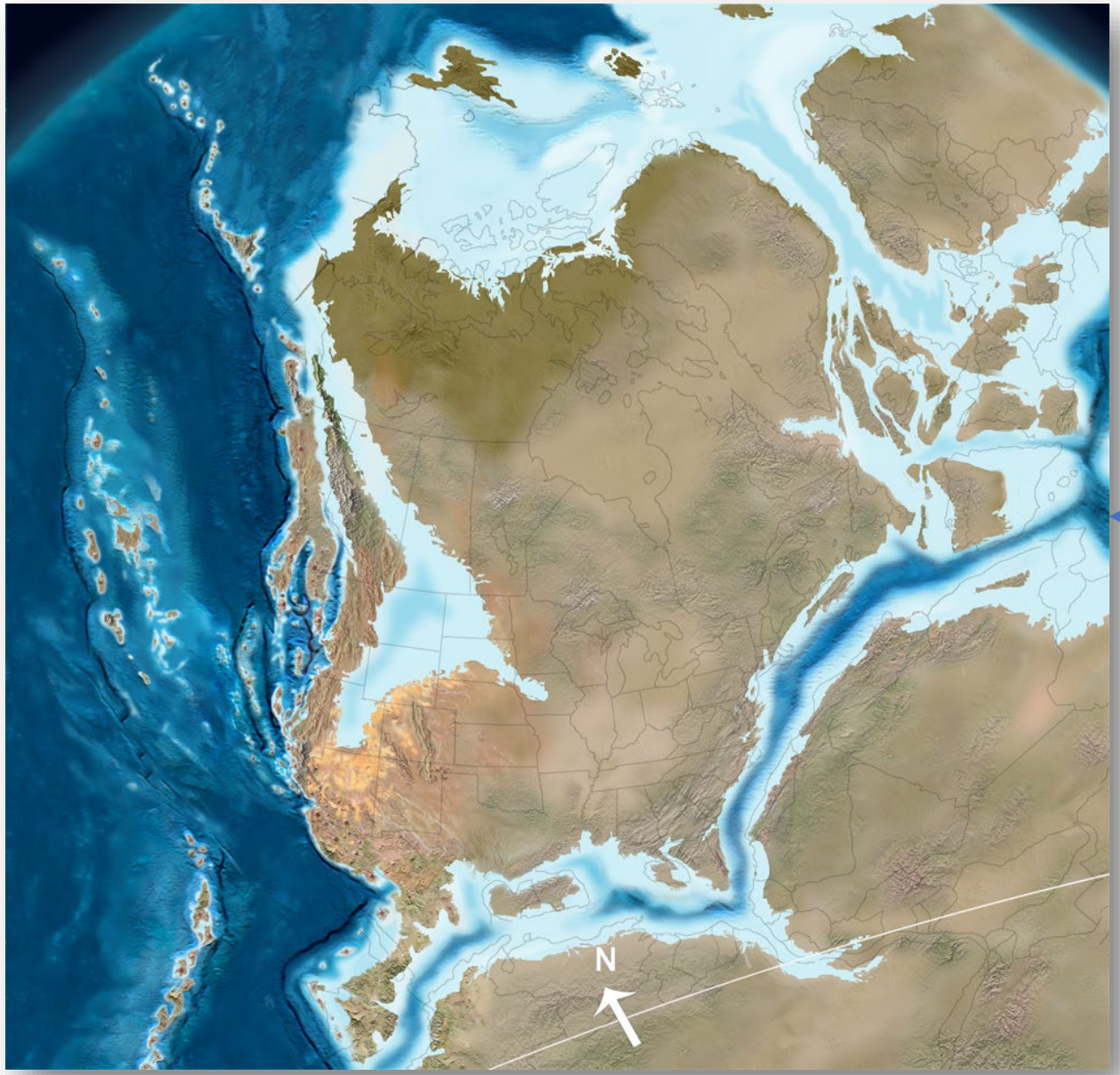


North America @ 210 Ma, Late Triassic

North America @ 195 Ma, Early Jurassic



North America @ 170 Ma, Middle Jurassic



dark blue = true ocean crust

North America @ 150 Ma, Late Jurassic

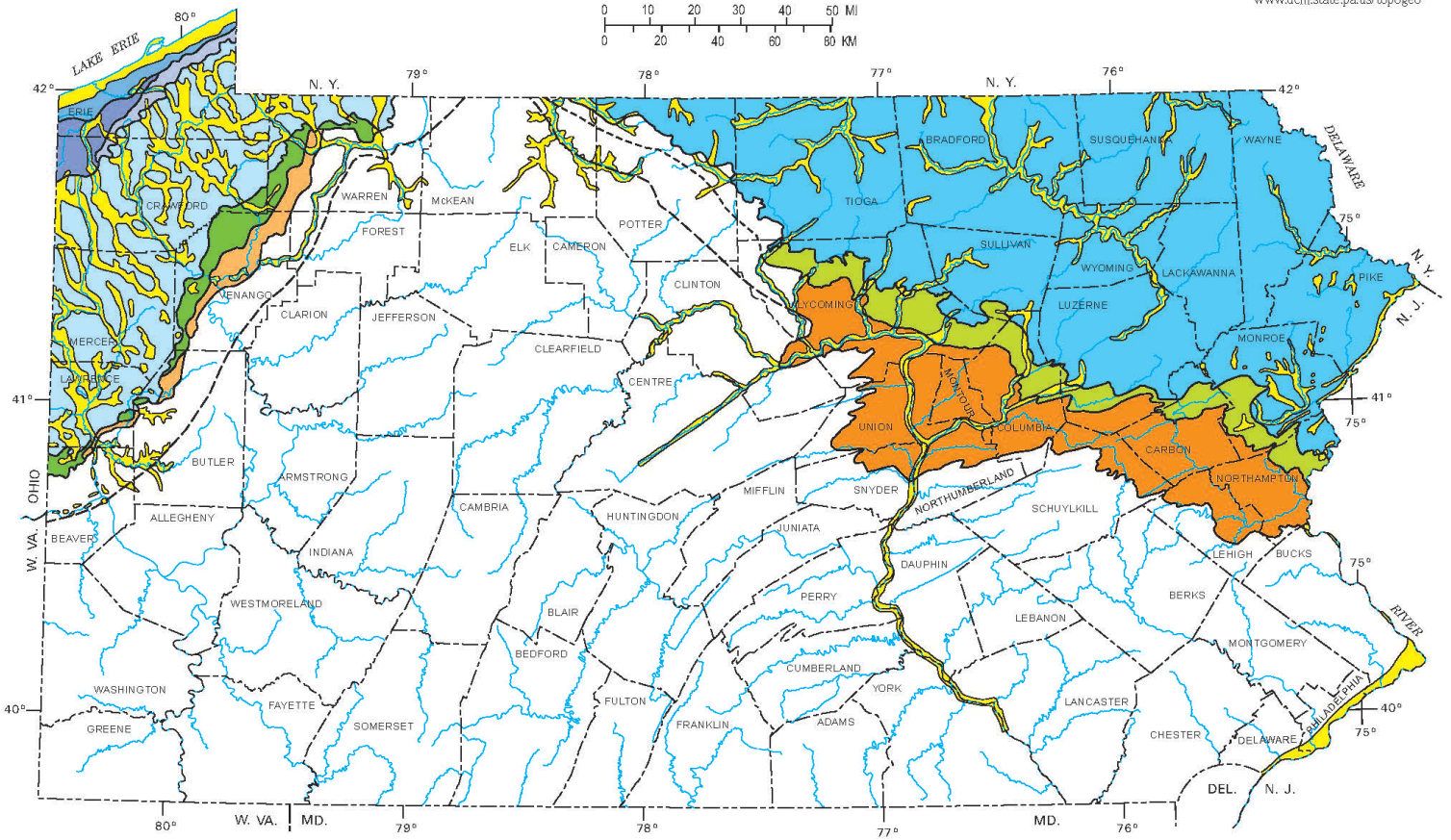
Proto-Atlantic Ocean

MAP 59

GLACIAL DEPOSITS OF PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF
CONSERVATION AND NATURAL RESOURCES
BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
www.dcnr.state.pa.us/topogeo

SCALE
0 10 20 30 40 50 MI
0 20 40 60 80 KM



EXPLANATION

RECENT TO LATE ILLINOIAN (0–198,000 yrs.)

