Does the Grenville Front Tectonic Zone Lie West of its Previously Inferred Location in West-Central Ohio?

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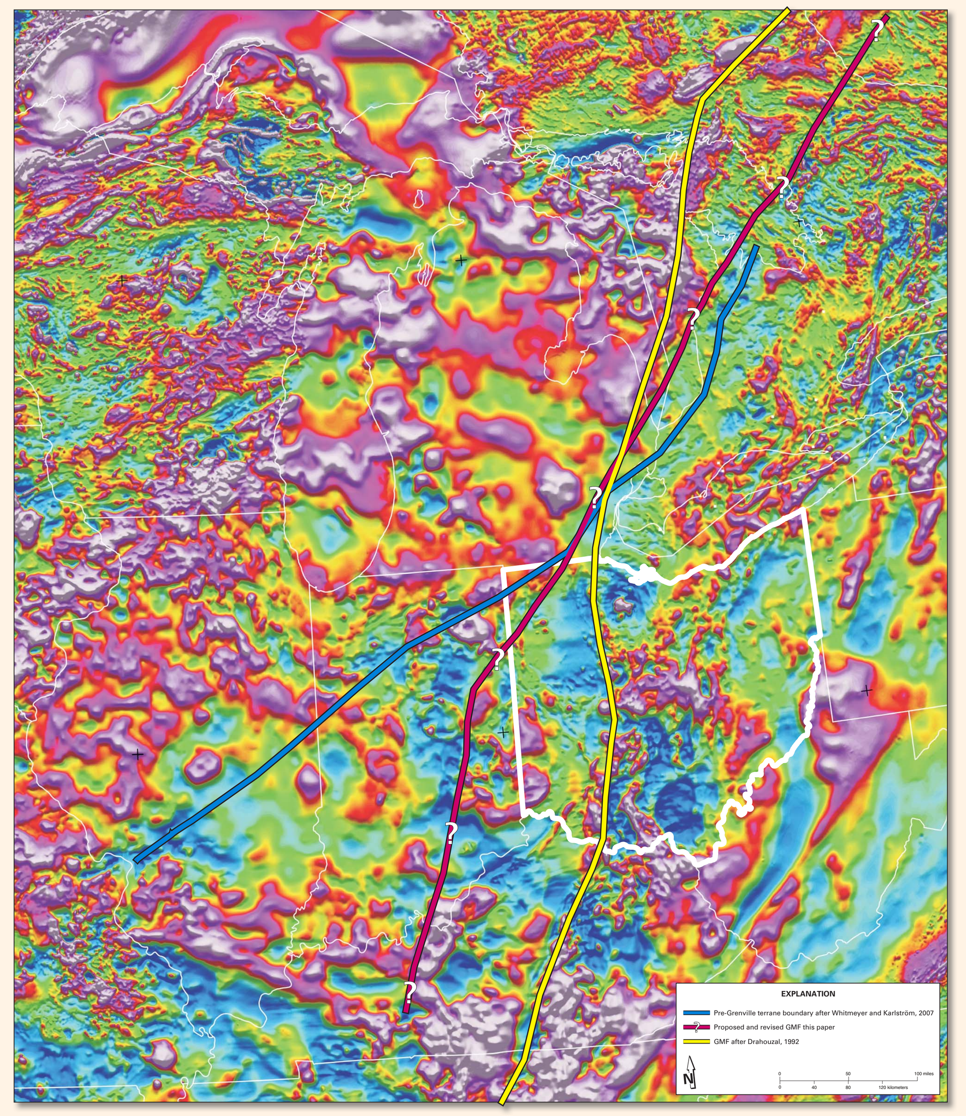
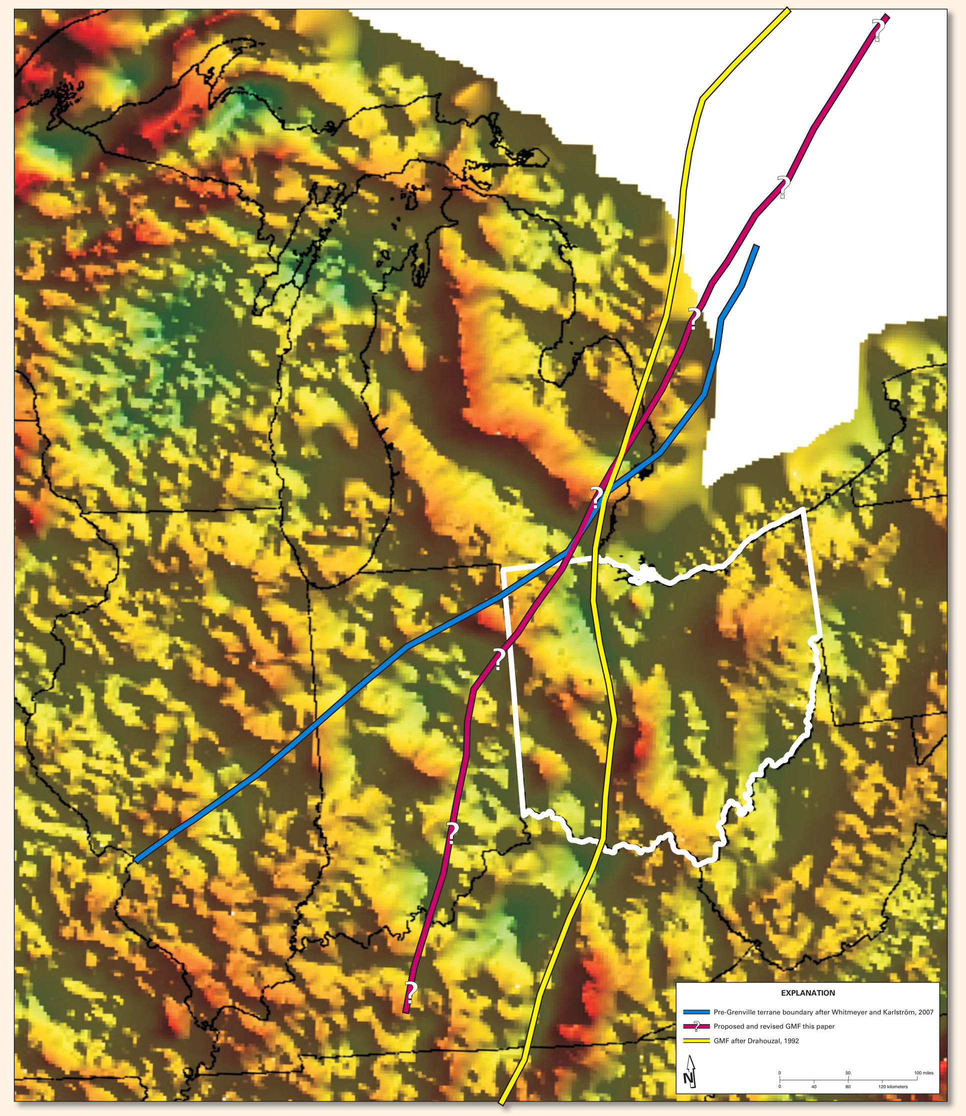
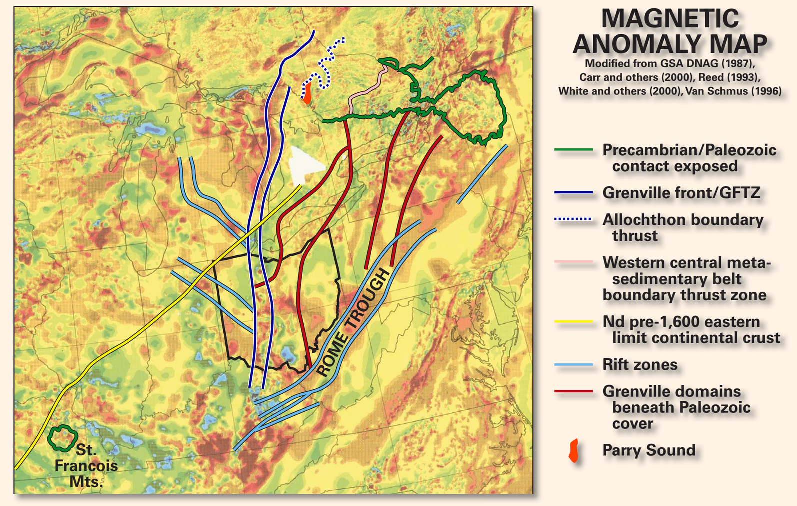
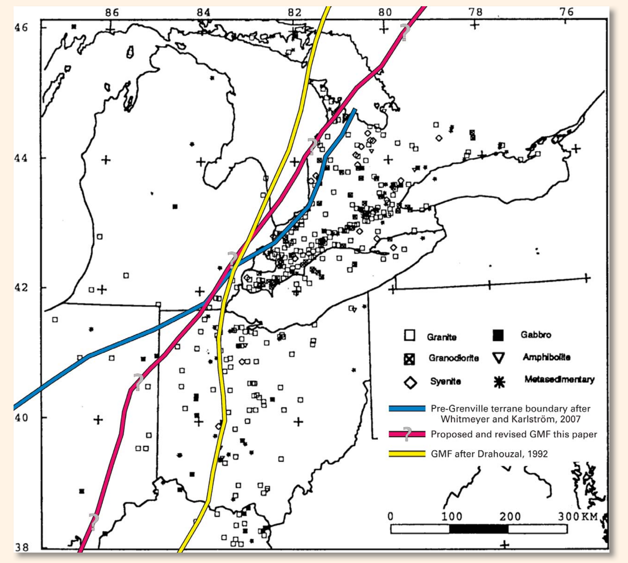
STOP 4

