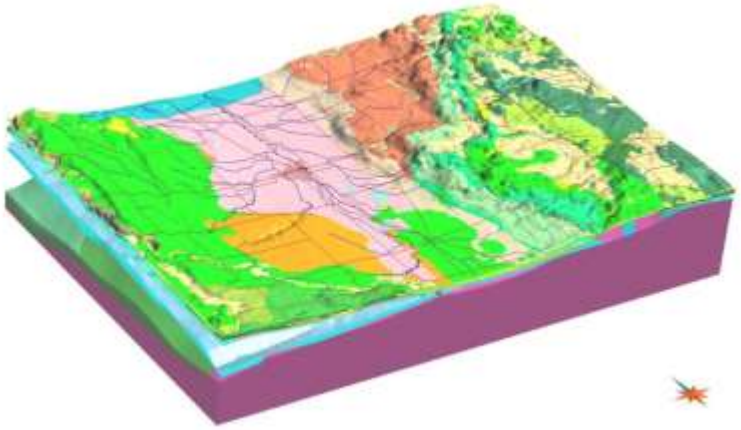
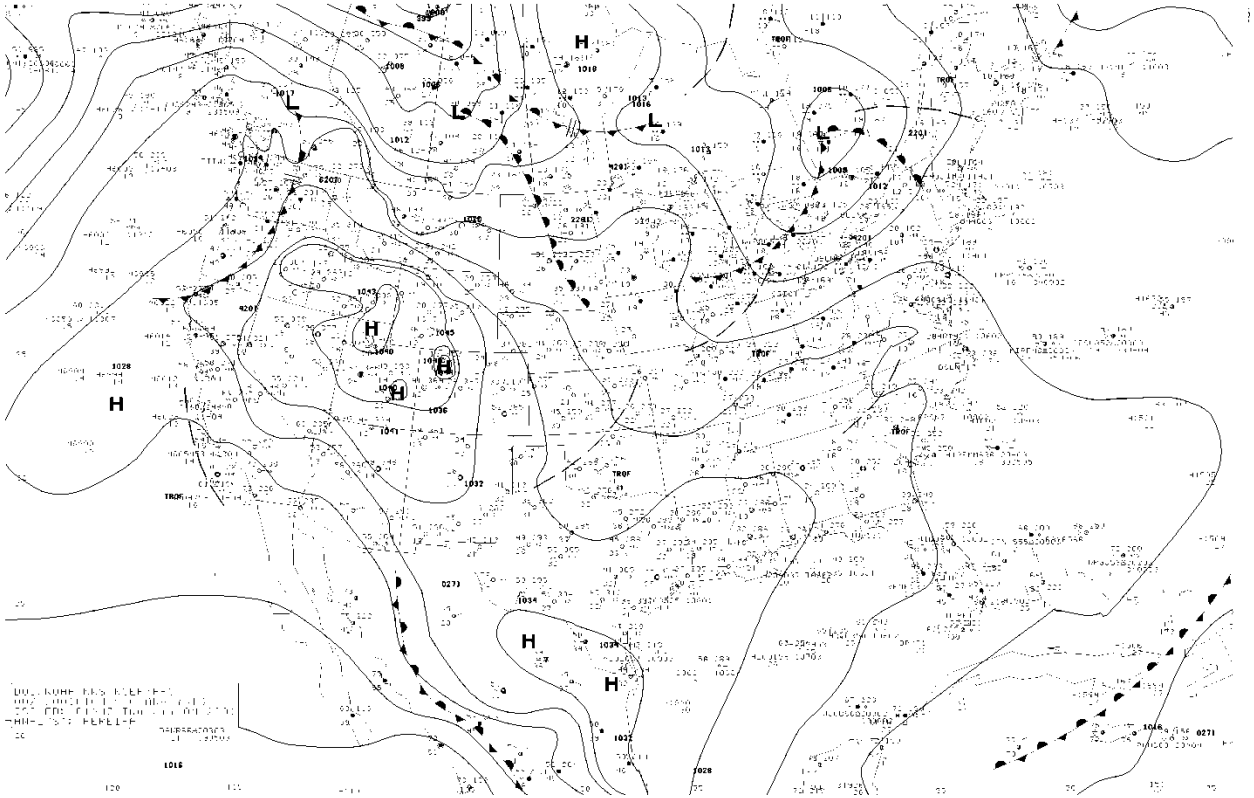
Minnesota Geological Survey Information Systems

Harvey Thorleifson Ph.D.
Director, Minnesota Geological Survey

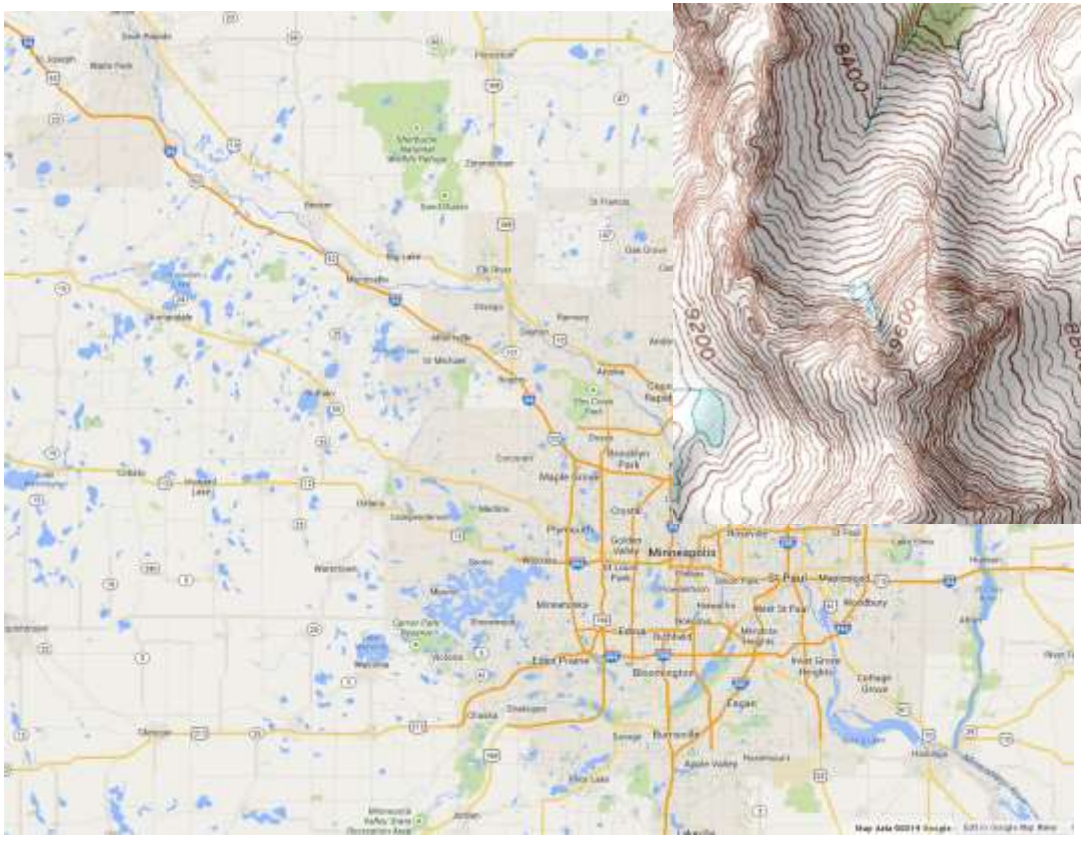
National Geospatial Advisory Committee
April 6 - 7, 2016



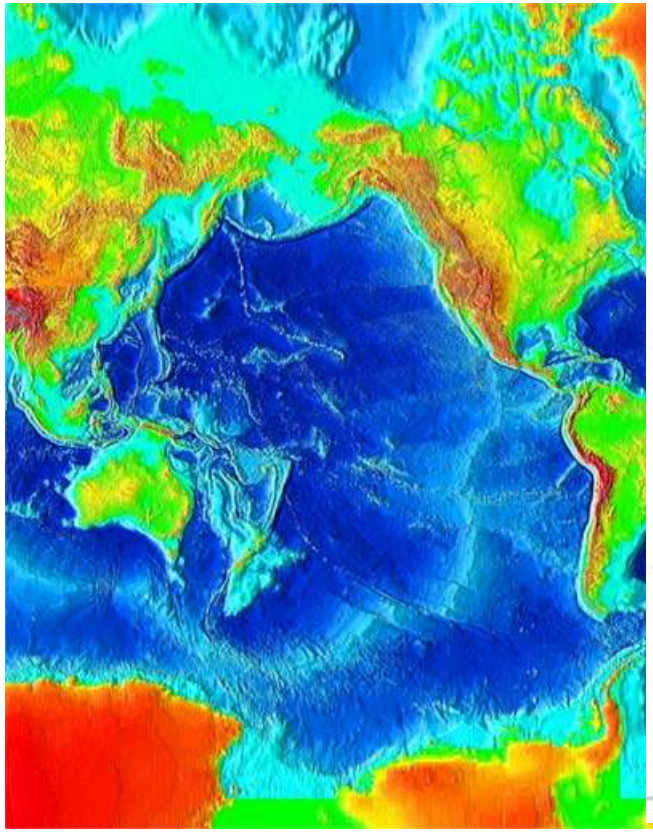
Some of us look up, to construct meteorological charts

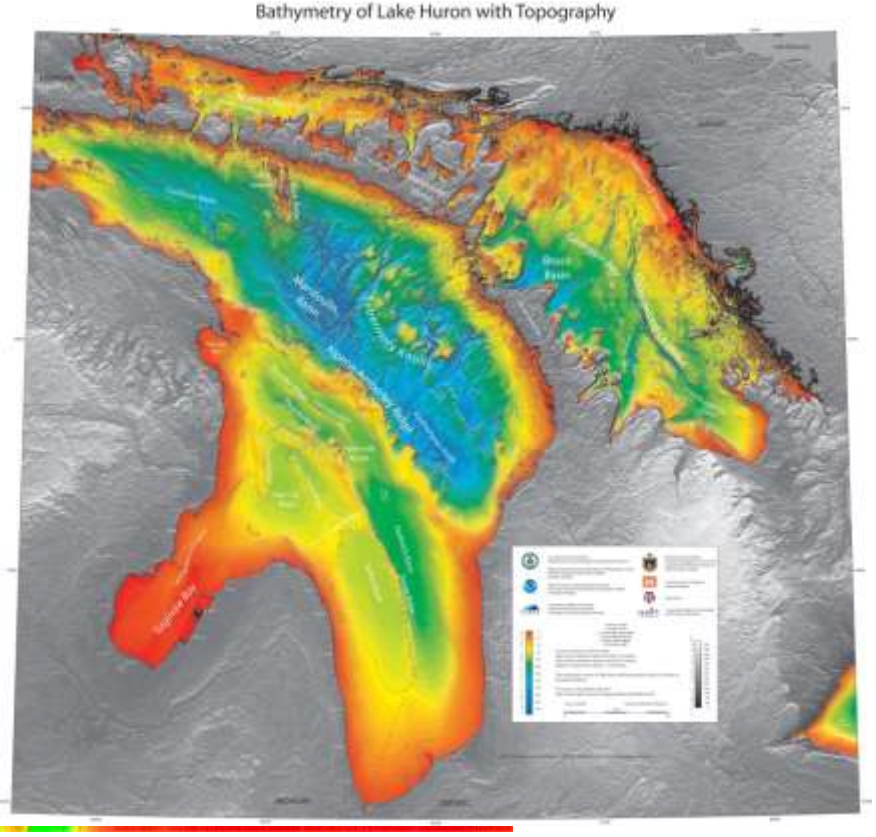


Much of our effort is in depicting land-surface features

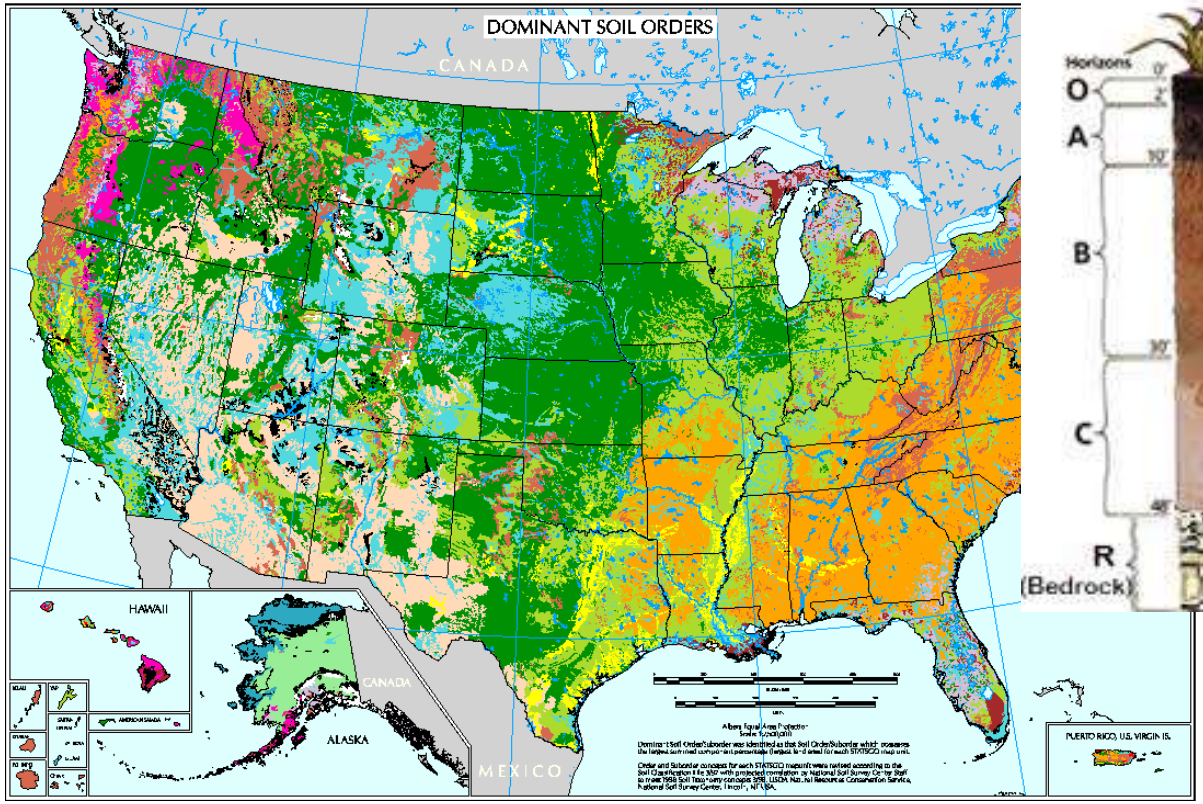


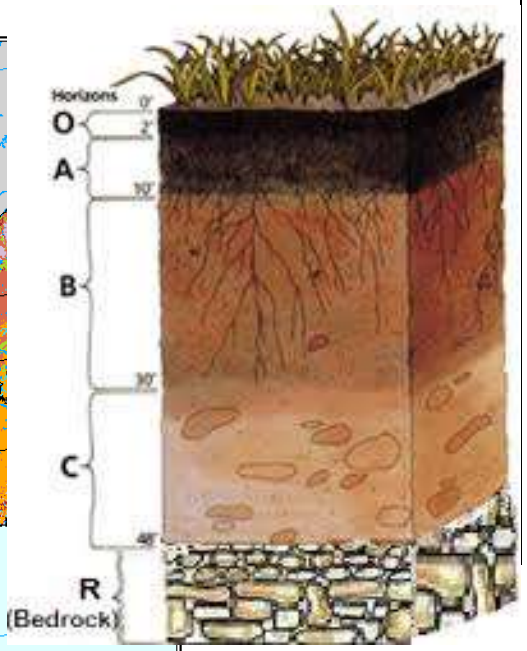
The first subsurface layer is bathymetry

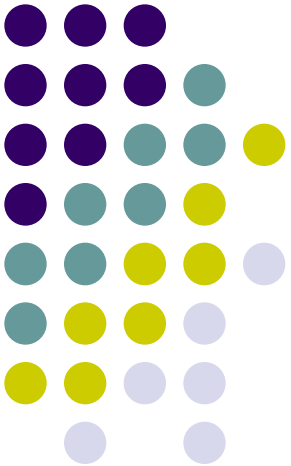




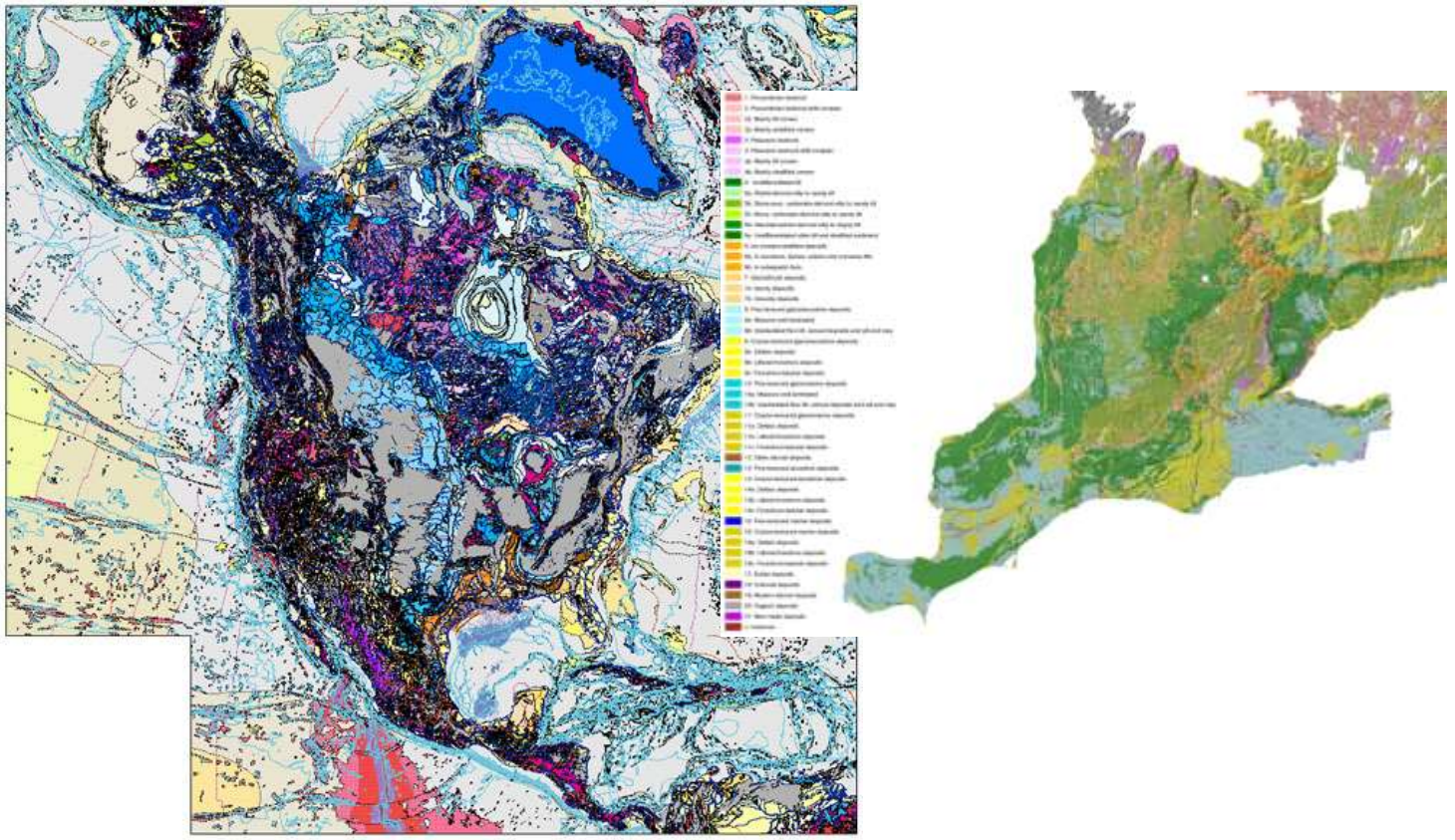
Next, soil mapping by agricultural agencies







Then, geology



Geological mapping, like all of the mapping we do, is an essential service

Energy
Minerals
Water
Hazards
Environment
Waste
Engineering

Geological mapping, like all of the mapping we do, saves money

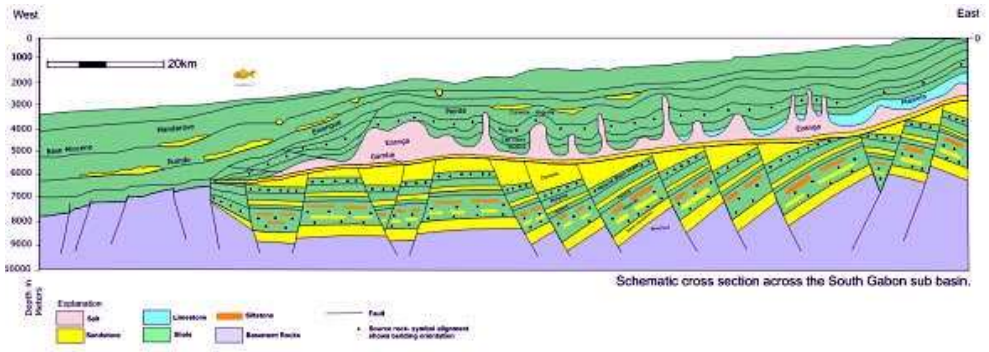
lives saved

resources discovered

costs avoided

increased efficiency

fundamental understanding



Schematic cross section across the South Gabon sub basin.