STRATIFIED DRIFT — Sand and gravel in eskers, kames, kame terraces, and outwash, principally in valleys; silt and clay in lake deposits in formerly ice-dammed valleys; lake clays and beach sands and gravels along Lake Erie, thin (Recent) to thick (late Illinoian) soils.

WISCONSINAN (17,000–22,000 yrs.)

ASHTABULA TILL
HIRAM TILL
LAVERY TILL
KENT TILL

Thick, gray, clayey to silty to sandy till covering over 75 percent of the ground; topography is mainly gently undulating, but there is also some knob-and-kettle topography; thin soil.

OLEAN TILL — Moderately thick, gray to grayish-red, sandy till covering 25 to 50 percent of the ground; very thin till covers an additional 25 percent of the ground; topography reflects the underlying bedrock; thin soil.

LATE ILLINOIAN (132,000–198,000 yrs.)

TITUSVILLE TILL
UNNAMED TILLS

Thin, gray (Titusville) to brown and grayish-red (unnamed), clayey to sandy till covering 10 to 25 percent of the ground; topography reflects the underlying bedrock; moderately thick, well-developed soil.

PRE-ILLINOIAN (>770,000 yrs.)

MAPLEDALE TILL
UNNAMED TILLS

Thin, gray, clayey to silty till in patches covering up to 10 percent of the ground; topography reflects the underlying bedrock; thick, well-developed soil, commonly having a yellowish-red color.

SYMBOLS

Southern limit of glacial advance

Approximate limit of Illinoian advance

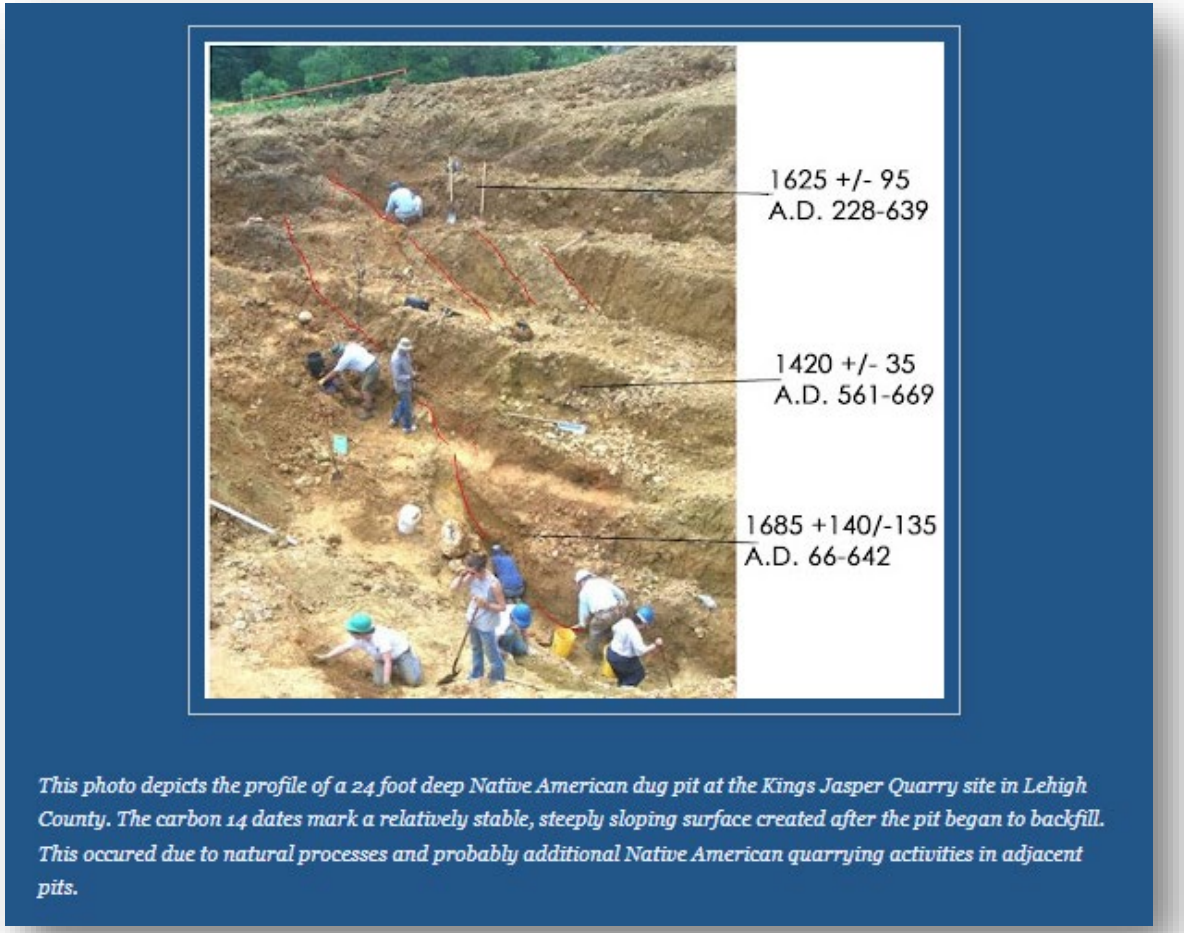
Approximate limit of pre-Illinoian advance

By W. D. Sevon and D. D. Braun.
Second Edition, 1997; Second Printing, 2000.

2200-MP-DCNR3027
Printed on Recycled Paper

Earliest Use of Stone in Pennsylvania

Native Americans quarried local stone for tools as early as the Paleoindian period (chert, jasper, quartz, metarhyolite, argillite)



This photo depicts the profile of a 24 foot deep Native American dug pit at the Kings Jasper Quarry site in Lehigh County. The carbon 14 dates mark a relatively stable, steeply sloping surface created after the pit began to backfill. This occured due to natural processes and probably additional Native American quarrying activities in adjacent pits.