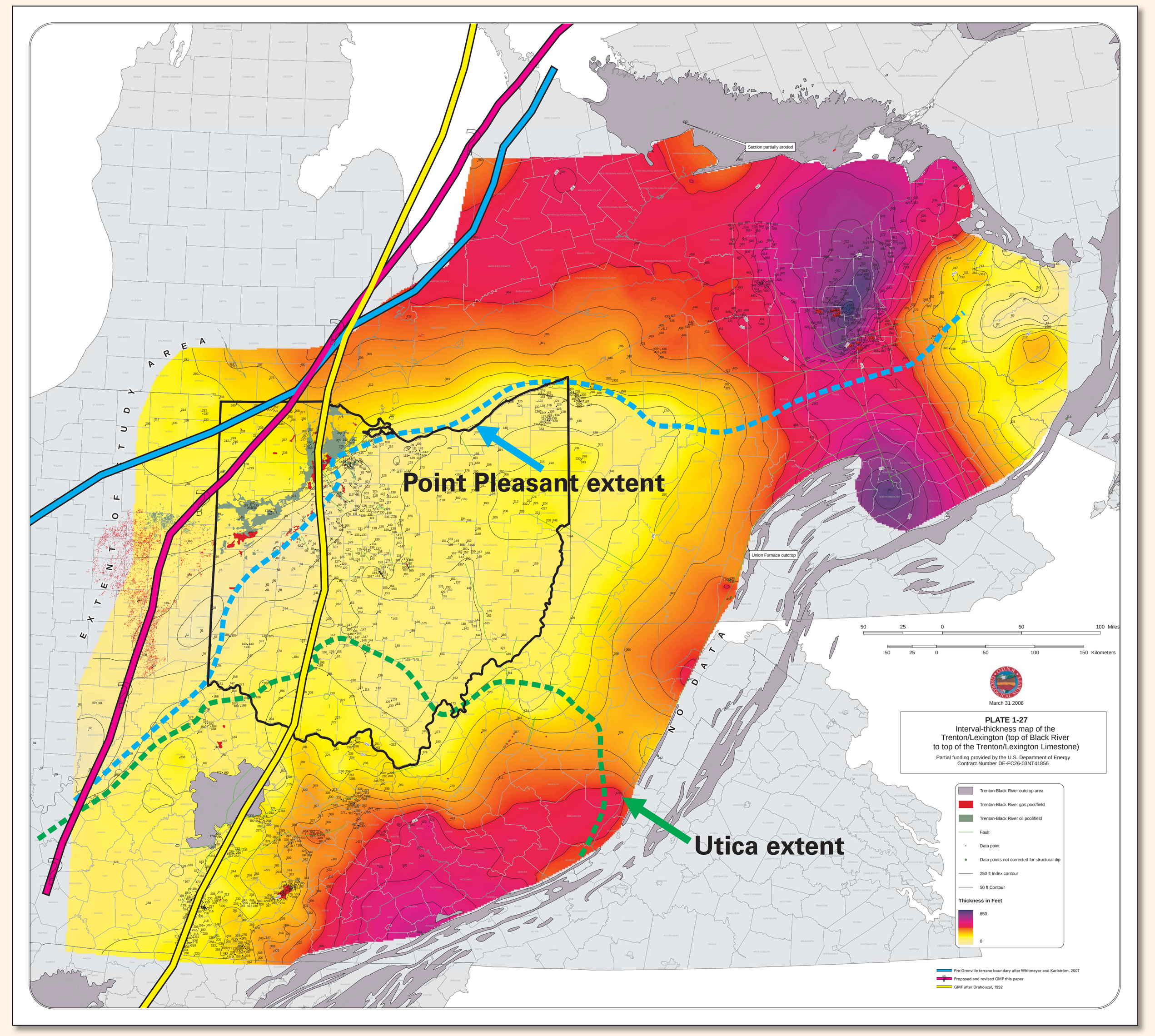

Composite aeromagnetic map of part of the eastern United States and Canada. Simulated flight altitude 305-meters above ground, spectral color display, and sun angle zero degrees. Compiled from various sources and processed by USGS Reston, Virginia. Major tectonic trends illustrated.


Map of Ohio region showing isostatic residual Bouguer gravity anomalies, modified from USGS (1995). Trends discussed for poster shown.