We need to accelerate in response to societal needs

Content
Collaboration
Administration
Infrastructure
Formats
Accessibility

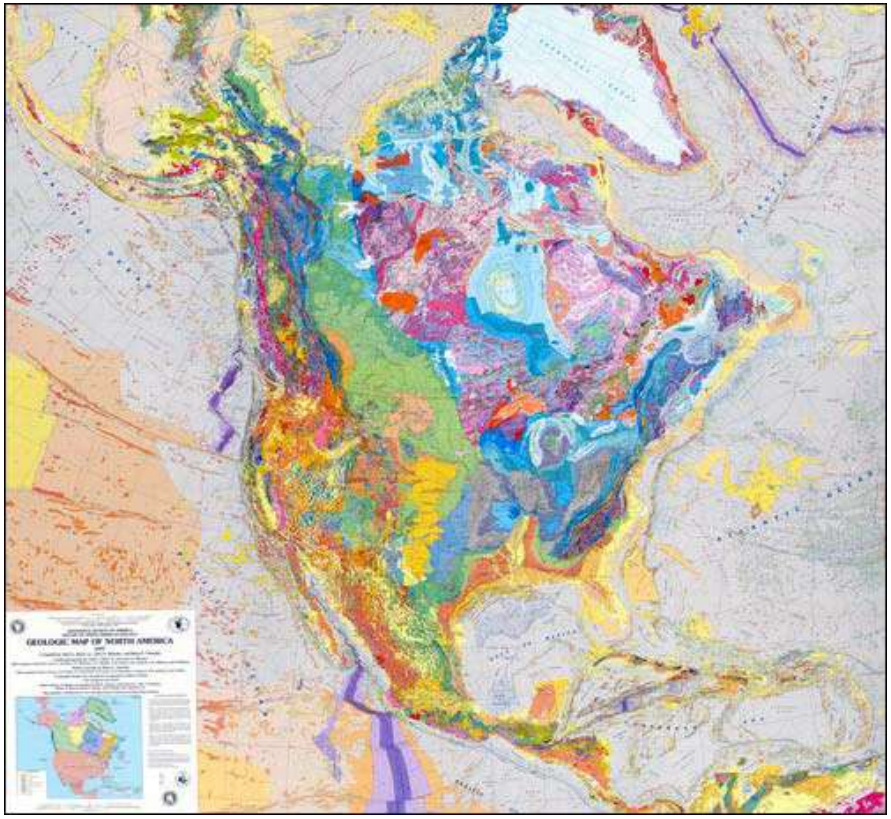
Resolution

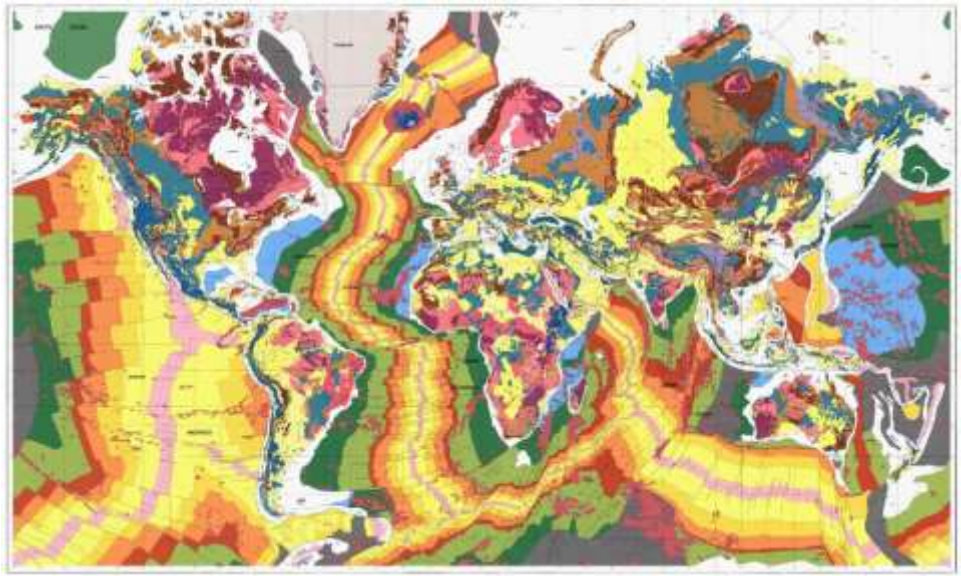
Global

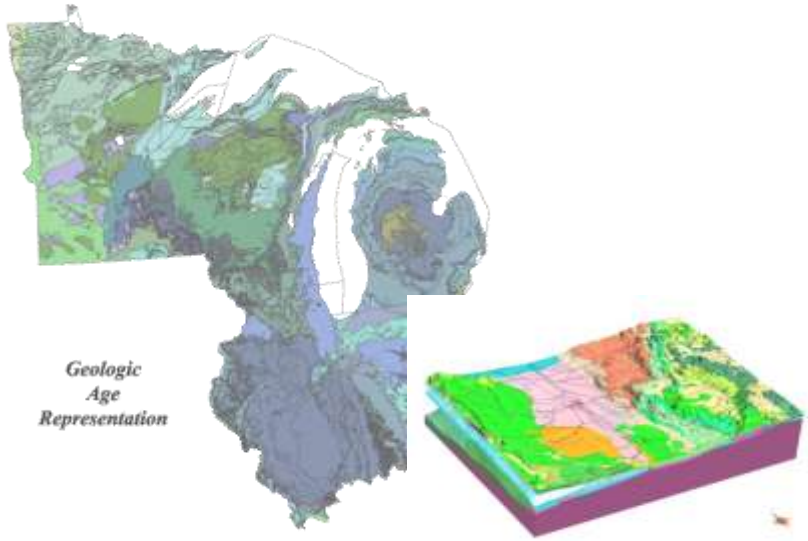
National

State

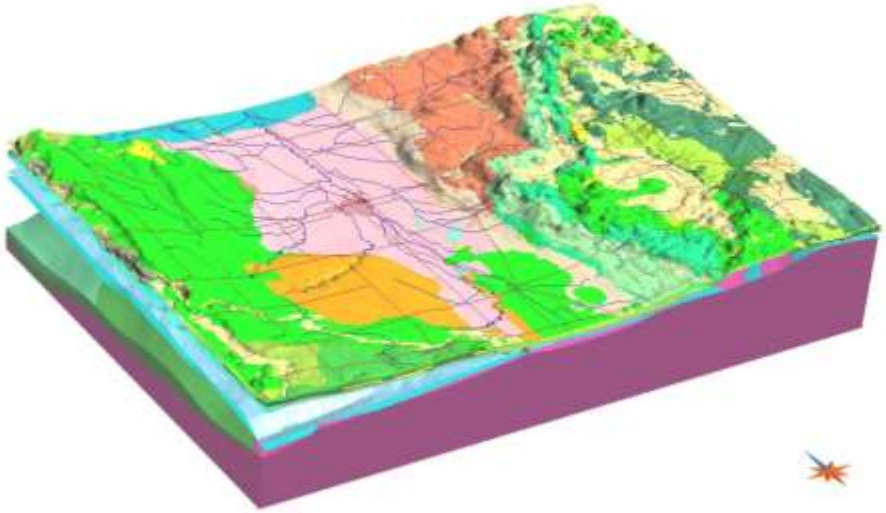
County







Future geological mapping needs to be



Regularly updated

Zoomable

Queryable

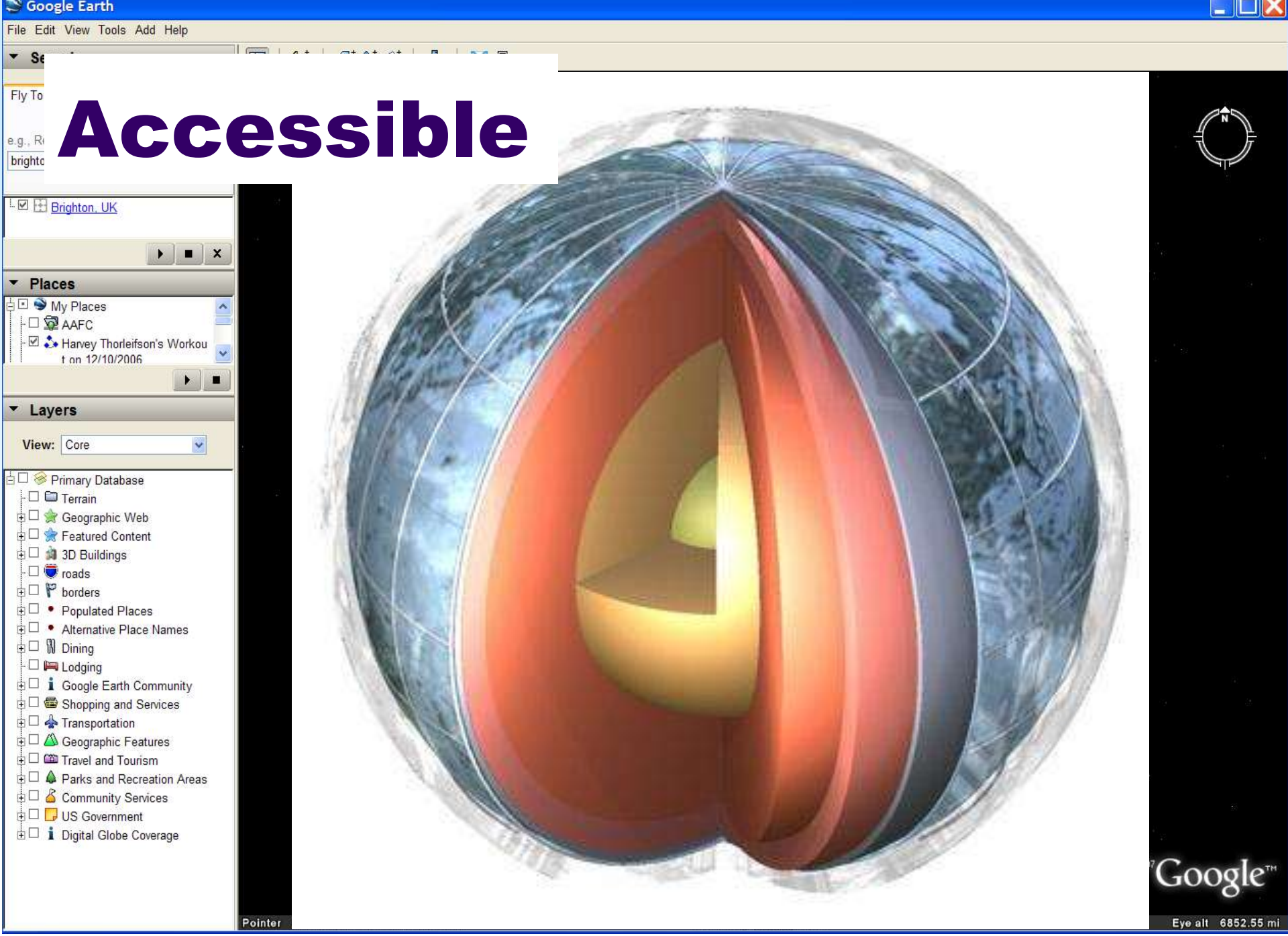
Complete

Seamless

3D

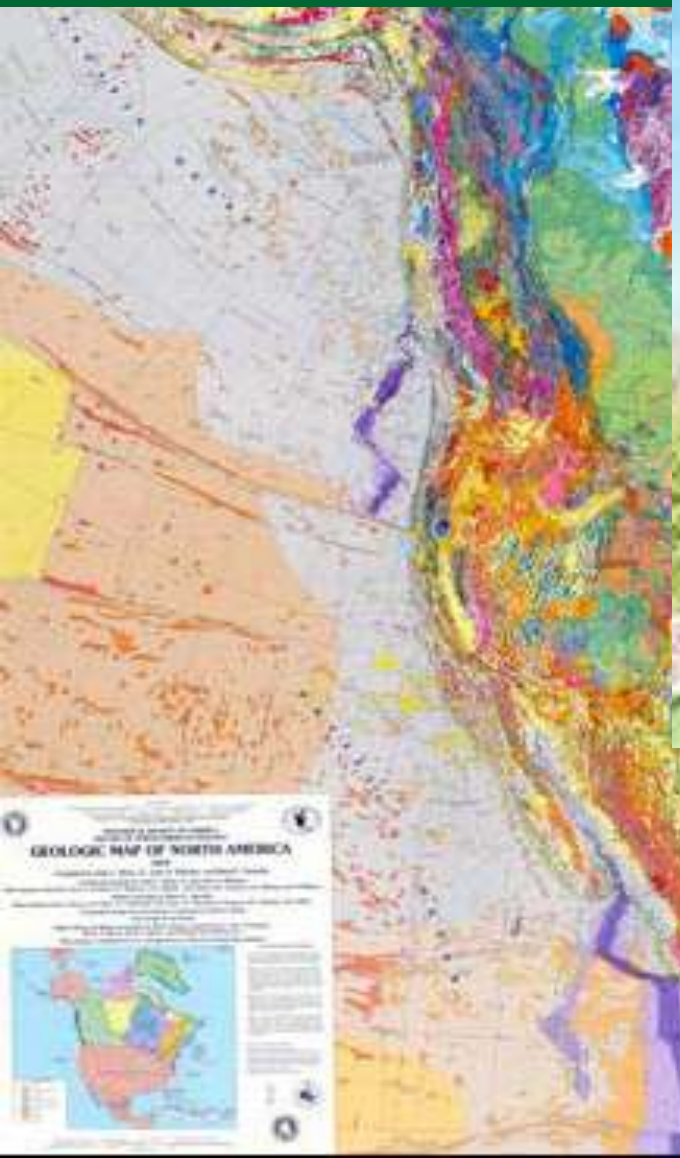
Onshore to offshore

Accessible


Google Earth
File Edit View Tools Add Help
Fly To
Brighton, UK
Places
My Places
AAFC
Harvey Thorleifson's Workou
t on 12/10/2006
Layers
View: Core
Primary Database
Terrain
Geographic Web
Featured Content
3D Buildings
roads
borders
Populated Places
Alternative Place Names
Dining
Lodging
Google Earth Community
Shopping and Services
Transportation
Geographic Features
Travel and Tourism
Parks and Recreation Areas
Community Services
US Government
Digital Globe Coverage
Pointer
Google
Eye alt 6852.55 mi

USGS

science for a changing world



Association of American State Geologists

LOG-IN

AASG

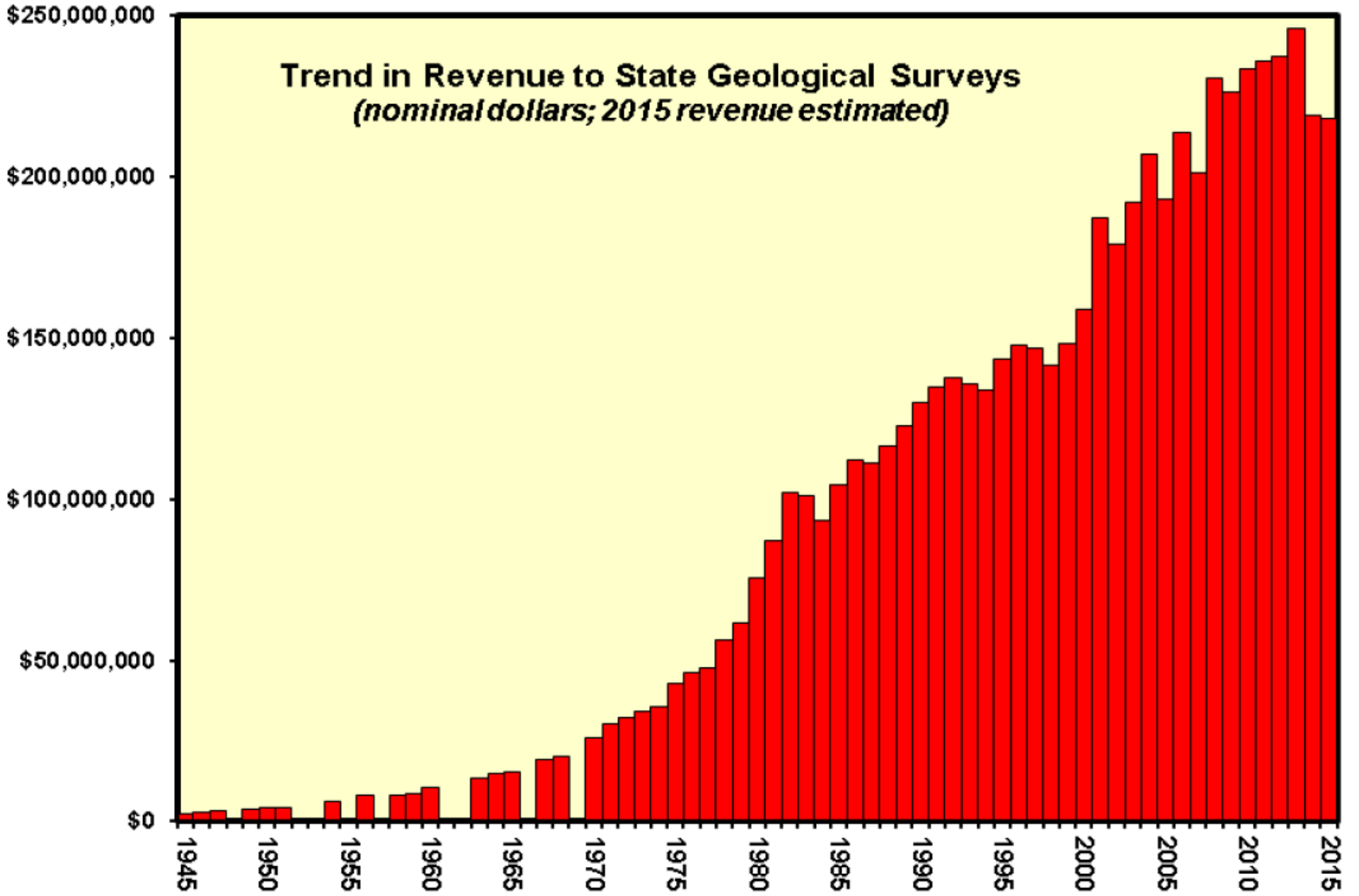
The **Association of American State Geologists (AASG)** represents the State Geologists of the 50 United States and Puerto Rico. Founded in 1908, AASG seeks to advance the science and practical application of geology and related earth sciences in the United States and its territories, commonwealths, and possessions.

