Characterization of Fermi Region Geology

Second Annual VLHC Meeting

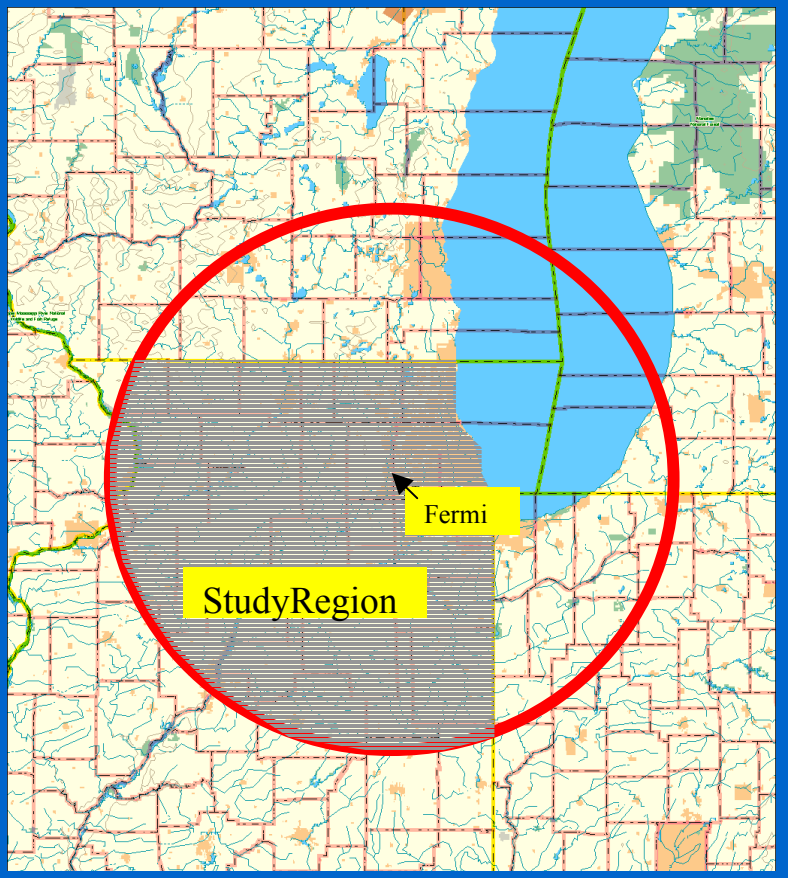
Port Jefferson, Long Island, NY

October, 2000

Peter Conroy

Study Criteria

- Center on Fermi
- Locate in Illinois
- Avoid Lake Michigan