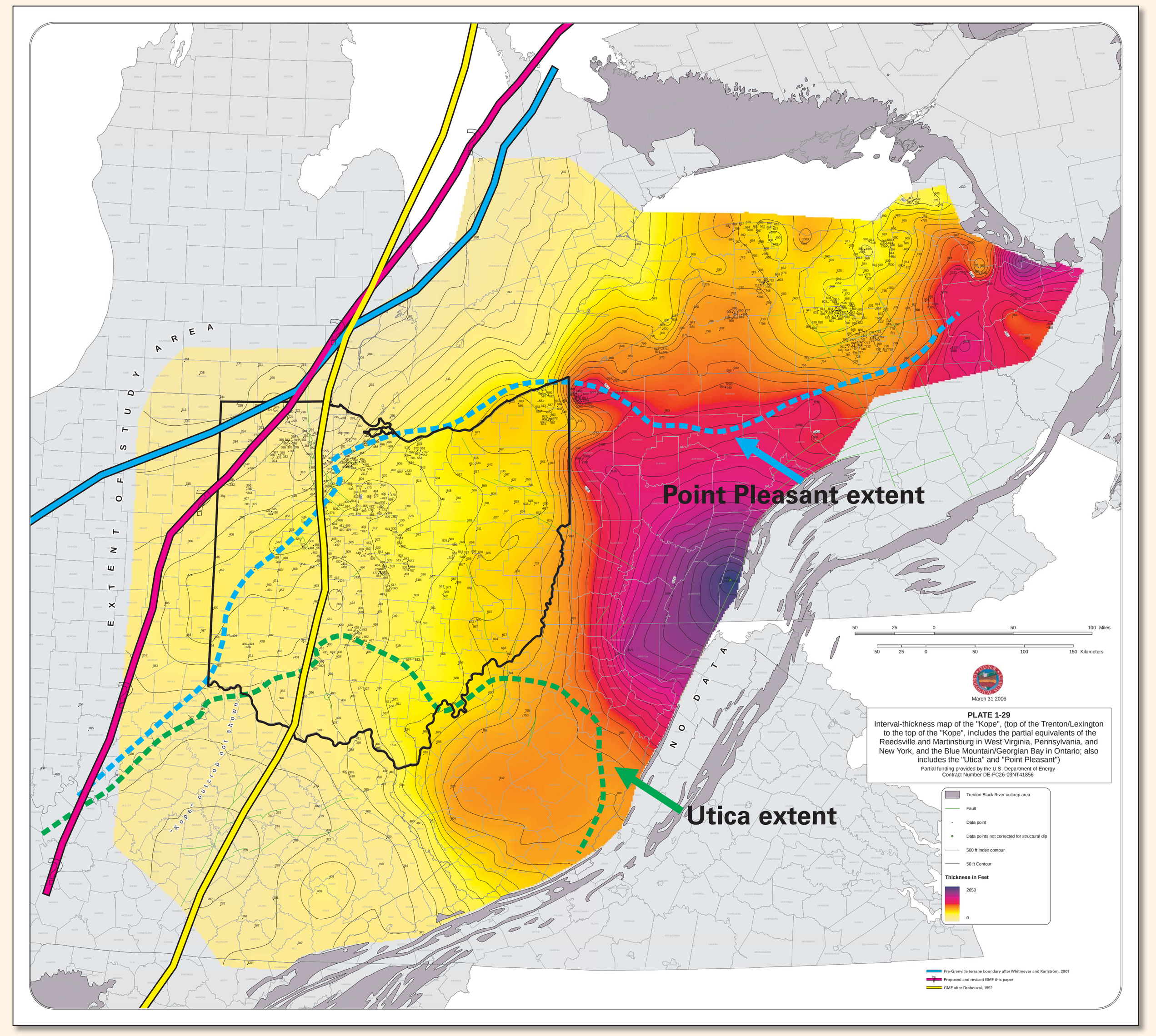


Magnetic anomaly map modified from GSA (1987) shows changes in relative intensity along tectonic boundaries and structural trends.


Map showing generalized basement lithologies from well control. Modified from Lidiak and Hinze (1993). Trends discussed for poster shown.

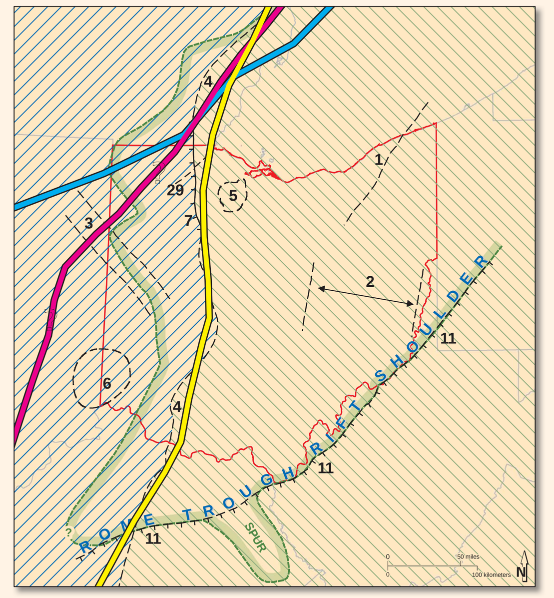


Trenton isopach map with form lines along facies boundaries and thickness trends. Modified from Baranoski and Riley (2011). Trends discussed for poster shown.