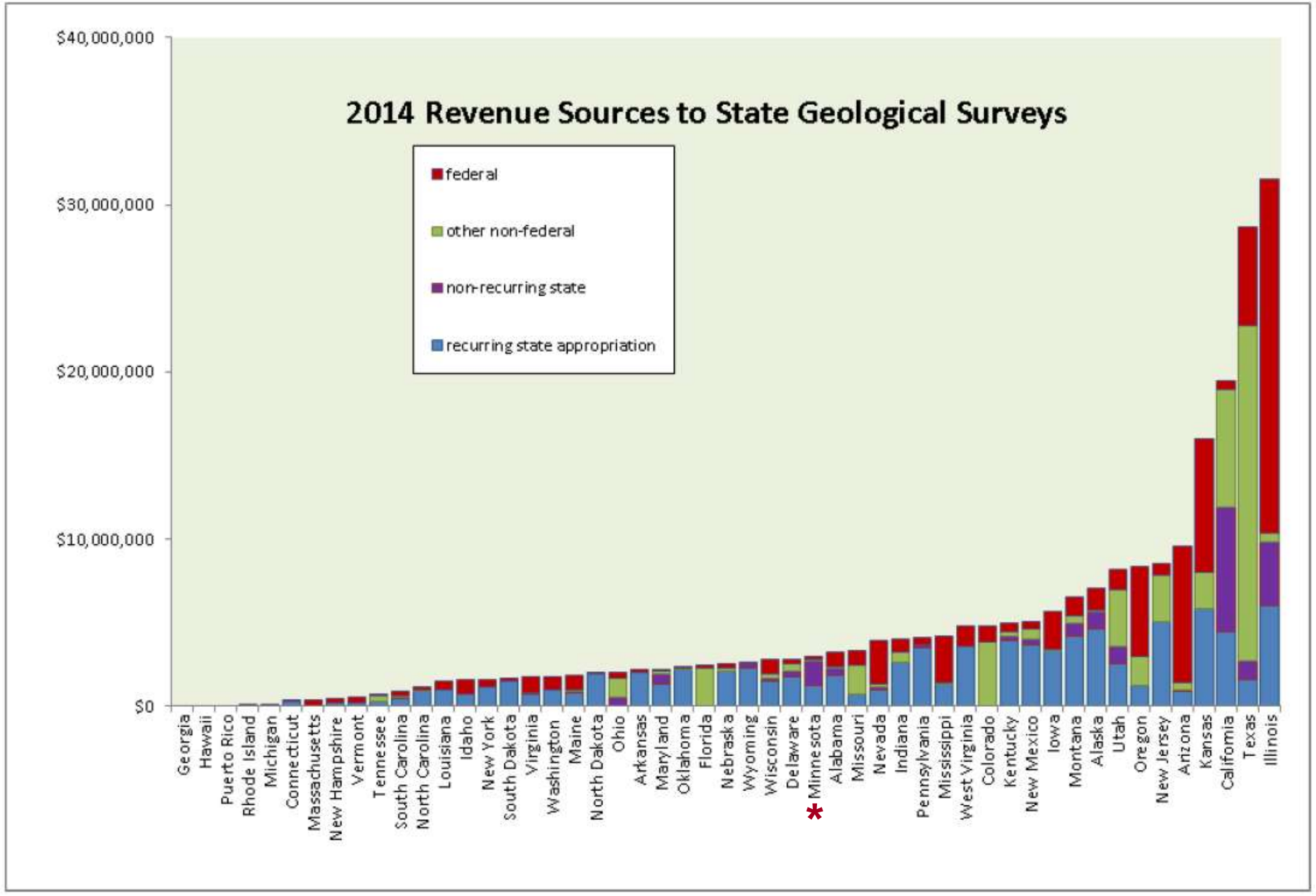
Click on each state to go to its geological survey!

Other selection options...

- **Home**
- About AASG
- State Geological Surveys
- Officers and Committees
- Upcoming Meetings
- Awards and Honors
- Fact Sheets
- In the News
- Useful Links
- Employment Opportunities

This server is run by the Alaska Division of Geological & Geophysical Surveys (DGGS).
Last updated 05/25/2007 10:32:42.
Comments to the DGGS Webmaster.


Trend in Revenue to State Geological Surveys
(nominal dollars; 2015 revenue estimated)
$250,000,000
$200,000,000
$150,000,000
$100,000,000
$50,000,000
$0
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015

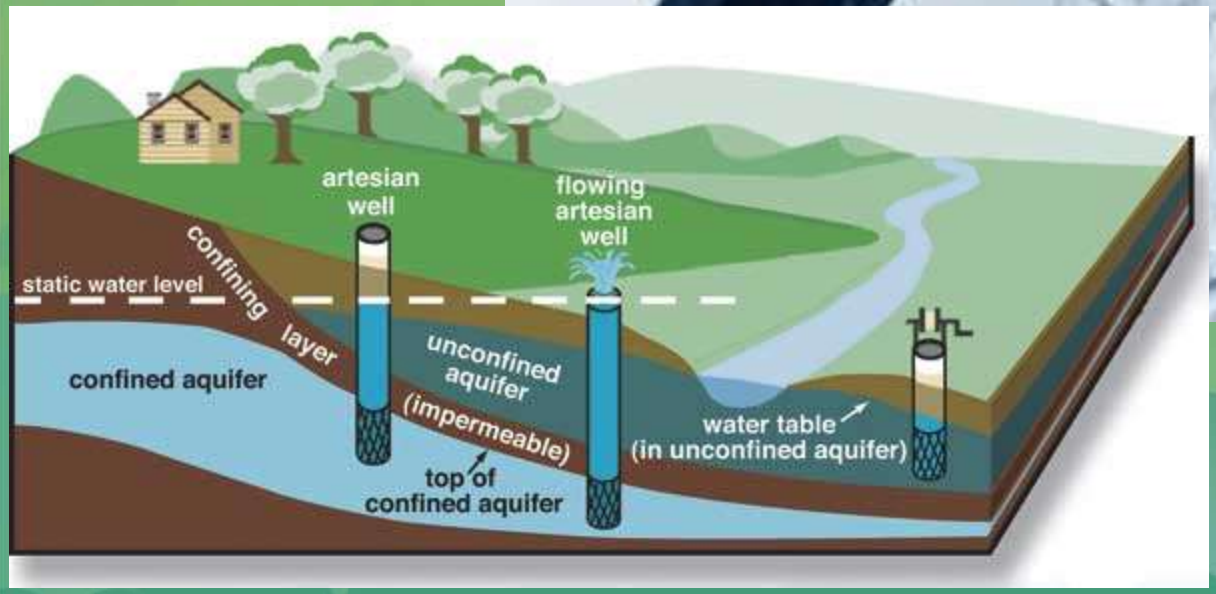

2014 Revenue Sources to State Geological Surveys
federal
other non-federal
non-recurring state
recurring state appropriation
$40,000,000
$30,000,000
$20,000,000
$10,000,000
$0
Georgia
Hawaii
Puerto Rico
Rhode Island
Michigan
Connecticut
Massachusetts
New Hampshire
Vermont
Tennessee
South Carolina
North Carolina
Louisiana
Idaho
New York
South Dakota
Virginia
Washington
Maine
North Dakota
Ohio
Arkansas
Maryland
Oklahoma
Florida
Nebraska
Wyoming
Wisconsin
Delaware
Minnesota
Alabama
Missouri
Nevada
Indiana
Pennsylvania
Mississippi
West Virginia
Colorado
Kentucky
New Mexico
Iowa
Montana
Alaska
Utah
Oregon
New Jersey
Arizona
Kansas
Califomia
Texas
Illinois
*

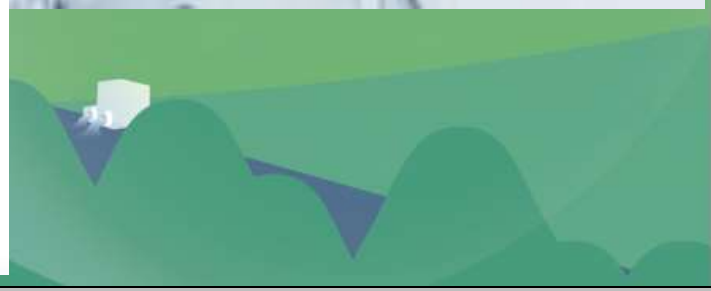
Minnesota Geological Survey

Minnesota Geological Survey

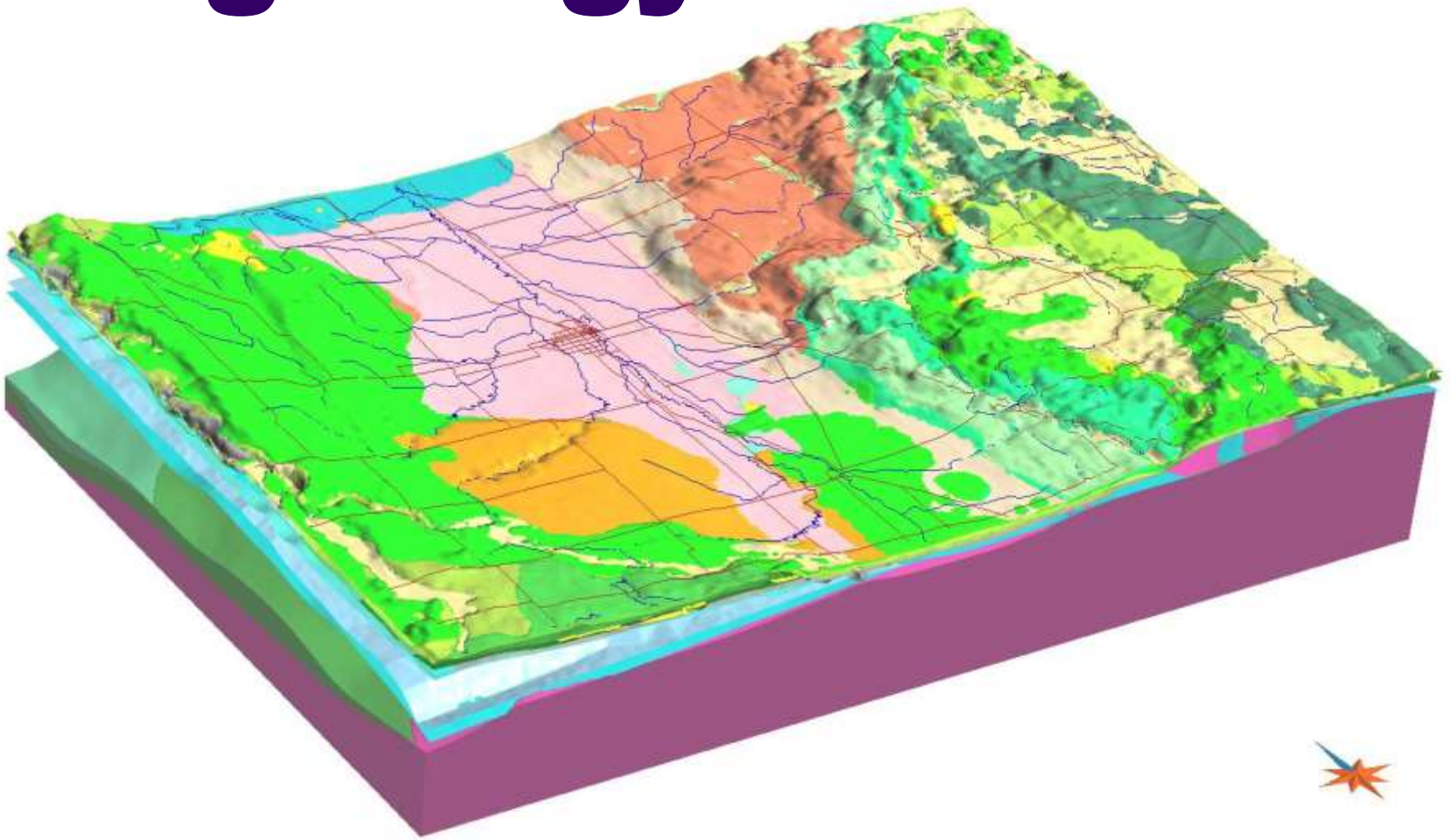
Thomsonite from northern Minnesota

MINNESOTA WATER SUSTAINABILITY FRAMEWORK

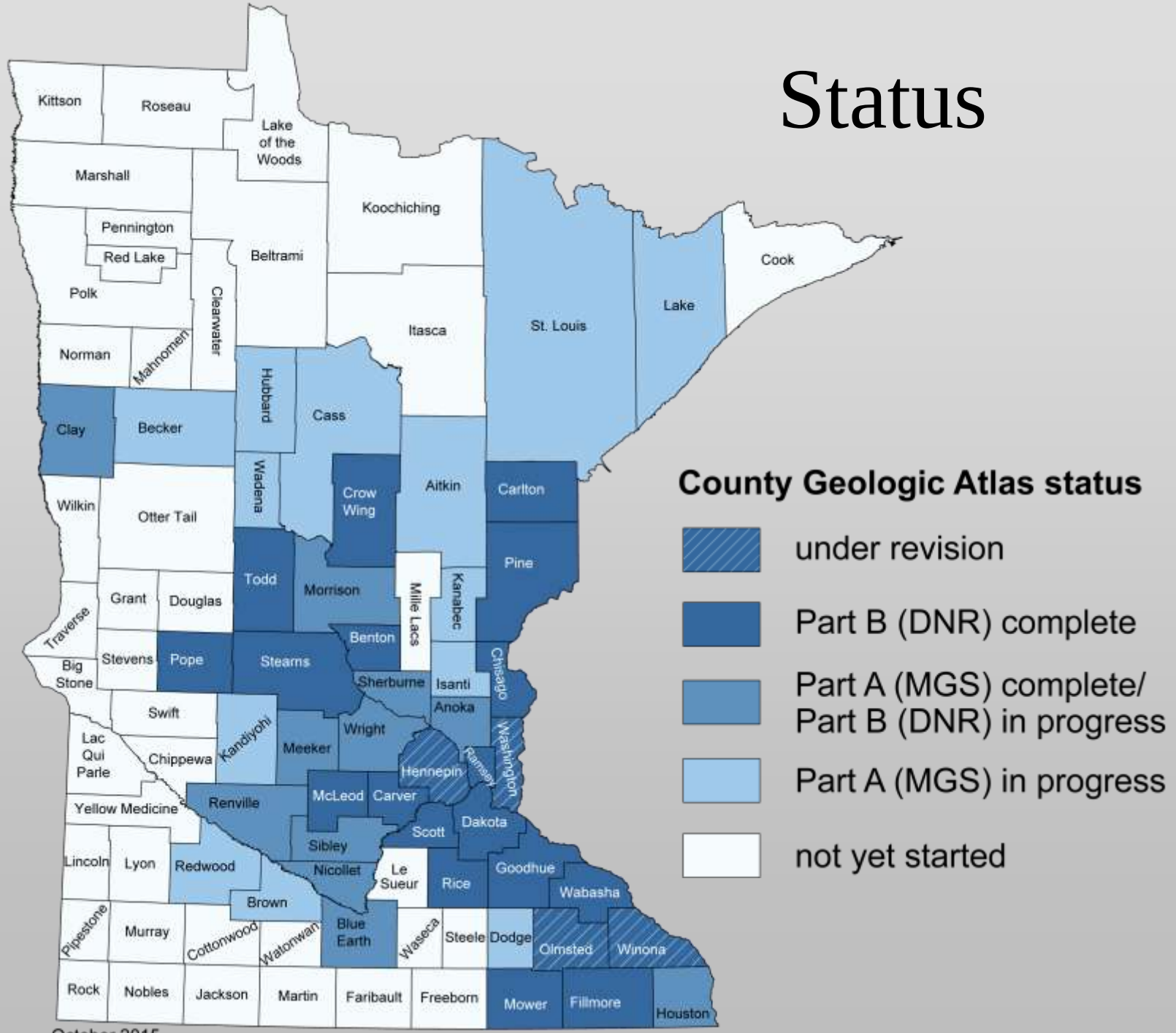




3D geology



Status



County Geologic Atlas status

- under revision
- Part B (DNR) complete
- Part A (MGS) complete/ Part B (DNR) in progress
- Part A (MGS) in progress
- not yet started

UNIVERSITY OF MINNESOTA

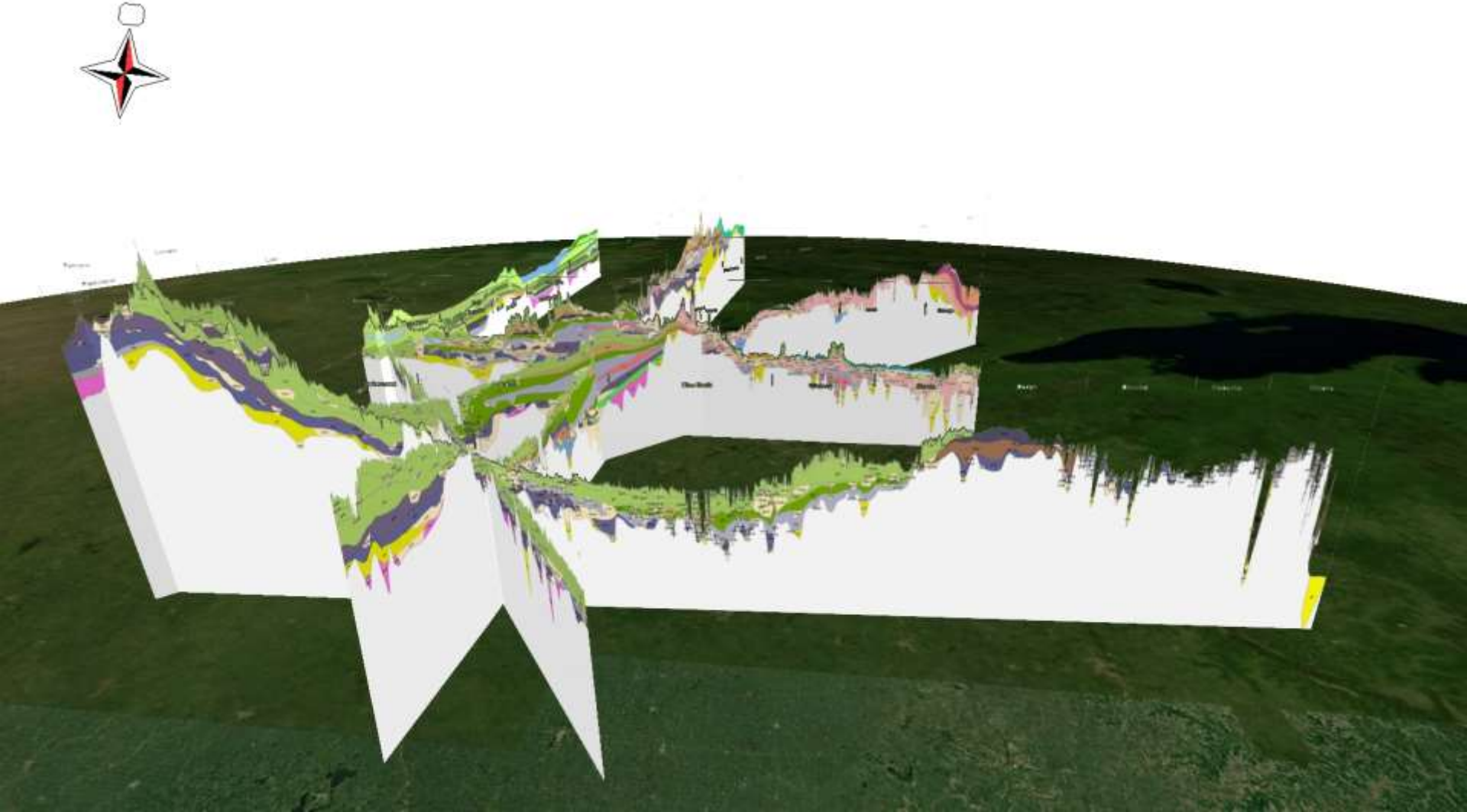
Minnesota Geological Survey

MINNESOTA GEOLOGICAL SURVEY INFORMATION SYTEMS

We are heading toward a 2-resolution, layered set of databases that will include the offshore, that will underly bathymetric and soil mapping, and that will be as compatible as possible with neighbors.