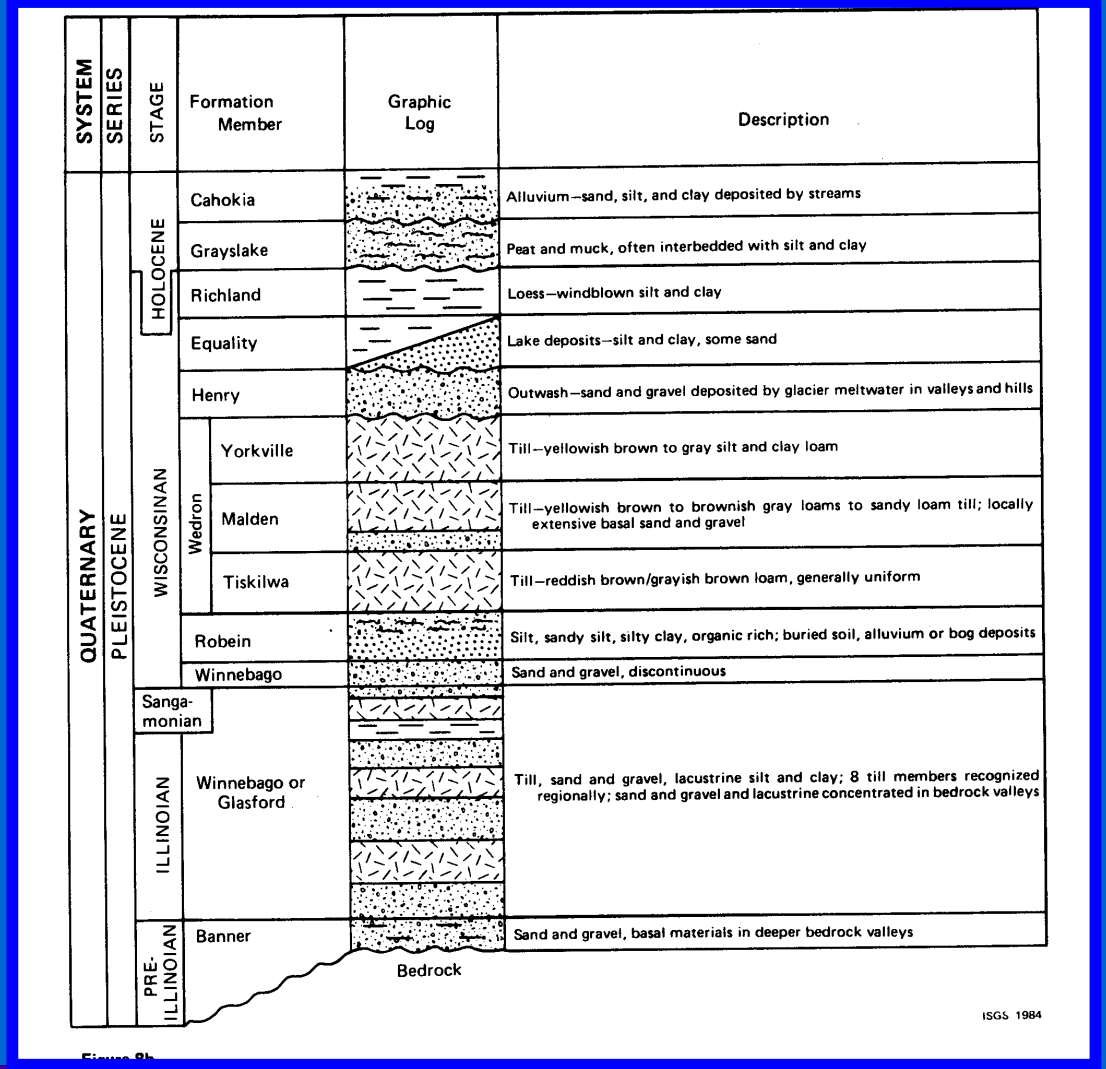
Presentation Outline

- Regional Geology
- Tunneling Considerations
- Estimated Tunneling Cost

Regional Geology

- Surficial Deposits
- Bedrock
- Groundwater
- Seismicity

Surficial Deposits Description



