



Next Generation Water Observing System (NGWOS) Illinois River Basin (IRB) Geophysics and Airborne Electromagnetic (AEM) Survey

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NGWOS Illinois River Basin: Geophysics and AEM Survey

Geophysical data and AEM collected to inform:

- Depth to bedrock and structural interpretation
- Subsurface characterization of lithology and investigate groundwater salinity
- Regional observation, integration, and extrapolation at a variety of scales

NGWOS
surficial studies

Integrated Water
Availability Assessment
(IWAA) groundwater
modeling

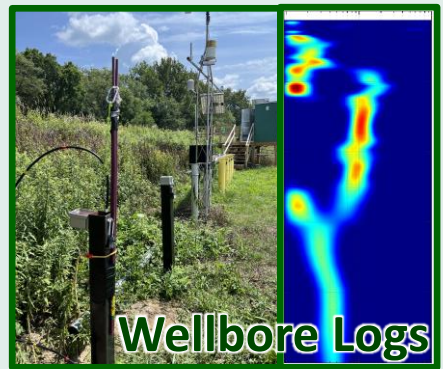
Cooperators'
subsurface interests

Geophysical Methods and Data Collection

Airborne Electromagnetic Survey



DualEM



Wellbore Logs



LoupeEM



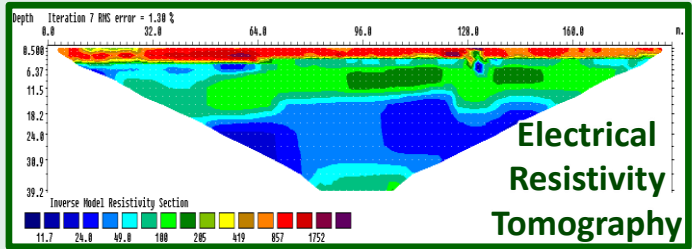
WalkTEM



Horizontal-to-Vertical
Spectral Ratio

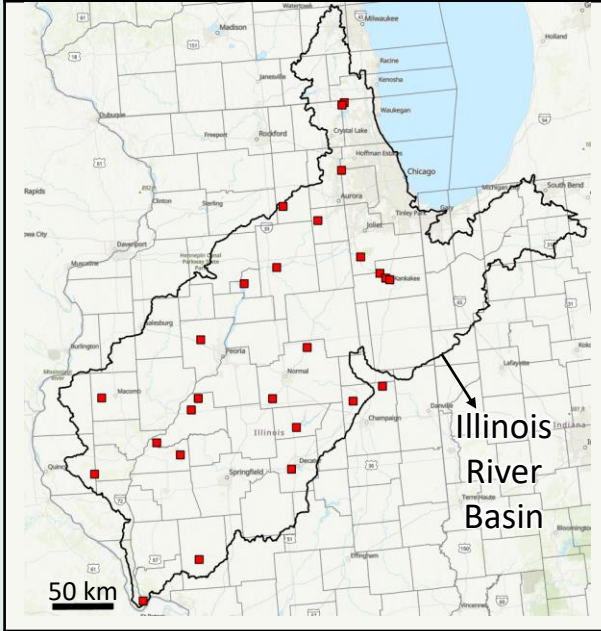


FloatTEM

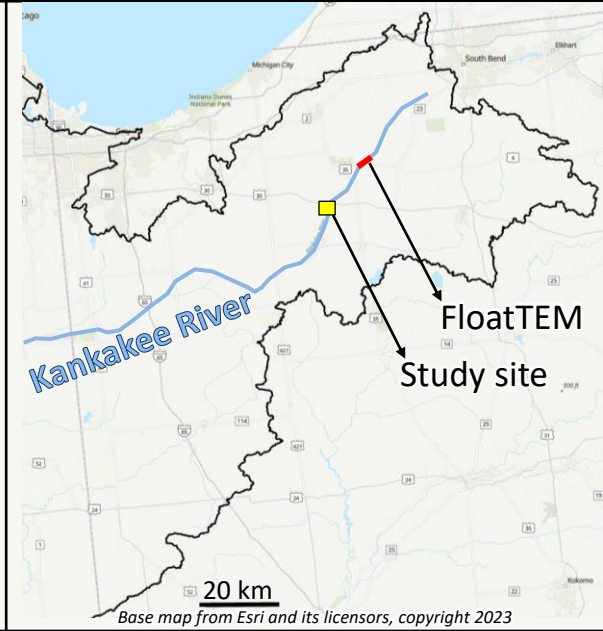


Data Releases to be published

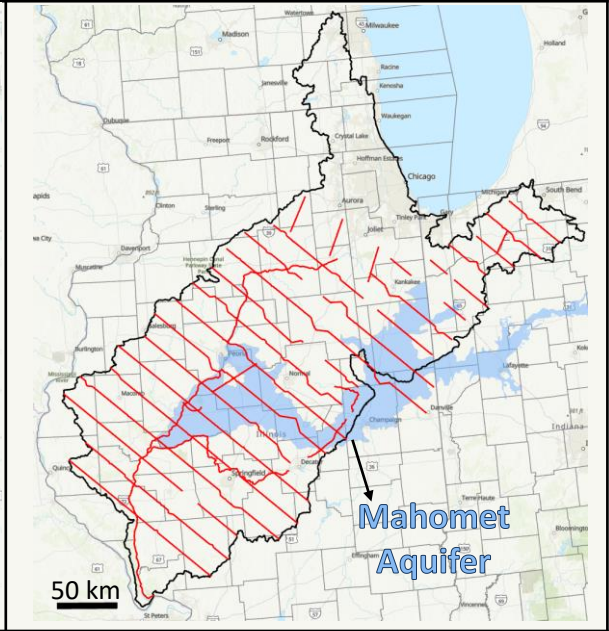
Late 2022 ground-based



2023 Indiana – Kankakee study site



2023 Regional AEM survey



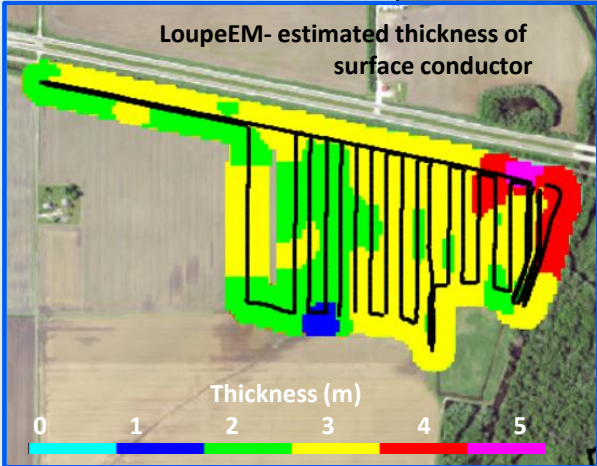
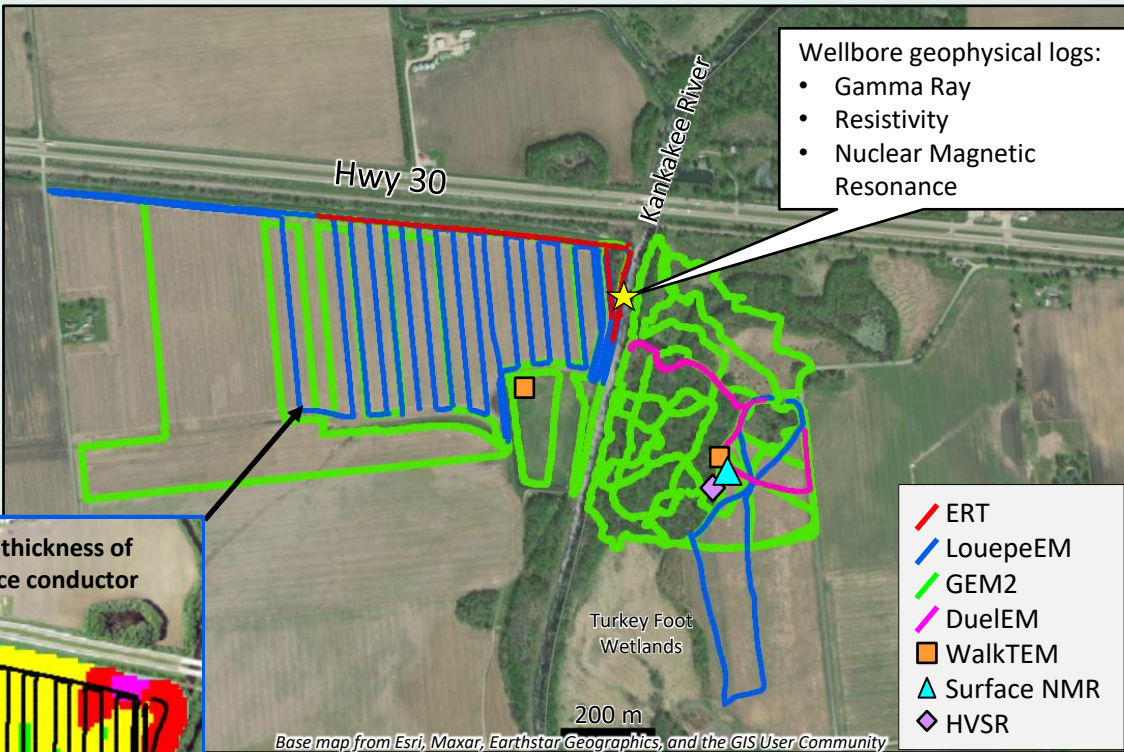
- 26 ground geophysics sites.
- Time domain electromagnetic (1D)
- Horizontal-to-Vertical Spectral Ratio (HVSR) (1D).