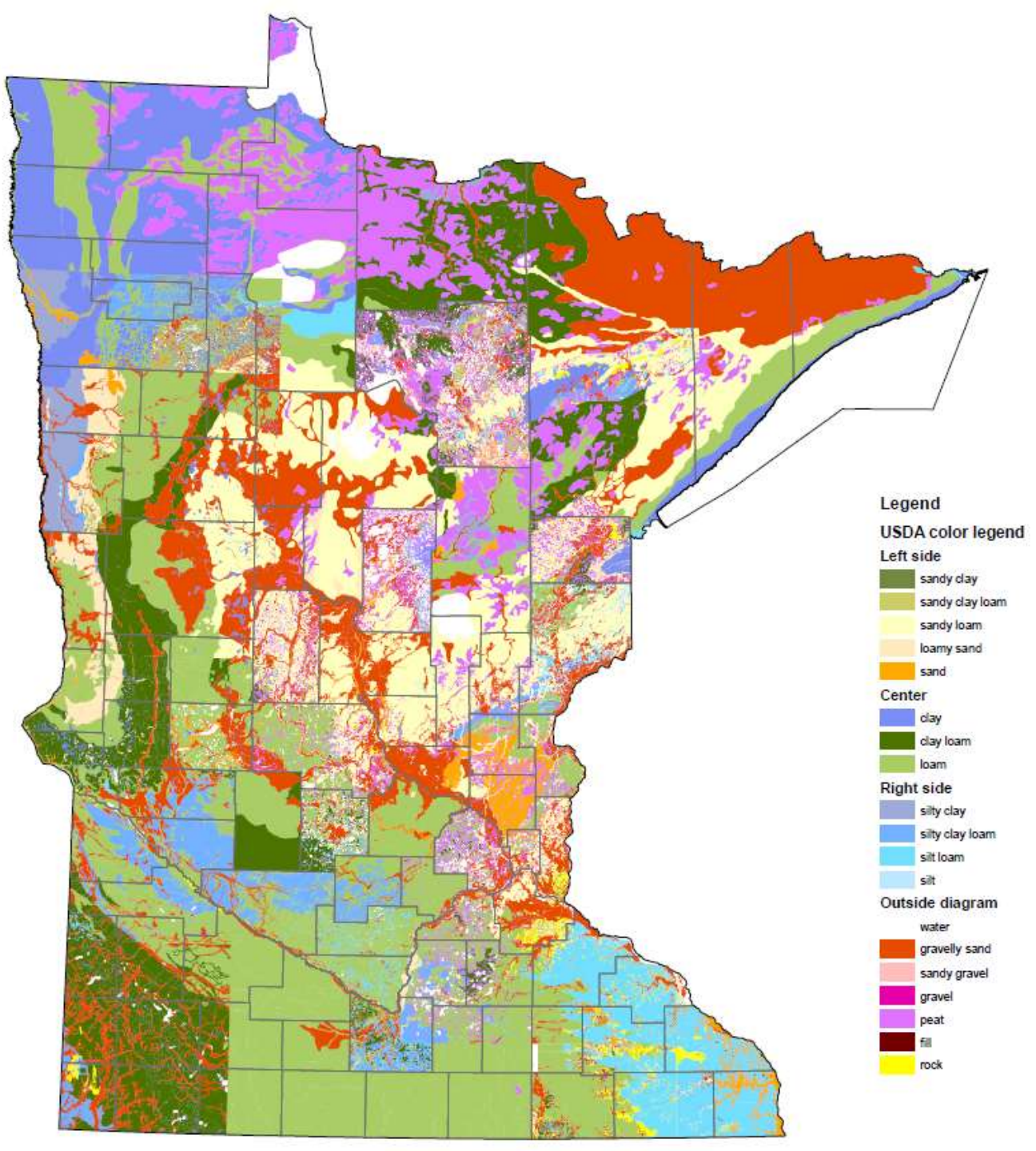
The geological mapping database will be underpinned by authored and peer-reviewed geological maps, while efforts to refine stratigraphic nomenclature are ongoing.

Minnesota Geological Survey



Progressively more seamless geological polygons, at 1:500,000 and 1:100,000, are tending to have thickness indicated, while properties, heterogeneity, and uncertainty will gradually be more specified. Parsing of legends, to facilitate queries, is using broadly accepted, well-defined terminology, to facilitate inference of properties.


Rainy
Grand Forks
Bemidji
Moorhead
MINNESO
Fargo
St Cloud
Minneapol
Mankato
Sioux Falls


Legend
USDA color legend
Left side
sandy clay
sandy clay loam
sandy loam
loamy sand
sand
Center
clay
clay loam
loam
Right side
silty clay
silty clay loam
silt loam
silt
Outside diagram
water
gravelly sand
sandy gravel
gravel
peat
fill
rock

Minnesota Geological Survey

A layered 1:500,000 state bedrock geologic map is largely complete, while a new state surficial geology map is in development.

University of Minnesota
Minnesota Geological Survey
Harvey Thorleifson, Director

GEOLOGIC MAP OF MINN
BEDROCK GEOLOG

Compiled by

Mark A. Jirsa, Terrance J. Boerboom, V.W.
John H. Mossler, Anthony C. Runkel, and Dale

2011

University of Minnesota
Minnesota Geological Survey
Harvey Thorleifson, Director

GEOLOGIC MAP OF MINNESOTA
PRECAMBRIAN BEDROCK GEOLOGY

Compiled by

Mark A. Jirsa, Terrance J. Boerboom, and V.W. Chandler

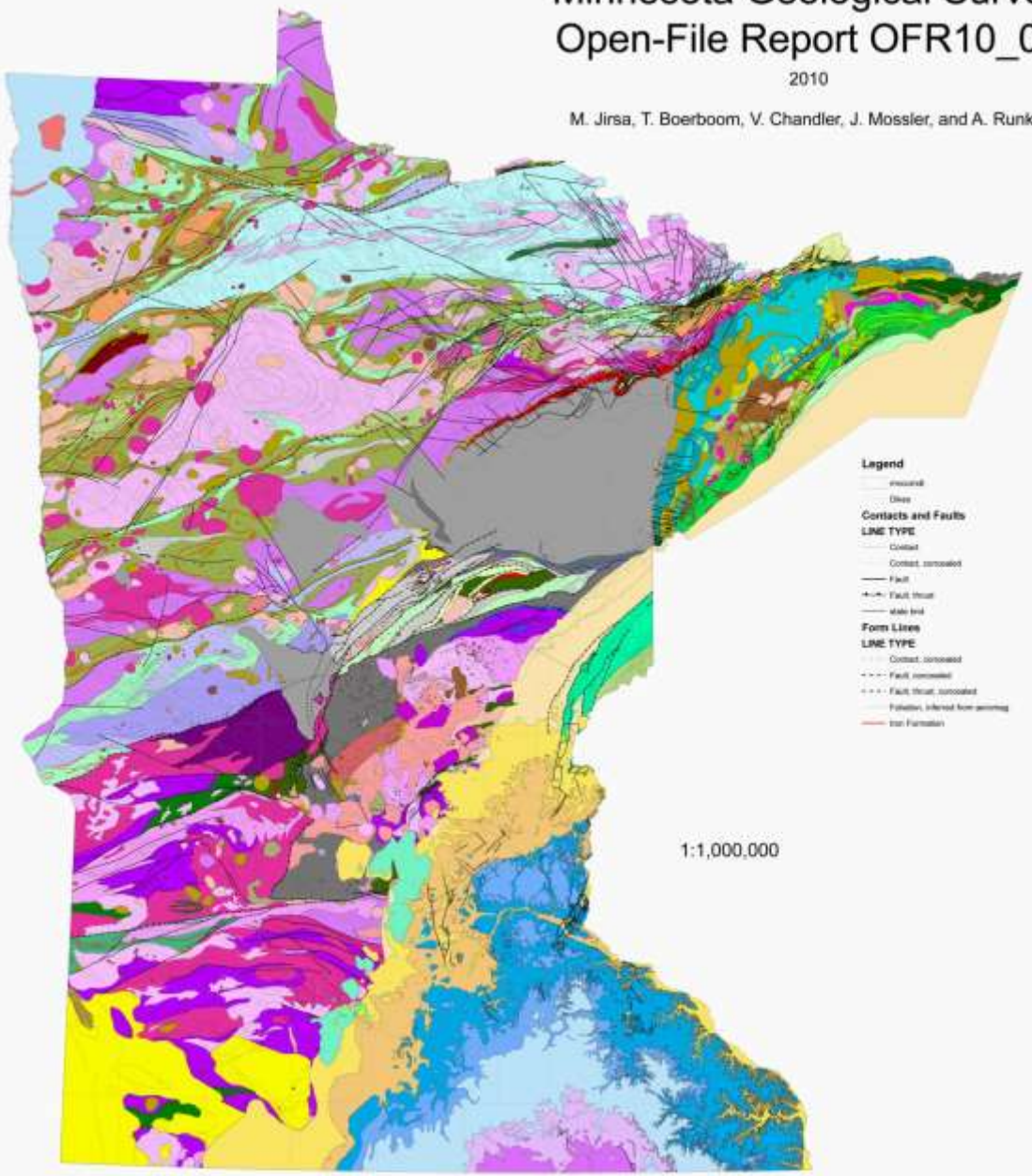
2012

Preliminary Bedrock Geologic Map of Minnesota

Minnesota Geological Survey
Open-File Report OFR10_02

2010

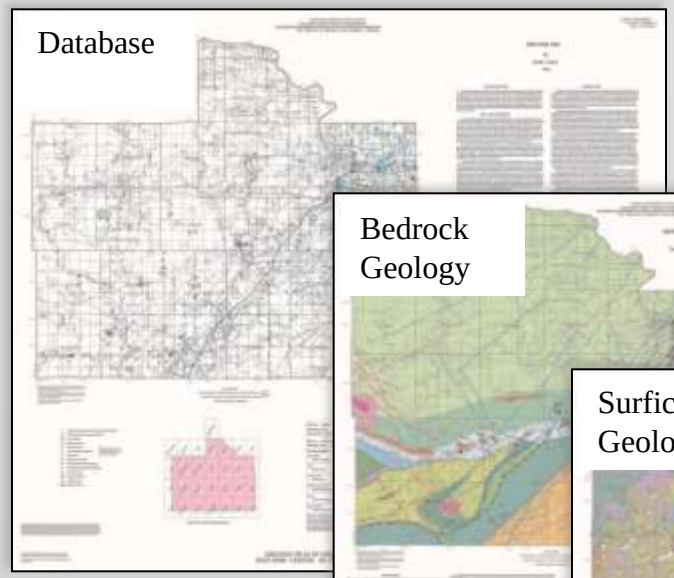
M. Jirsa, T. Boerboom, V. Chandler, J. Mossler, and A. Runkel

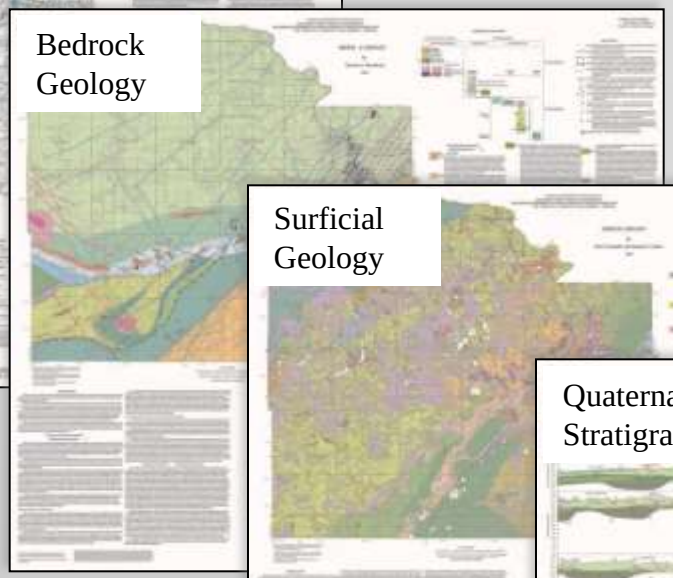


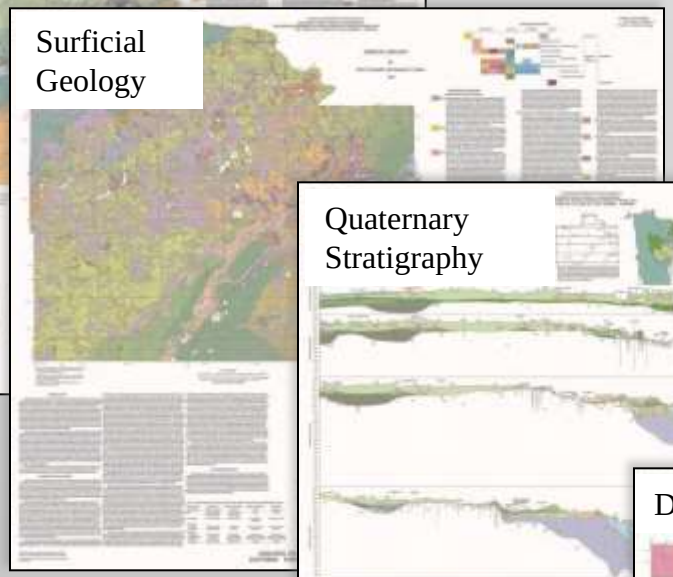
Minnesota Geological Survey

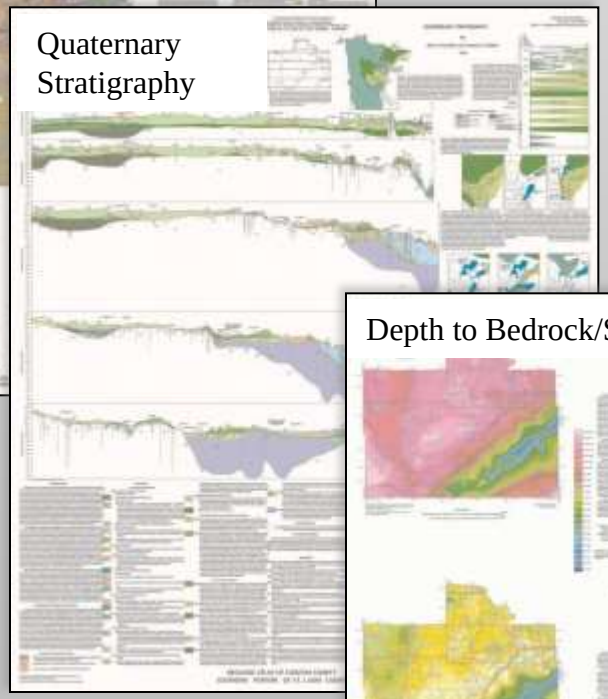
New 1:100,000 mapping is county-based, is meant to be complete statewide within a decade or two, and is focused on societal needs, with an emphasis on groundwater protection and management, while taking a broad approach. Where required to resolve issues, 1:24,000 mapping is conducted.