Surficial Deposits Thickness

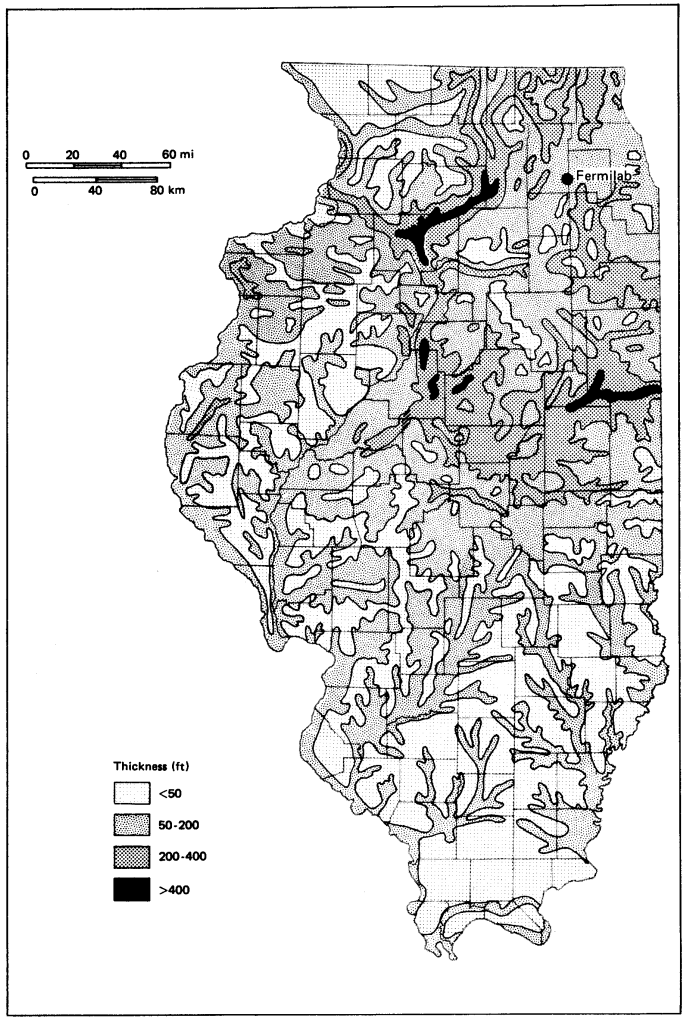


Figure 6.

Bedrock Surface

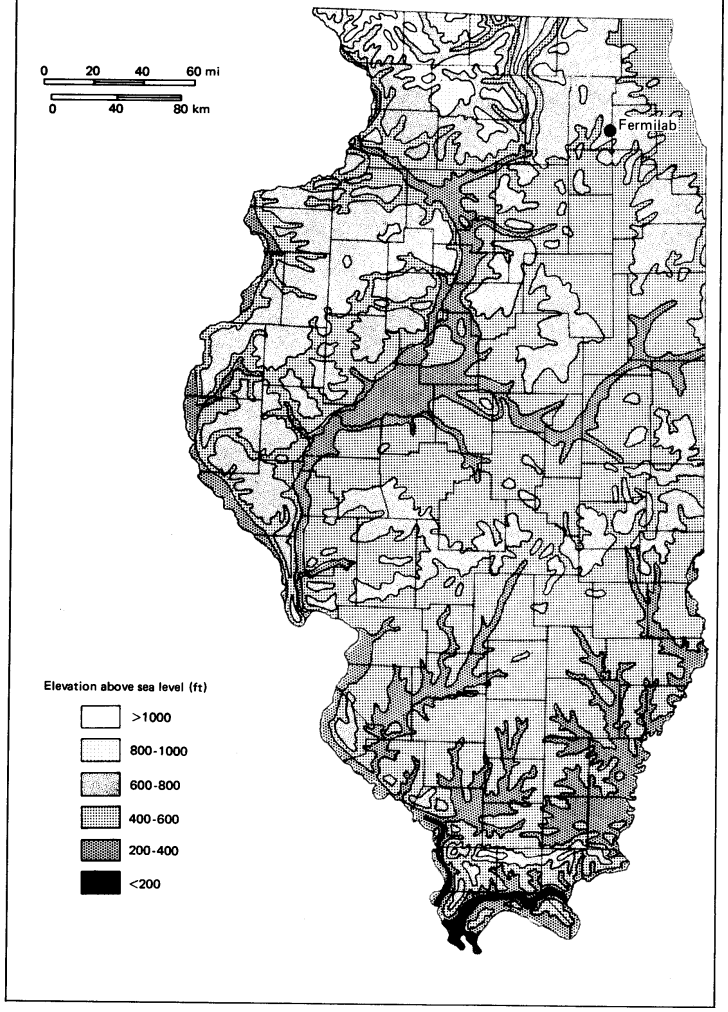
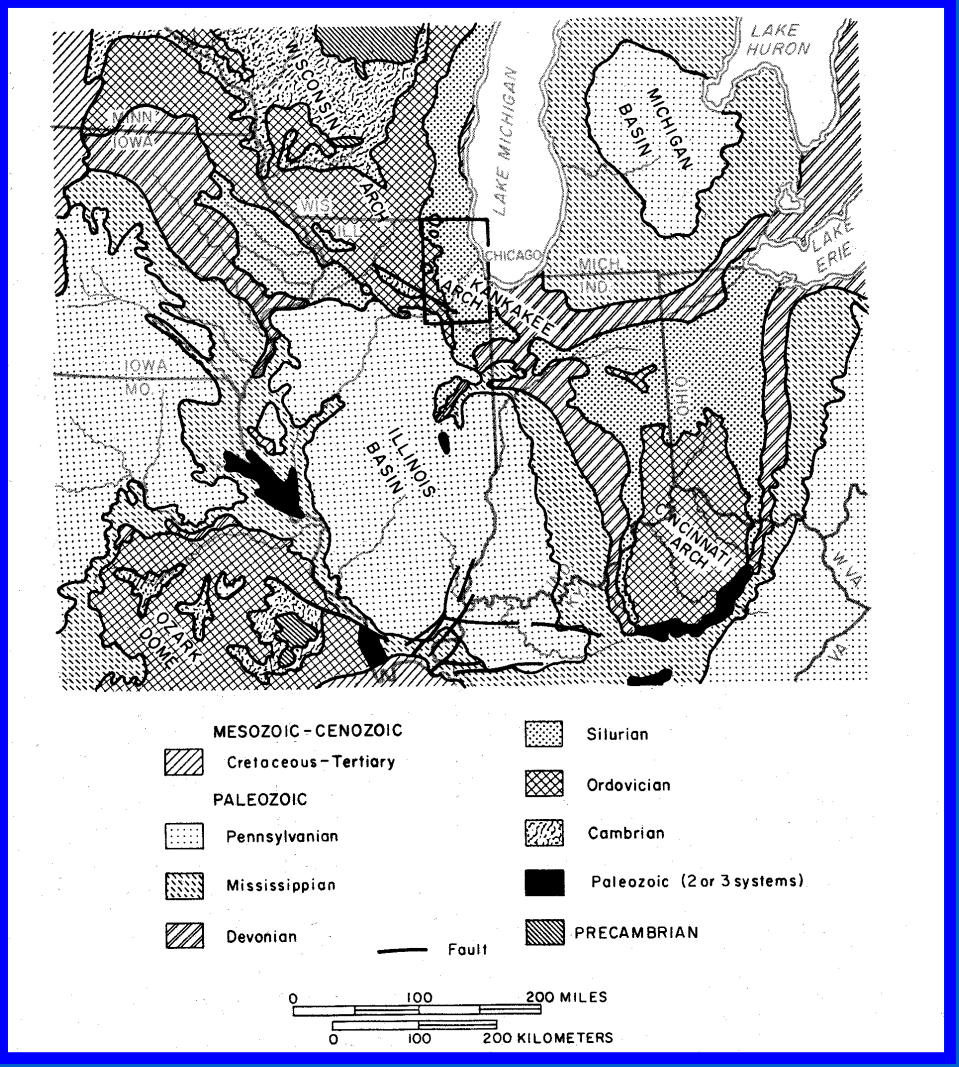
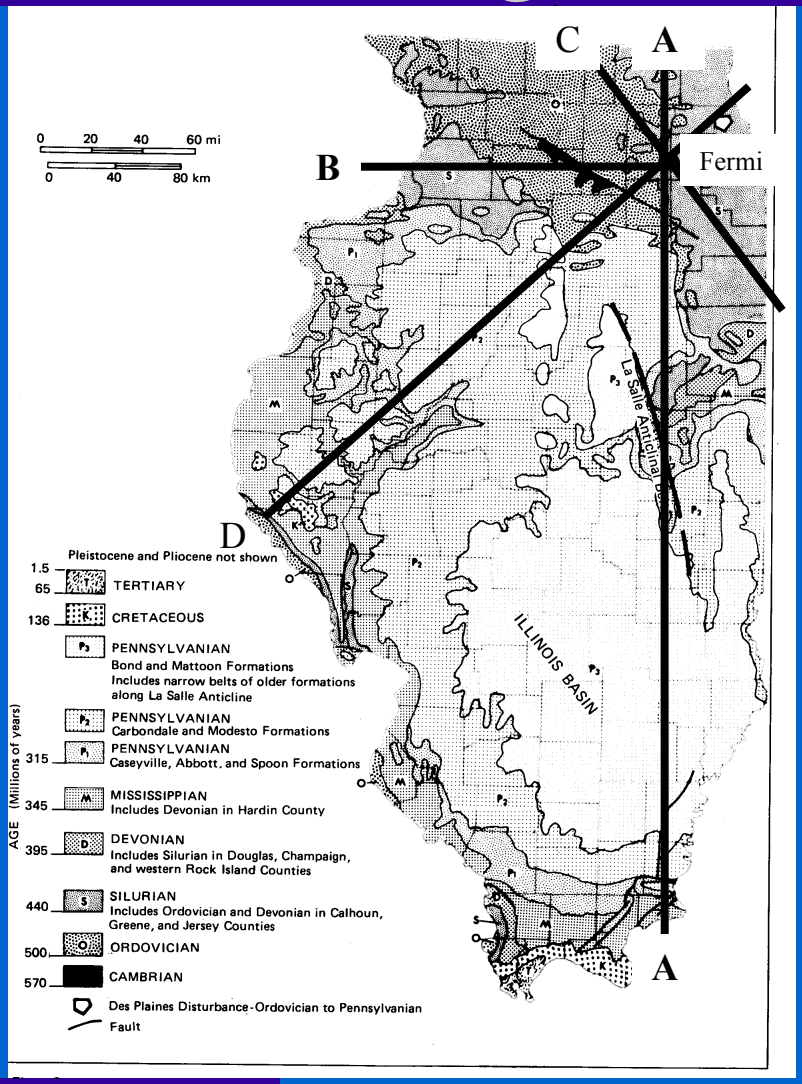