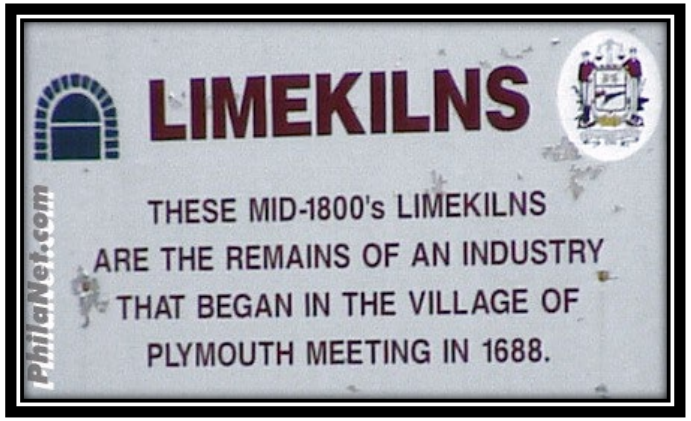
Early European Settlement

"Civilization" requires stone

Caleb Pusey House, 1683 Upland, Delaware County

Abandoned quarry hiding out as a pond,
Chester County

Limestone



- Fertilizer, mortar, whitewash to protect barns and tree bases.
- Oldest lime kiln in Pennsylvania dates to 1693 (Montgomery County)*

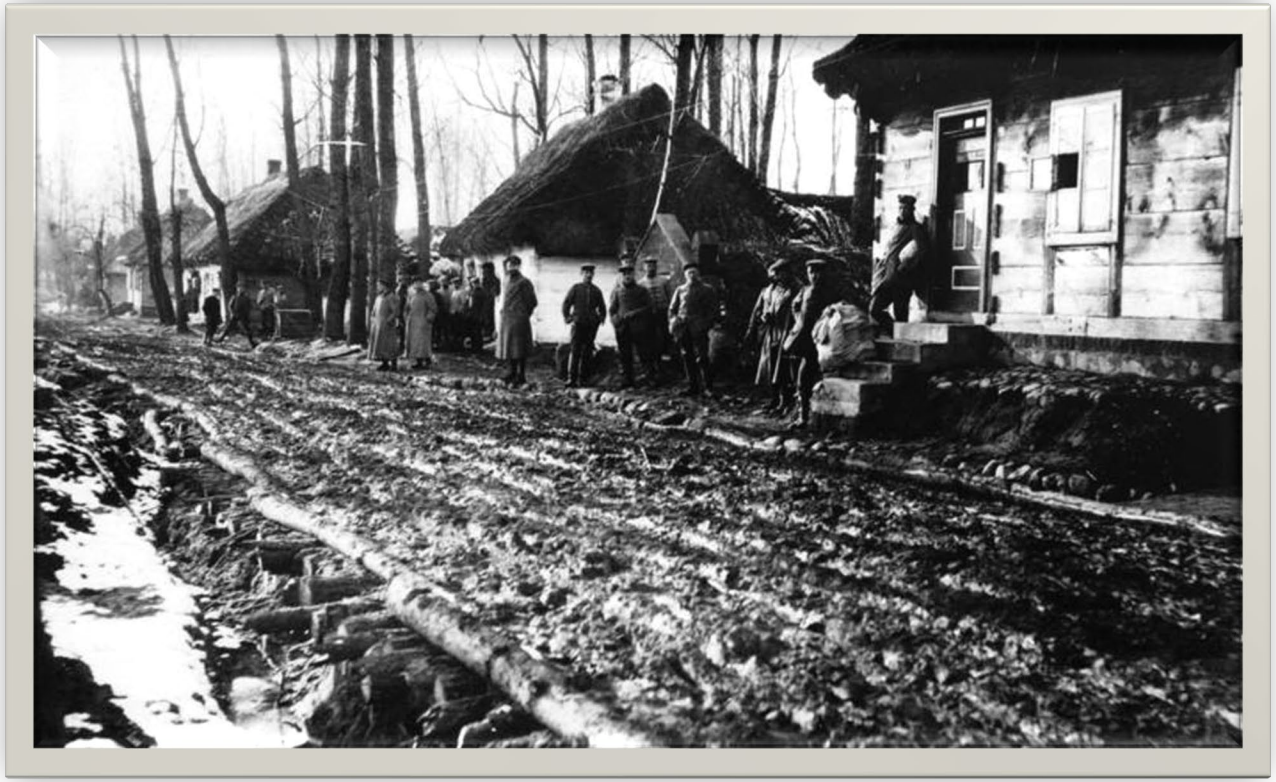
**https://unchartedlancaster.com/2019/03/30/lancaster-county-once-boasted-nearly-500-of-these-silent-stone-sentinels-today-fewer-than-20-percent-remains-unlock-the-mystery-of-these-ancient-masonry-guardians/*

Wood makes poor roads

"I am aware, Gentlemen, that the want of a good, permanent road is, at present, the principal defect in the communication between the middle counties and the metropolis"

-Pennsylvania Governor Thomas Mifflin, 1791

Early roads were constructed of logs laid perpendicular to the path and covered with a layer of soil or planks.



Example of a corduroy road in Ukraine circa 1918.

Roads made of stone are much better

Philadelphia and Lancaster Turnpike, 1795 the first hard-surfaced road in the US

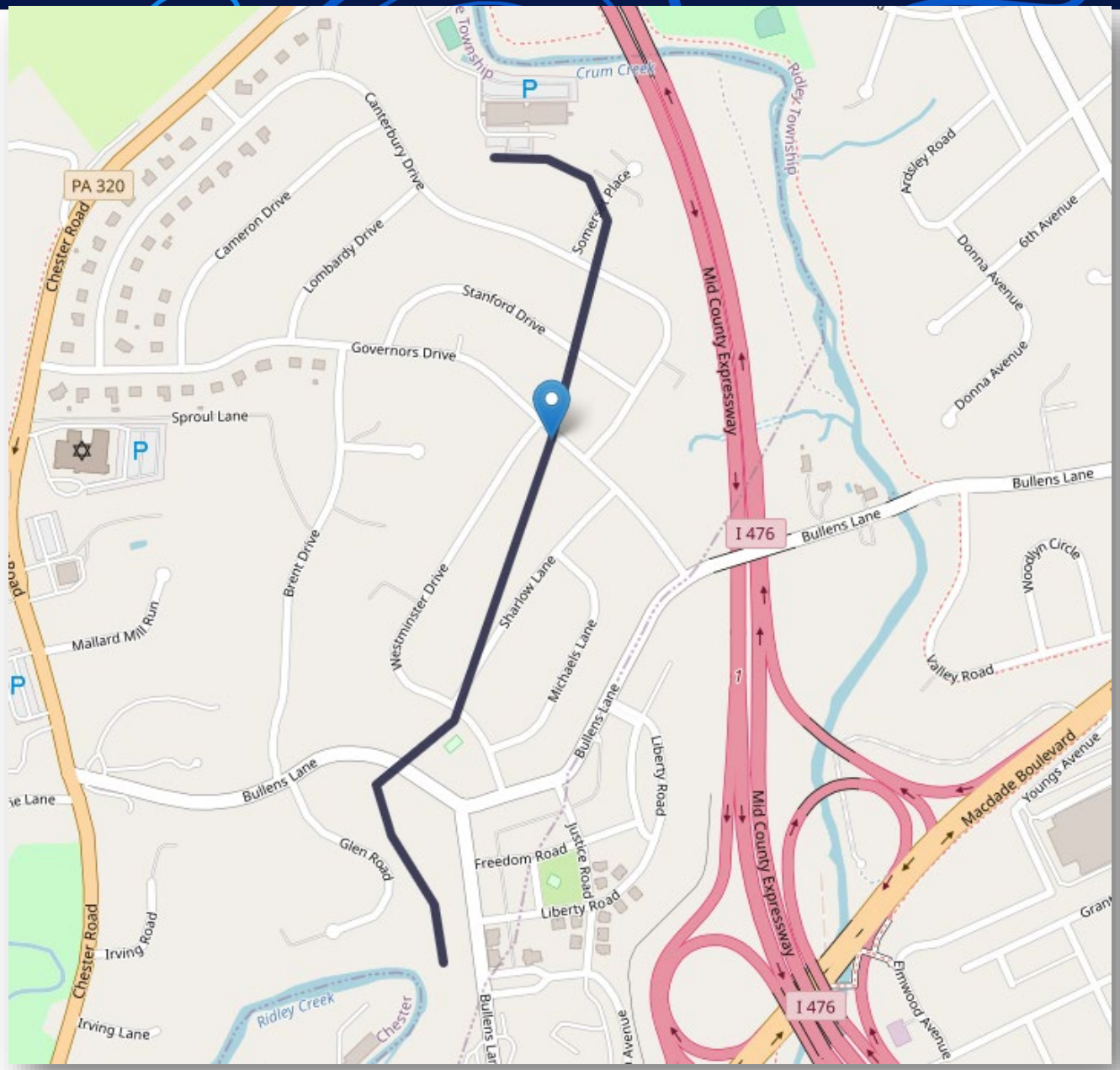
Construction of a macadamized road ca. 1823