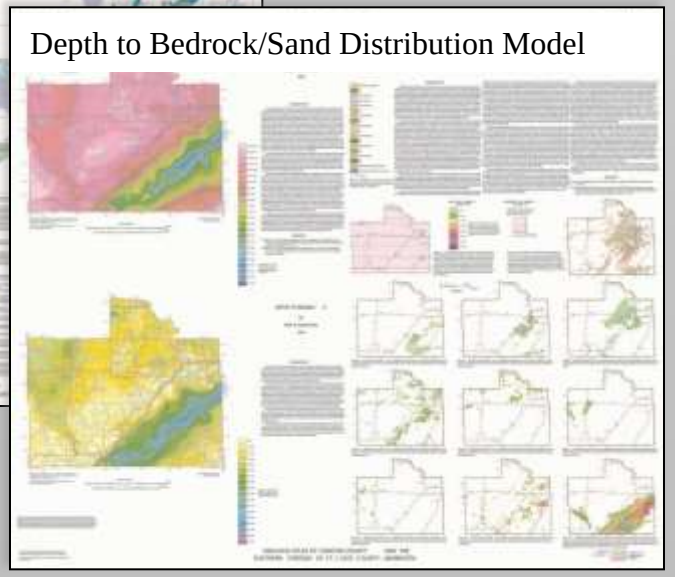
COUNTY GEOLOGIC ATLAS
Part A







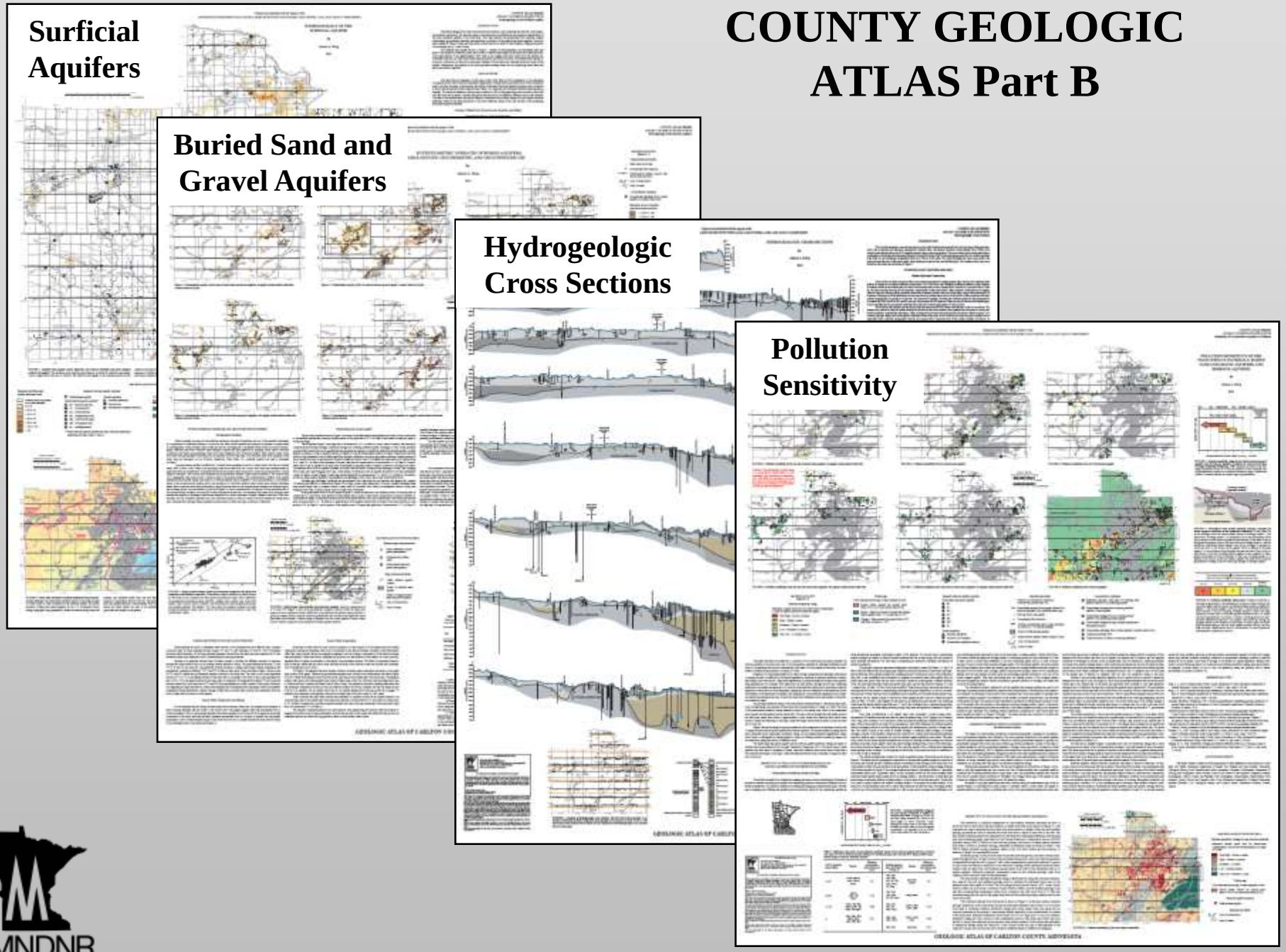




Available for ~ half of Minnesota's 87 counties via:

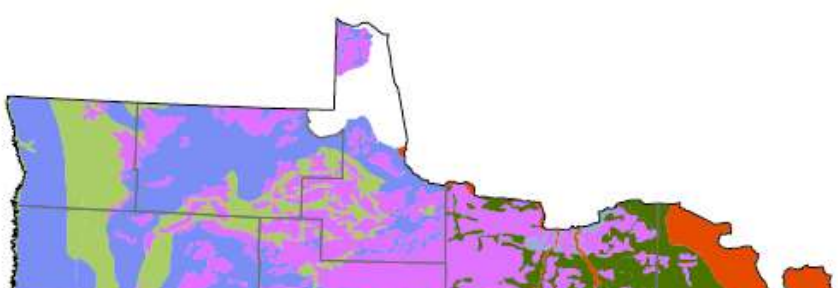
http://www.mngs.umn.edu

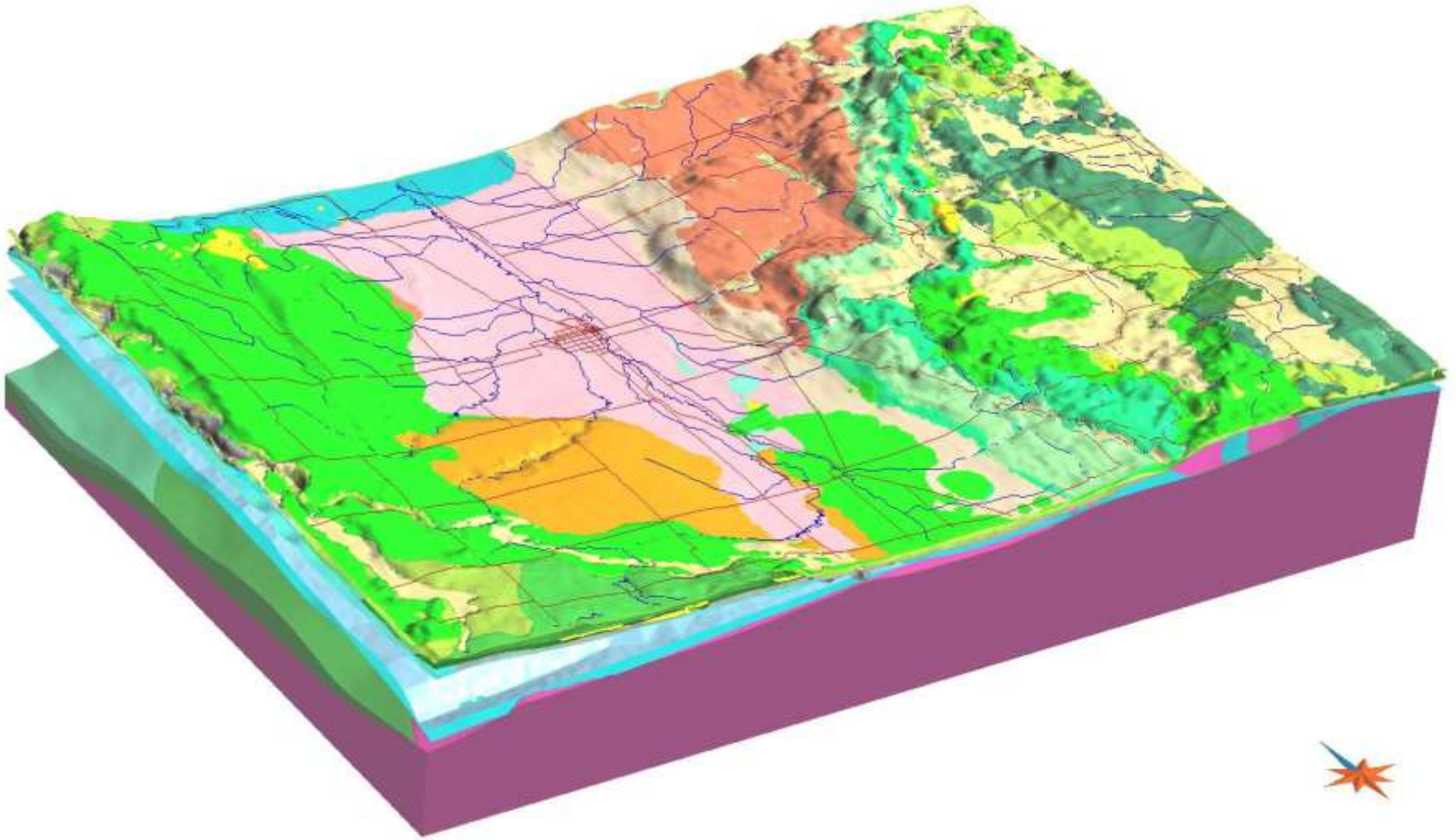
COUNTY GEOLOGIC ATLAS Part B



MNDNR


Rainy





The geological mapping is meant to be linked to associated spatial databases.

- ***Minnesota Geological Survey Databases***
  - ***Geological Survey Publications***
  - ***Geological Mapping; 1:0.5M & 1:100K***
  - ***Geological data***
  - ***Geological collections***
  - ***Geophysical data***
  - ***Geochemical data***

The publication database, which is spatial through publication footprints, includes nearly 50,000 pages, and 700 scanned maps, both searchable and fully web accessible.

road cut shows a mixture of Cretaceous clay with the Cambrian, the top of the whole being thinly and irregularly covered over and chinked up with coarse drift. The Cambrian is more or less broken and tilted, at least the bedding seems to have been cut out into huge blocks by divisional planes, which, either by weathering or water-wearing, were widened, the blocks themselves being subsequently thrown to some extent from their horizontality, tipping in all directions. The opened cracks and seams were then filled with the Cretaceous clay, which is deposited between these loosened masses, and sometimes even to the depth of twenty feet below the general surface of the top of the rock. The clay sometimes occupies nooks and rounded angles, sometimes sheltered *below* heavy masses of the Cambrian beds. The clay is uniformly bedded, about horizontally, with some slope in accordance with the surface on which the sedimentation took place. But the most interesting and important feature is *the condition of these old Cambrian surfaces.* They are rounded by the action of water, evidently waves. The cavities and porous spots are more deeply eroded, making little pits on the face of the rock; or along the lines of section of the sedimentation planes with the eroded surface, there are furrows due to the greater effect of water. The rounded surface of these huge masses of limestone is coated with a thickness of about a half inch, or an inch and a half, of iron ore, which scales off easily, and is easily broken by the hammer. While this scale of iron ore is thicker near the top and on the upper surface of the blocks, yet it runs down between the Cretaceous clay and the body of the rock."

Another deposit of greenish clay (Fig. 25) similar to the two last described, enclosed in a cavity of the Shakopee limestone and in part appearing to be a stratum overlain by it, was noted beside the carriage road from South Bend to Mankato close east of its bridge over the Blue Earth river.

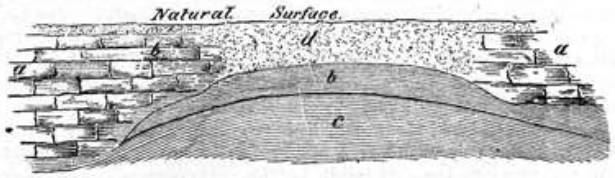


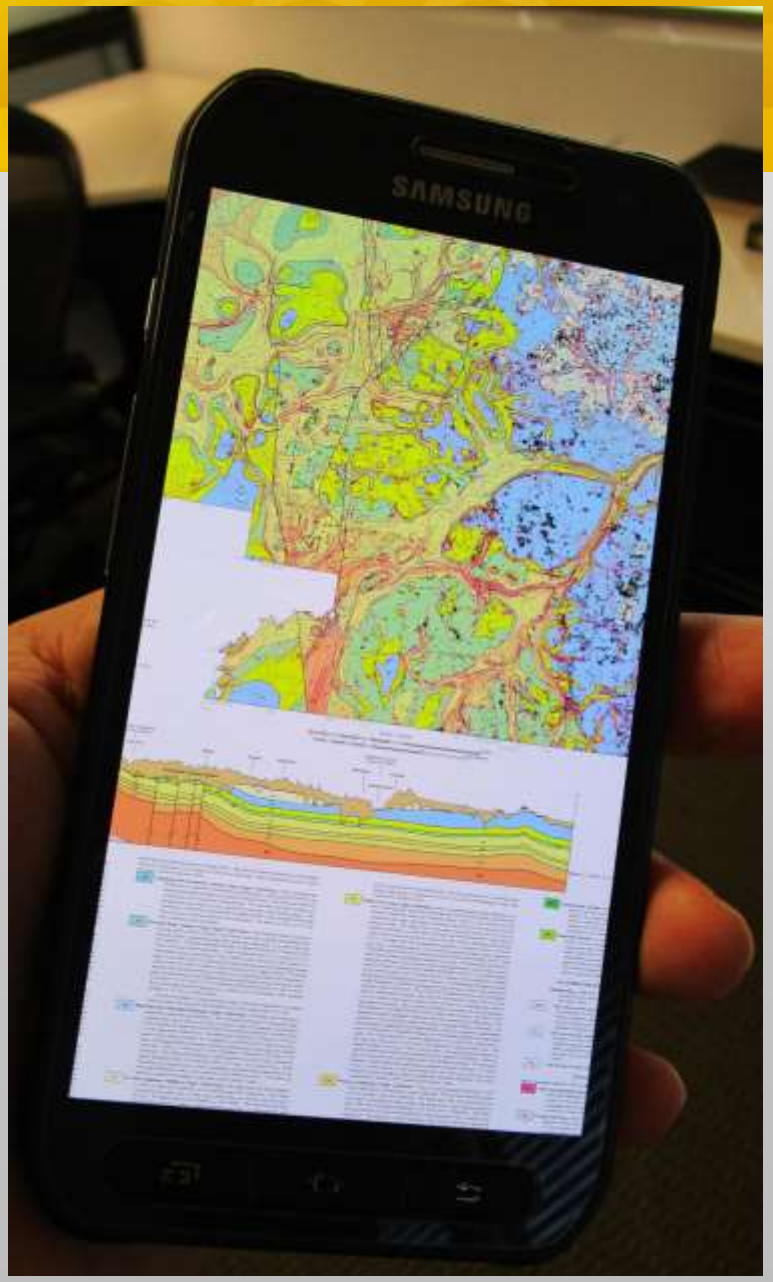
FIG. 25. CRETACEOUS CLAY BENEATH THE SHAKOPEE LIMESTONE, MANKATO.
a. Shakopee limestone. *b*. Bedded greenish clay, weathering white, but little sandy. *c*. Sandy, bedded greenish clay. *d*. Drift, mostly coarse fragments of Shakopee limestone.

In the S. W. ¼ of section 20, Lime, the quarry of J. R. Beatty & Co. exhibits a thickness of twenty to twenty-five feet of the Shakopee limestone. The top of this ledge is waterworn and hollowed in shallow pot-holes. Near the middle of the quarry face, as it was at the time of examination, these waterworn cavities reach to a depth of fifteen feet, their sides being in part encrusted with an iron-rusty scale, an eighth to a half of an inch thick. They are filled with very coarse ferruginous gravel, much waterworn, so that sometimes its pebbles up to three or four inches in diameter are almost perfectly spherical. In some of these crevices scanty traces of white clay occur with the gravel, the former being probably Cretaceous, while the latter seems to be older than the glacial drift, and may be Cretaceous or of earlier date, possibly representing the period in which these hollows were eroded. Close west of this quarry is found a thick bed of whitish, very fine earth (analysis 2, page 438), containing too little clay for brick-making.

Professor Winchell writes as follows respecting these probably Cretaceous deposits at localities recently examined by him near Mankato. "At the quarry of the Standard Cement company, lately opened in the east bank of the Blue Earth river about a third of a mile south of the railroad bridge, the Shakopee limestone is separated from the Jordan sandstone by a course of light green or often nearly white shale or clay, highly siliceous and aluminous, having a thickness of about three feet. The hydraulic qualities of the Shakopee limestone seem to be associated with the occurrence of this bed of shale, and to be altogether an accidental and local character. The formation has before been known to be somewhat hydraulic, but here this quality is so far extended as to make a valuable source of hydraulic lime. In the Shakopee limestone here are also numerous pits and gorges, rounded off with age and crusted over with a ferruginous scale

➢ Publications

- Scanned maps
- 700 maps



Minnesota Geological Survey

MGS Publication Footprints tab app

Downloadable MGS Publications

2001 to Present | 1981 to 2000 | 1961 to 1980 | 1941 to 1960 | 1921 to 1940 | 1901 to 1920 | 1881 to 1900 | 1861 to 1880 | All

Minnesota Geological Survey - Digital Data

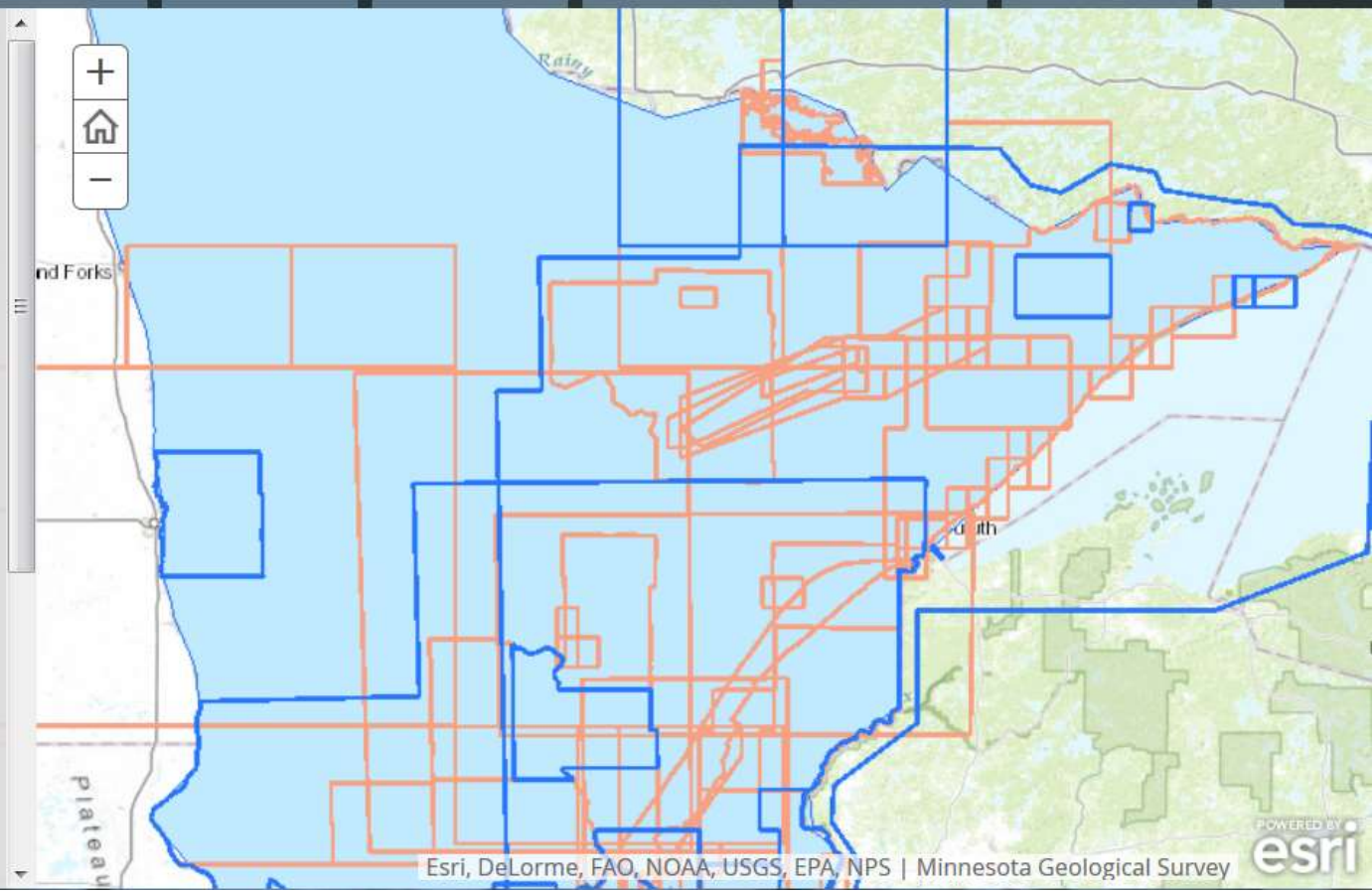
The Minnesota Geological Survey (MGS) has published over **660** maps and reports. The MGS Publication Footprints display the time and location of each project.