Figure 5.

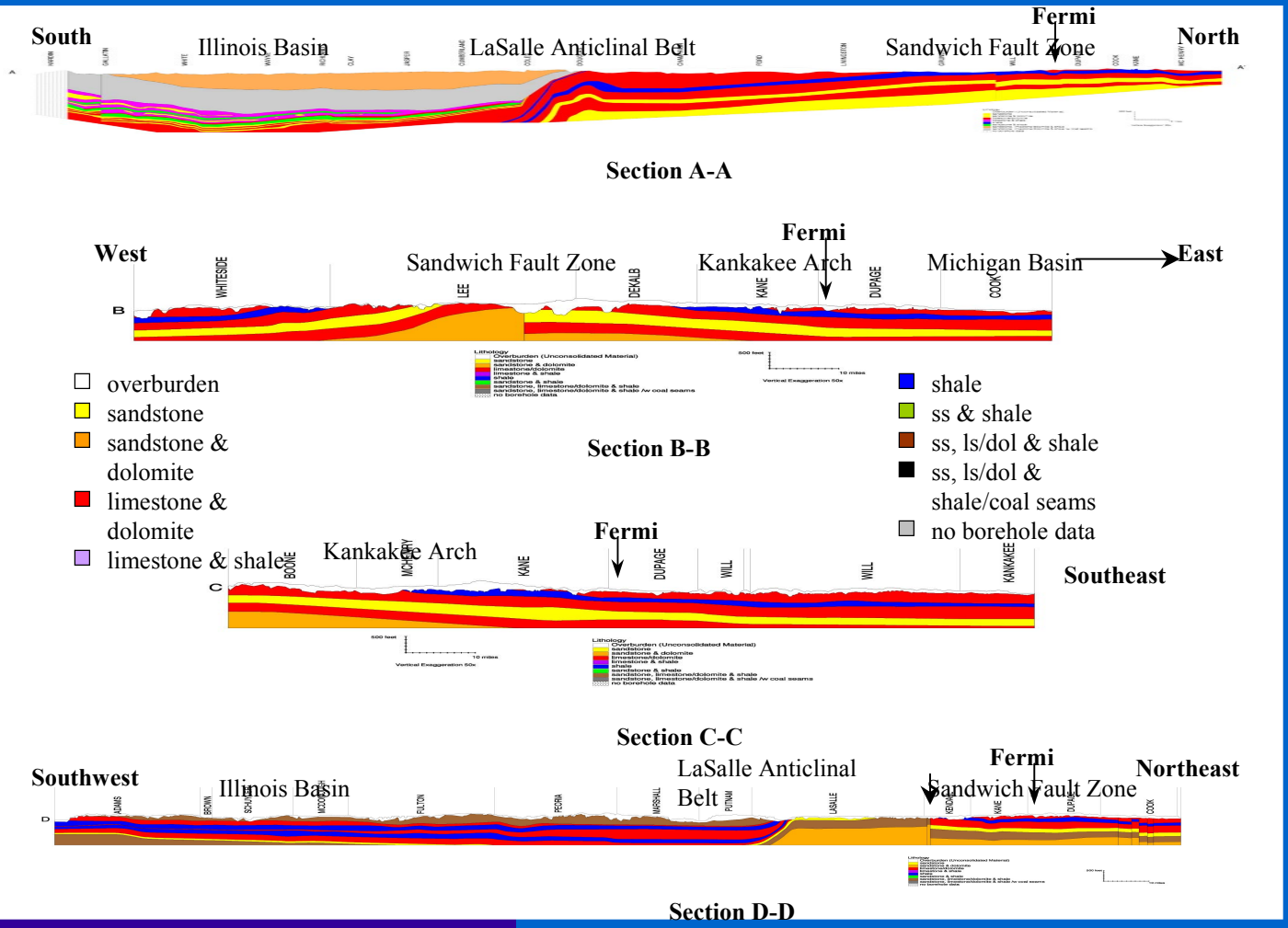
Regional Geologic Map



Illinois Geologic Map



Illinois Geologic Sections



Bedrock Stratigraphy

SYSTEM	SERIES AND MEGAGROUP	GROUP AND FORMATION	HYDROSTRATIGRAPHIC UNITS: Aquigroup	HYDROSTRATIGRAPHIC UNITS: aquifer/aquitard	LOG	THICKNESS (ft)	DESCRIPTION
Quaternary	Pleistocene	Undifferentiated	Prairie	Pleistocene		0 – 600	Unconsolidated glacial deposits – pebbly clay (till) silt, and gravel. Loess (windblown silt), and alluvial silts, sands and gravels.
Tertiary & Cretaceous		Undifferentiated				0 –100	Sand and silt.
Carboniferous: Pennsylvanian		Undifferentiated	Upper Bedrock: Mississippi Valley	Pennsylvanian		0 – 500	Mainly shale with thin sandstone, limestone and coal beds.
Carboniferous: Mississippian	Valmeyeran	St. Louis Ls Salem Ls Warsaw Ls Keokuk Ls Burlington Ls		St. Louis – Salem aquifer Keokuk – Burlington aquifer		0 – 600	Limestone, cherty limestone, green, brown and black shale, silty dolomite.
Carboniferous: Mississippian	Kinderhookian	Undifferentiated					
Devonian		Undifferentiated		Devonian		0 – 400	Shale, calcareous; limestone beds, thin.
Silurian	Niagaran	Port Byron Fm Racine Fm Waukesha Ls Joliet Ls		Silurian dolomite aquifer		0 – 465	Dolomite, silty at base, locally cherty.
Silurian	Alexandrian	Kankakee Ls Edgewood Ls					
Ordovician	Cincinnatian	Maquoketa Shale Group	Midwest Bedrock	Maquoketa confining unit		0 – 250	Shale, gray or brown; locally dolomite and/or limestone, argillaceous.
Ordovician	Mohawkian (Ottawa Ls Megagroup)	Galena Group Decorah Subgroup Platteville Group		Galena-Platteville unit		0 – 450	Dolomite and/or limestone, cherty. Dolomite, shale partings, speckled. Dolomite and/or limestone, cherty, sandy at base.
Ordovician	Mohawkian (Ancell Gr.)	Glenwood Fm		Ancell aquifer		100 – 650	Sandstone, fine- and coarse-grained; little dolomite; shale at top. Sandstone, fine- to medium-grained; locally cherty red shale at base.
Ordovician	Chazyan (Ancell Gr.)	St. Peter Ss					
Ordovician	Canadian (Prairie du Chien Group)	Shakopee Dol New Richmond Ss Oneota Dol Gunter Ss		Middle confining unit: Prairie du Chien		100 – 1300	Dolomite, sandy, cherty (oolitic), sandstone. Sandstone, interbedded with dolomite. Dolomite, white to pink, coarse-grained, cherty (oolitic), sandy at base.
Cambrian	St. Croixian (Knox Megagroup)	Jordan Ss Eminence Fm– Potosi Dolomite		Middle confining unit: Eminence-Potosi			Dolomite, white, fine-grained, geodic quartz, sandy at base.
Cambrian	St. Croixian (Knox Megagroup)	Franconia Fm		Middle confining unit: Franconia			Dolomite, sandstone, and shale, glauconitic, green to red, micaceous.
Cambrian	St. Croixian (Knox Megagroup)	Ironton Ss		Ironton-Galesville aquifer		0 – 270	Sandstone, fine- to medium-grained, well sorted, upper part dolomitic.
Cambrian	St. Croixian (Knox Megagroup)	Galesville Ss					
Cambrian	St. Croixian	Eau Claire Fm	Basal Bedrock	Eau Claire		0 – 450	Shale and siltstone; dolomite, glauconitic; sandstone, dolomitic, glauconitic.
Cambrian	St. Croixian	Mt. Simon Fm		Elmhurst-Mt. Simon aquifer		0 – 2600	Sandstone, coarse-grained, white, red in lower half; lenses of shale and siltstone, red, micaceous.
Pre-Cambrian			Crystalline				No aquifers in Illinois

Note: The rock-stratigraphic and hydrostratigraphic-unit classifications follow the usage of the Illinois State Geological Survey.