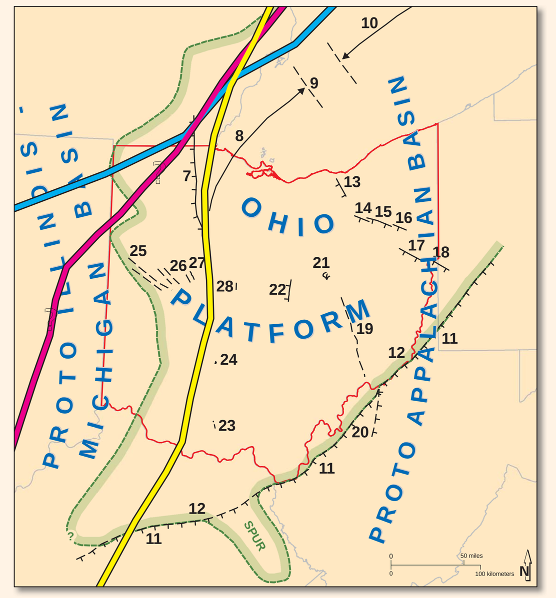


Isopach map of Kope/Utica/Point Pleasant interval with form lines along facies boundaries and thickness trends. Modified from Baranoski and Riley (2011). Trends discussed for poster shown.

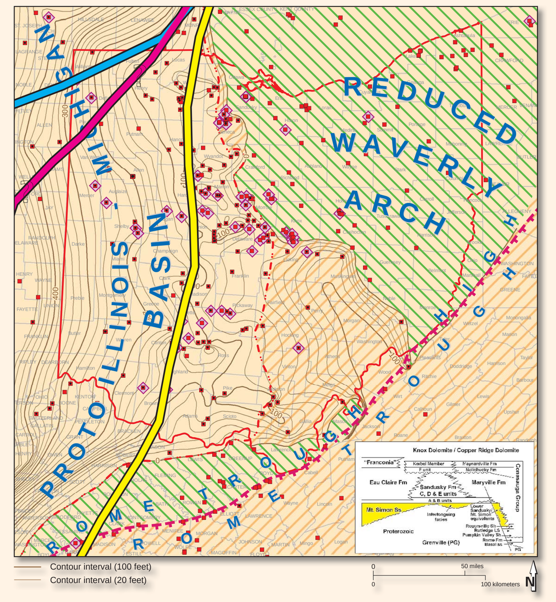
STOP 5



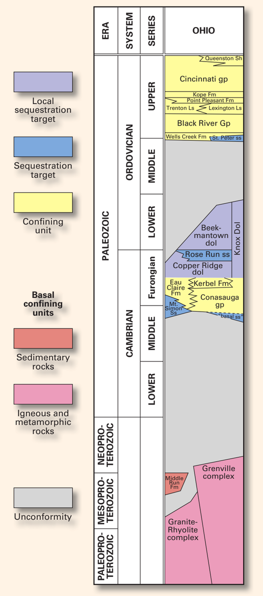
Proposed extension of the Late Mesoproterozoic to Neoproterozoic Waverly Arch and major structural features. Modified from Baranoski (unpub. data, 2009). Trends discussed for poster shown.

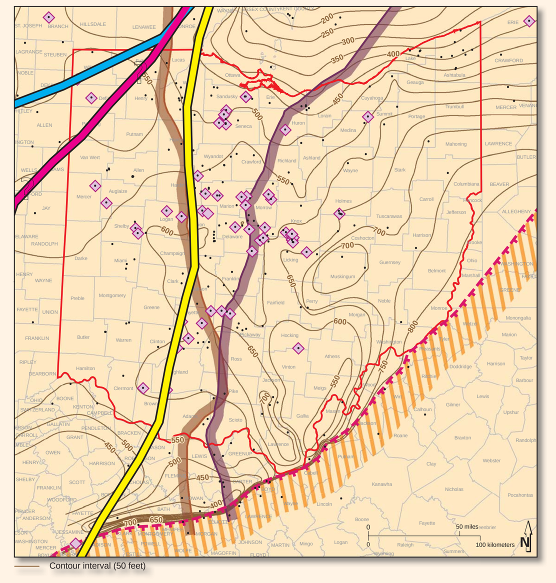


Emergent Ohio Platform, proto-basins, and major structural features. Modified from Baranoski (unpub. data, 2009). Trends discussed for poster shown.