- NGWOS Kankakee study site focused on groundwater – surface water interaction and nutrient exchange.

- Completed survey data acquisition ~3,700 km.
- 20 km for regional scale observations.



NGWOS Kankakee groundwater-surface water interaction site

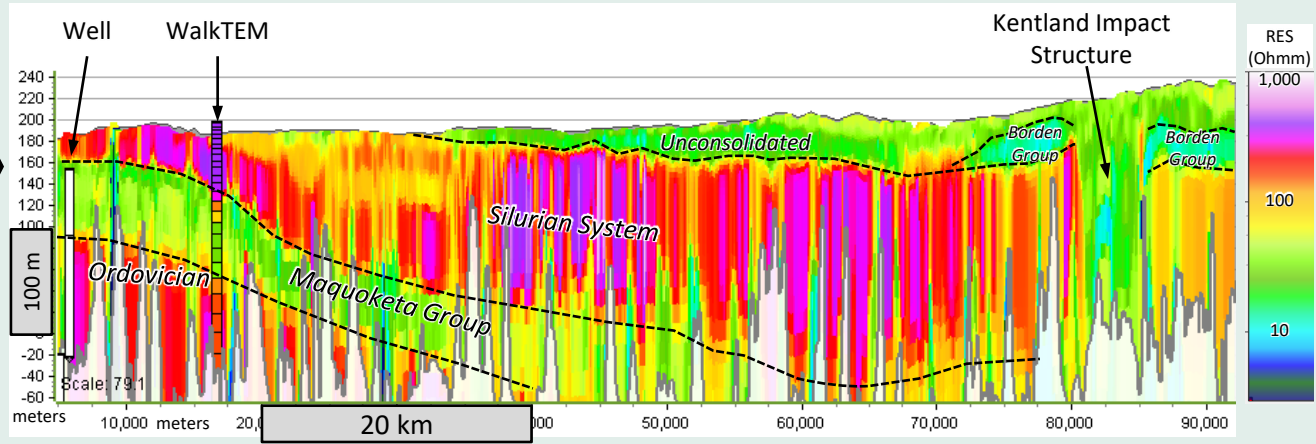
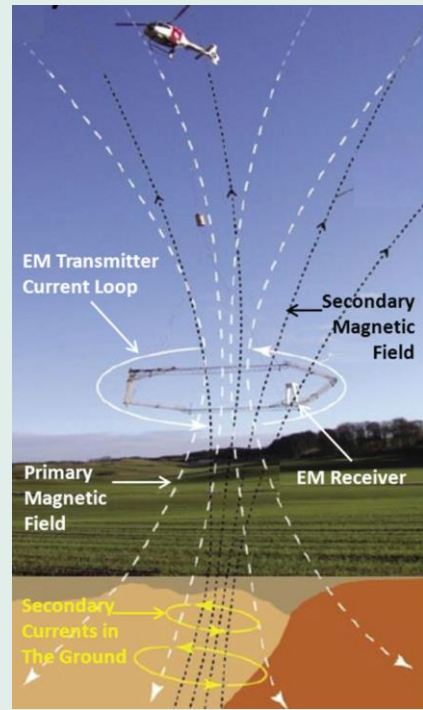


AEM Geophysical Technique and Interpretation

Resistivity measurements can be interpreted to indicate lithology, salinity, and contact with bedrock.

low **high**

Clays, Silts, Shales, Elevated salinity Sands, gravels, Bedrock, limestones



Typical instrument loop height above ground: ~100 ft

Typical depth of investigation: ~250-950 ft

AEM provides data at a scale to compliment other common datasets (wellbore, site study)

Modified from Brown, Bill, and Flemming, Efferso, 2017, The Application of Airborne Geophysics for Water Exploration.