Bedrock Properties

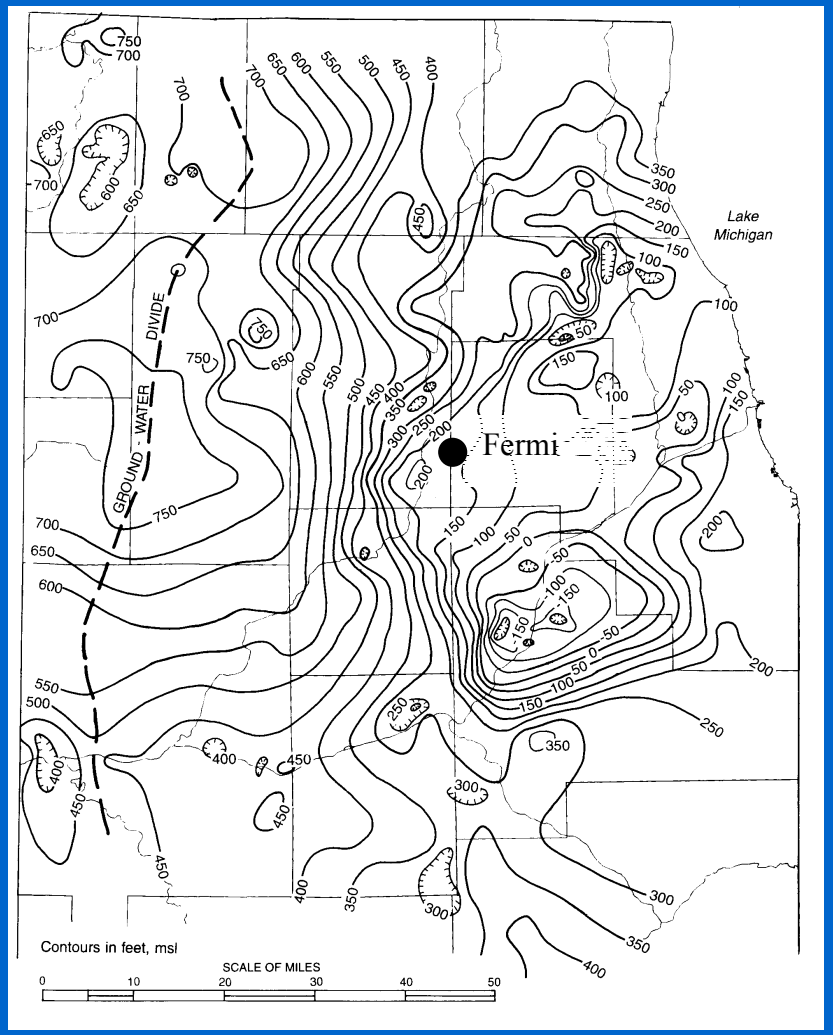
- Dolomites/Limestones
  - Competent
- Shales
  - Slaking horizons require protective coating
- Sandstones
  - Friable horizons, some are aquifers
- Carboniferous
  - Horizons may contain methane