- Foundation of broken limestone and gravel, top layer of smoother, loosely packed stone
- Method devised by Scottish engineer John MacAdam.
- Early aggregate specs: not to exceed 6 ounces in weight or to pass a two-inch ring

Railroads

The first railway in Pennsylvania

- Leiper Railroad – built to carry stone from Leiper family quarries near Crum Creek to Ridley Creek, Delaware County
- Started operations in 1809
- ¾ mile long
- Wooden rails, horse-drawn cars
- Replaced by a canal in 1828, then again by a railroad in 1852.
- Second railroad became the Crum Creek Branch of the Baltimore and Philadelphia Railroad (part of B&O Railroad); abandoned in the 1950s



Railroads move stone and need stone

Philadelphia and Columbia Railway

- Construction began 1829, operational 1832
- Part of the Main Line of Public Works, a network of railroads and canals that connected Pittsburgh with Philadelphia

By Unknown author - http://railroadheritage.org/r1808/01_early_photograph_of_an_early_locomotive_the_tioga_editors_title

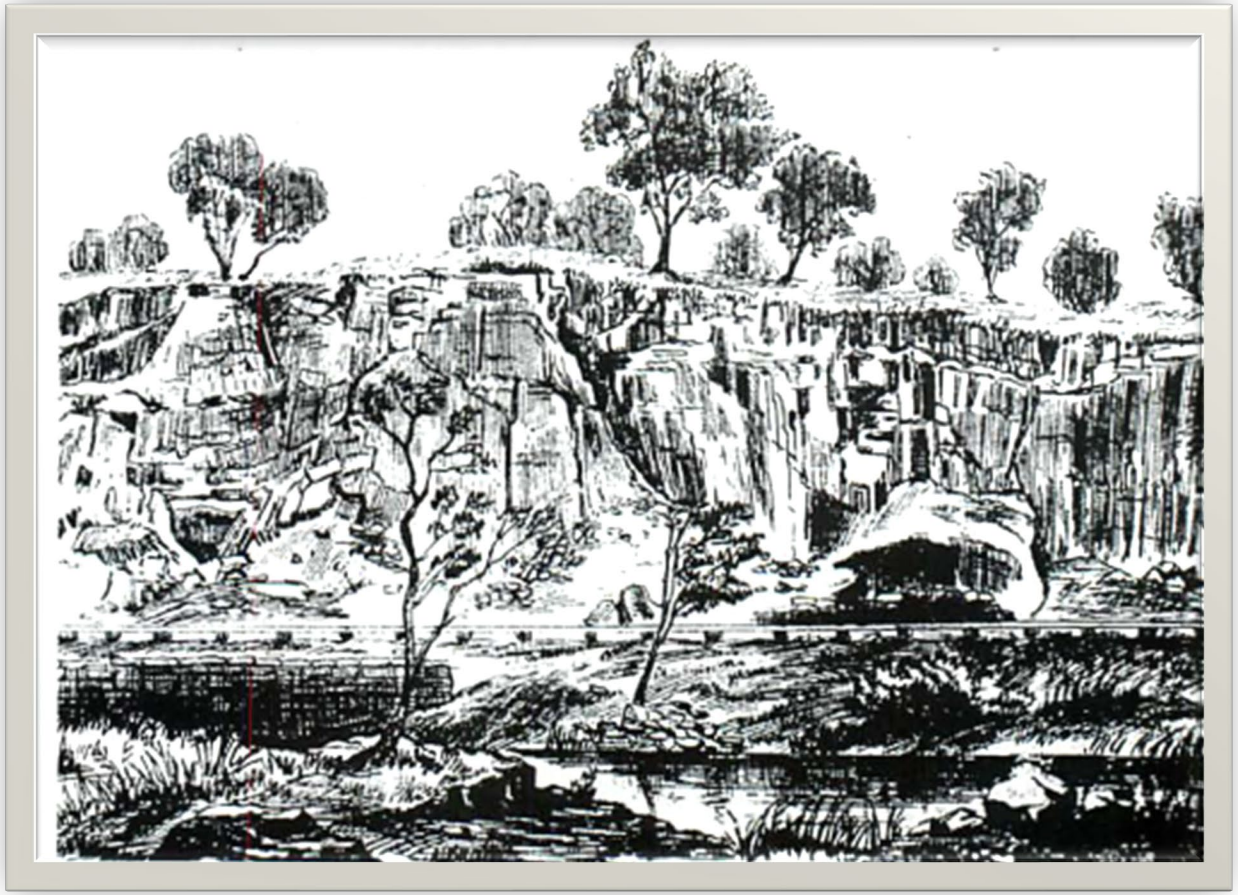
First Pennsylvania Geological Survey 1836-1842

- Organized to conduct a geological and mineralogical survey of the state
- Careful mapping set the geologic framework for all the other states along the Appalachian Mountains
- Learned much about the form and arrangement of rock layers and correlation of units across the state

Henry Darwin Rogers
State Geologist of the First PA Geological Survey

The First Survey is famous for its beautiful lithographs, sketched by George Lehman

