Identifying Cyclothems in the Pennsylvanian Tradewater Formation in the Subsurface of the Illinois Basin

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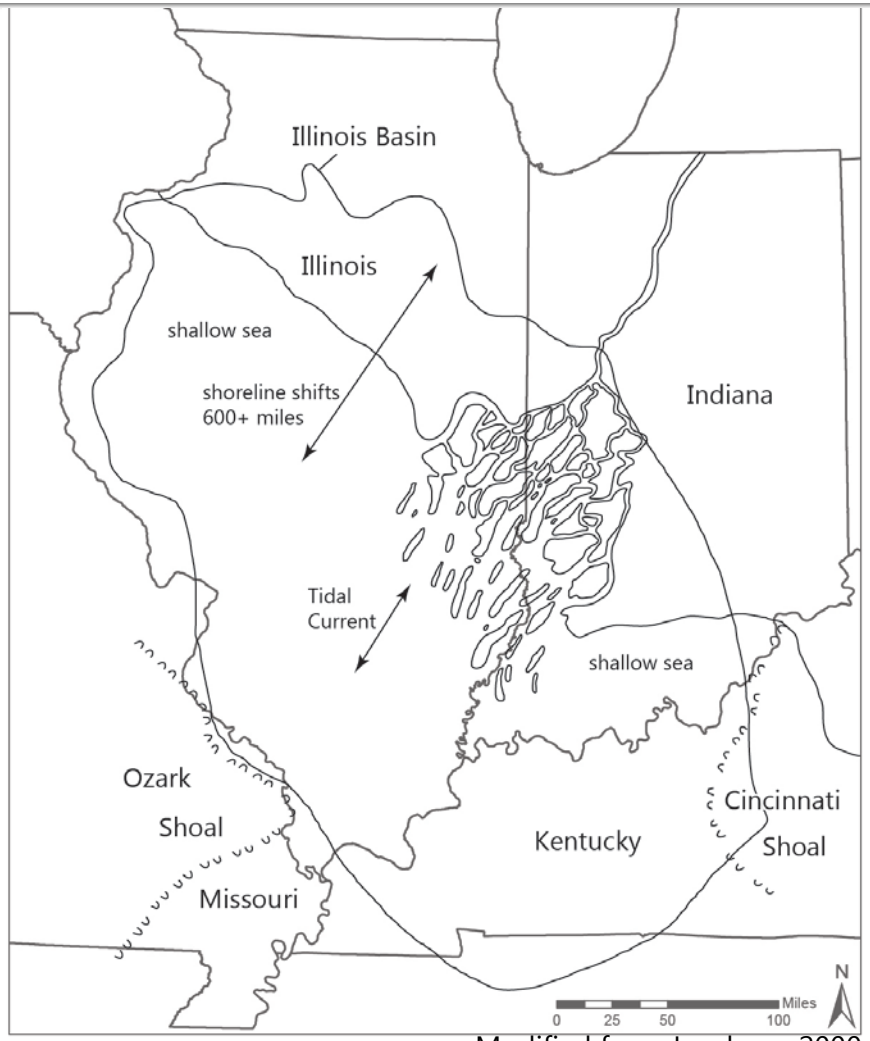
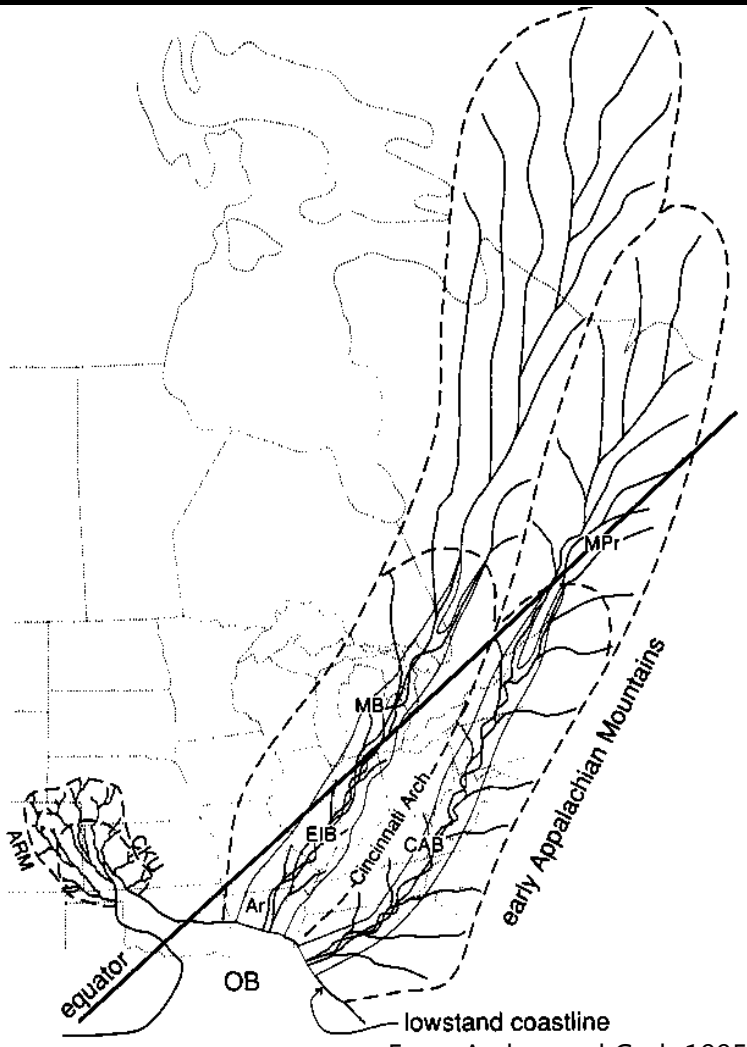
Outline

- Background
  - Geologic setting & previous work
- Methods
  - Geophysical logs, core, and outcrop
- Results
  - Preliminary correlations
  - Variations within cycles
  - Sequence stratigraphic applications
- Implications