Groundwater

- Shallow Aquifer
- Aquitard
- Deep Aquifer

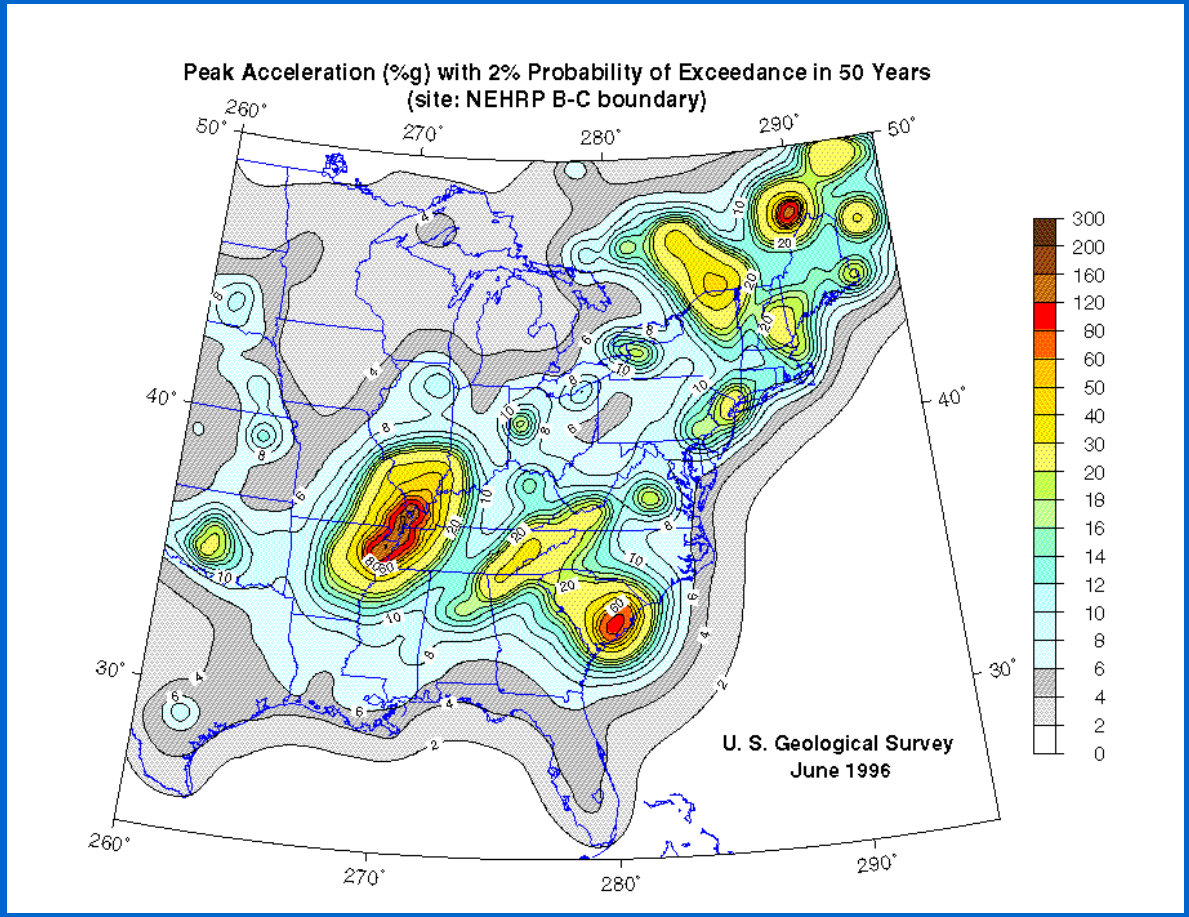
Groundwater Surface

- Deep Aquifer



Seismicity

- Seismic Hazard Map



Possible VLHC Alignments

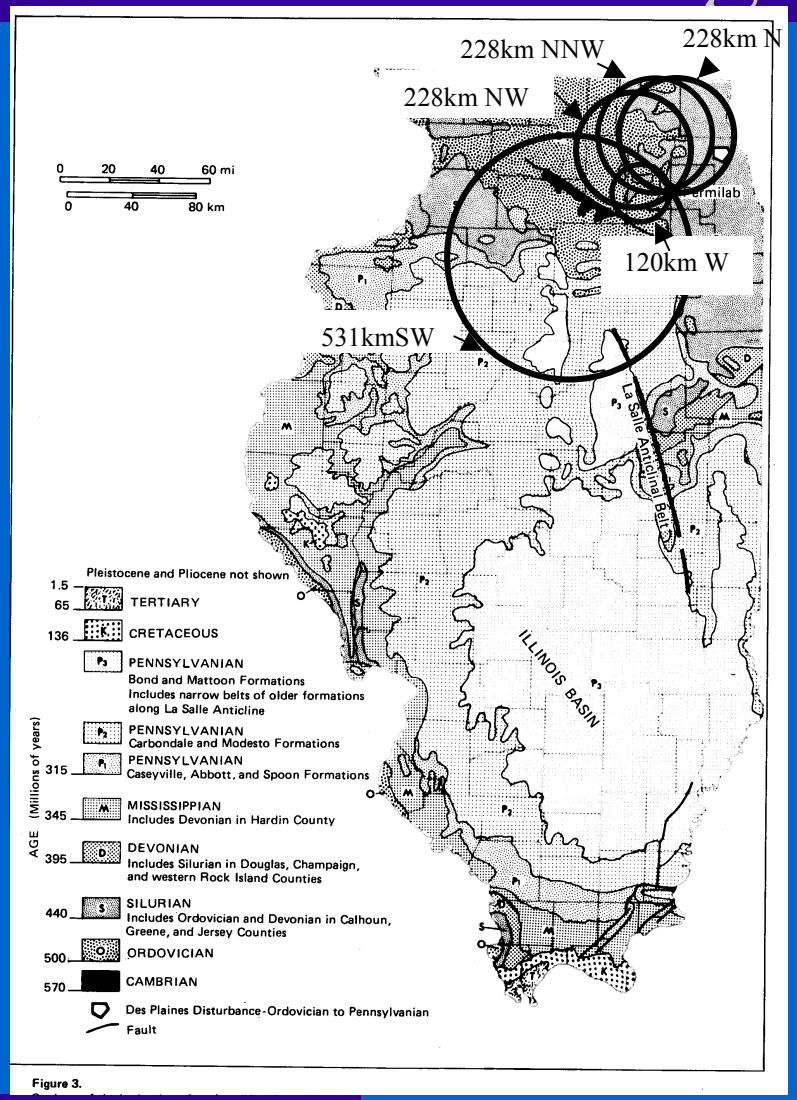
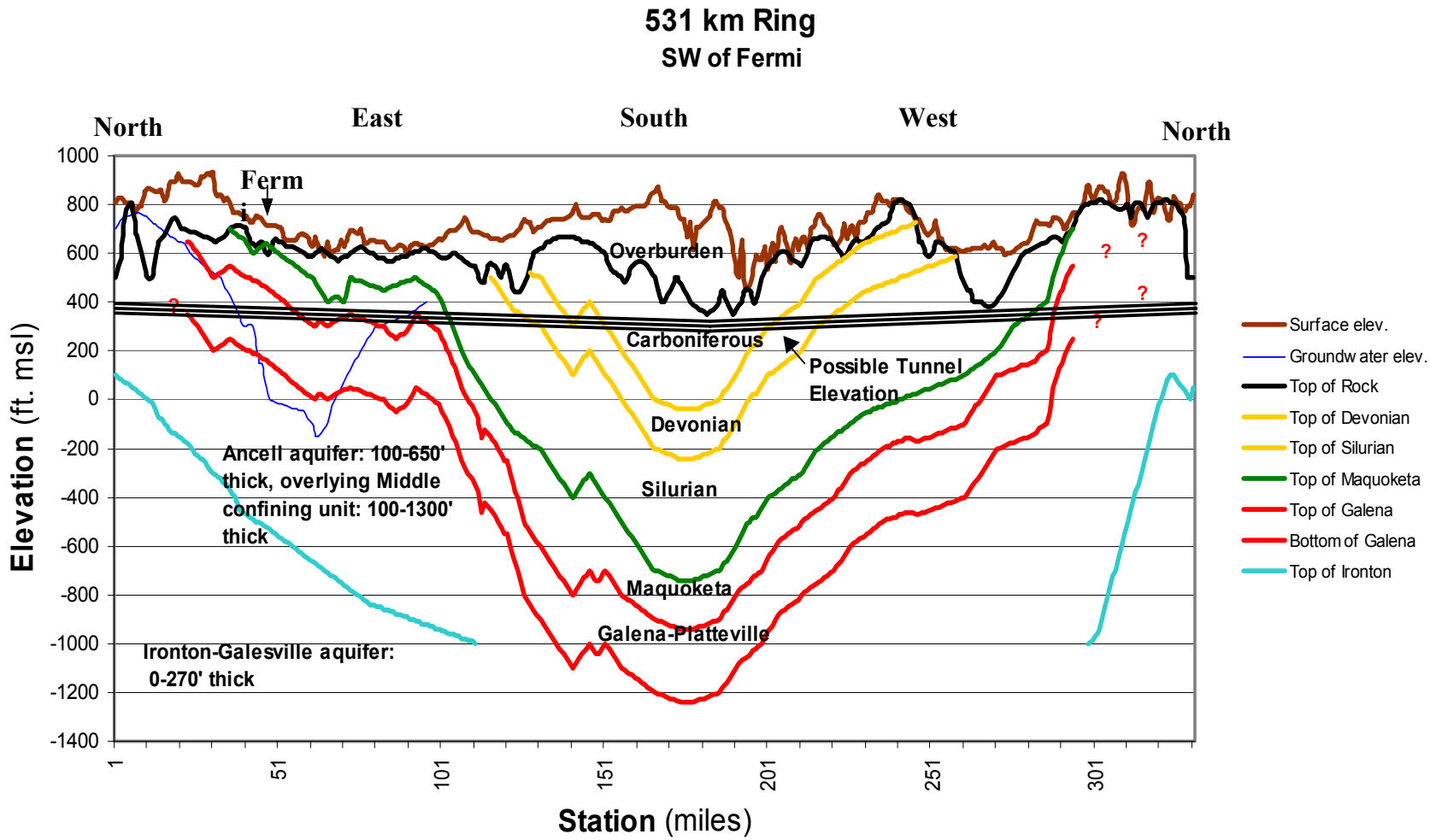


Figure 3.