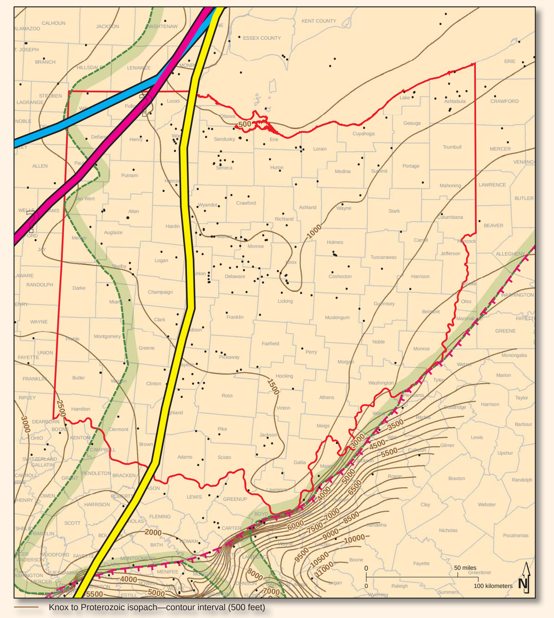


Isopach of Mt. Simon Sandstone shows reduced Waverly Arch, basin development, and the emergence of the Ohio Platform. Modified from Baranoski (unpub. data, 2009). Trends discussed for poster shown.

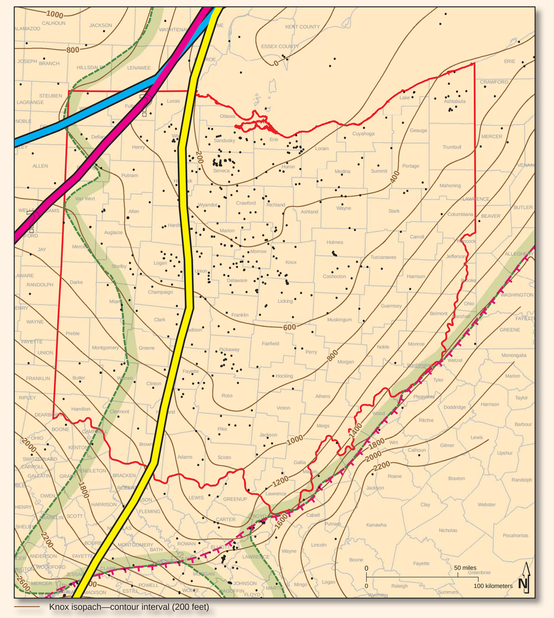

Generalized stratigraphic column of Ordovician and older rock units.



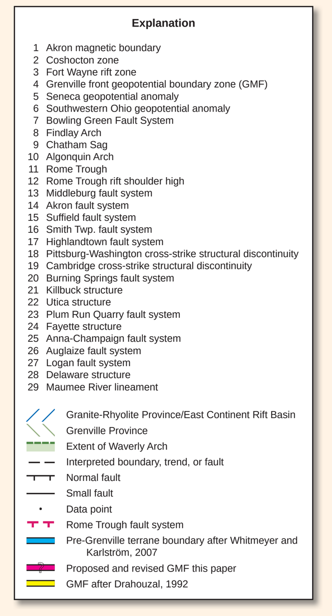
Isopach of Eau Claire/Conasauga/Sandusky interval shows extent of facies, reduced Waverly Arch, basin development, and the emergence of the Ohio Platform. Modified from Baranoski (unpub. data, 2009). Trends discussed for poster shown.