Geologic setting

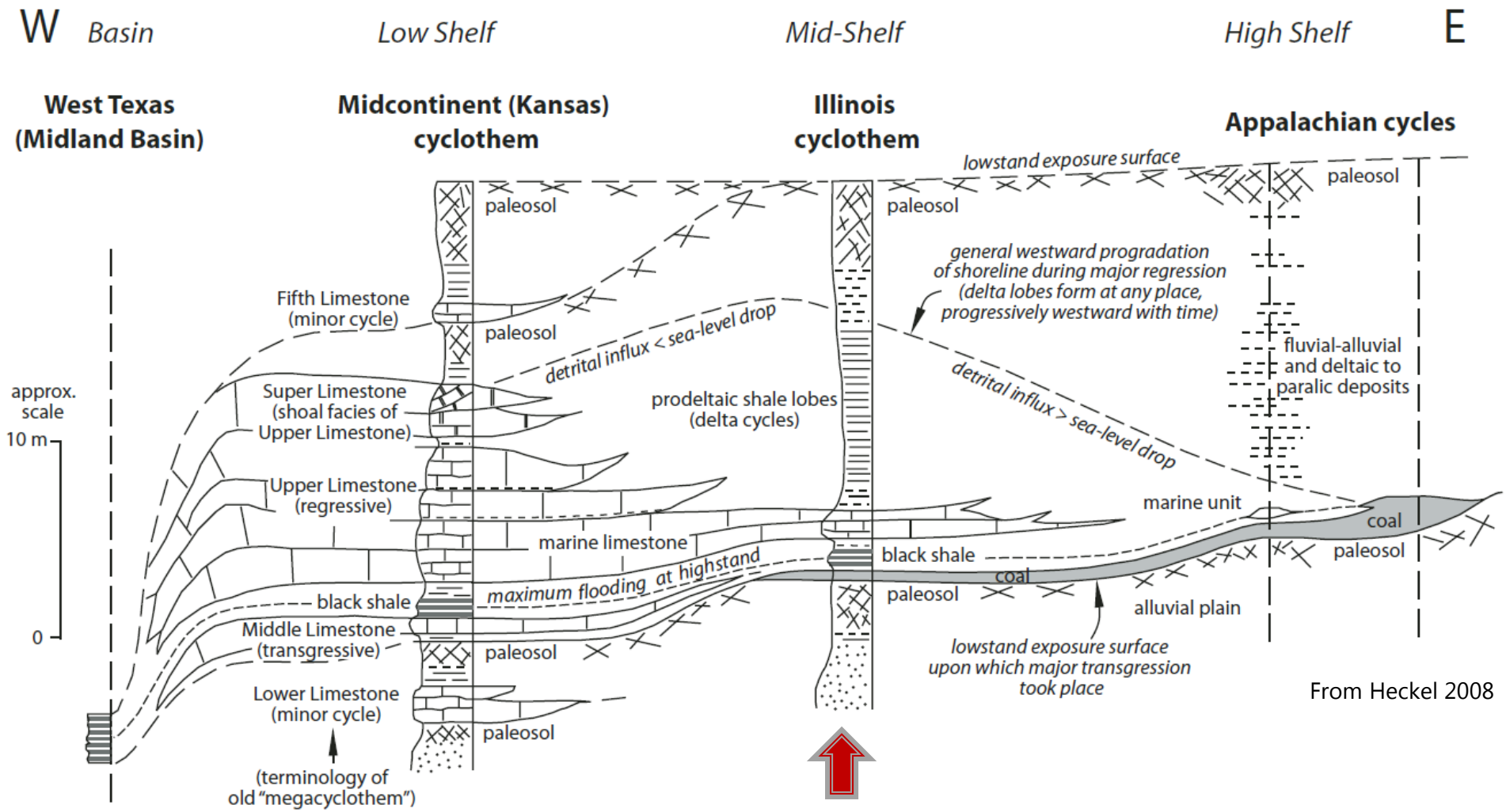


Modified from Jacobson 2000



From Archer and Greb 1995

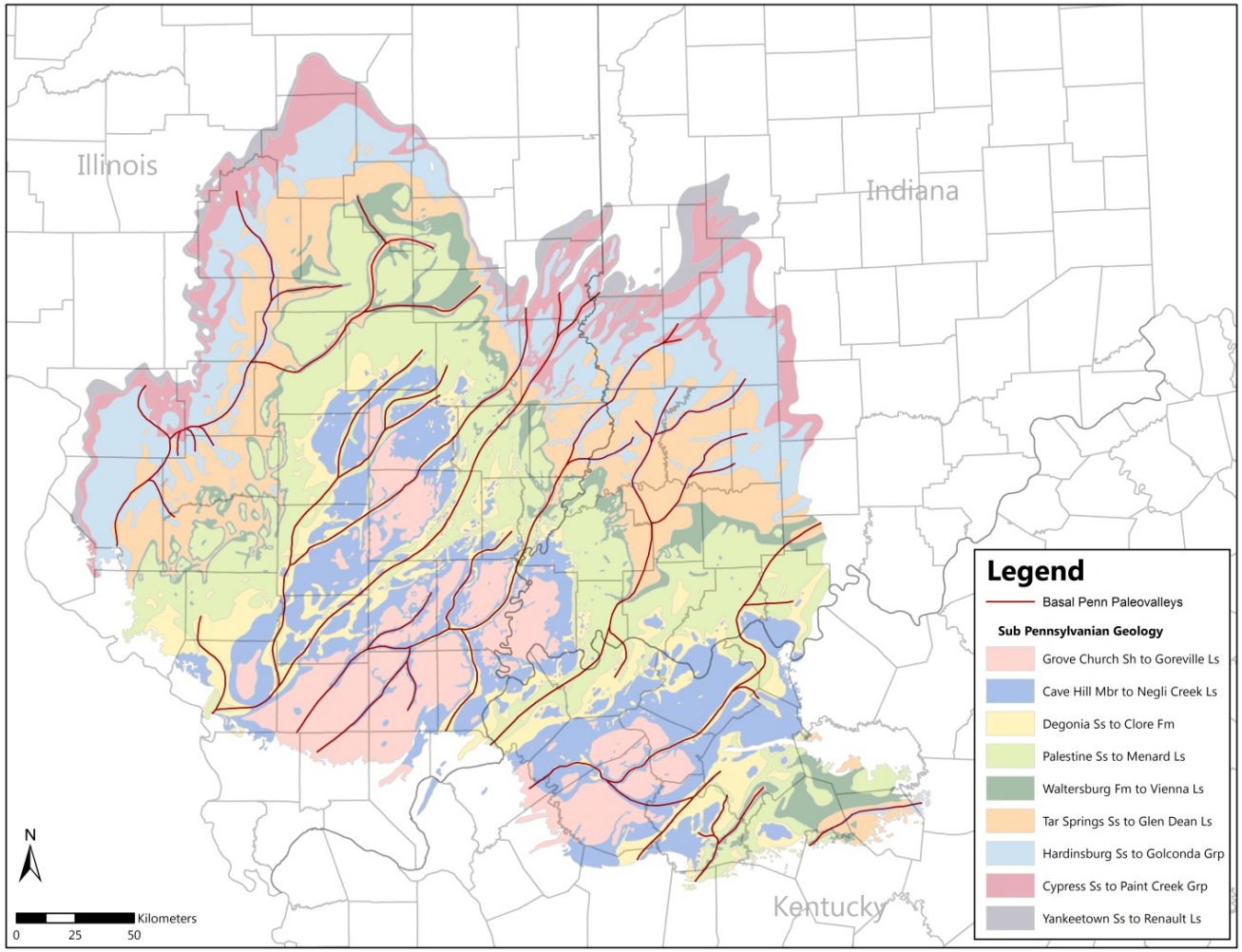
Pennsylvanian cyclothems



From Heckel 2008

Sub-Pennsylvanian Unconformity

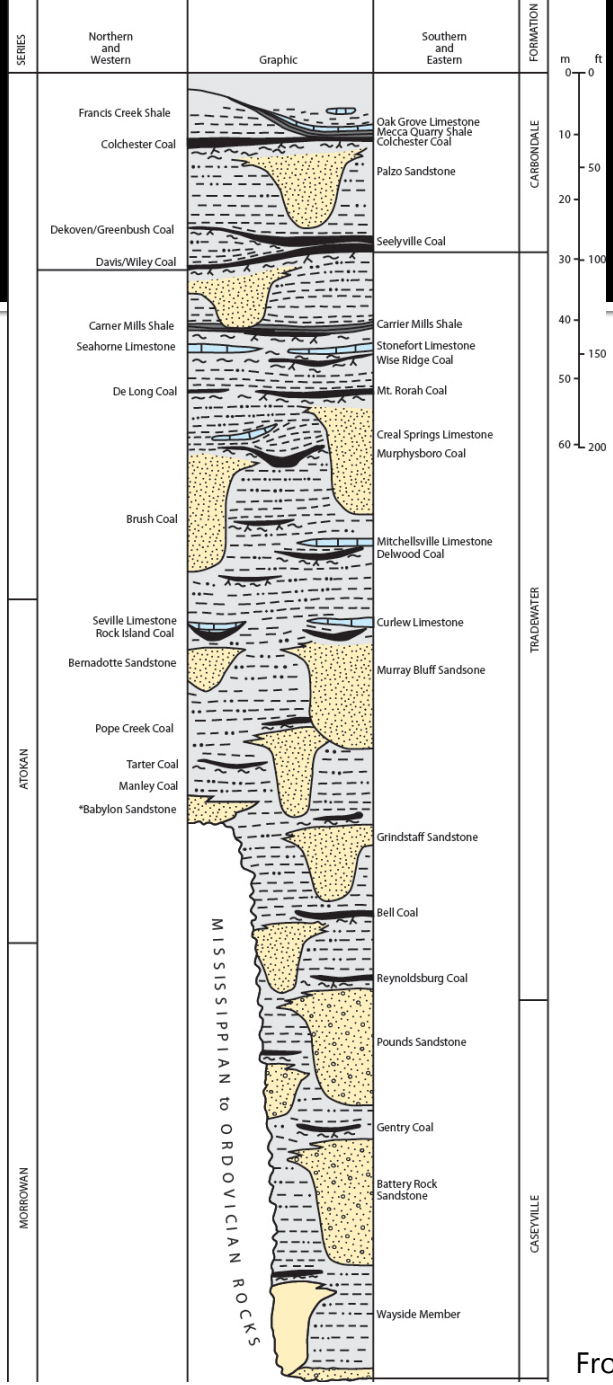
- Chesterian subcrop
- SW trending paleovalleys
- 134 m of relief
- Overprinted on structural features



From Bristol & Howard 1971

Stratigraphy

- Complicated Lower Pennsylvanian Stratigraphy
  - Unconformity
  - Restricted deposits
  - Few marker beds
  - Extreme variability