How to use this map

- Click on the map to the right in the location of interest.
- Brows thru the pop-up window using the small arrows located in the upper right of the pop-up.
- Scroll down to find *MORE INFO* on a particular publication. You can download data through this link.

To find out more information during a particular time select the tab that displays the year of publication.

Enjoy the 16+ decades of publication



Minnesota Geological Survey

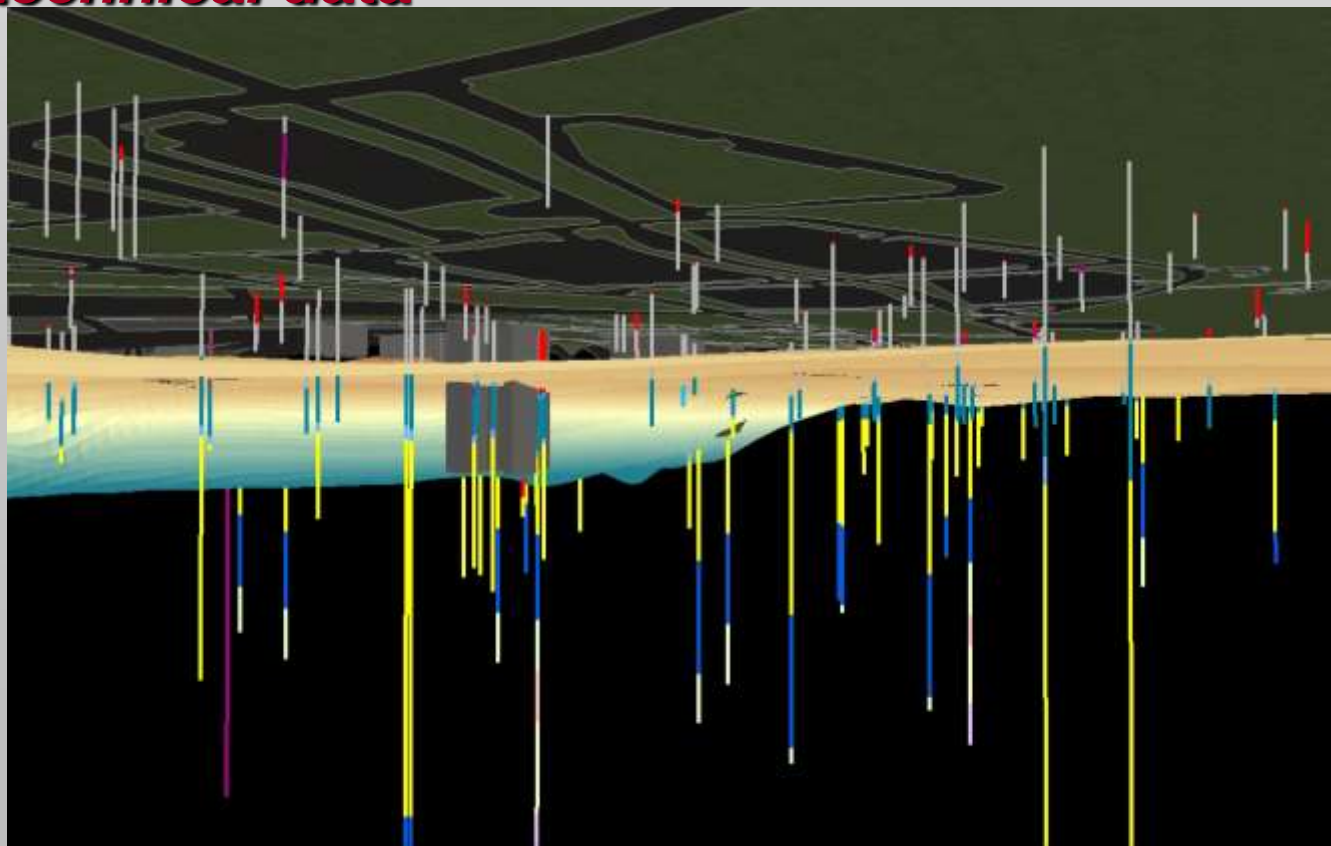
Geological databases include field observations, geotechnical data, hydrogeological data, images, karst database, the mineral exploration document archive maintained by the natural resources department (DNR), sediment texture and lithology, as well as the largest and most important database in this group – the half-million site water well database.

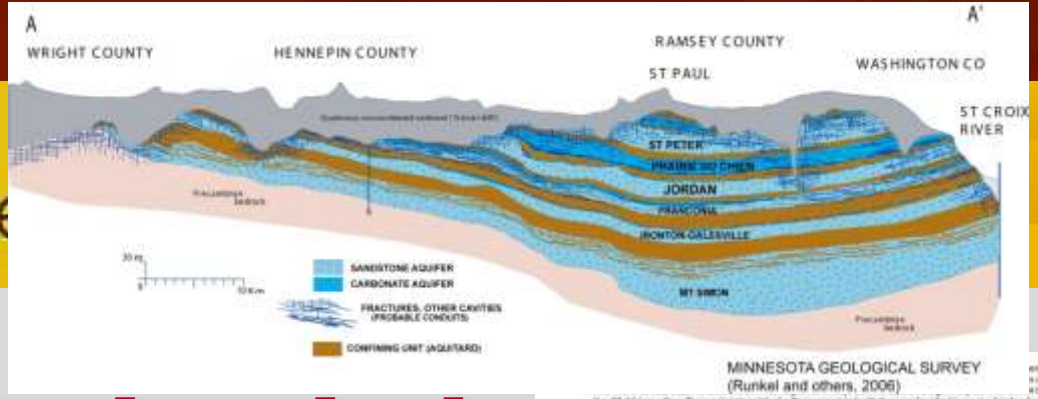
➢ Geological data

- Geological observations
  - ➢ MGS – 40,000 sites
  - ➢ DNR Aggregate

➢ Geological data

- **Geotechnical data**

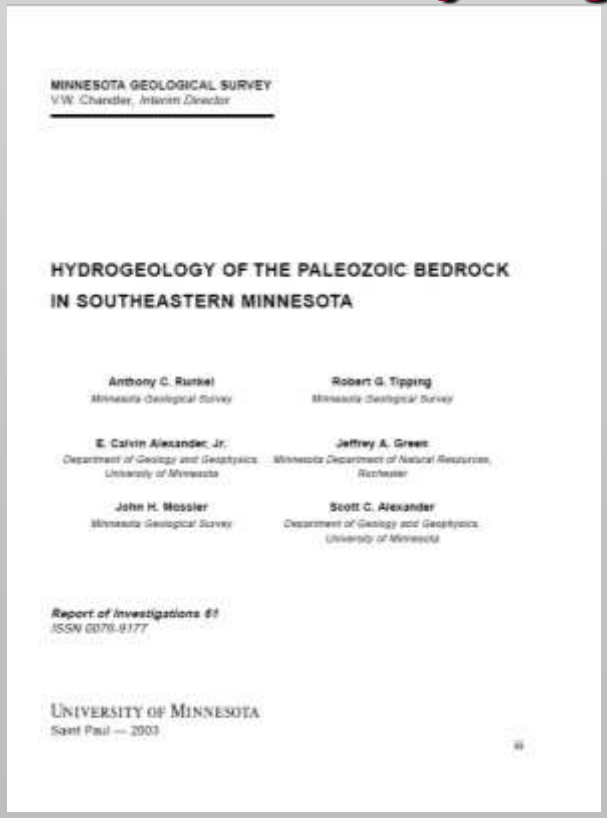




MINNESOTA GEOLOGICAL SURVEY
(Runkel and others, 2006)

➢ Geological data

- ***Hydrogeological data***



MINNESOTA GEOLOGICAL SURVEY
V.W. Chandler, *Interim Director*

HYDROGEOLOGY OF THE PALEOZOIC BEDROCK IN SOUTHEASTERN MINNESOTA

Anthony C. Runkel — Minnesota Geological Survey
Robert G. Tipping — Minnesota Geological Survey
E. Calvin Alexander, Jr. — Department of Geology and Geophysics, University of Minnesota
Jeffrey A. Green — Minnesota Department of Natural Resources, Rochester
John H. Mossler — Minnesota Geological Survey
Scott C. Alexander — Department of Geology and Geophysics, University of Minnesota

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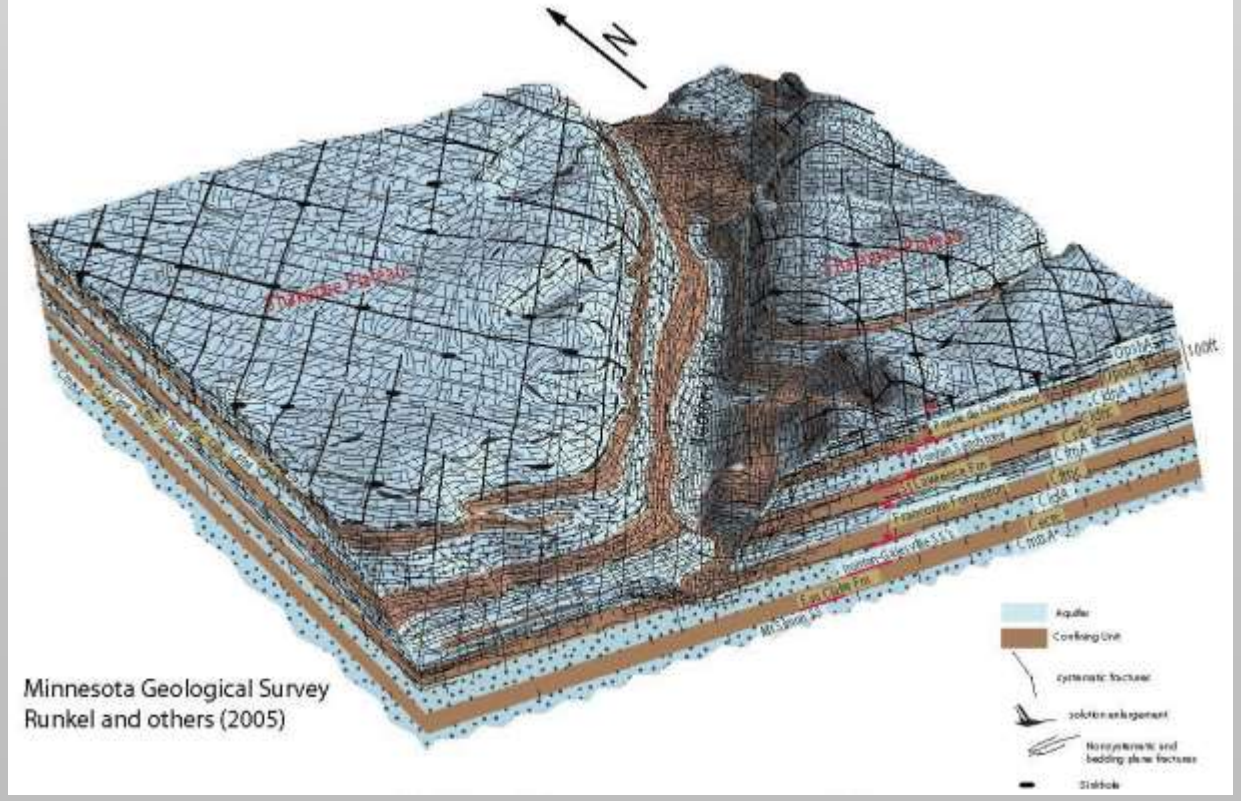
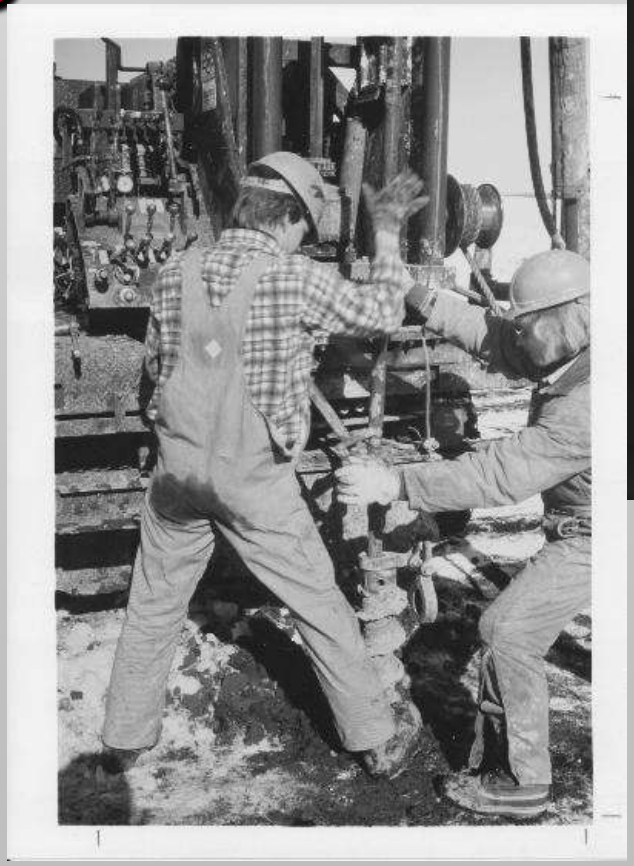
Saint Paul — 2003



Minnesota Geological Survey
Runkel and others (2005)