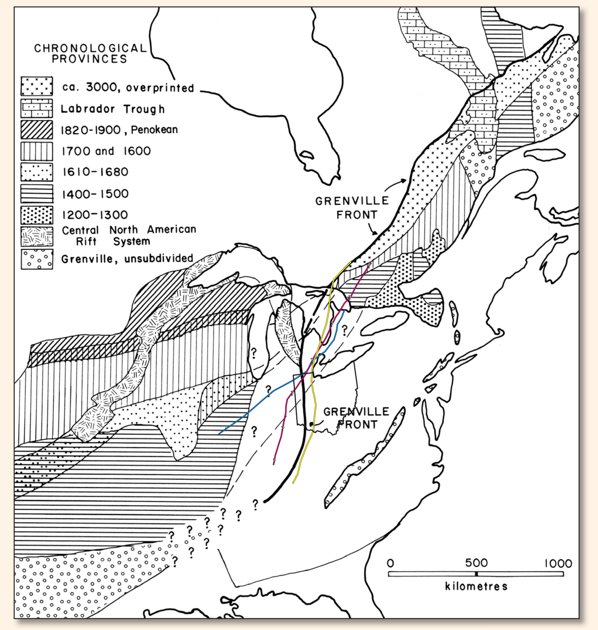


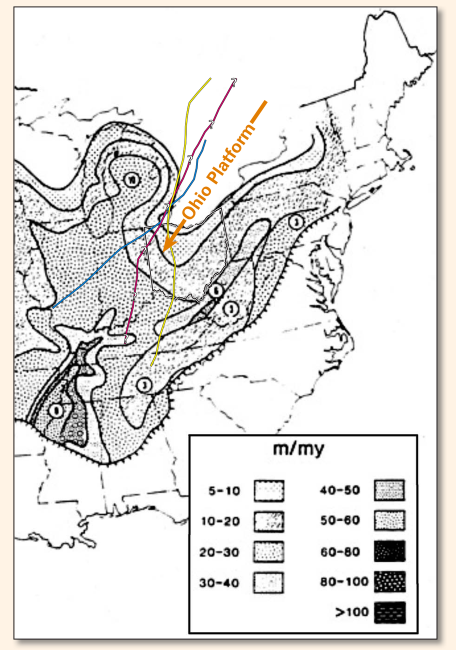
Isopach of Sauk sequence shows Cambrian/Early Ordovician extent of the emergent Ohio Platform. Modified from Baranoski (unpub. data, 2009). Trends discussed for poster shown.

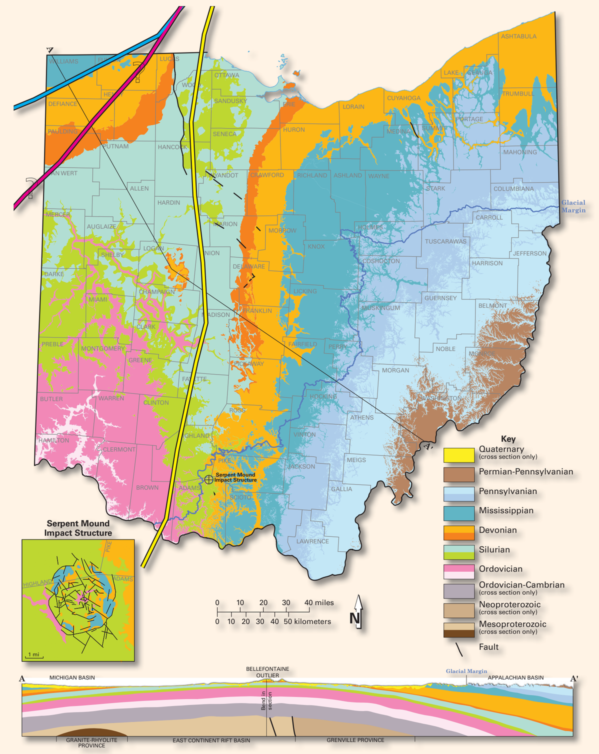


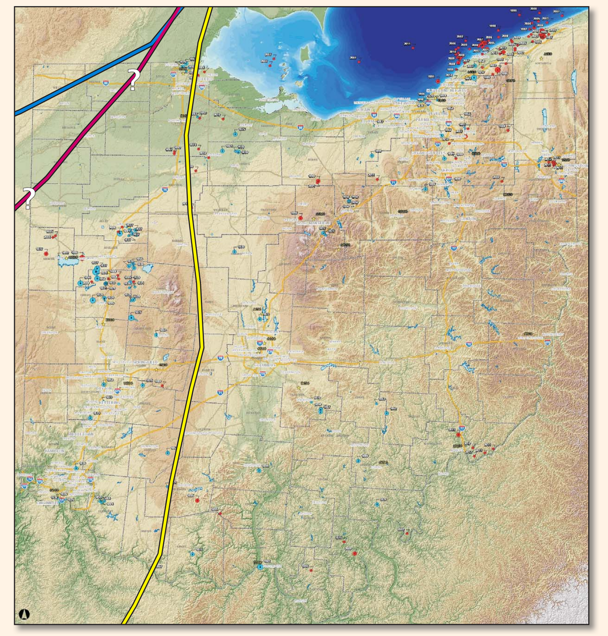
Isopach of Knox Dolomite shows Cambrian/Early Ordovician extent of the emergent Ohio Platform. Modified from Baranoski (unpub. data, 2009). Trends discussed for poster shown.




Map showing generalized Proterozoic provinces of eastern North America. Modified from Easton (1986). Trends discussed for poster shown.


Sauk subsidence rate map showing Ohio Platform extending from the exposed craton in Ontario to the Reelfoot Rift system and separating the Michigan Basin from the Rome Trough and Appalachian Shelf. Modified from Sloss (1988). Trends discussed for poster shown.


Map of bedrock geology of Ohio showing GMF lineament (blue line) and proposed new Grenville lineament (red line). Trends discussed for poster shown.


Map of Ohio area showing shaded topographic relief, earthquake locations with year and relative intensities. Trends discussed for poster shown.