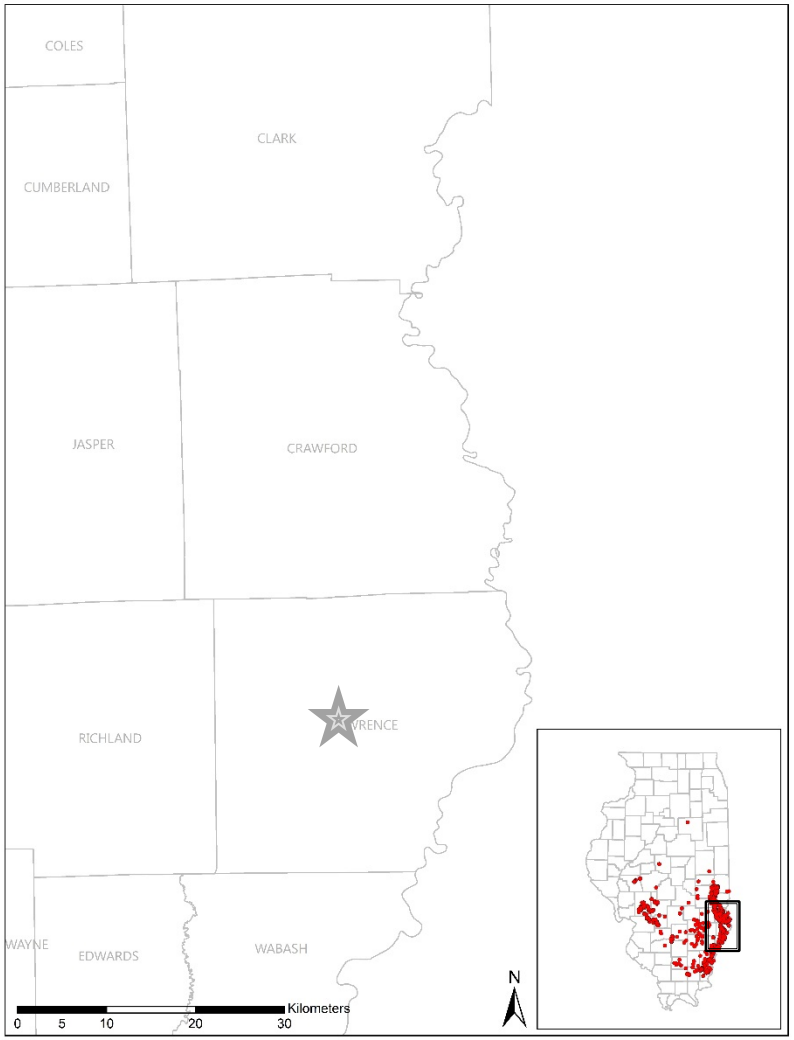


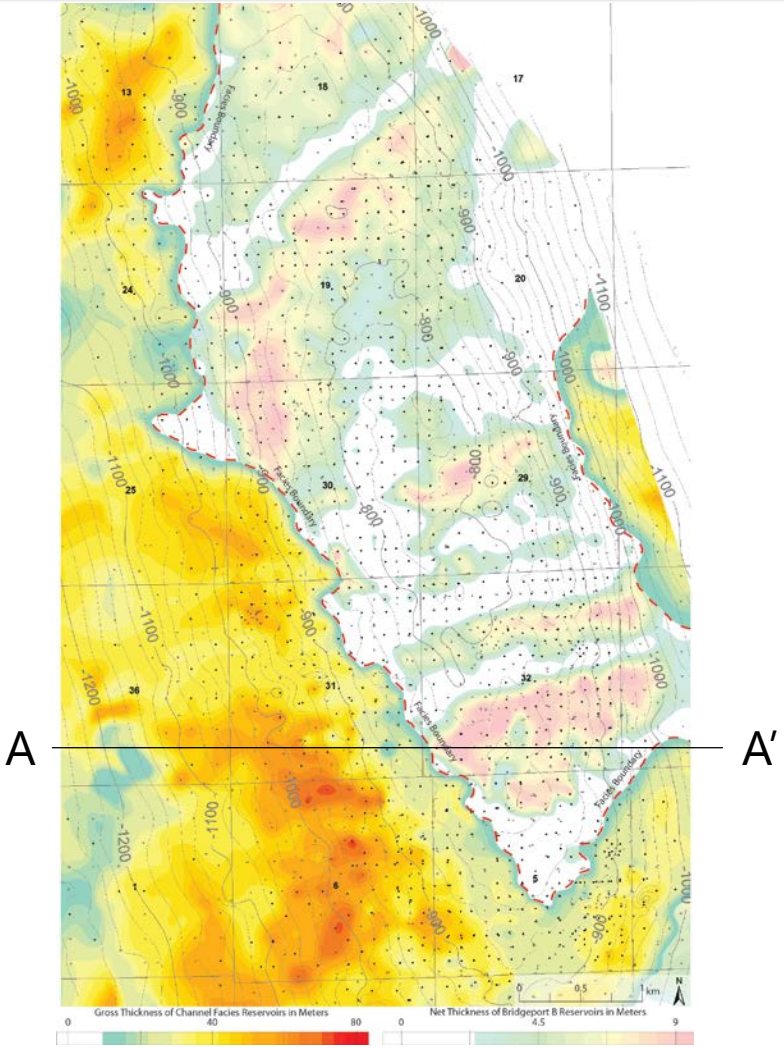
From Nelson et al., 2011

Objectives

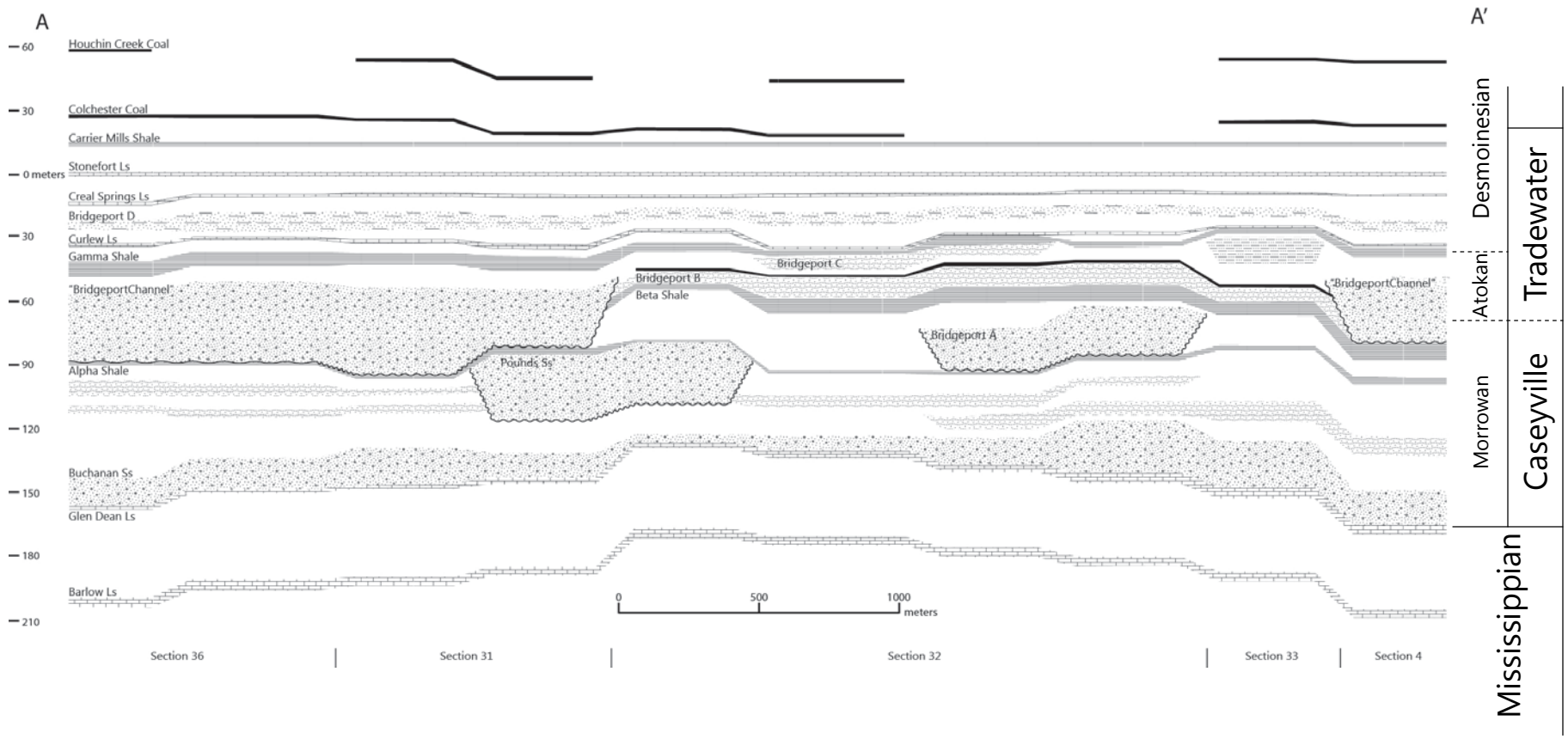
- Observations from Lawrence County, IL
- Synthesis of dataset
- Preliminary log correlations
- Lateral and vertical variations in facies
- Applications of sequence stratigraphy
- Implications and future work