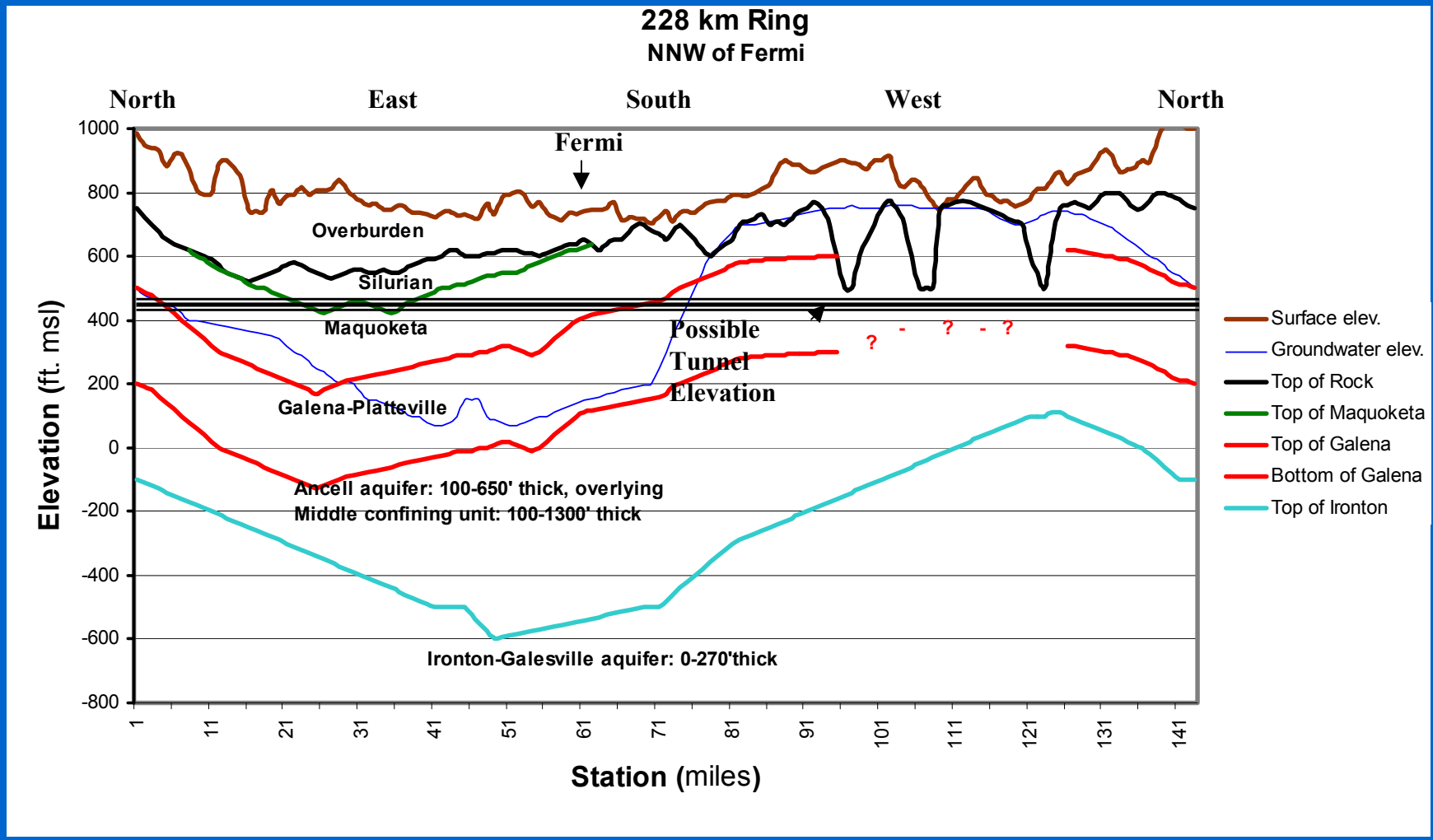
VLHC Geologic Sections

- Input
- Preparation

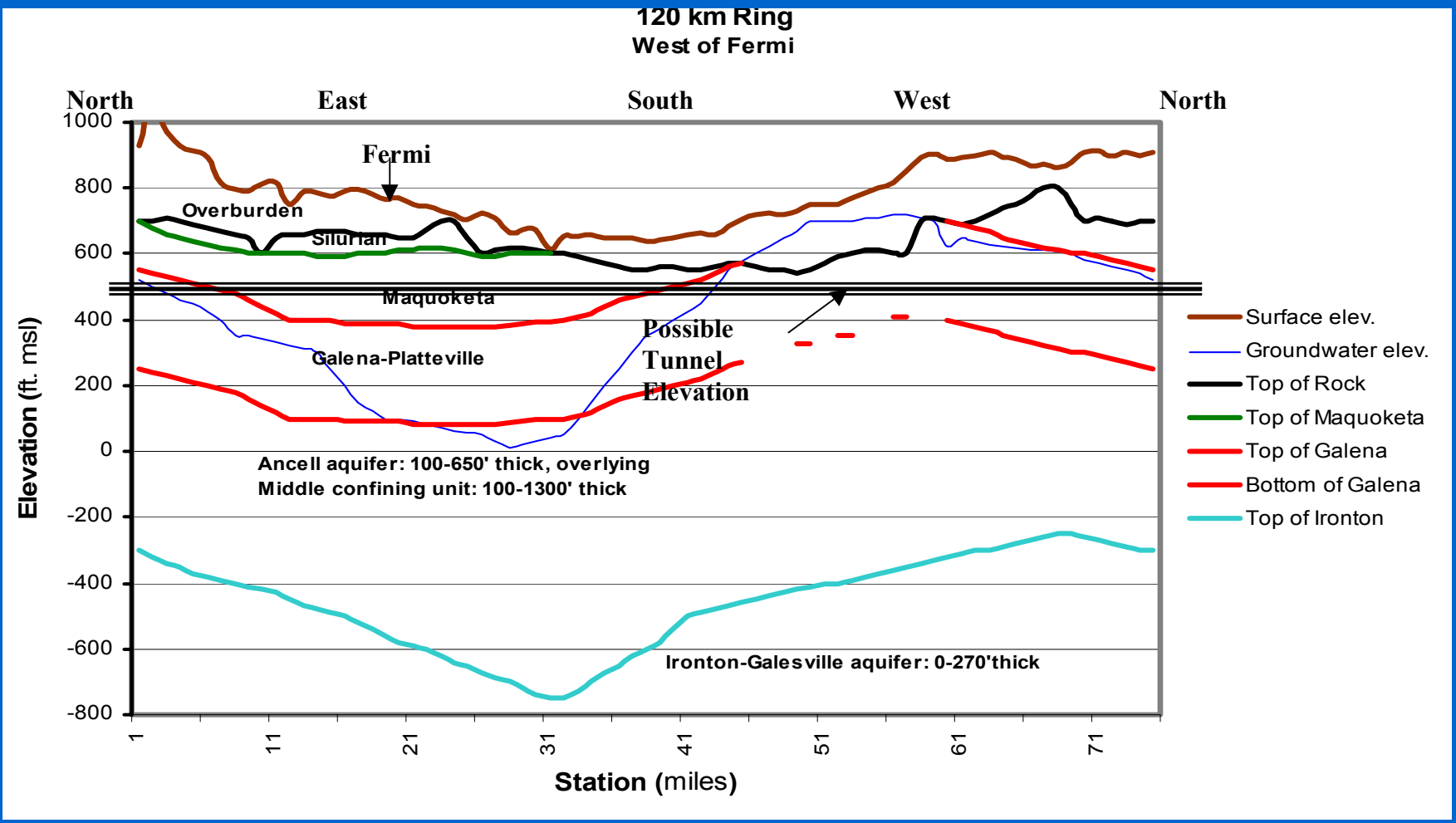
Geologic Section 531km SW



Geologic Section 228km NNW



Geologic Section 120km W



Geology Summary

•VLHC Alternatives

Formation	Tunneling Considerations	531km	228km NNW	120km W
Ancell	Aquifer, Friable horizons	45 miles		
Galena-Platteville	Aquitard, favorable tunneling	50 miles	76 miles	38 miles
Maquoketa	Aquitard, Slaking horizons	50 miles	53 miles	37 miles
Silurian	Favorable tunneling	95 miles	13 miles	
Devonian	Slaking horizons	35 miles		
Carboniferous	Methane horizons, Aquifer horizons	55 miles		

Kenny Estimate Input

3 TeV Project Dimensions		
Item	**Fermi Requirement**	**Kenny**
Tunnel Length (miles)	21.1	21.1
Tunnel Diameter (ft.)	10 minimum.	12
Construction shafts (ea)	4	4
Construction Shafts diameter (ft.)	20	20
Utility Shafts (ea)	0	20
Utility Shafts diameter (ft.)	0	6
Concrete invert (miles)	21.1	21.1
Water inflow (gpm/mile)	50	50
Elevation (ft. msl)	320	320