AEM Interpretation

Interpretation objectives:

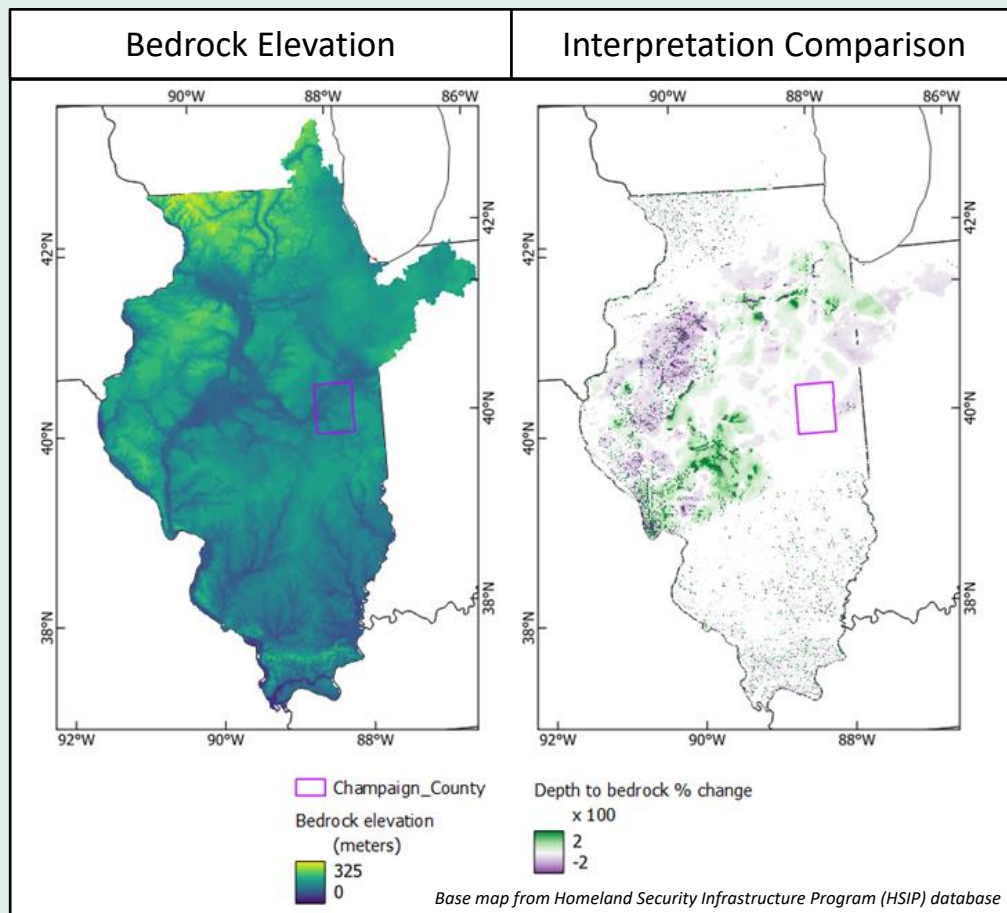
- Top of bedrock elevation
- Delineate bedrock intervals
- Identify Quaternary features

Interpretations to inform and support:

- Illinois State Water Survey (ISWS) and Integrated Water Availability Assessment (IWAA) groundwater modeling efforts
- NGWOS studies subsurface characterization