Lawrence Field study





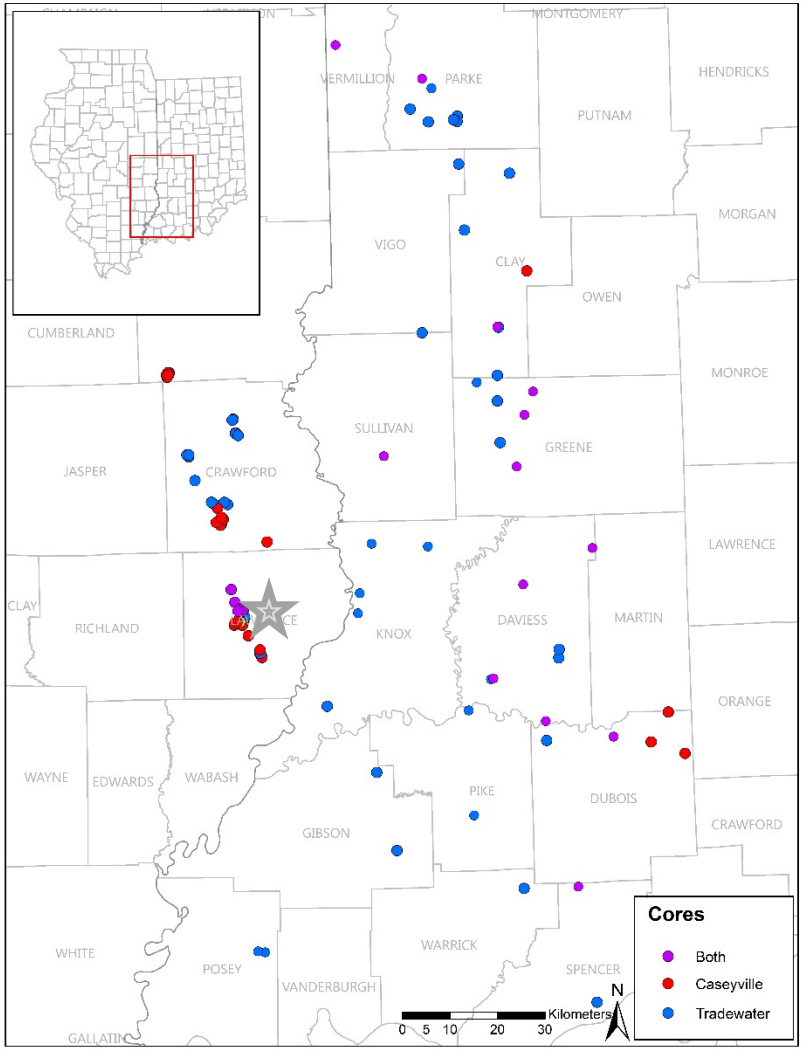
Lawrence Field study



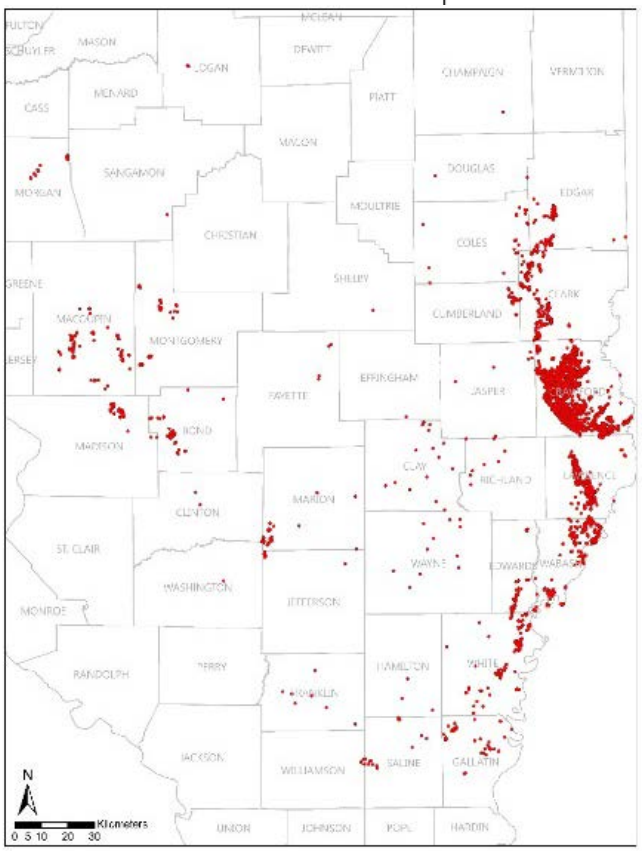
- Continuous beds not far above unconformity