Indian Chief Rock, on the Juniata River near Williamsburg

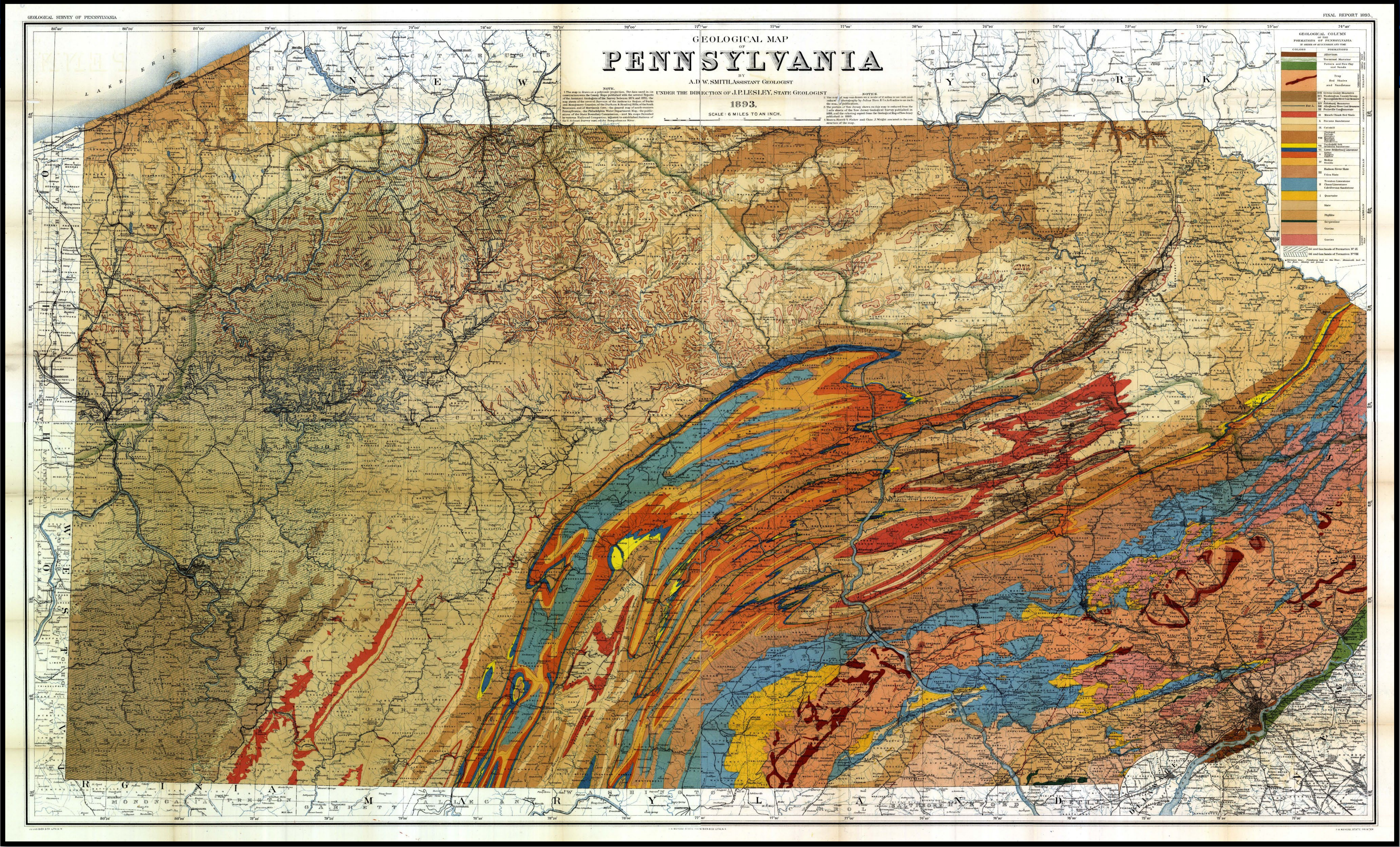


Limestone quarry near Conshohocken

Second Pennsylvania Geological Survey 1874-1889

- Brought on by accelerated industrial growth and discovery of oil.
- More staff, more time, work up areas in more detail
- Nearly 120 atlases and volumes; each project published as it was completed. Geologic maps of all 67 counties.
- Established much of the stratigraphy we use today

J. Peter Lesley
State Geologist of the Second Geological Survey



GEOLOGICAL SURVEY OF PENNSYLVANIA
FINAL REPORT 1893.
GEOLOGICAL MAP
OF
PENNSYLVANIA
BY
A. D. W. SMITH, ASSISTANT GEOLOGIST
UNDER THE DIRECTION OF J. P. LESLEY, STATE GEOLOGIST
1893.
SCALE: 6 MILES TO AN INCH.
LAKE ERIE

Third Pennsylvania Geological Survey 1899-1914

- Primarily produced topographic maps in cooperation with U.S. Geological Survey
- Geologic work focused on coal, gas, and oil
- Perpetual funding issues
- In 1910, PA produced nearly a third of the mineral wealth of the US but spent only $1 on geologic work for each $65,700 in mineral products.

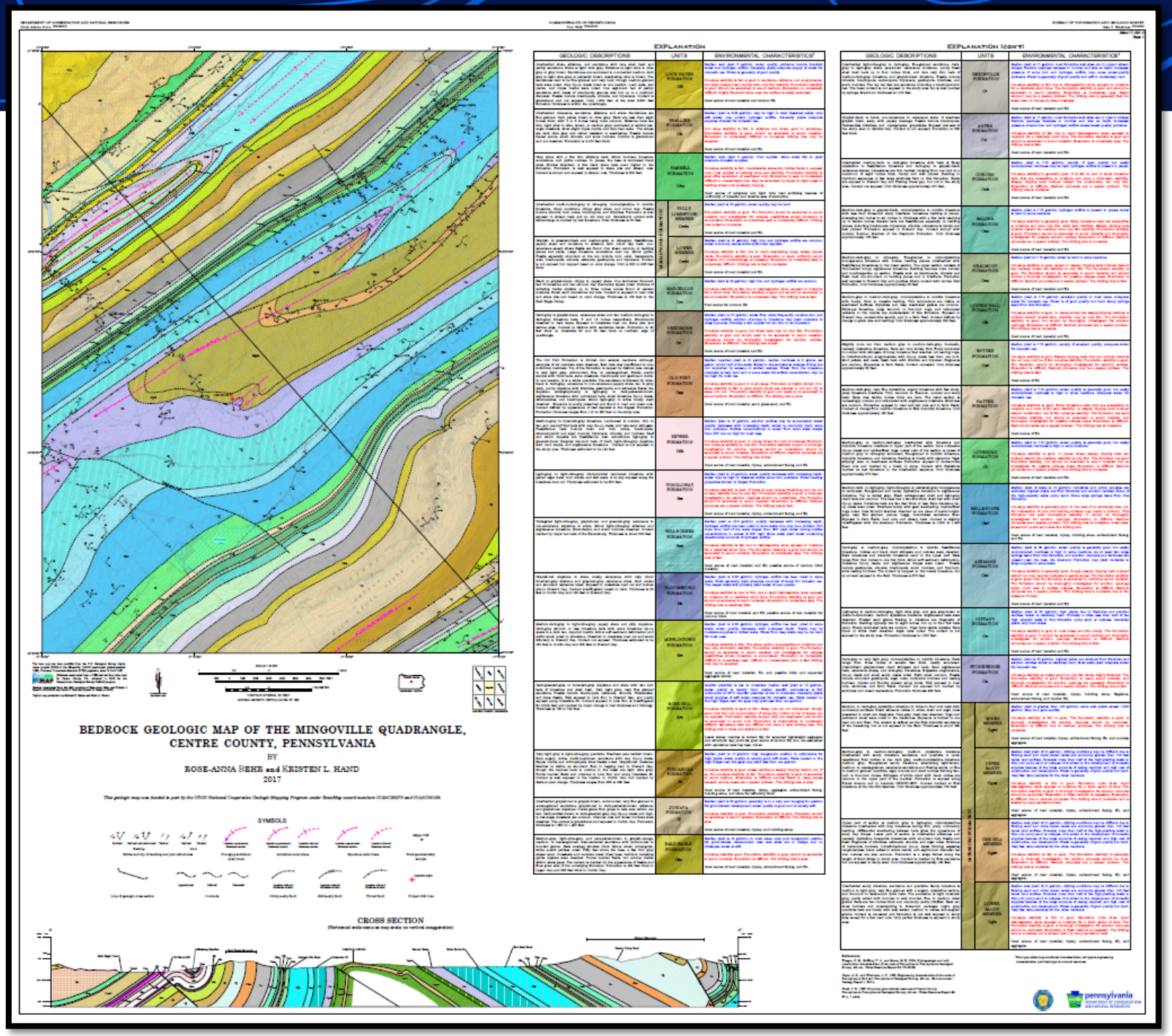
Richard Hice
State Geologist of the Third Geological Survey

Fourth Pennsylvania Geological Survey
1919-forever

- "…undertake, conduct, and maintain…a thorough and extended survey of the State for the purpose of elucidating the geology and topography of the State."
- Enabling legislation assigned many tasks:
  - Mapping and chemical analysis of mineral resources, energy resources, clays, soils, and fertilizers.
  - Mapping and characterization of rock formation that would be useful for highway construction or for any other purpose.
  - Put information into a "form convenient for reference."