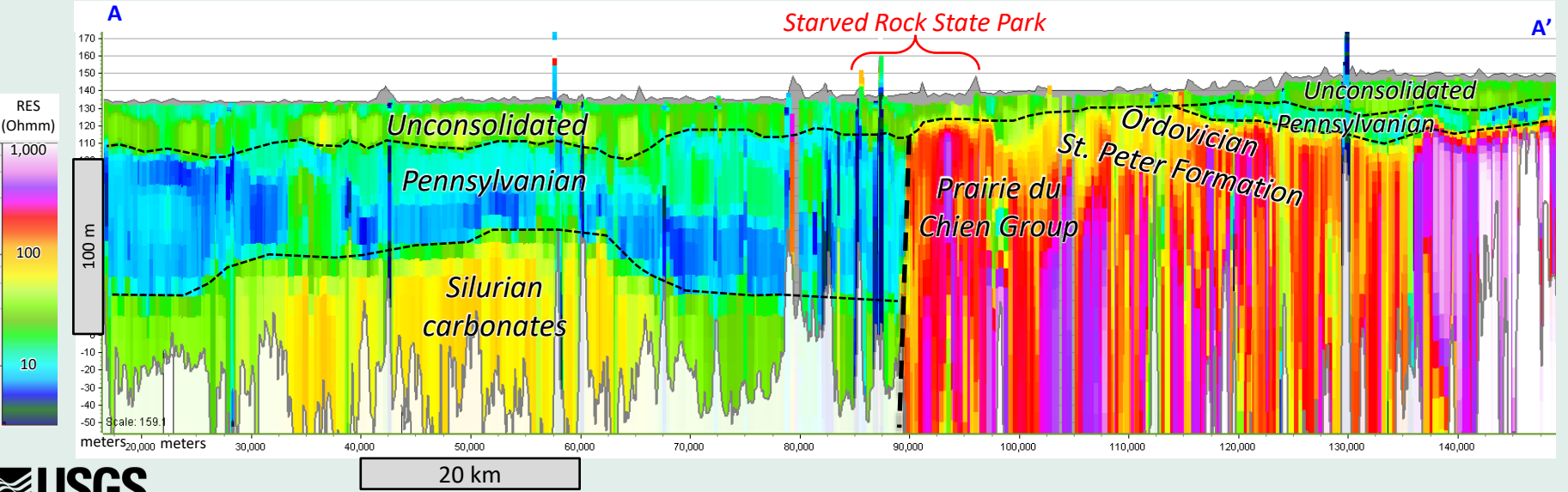
Collaboration

- Illinois State Water Survey
- Illinois State Geologic Survey
- IWAA modelers
- Indiana Geological and Water Survey
- Ohio-Kentucky-Indiana Water Science Center



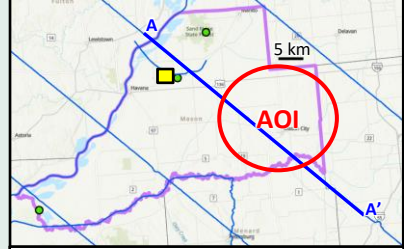
AEM Interpretation – Bedrock Characterization

- Starved Rock State Park is host to testbed and super gage site.
- Resistivity data along the Illinois River indicates bedrock structure and contacts changes at depth.
- Do changes in bedrock structure or unconsolidated materials factor in surficially observed data trends?

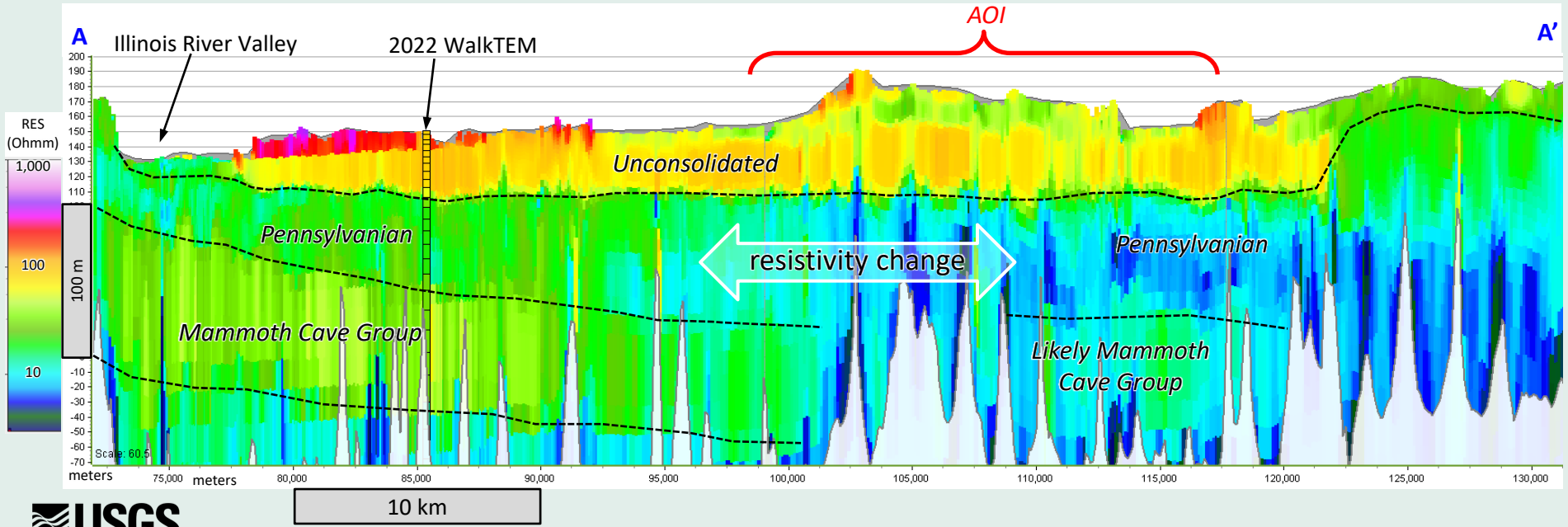


AEM Interpretation – Groundwater model refinement

- Resistivity interpretation to support groundwater model refinement.
- Area of Interest (AOI) to better understand groundwater drawdown.
- Notable change in resistivity may be indicative of facies, lithology, and/or fluid salinity changes, that could be reflected in hydrologic parameters.