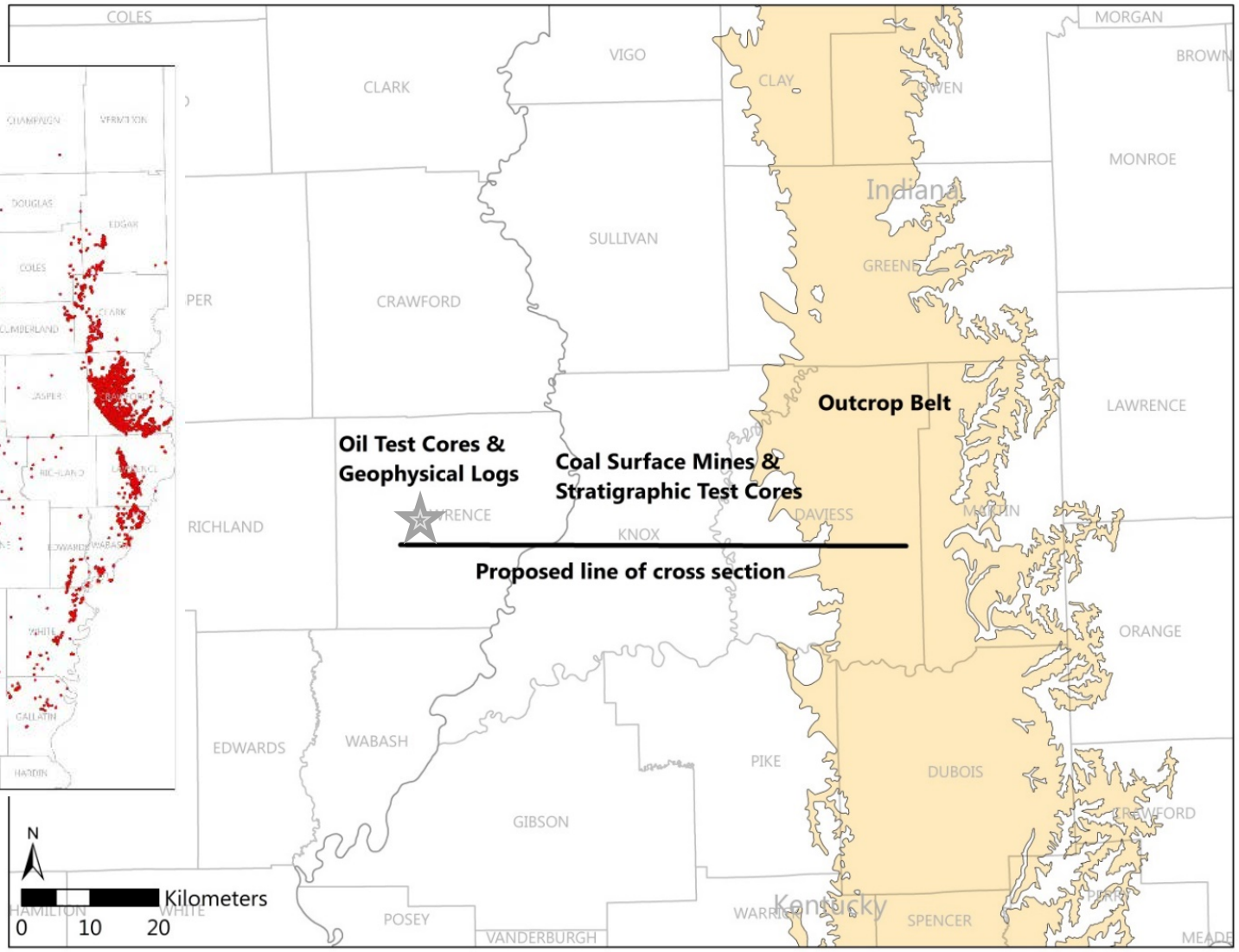
Available data

- Outcrop & surface mines
- Geophysical logs
  - >20,000 in immediate area
  - >3,000 in database now
  - Electric logs
  - Gamma, density/neutron
- Core
  - Coal and Oil
  - Stratigraphic