Survey Staff, 2019

Survey Products: Geologic Maps and Reports



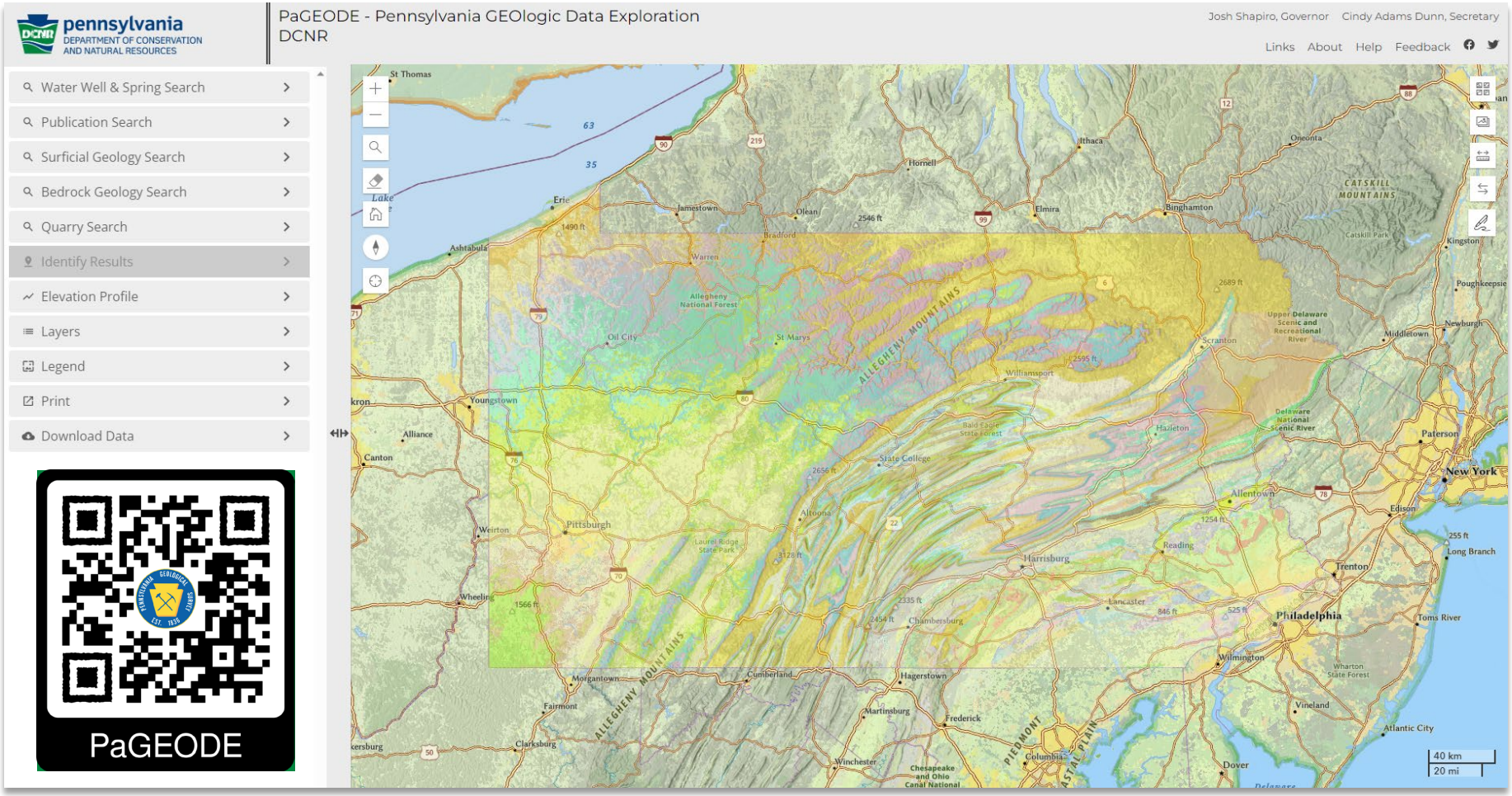
Survey Products: Analytical data

- Geochemistry
- PennDOT lab tests
- In-house labs for microscopic work

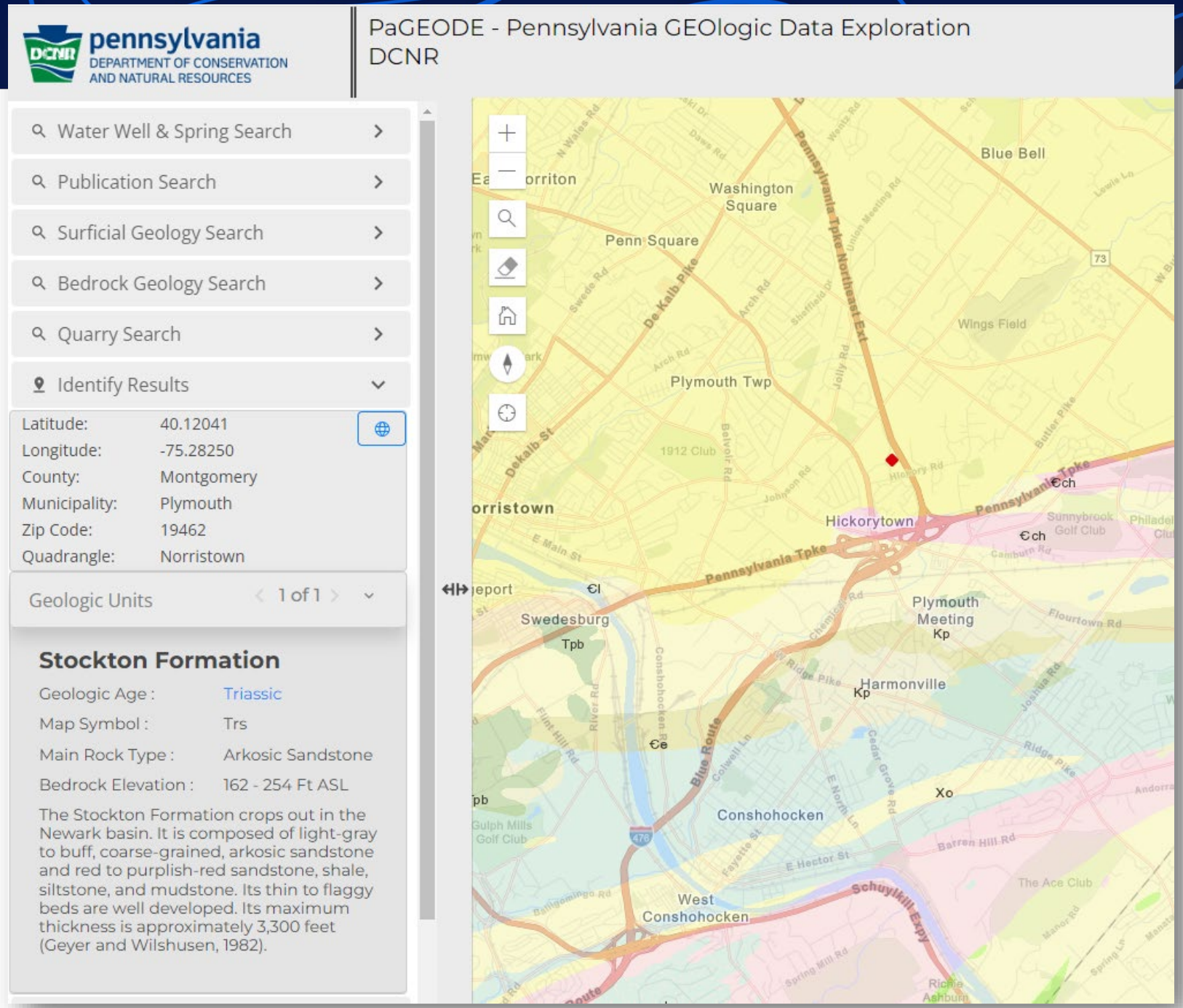
Survey's first X-ray diffractometer, 1958

PA Geologic Data Exploration

https://www.gis.dcnr.state.pa.us/pageode/



You are here… geologically



Publication Search

pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

PaGEODE - Pennsylvania GEOlogic Data Exploration
DCNR

Josh Shapiro, Governor Cindy Adams Dunn, Secretary

Links About Help Feedback

- Water Well & Spring Search
- Publication Search
  - 4th (Current) PA Geological Survey
  - Selected 2nd PA Geological Survey
  - Selected 1st PA Geological Survey
  - Selected U.S. Geological Survey
  - Exclude Statewide Publications?