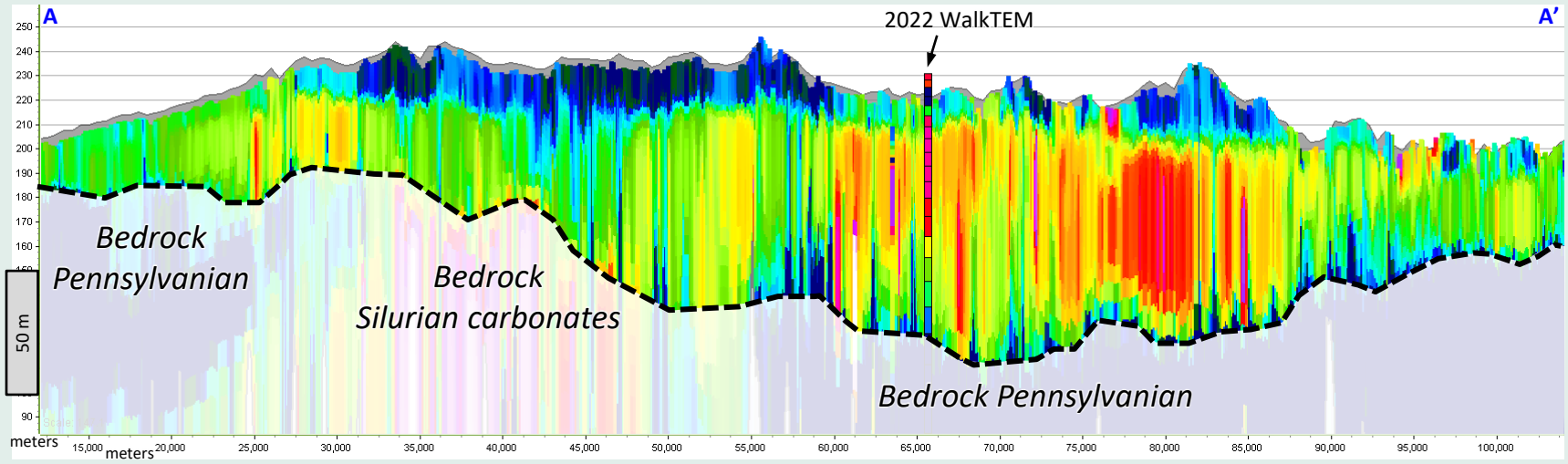
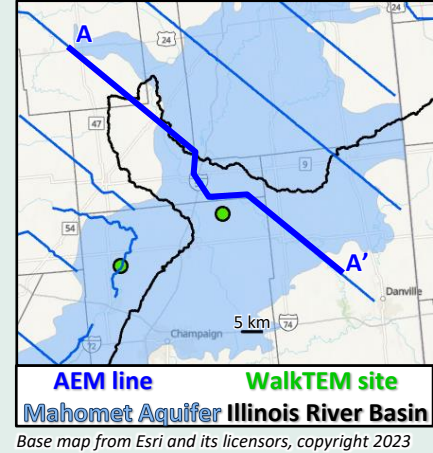
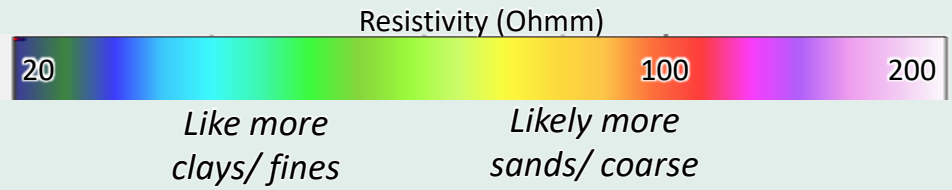


AEM line WalkTEM site
Mason Co. NGWOS GW-SW
Base map from Esri and its licensors, copyright 2023



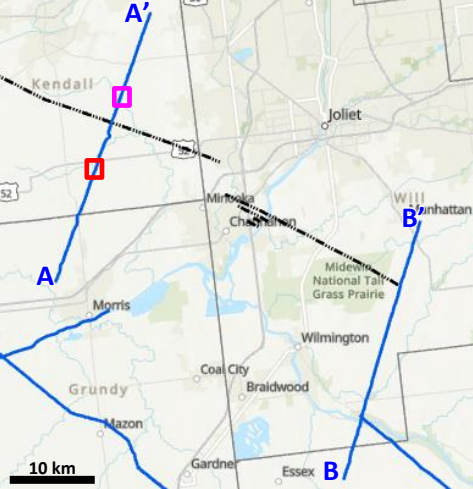
AEM Interpretation – Groundwater model refinement

- Resistivity changes may be indicative of facies, lithology, and/or fluid salinity changes.
- Collaborate with partners while integrating additional data sets and correlating to known hydrologically significant layers.