Kenny Cost Summary

Item	TotalCost	Cost/Mile
Shafts	**12.7m**	
Tunnel Excav.	**94.4m**	**4.5m**
Invert Lining	**13.5m**	**0.6m**
Grouting	**23.4m**	**1.1m**
Slopes	**23.3m**	
TOTAL	**167.3m**	

Estimated Cost

228km Ring NNW of Fermi

Item	Formation	Units	Quantity	Cost/Unit (rounded)	Total (rounded)
Excavation	All	mile	142	4.5M	635.2M
Invert Lining	All	mile	142	0.6M	91.1M
Concrete Lining	Maquoketa	mile	53	1.6M	84.0M
Grouting	Silurian-Galena	mile	89	1.1M	98.6M
Shafts		each	24	3.2M	76.2M
Slopes		all			23.3M

- TOTAL 1,008.2M

Future Investigations

- Geology
  - Update Regional Data
    - Geologic Contacts
    - Geohydrology
- Tunneling
  - Study Characteristics of Deeper Units
    - Particularly Sandstones and Carboniferous Strata
  - Study increasing TBM productivity

Characterization of Fermi Region Geology

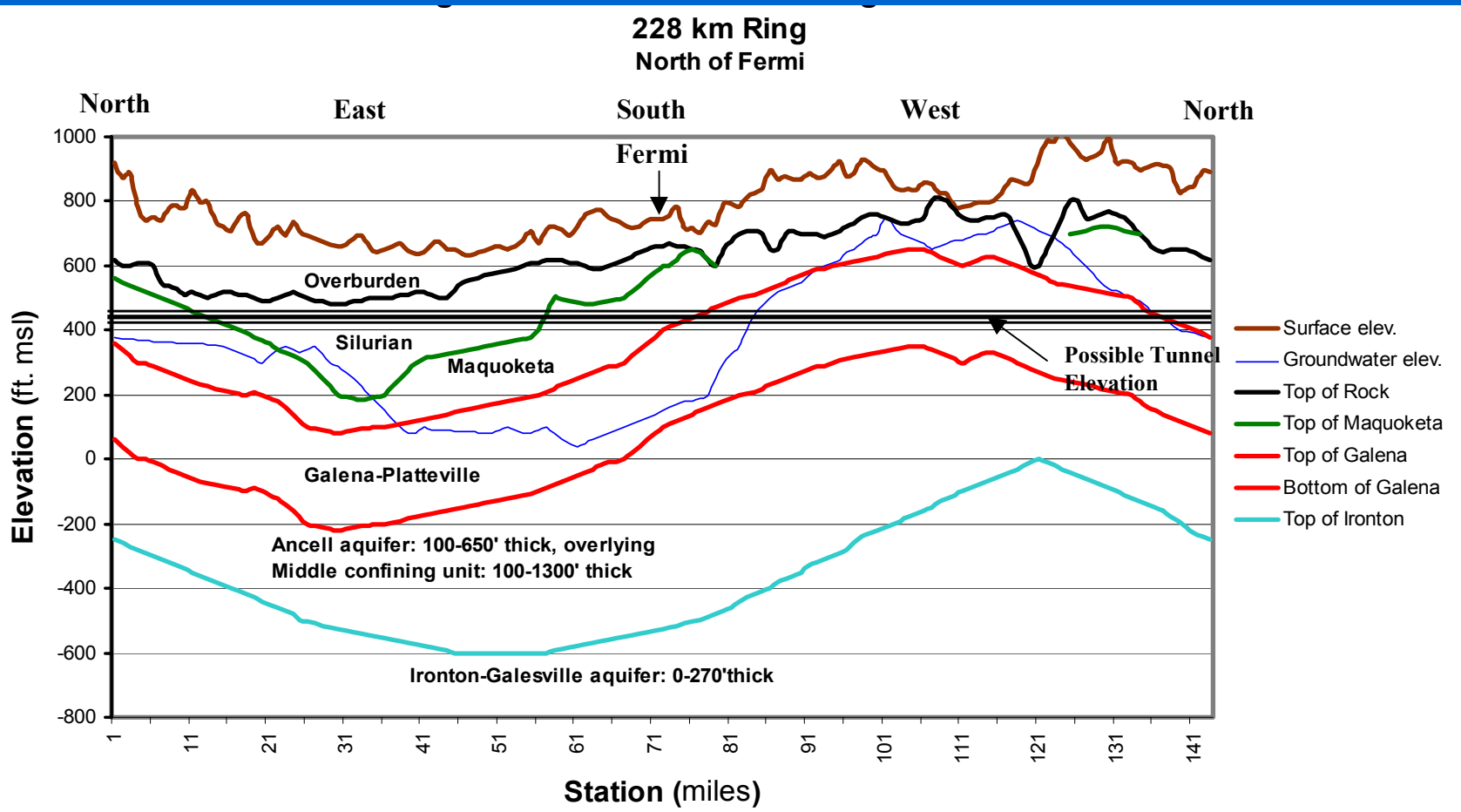
Second Annual VLHC Meeting

Port Jefferson, Long Island, NY

October, 2000

Peter Conroy

Geologic Section 228km N



Geologic Section 228km NW