To start your search either:

Draw on map to select features

OR

Select from a defined area

Layer: ...

Value: ...

- Surficial Geology Search
- Bedrock Geology Search
- Quarry Search
- Identify Results

Latitude: 40.12042
Longitude: -75.28231

Publication Search Results x

Search returned 170 records.

Report_ID	SERIES	TITLE	General_Pub_Extent	LINK_PAGE
W 02	Water Resource Reports	Ground water in southeastern Pennsylvania	Regional	Open Link
W 07	Water Resource Reports	Ground-water resources of Pennsylvania	Statewide	Open Link
W 14	Water Resource Reports	Geology and hydrology of the Stockton Formation in southeastern Pennsylvania	Local	Open Link
W 20	Water Resource Reports	The ground-water observation-well program in Pennsylvania	Statewide	Open Link
W 29	Water Resource Reports	Ground-water resources of Montgomery County, Pennsylvania	Local	Open Link
W 69	Water Resource Reports	Hydrogeologic and well-construction characteristics of the rocks of Pennsylvania	Statewide	Open Link
W 70	Water Resource Reports	Summary of groundwater-recharge estimates for Pennsylvania	Statewide	Open Link
OF 93-02	Open-File Reports	Sinkholes and karst-related features of Montgomery County, Pennsylvania	Local	Open Link
OF 96-49	Open-File Reports	Correlation chart showing suggested revisions of uppermost Devonian through Permian stratigraphy, Pennsylvania	Statewide	Open Link
OFGG 05-01.0	Open-File Reports	Basement depth and related geospatial database for Pennsylvania	Statewide	Open Link

<< < > >> Page 1 of 17 | Go to page: 1 Show 10

Quarry Search

pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

PaGEODE - Pennsylvania GEOlogic Data Exploration
DCNR

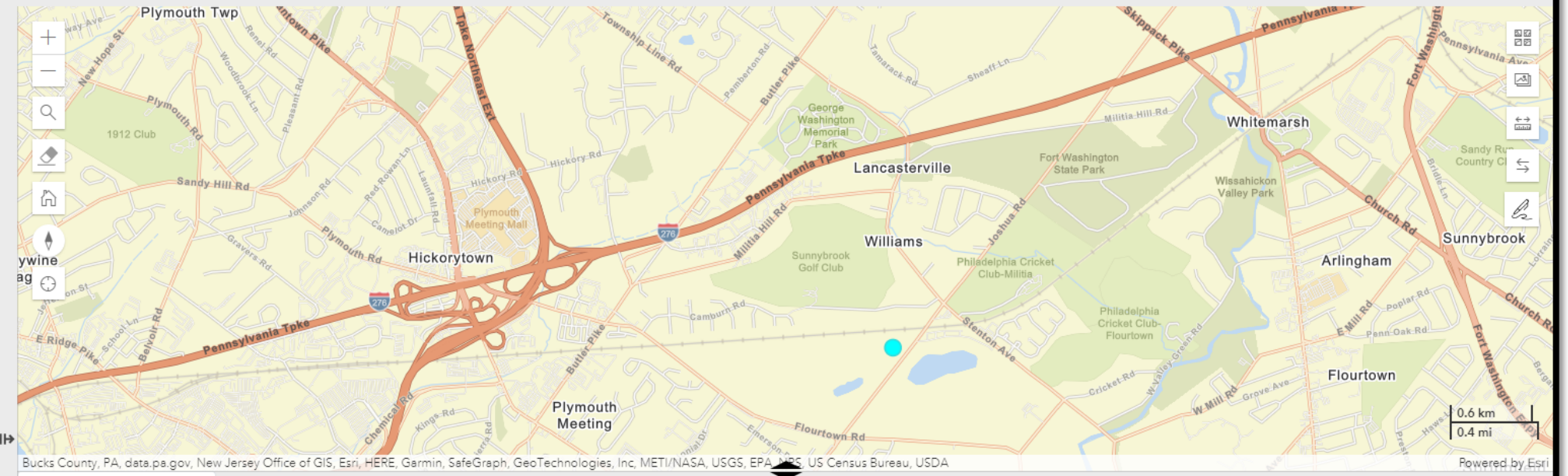
Josh Shapiro, Governor Cindy Adams Dunn, Secretary

Links About Help Feedback

- Surficial Geology Search
- Bedrock Geology Search
- Quarry Search
- Product / Lithology Search
- Operation Name Search

Product: Select
Lithology: Select
County: Montgomery

Clear Search



Identify Results

Latitude: 40.10754
Longitude: -75.24822
County: Montgomery
Municipality: Whitemarsh
Zip Code: 19462
Quadrangle: Germantown

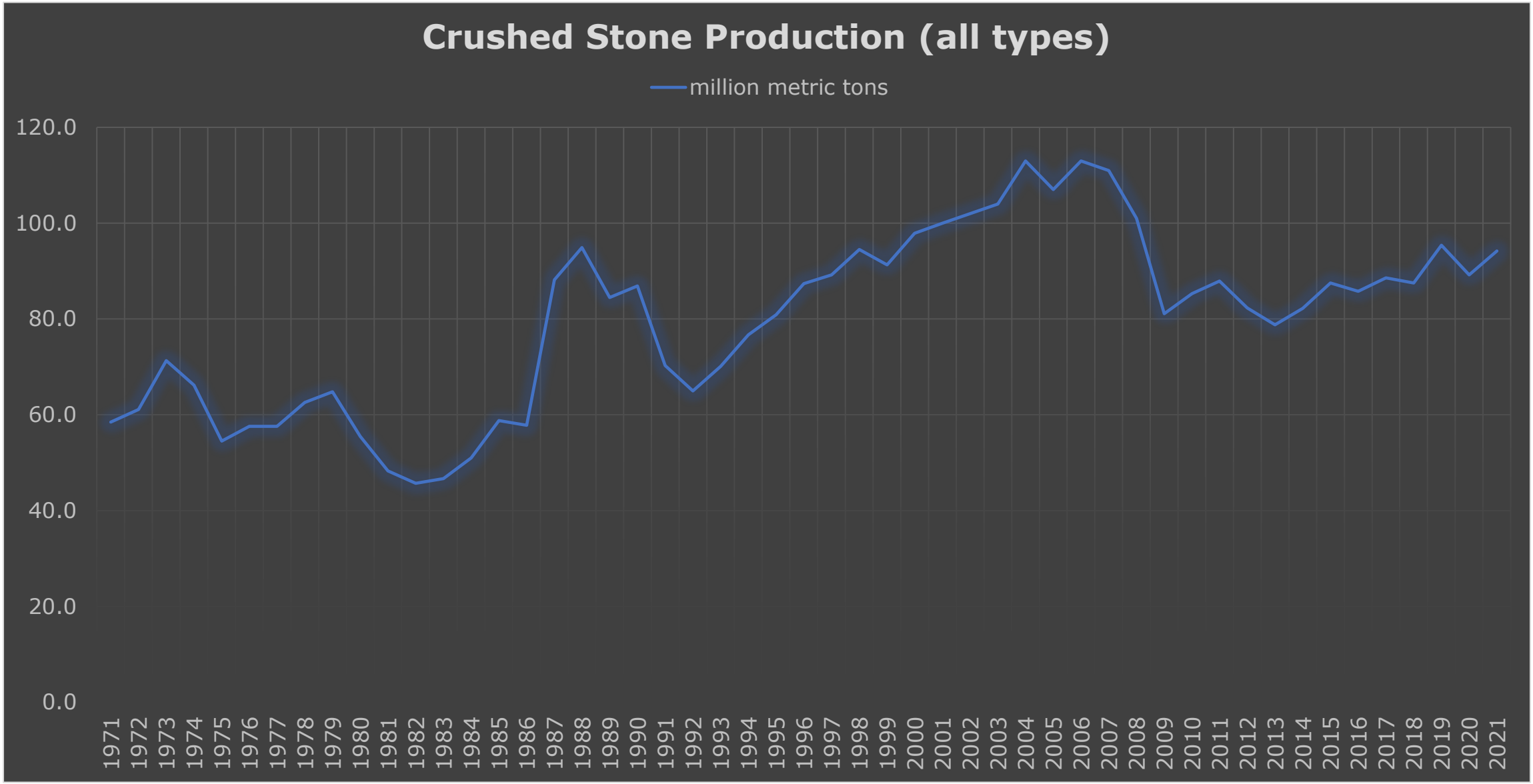
- Elevation Profile
- Layers
- Legend
- Print
- Download Data