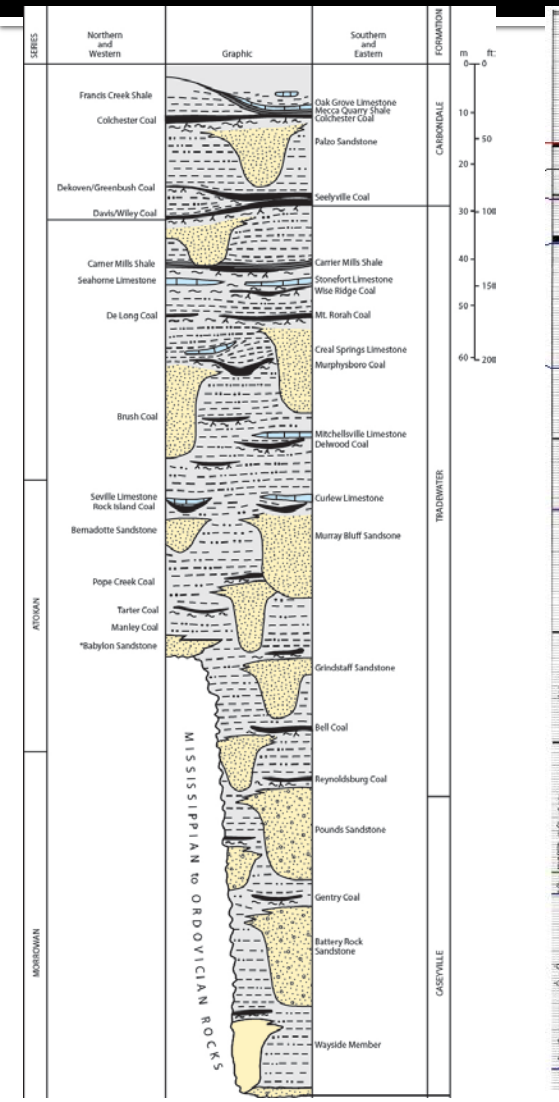


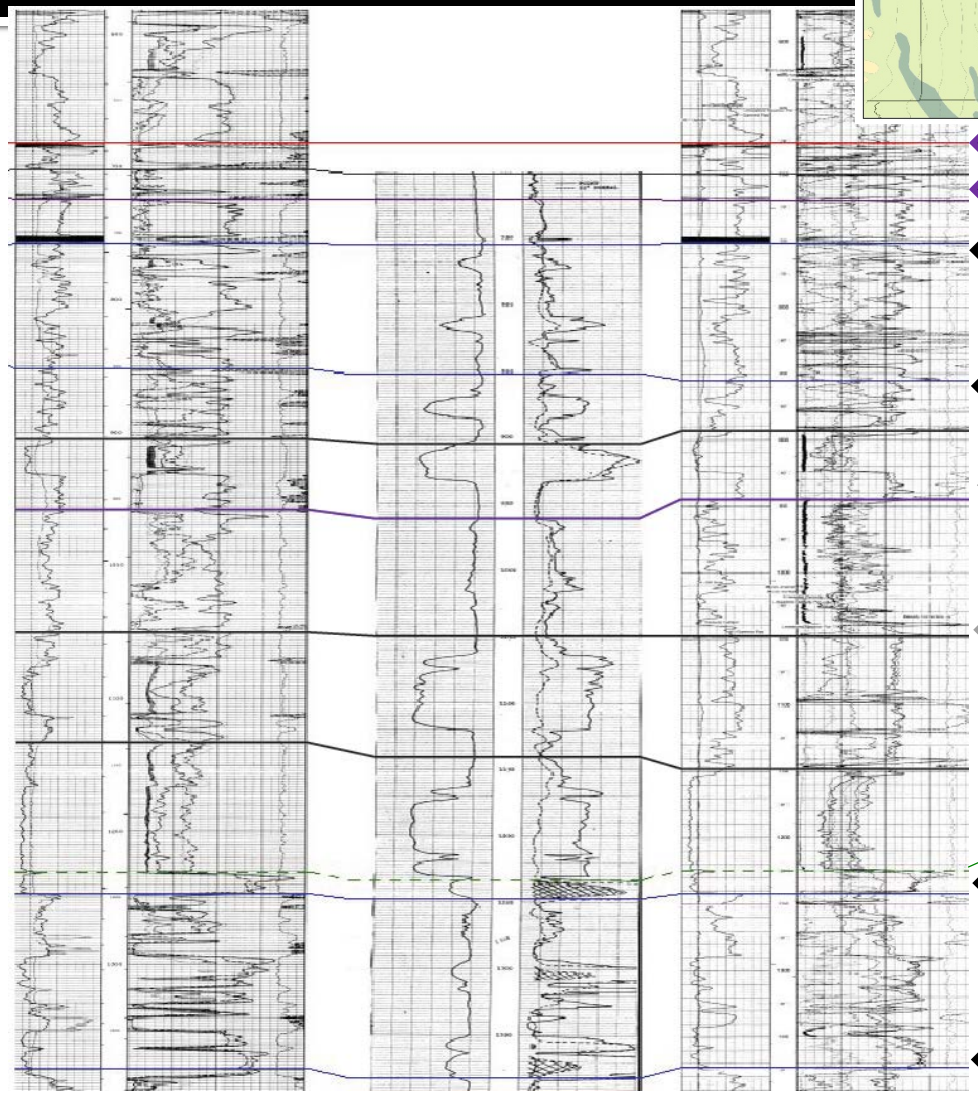
Study area

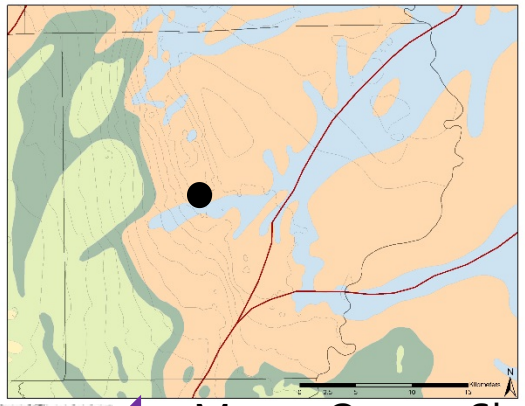

N
Kilometers
0 5 10 20 30


Oil Test Cores &
Geophysical Logs
Coal Surface Mines &
Stratigraphic Test Cores
Outcrop Belt
Proposed line of cross section
Indiana
Kentucky
COLES
CLARK
VIGO
CLAY
MORGAN
BROWN
MONROE
SULLIVAN
GREENE
CRAWFORD
PERRY
LAWRENCE
RICHLAND
KNOX
DAVIESS
MARTIN
ORANGE
EDWARDS
WABASH
PIKE
DUBOIS
GIBSON
POSEY
VANDERBURGH
WARRICK
SPENCER
HAMILTON
WHITE
N
Kilometers
0 10 20

Preliminary correlations







Mecca Quarry Sh.

Carrier Mills Sh.

Stonefort Ls.

"Curlew" Ls.

dark grey shale

dark grey shale

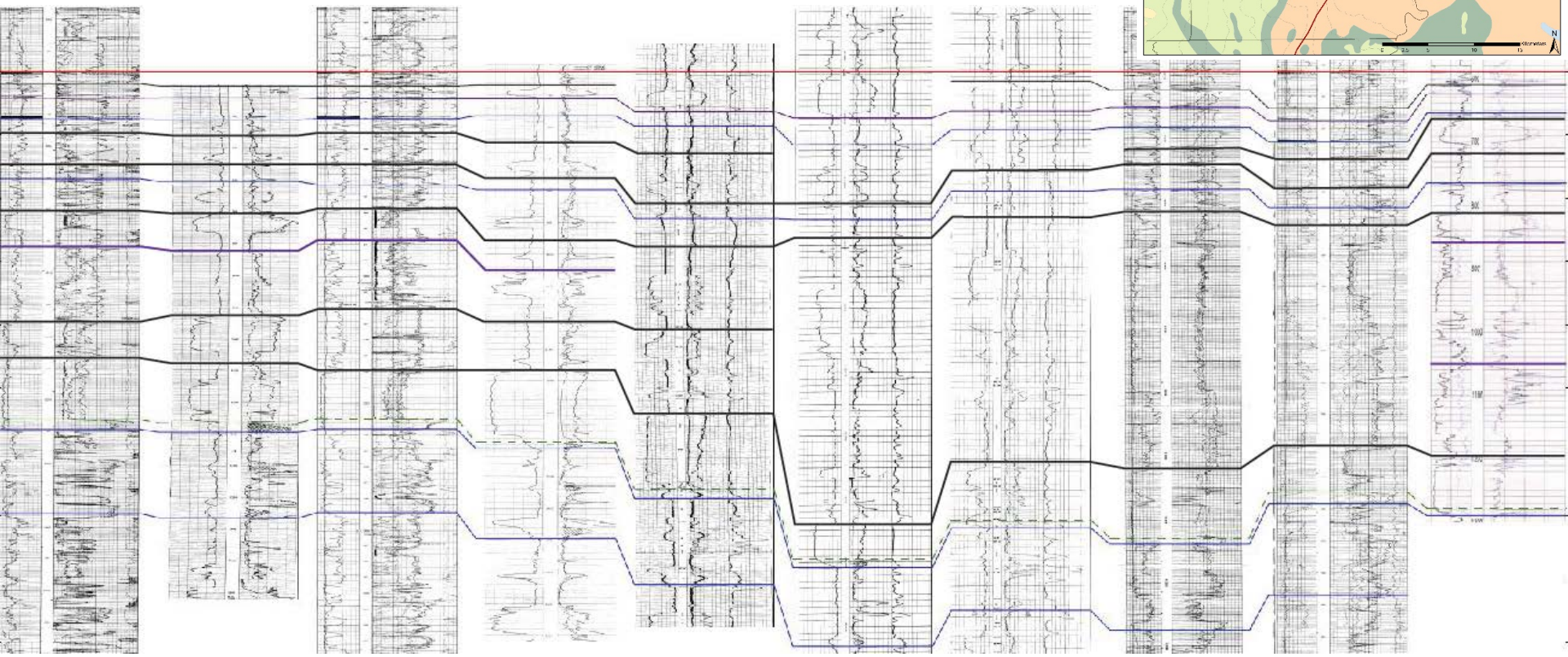
Unconformity

Glen Dean Ls.