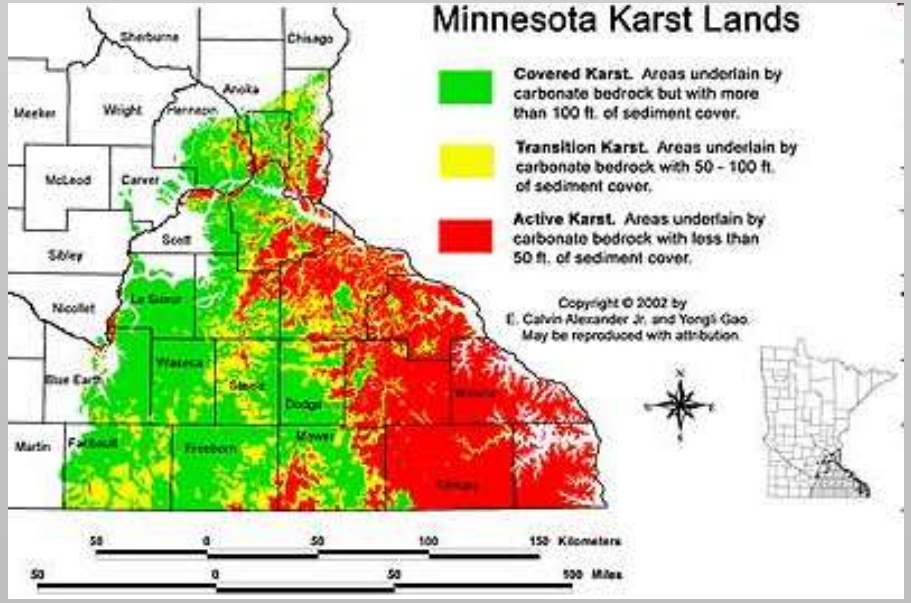
➢ Geological data

- *Images*



➢ Geological data

- **Karst database**
  - ➢ **12,164 sites**

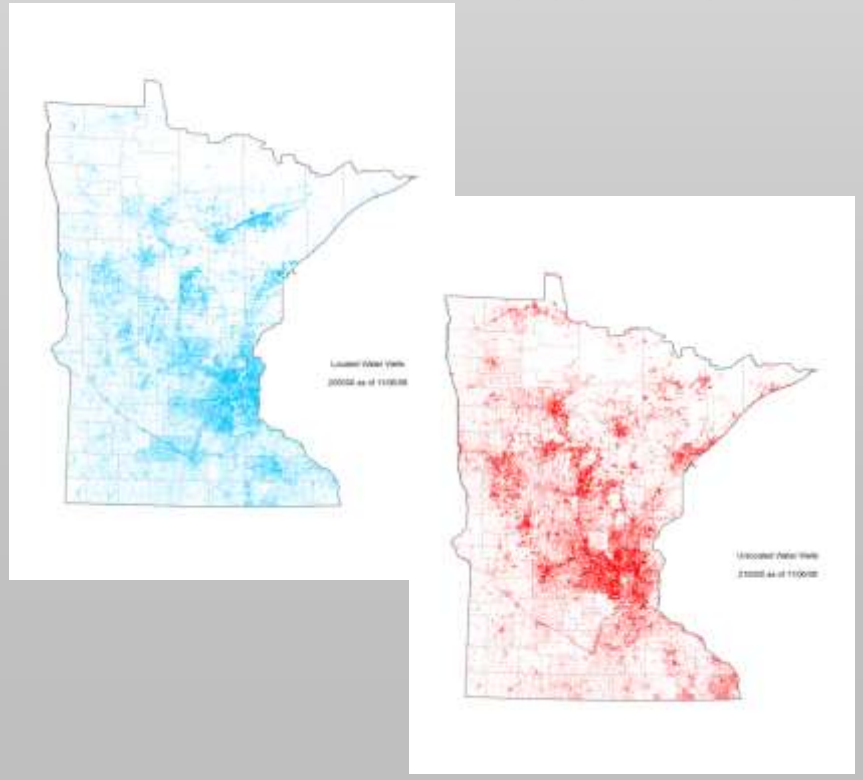


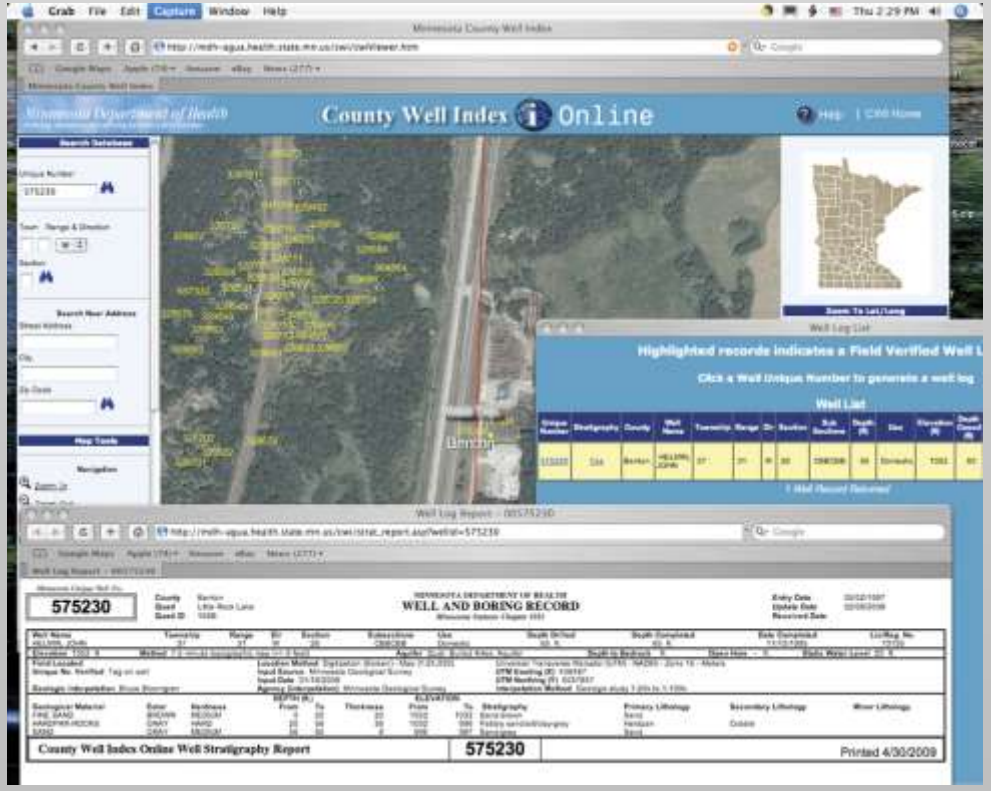
➢ Geological data

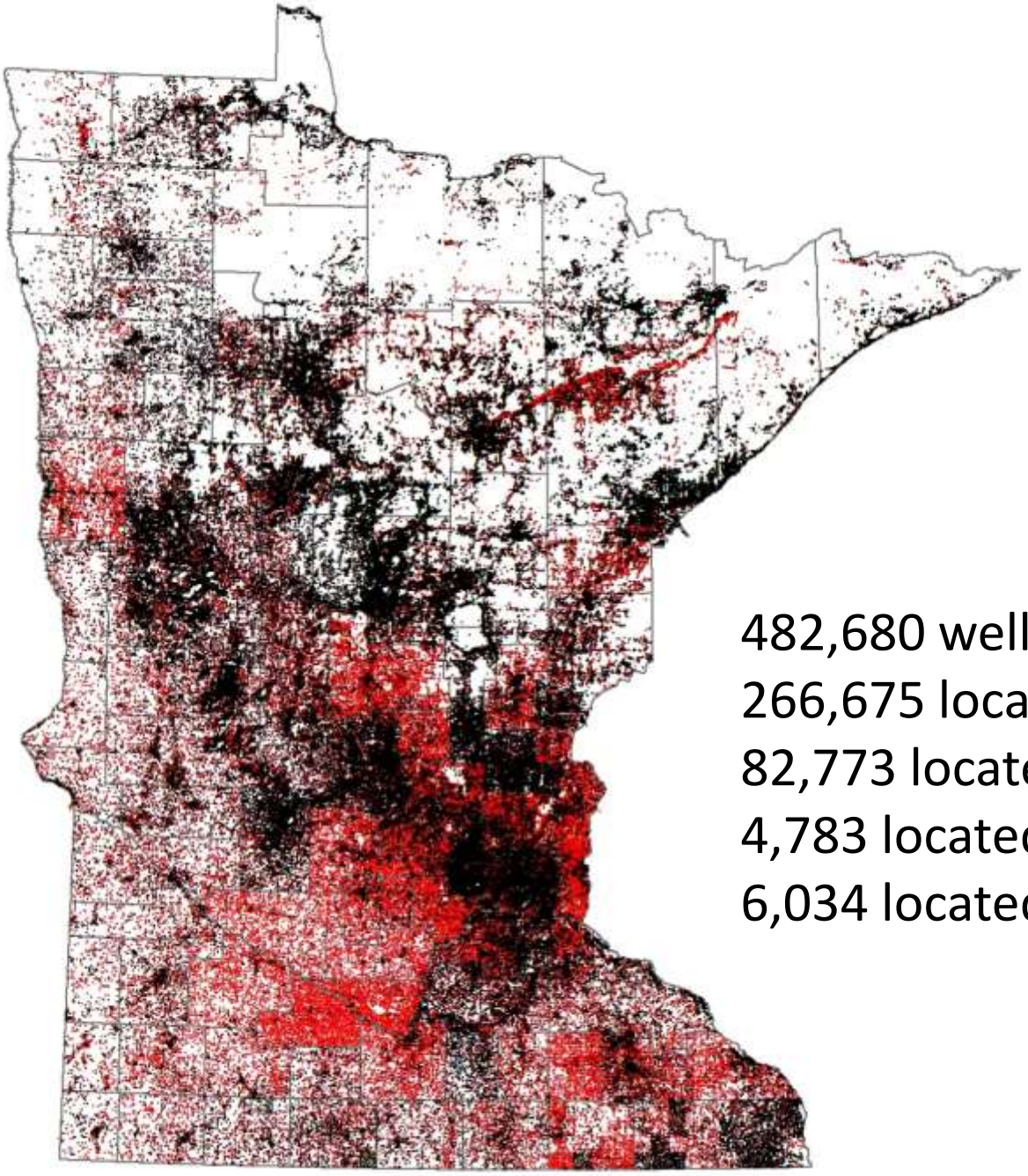
- ***Sediment texture and lithology***
  - ➢ ***12,000 analyses***

➢ Databases

- **Water well data**







482,680 wells
266,675 located
82,773 located bedrock
4,783 located cuttings
6,034 located geophysics

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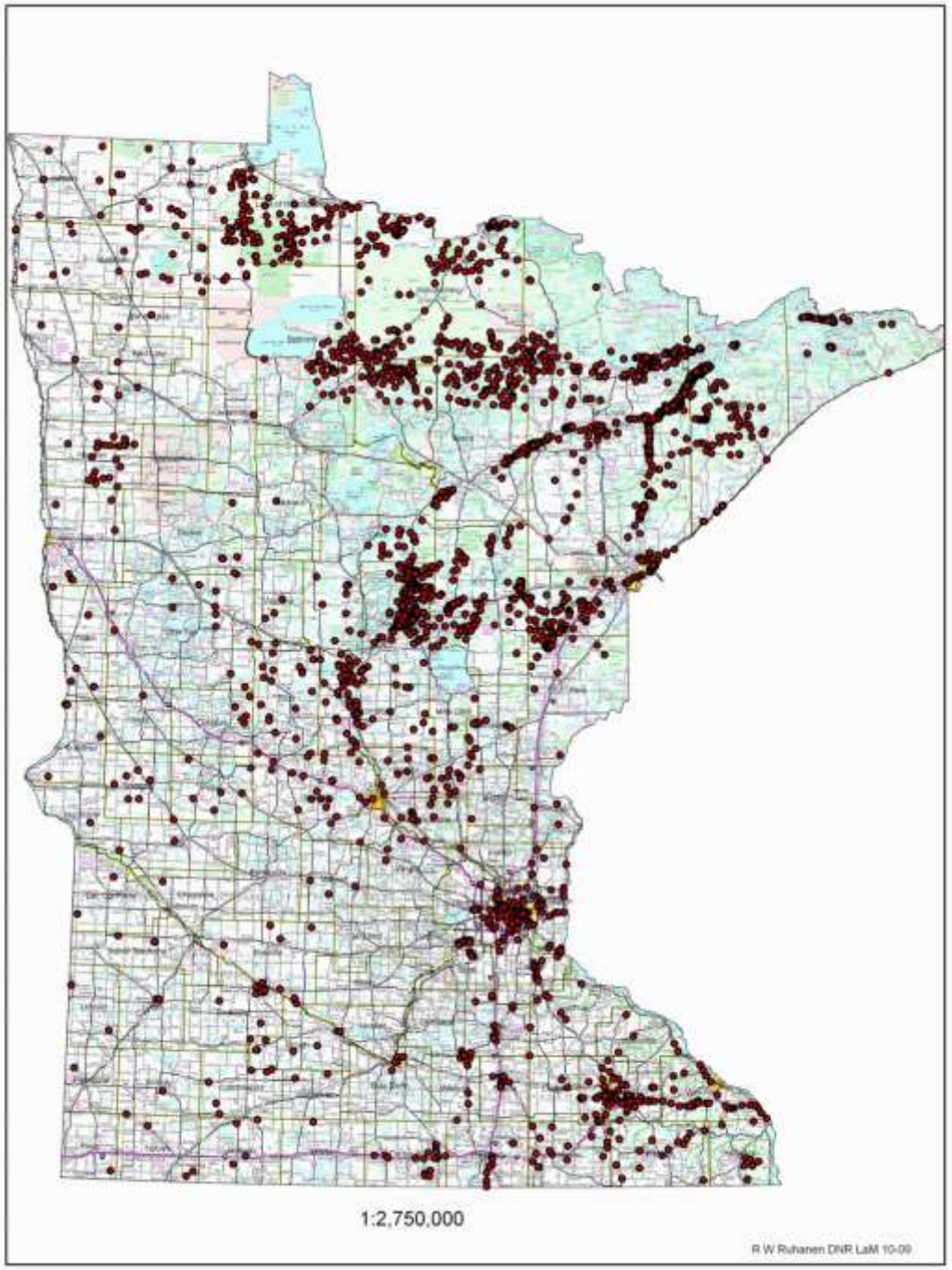
Geological collection databases include cuttings, the million-meter DNR drill core library, fossils at the Bell Museum, geochemical samples, hand samples, sediment samples, and thin sections.

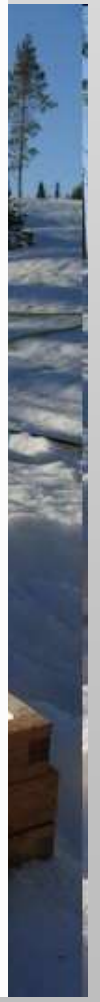
➢ Collections

- **Cuttings**
  - ➢ **4800 sites**

➢ Collecti

- DNR drill c
  - ➢ 3 million fe





➢ Collections

- *Fossils*
  - ➢*16,242 specimens*

BELL MUSEUM
of Natural History

➢ Collections

- Geochemical samples

➢ Collections

- Hand samples

➢ Collections

- **Sediment samples**
  - ➢ **~25,000 samples**

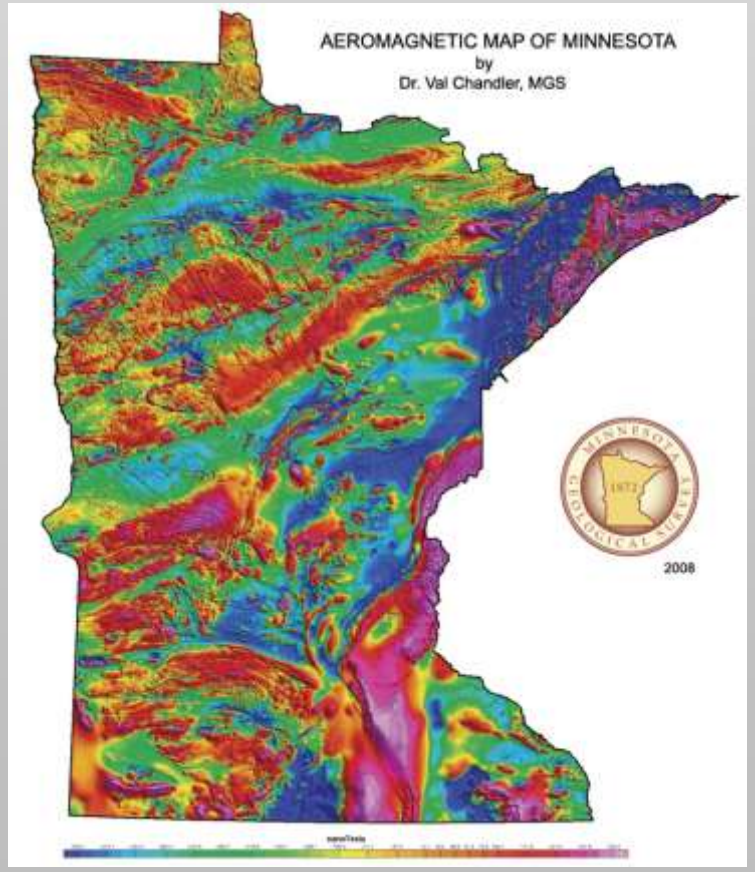
➢ Collections

- *Thin sections*

Geophysical databases include borehole geophysics, gravity, magnetic, rock properties, and soundings.