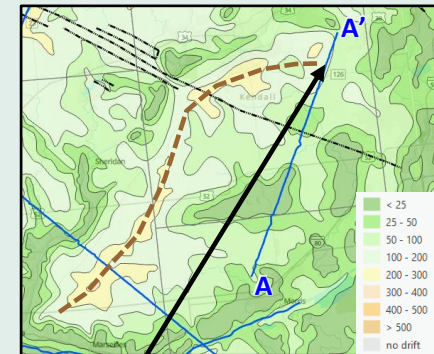


AEM Interpretation – Sandwich Fault Zone (SFZ)

- Broad region (10 km) of notable structural offset and dip changes. Largest offset ~5.5 km SW of mapped SFZ.
- Possible bedrock valley.
- More closely spaced AEM lines could aid in mapping 3D and at depth.

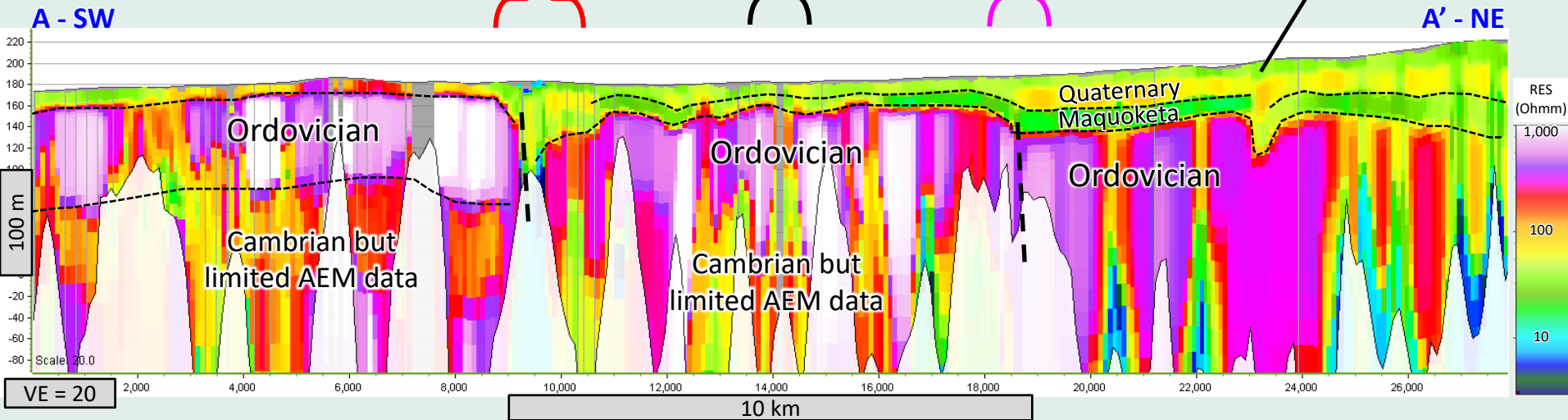


AEM lines
ISGS Structural Features in Illinois - 1995 - Faults



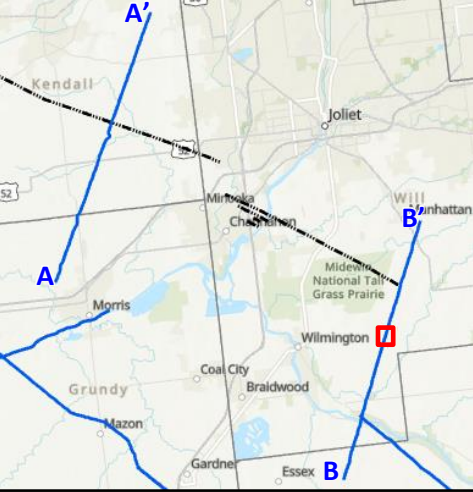
ISGS Glacial Drift thickness in Illinois 1994

Area with significant offset Location of SFZ per regional structure map notable offset