PROS & CONS WITH MOVING THE GRENVILLE PROVINCE BOUNDARY FURTHER WEST IN OHIO AND ADJACENT INDIANA

PRO:

Seismic reflection profiles

Reinterpreted COCORP OH-1:

- Layered Proterozoic unconformity-bounded sequences
- Westward-thrusted and partitioned basins
- Anomalous, relatively low interval velocities in basin-fill
- Reflector impedence contrasts between basin-fill and underlying igneous/metamorphic rocks
- Westward horizontal shortening of basins

Layered Proterozoic unconformity bounded sequences on other seismic profiles in the region.

Diachronous assemblage of complex terranes suggests the unlikely possibility of broad linear continuous accretion/collision.

Total magnetic intensity

Second vertical derivative along COCORP profile supports alternating pattern of basin-fill and basement topographic highs.

Spectral output supports alternate lineament trends.

Profiles in Ohio are NOT comparable to profiles on the outcropping Grenville front in Ontario.

The inclusion of exotic terrains and the effects of tectonics including complex faulting, folding, and fluid migration along zones of weakness further complicates the magnetic crustal signal relative to that in Ontario and Ohio.

Bouguer gravity

Gravity lows in western and central Ohio interpreted as rift basins by various workers.

Well control with interesting lithologies beneath the Mt. Simon

Friend well in Clark County, Ohio: thick black carbonates and volcanics (low-grade metamorphism?).

Binegar wells (2) in Jay County, Indiana: carbonates (rare graphite).

Numerous wells with Middle Run Fm. red lithic arenite (rhyolite clasts common).

Rhyolite clasts observed in Middle Run core samples may simply indicate eastward extension of EGR. Archean-aged rocks associated with the Ontario Grenville are NOT known in Ohio.

Parautochthonous block associated with the Ontario Grenville is NOT known in Ohio.

Ohio deep-well samples rarely contain high-grade metamorphic minerals.

Deep wells in SE Michigan with inclusive igneous/metamorphic assemblages on either side of GMF.

Regional Precambrian unconformity surface

Complex assemblage of terranes, paleotectonics across the region affected erosion geomorphology.

The Ohio region was not as deeply eroded prior to Paleozoic deposition, thus increasing the likelihood of preserved Grenville basins.

The complex underpinning architecture controlled Paleozoic structure and deposition and also affected contemporaneous crustal stresses (i.e., seismicity potential).

Regional Phanerozoic mapping

NE-trending alignment subparallel in NW Ohio with Trenton platform edge (ramp) and historic oil-and-gas fields. This approximates area of thin Trenton and Point Pleasant facies (aka Sebree trough).

NW Ohio, NE-trending alignment subparallel with Knox isopach and Sauk sequence isopachs.

Bedrock mapping of NW Ohio (SE Michigan Basin).

Shaded relief of ground level topography (ancestral western Lake Erie basin).

CON:

Seismic reflection profiles

Over-interpretation of data in light of very sparse well control.

Simplified interpretation might include Neoproterozoic and/or Early Cambrian sediments and volcanics within fault-bounded basins.

Total magnetic intensity

Over-interpretation of data in light of very sparse well control.

Proposed trend crosses GMF trend related to trend along Ontario Grenville front outcrop.

Proposed trend may suggest pre-Grenville tectonic lineament/crustal boundaries.

Low magnetic-susceptibility igneous/metamorphic bodies.

Bouguer gravity

Gravity lows in western and central Ohio interpreted as Neoproterozoic and/or Early Cambrian rift basins by various workers.

Well control with interesting lithologies beneath the Mt. Simon

Deep-well sample/core would benefit from new analyses.

Neoproterozoic and/or Early Cambrian sediments and volcanics within fault-bounded basins.

Rhyolite clasts derived from erosion of EGR to the west.

Regional Precambrian unconformity surface

Proterozoic terrains and simple geomorphology beneath the Paleozoic.

Earthquakes

No major trends following a new Grenville lineament. A hint of a wide alignment with northern part of GMF in Bowling Green Fault and Findlay Arch.

Isopach mapping

NNW alignment of Mt. Simon and Eau Claire isopach.

CONCLUSIONS

Our proposed and revised Grenville front magnetic lineament is a NE–SW-trending major crustal boundary in the Midwest United States and adjacent Canada. This new trend supports the presence of speculative Grenville-aged foreland/rift basins in the Ohio region. This deeply eroded, tectonically complex Proterozoic surface controlled development of the Rome Trough, Proto-Illinois/Michigan and Appalachian Basin architecture, and related Phanerozoic sedimentation.

FUTURE IMPLICATIONS

This preliminary work demonstrates the need to re-examine samples from deep well drilling using modern analytic techniques and methods to provide an updated framework for Proterozoic lithologies. This new data will enhance and further update geopotential, seismic reflection data, and seismological data. As the complex Proterozoic terranes are the foundation for the Phanerozoic geologic history, this new information has implications for seismicity; hydrocarbon exploration; gas storage; and waste injection, including hazardous, nonhazardous, and CO_2 sequestration.

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