➢Geophysical data

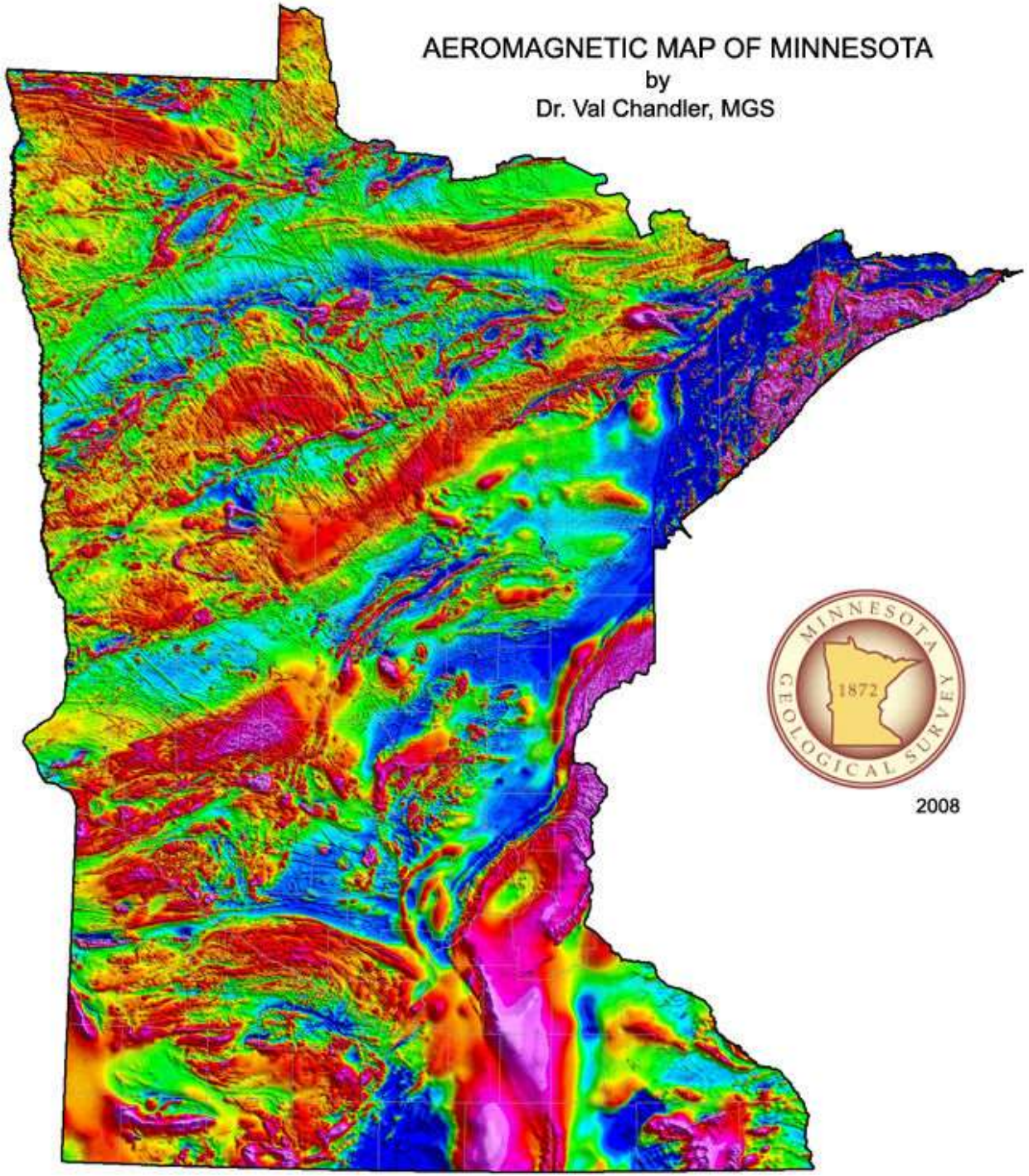
- **Aeromagnetic data**



AEROMAGNETIC MAP OF MINNESOTA

by

Dr. Val Chandler, MGS

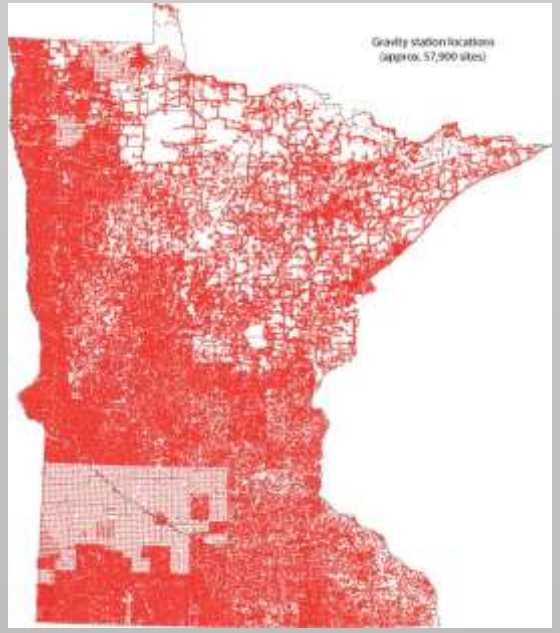


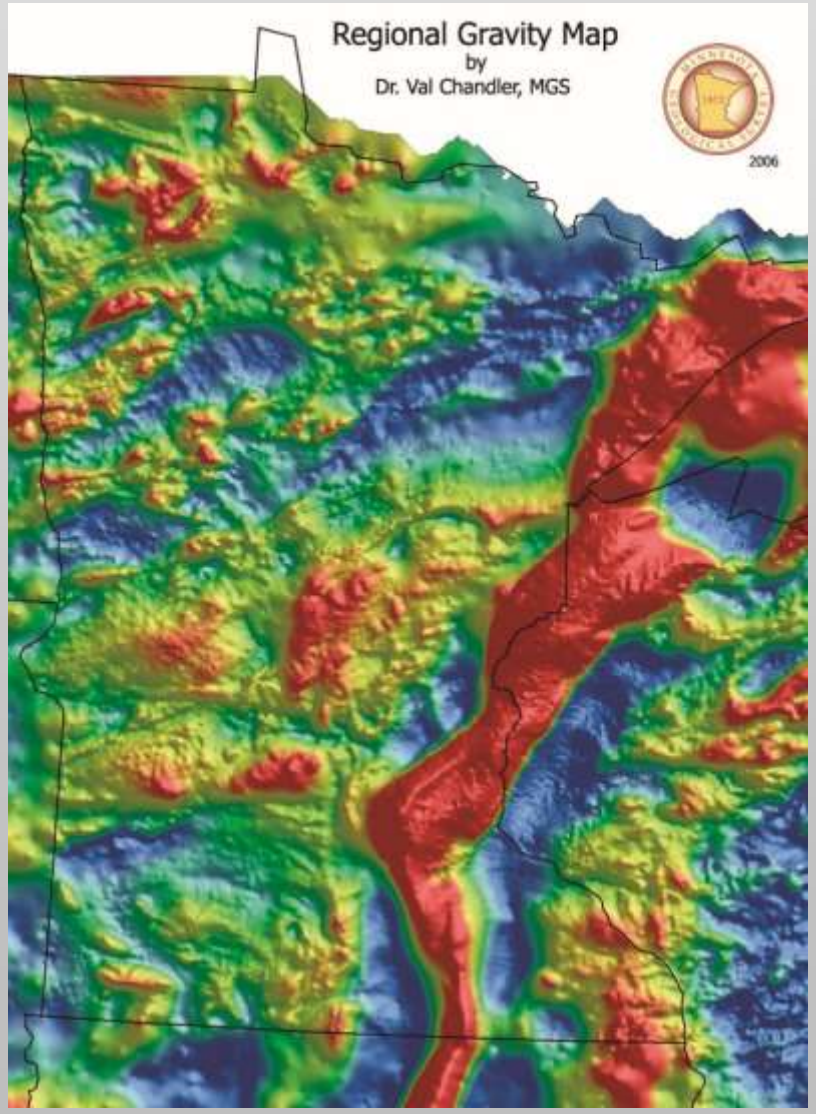
MINNESOTA GEOLOGICAL SURVEY 1872

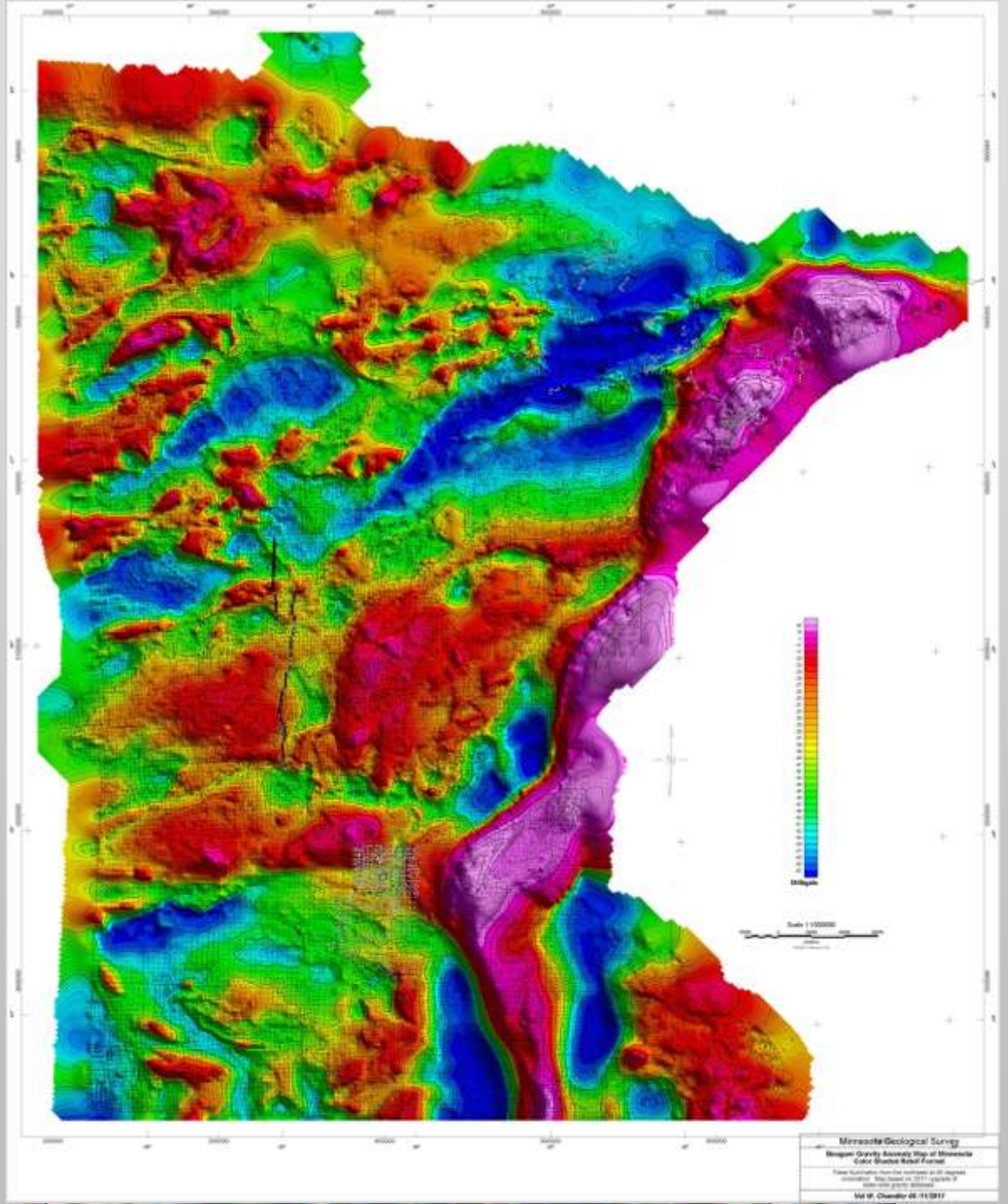
2008

➢ Geophysical data

- **Gravity**

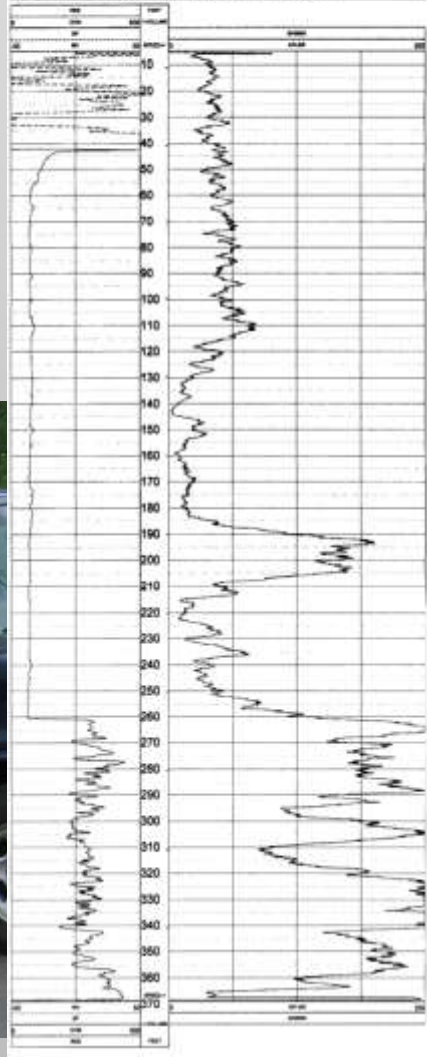





Minnesota Geological Survey

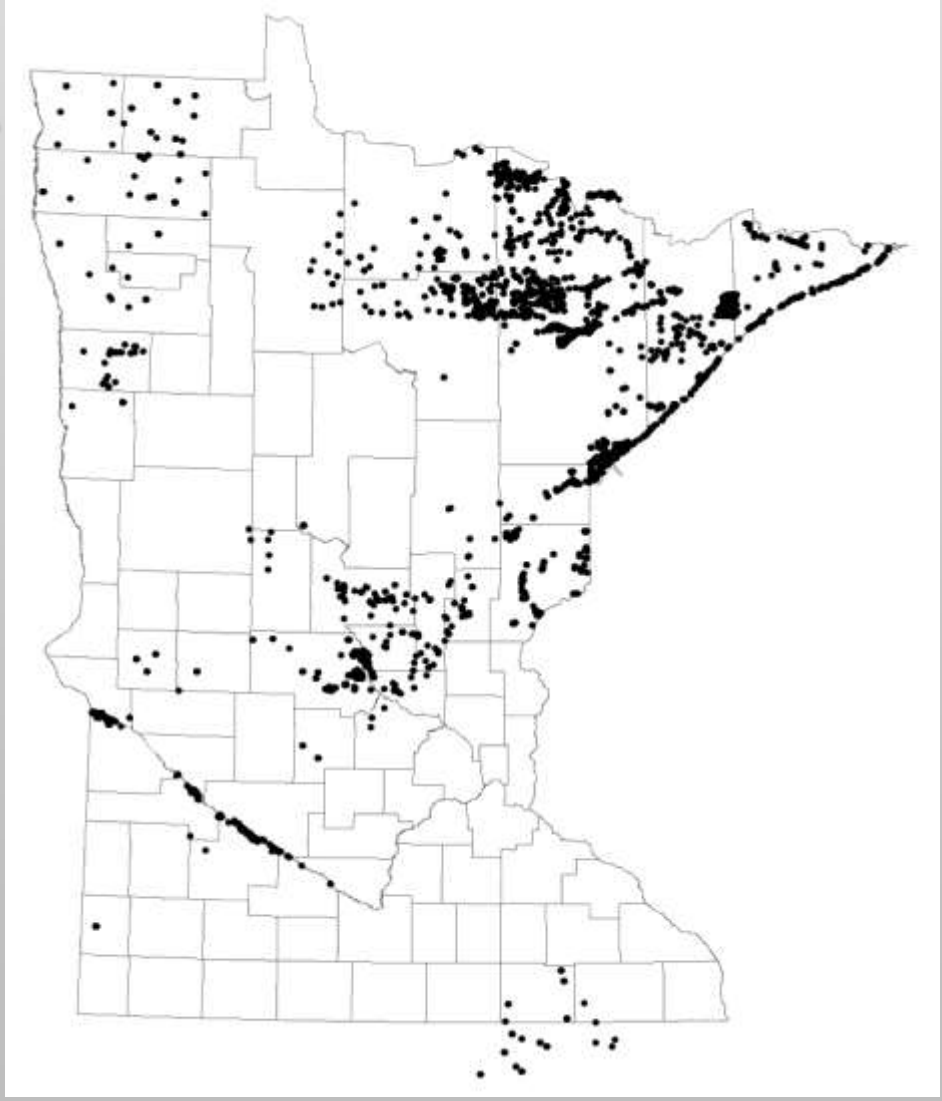
➢ Geophysical data

- Borehole geophysical log index
- 5500 logs
- Average depth 336’



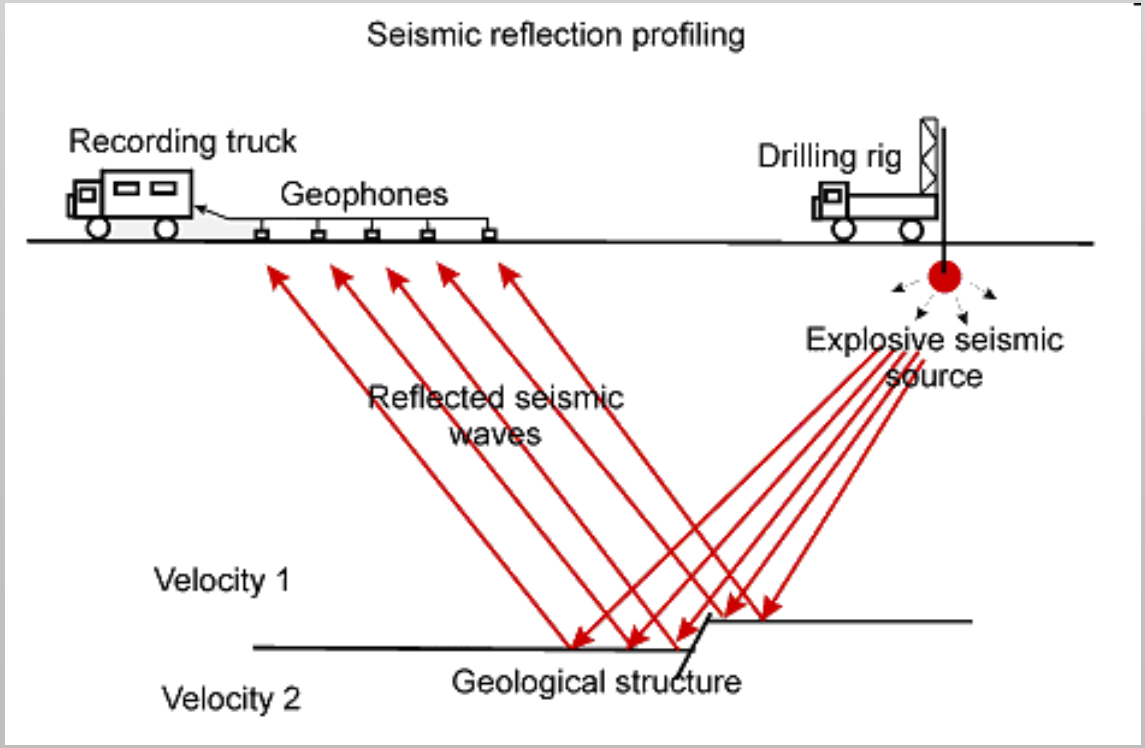
➢ Databases

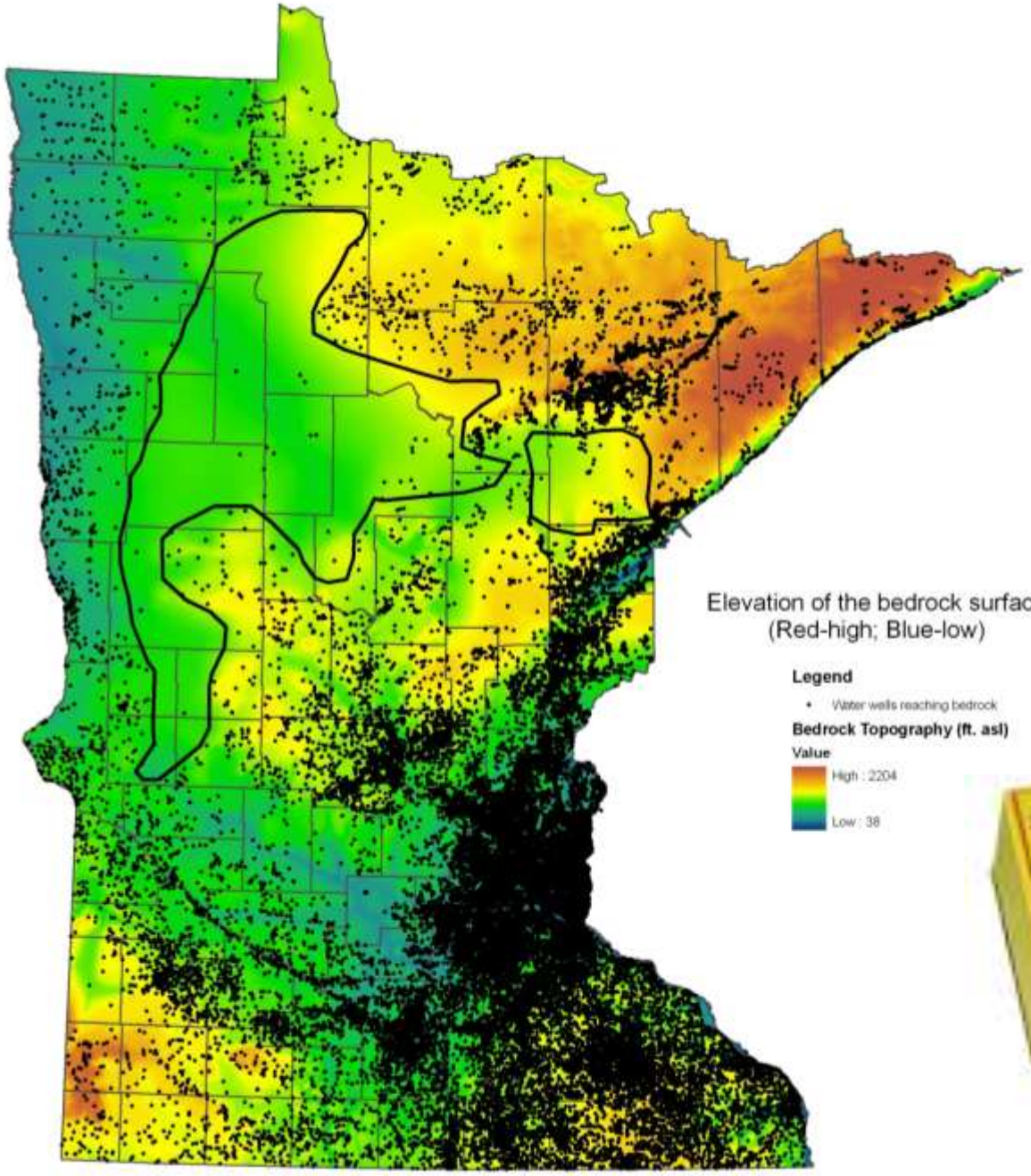
- **Rock Properties**
  - ➢ **4000 values**



➢ Geophysical data

- ***Soundings***

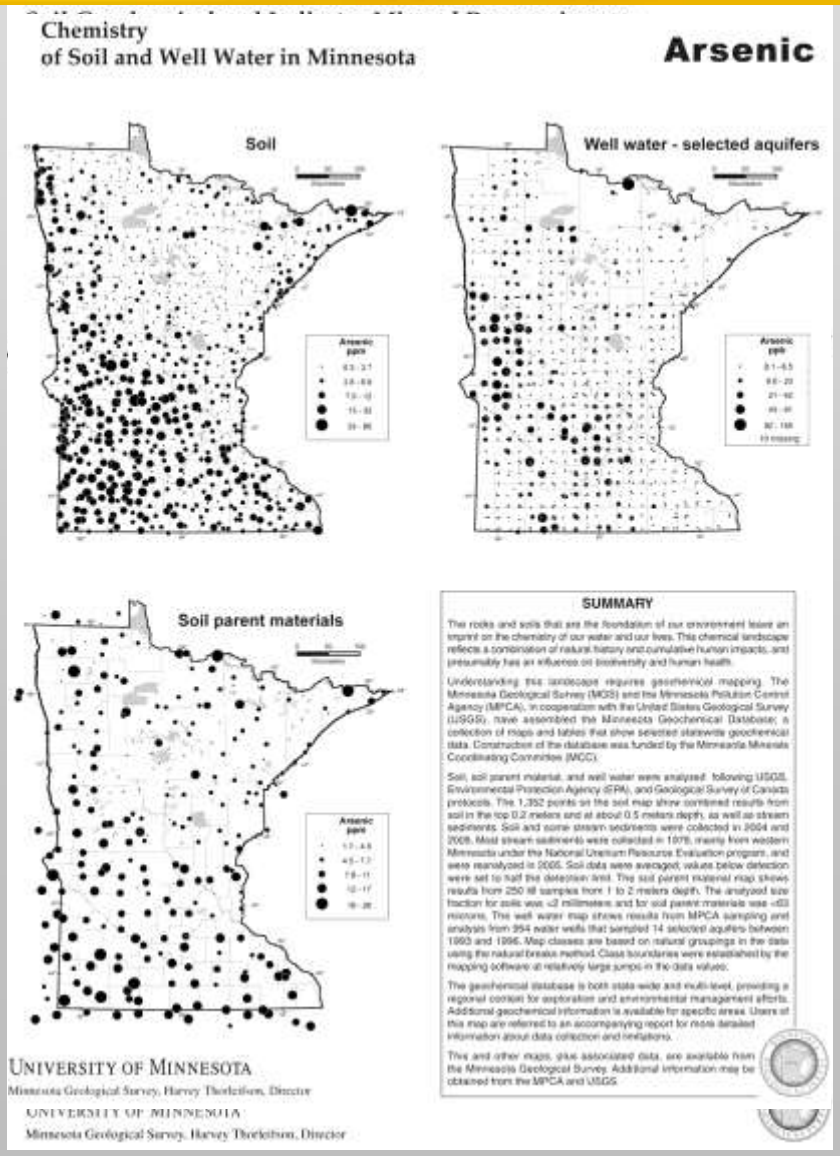



Elevation of the bedrock surface
(Red-high; Blue-low)
Legend
Water wells reaching bedrock
Bedrock Topography (ft. asl)
Value
High : 2204
Low : 38

Statewide geochemical databases include groundwater, soil, and soil parent material; while geochronological databases are in varying states.

➢Geochemical data

- Soil geochemical data
- Till geochemical data
- Groundwater geochemical data



Minnesota Geological Survey

Many elements of this emerging MGS information system exist, some are in preparation, and some are aspirational. The mapping will never be finished, but rather will be regularly-updated.

Minnesota Geological Survey Information Systems

Harvey Thorleifson Ph.D.
Director, Minnesota Geological Survey

National Geospatial Advisory Committee
April 6-7, 2016