Quarry Search Results X

Search returned 17 records.

Operation Name	Owner Name	Phone #	Website	Operation Type	County	Quadrangle	Formation 1	Formation 2	Lithology 1	Lithology 2	Product	Comments	Source	Publication Link
Plymouth Meeting	Highway Materials, Inc.	(610) 832-8000		quarry	Montgomery	Germantown	Ledger		dolomite		specialty limestone		OFMR 15-01.1	Open Link
Plymouth Meeting	Highway Materials, Inc.	(610) 832-8000		quarry	Montgomery	Germantown	Ledger		dolomite		aggregate-coarse	See O'Neill (1964) for analysis.	OFMR 15-01.1	Open Link
Plymouth Meeting	Highway Materials, Inc.	(610) 832-8000		quarry	Montgomery	Germantown	Ledger		dolomite		aggregate-fine	See O'Neill (1964) for analysis.	OFMR 15-01.1	Open Link
Perkiomenville	Highway Materials, Inc.	(610) 832-8000		quarry	Montgomery	Perkiomenville	Brunswick		hornfels		antiskid		OFMR 15-01.1	Open Link
Perkiomenville	Highway Materials, Inc.	(610) 832-8000		quarry	Montgomery	Perkiomenville	Brunswick		hornfels		aggregate-coarse		OFMR 15-01.1	Open Link
Perkiomenville	Highway Materials, Inc.	(610) 832-8000		quarry	Montgomery	Perkiomenville	Brunswick		hornfels		aggregate-fine		OFMR 15-01.1	Open Link

<< < > >> Page 2 of 2 | Go to page: 1 Show 10


Crushed Stone Production (all types)
million metric tons
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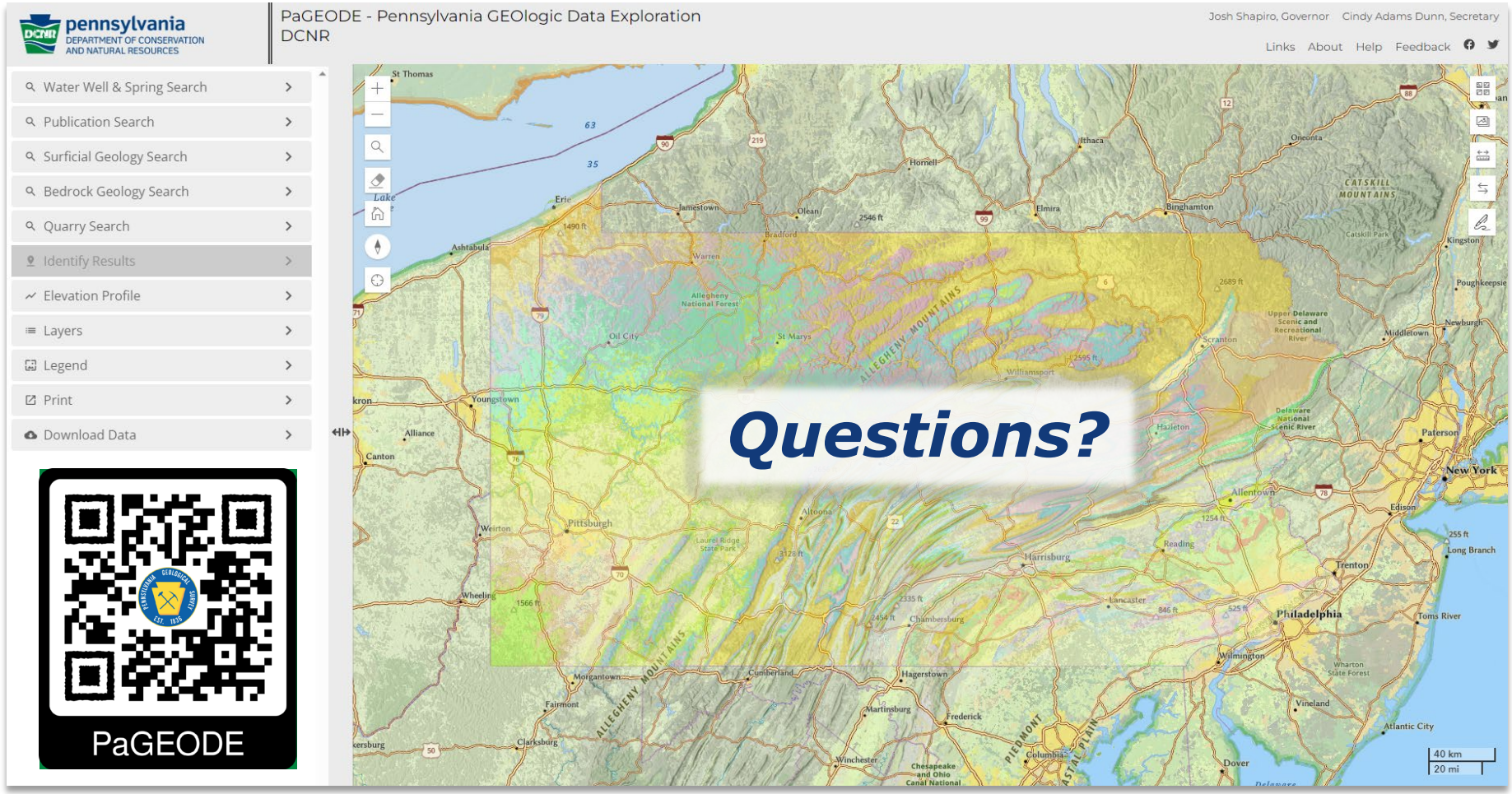
Activities of the Survey Supporting the Future of the Aggregate Industry

- Ongoing search for funding for aggregate availability study
- Through the Association of American State Geologists, engaging with NSSGA, National Mining Association, and the Essential Minerals Association
- New maps, reports, data; working to make data more easily accessible
- Geologic Mapping Advisory Committee
  - PACA representative is Josie Gaskey
  - We welcome your input

PA Geologic Data Exploration

https://www.gis.dcnr.state.pa.us/pageode/



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