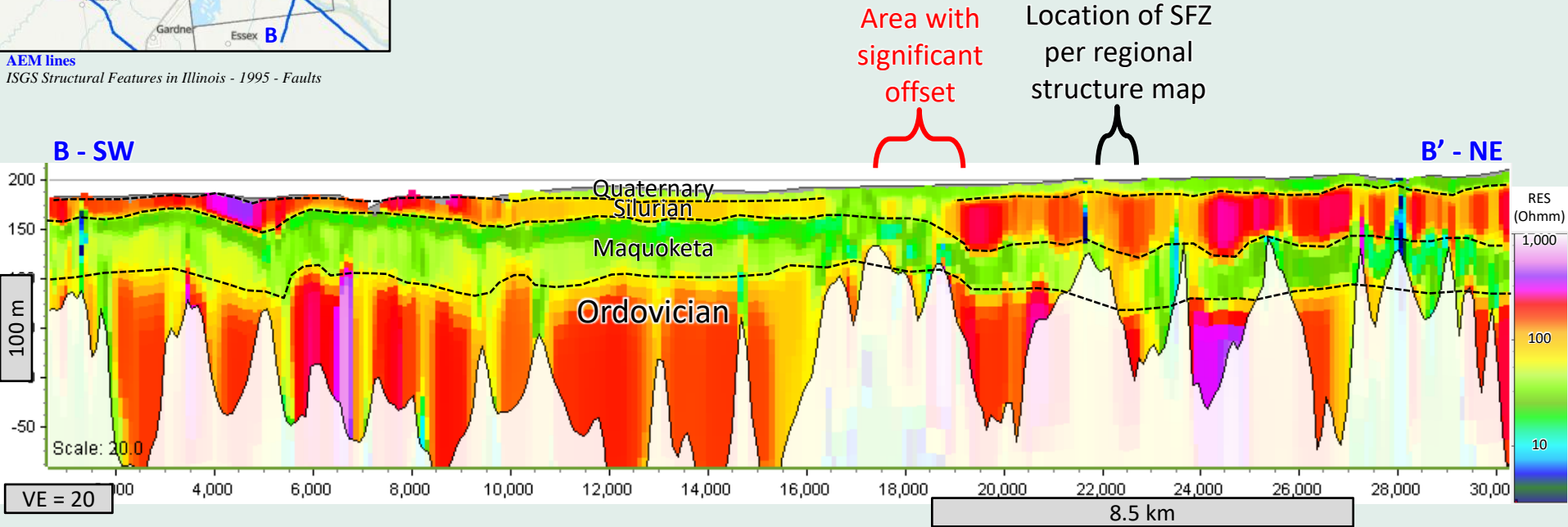


AEM Interpretation – Sandwich Fault Zone (SFZ)

- Broad region (8.5 km) of notable structural offset and dip changes at Maquoketa and Ordovician intervals. Largest offset ~4 km SW of mapped SFZ.
- More closely spaced AEM lines could aid in mapping 3D and at depth



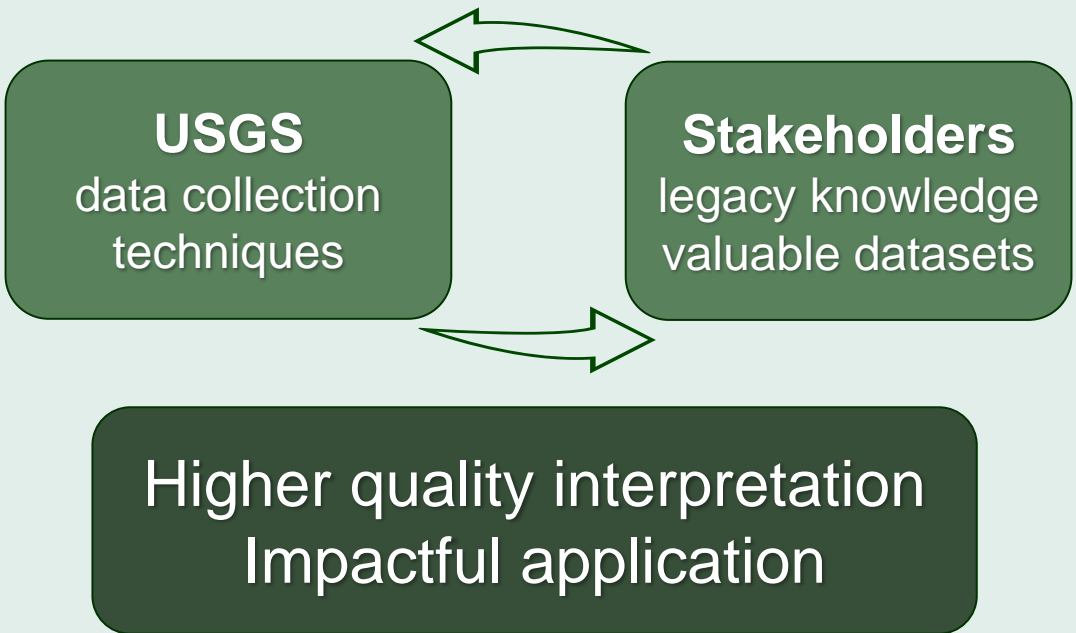
AEM lines
ISGS Structural Features in Illinois - 1995 - Faults



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- SkyTEM
- Illinois State Geological Survey (ISGS)
- Illinois State Water Survey (ISWS)
- Illinois Department of Natural Resources
- Indiana Geological and Water Survey
- Fellows Estates, LLC
- USGS Lake Michigan Ecological Research Station
- Indiana Geological and Water Survey
- Next Generation Water Observing System (NGWOS) Program
- Integrated Water Availability Assessment (IWAA)
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