Mississippian

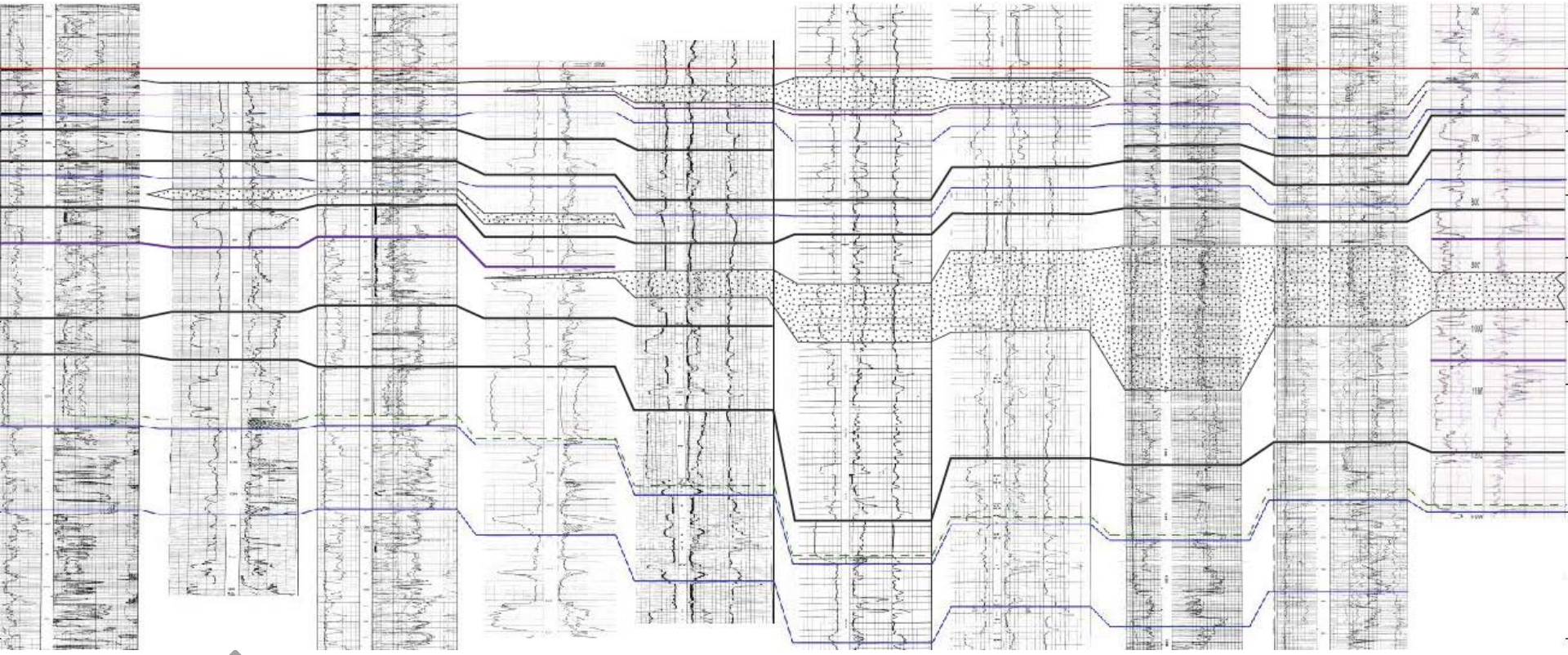
Beach Creek Ls.

Preliminary correlations



- Oblique strike section, ~20 km long

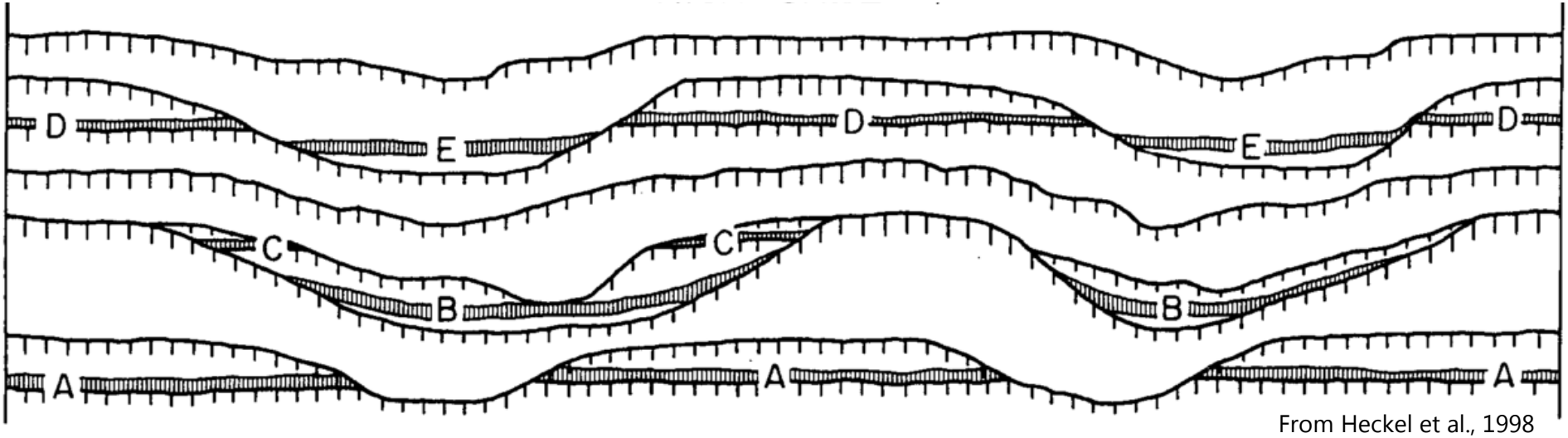
Lateral variations



Core

Core

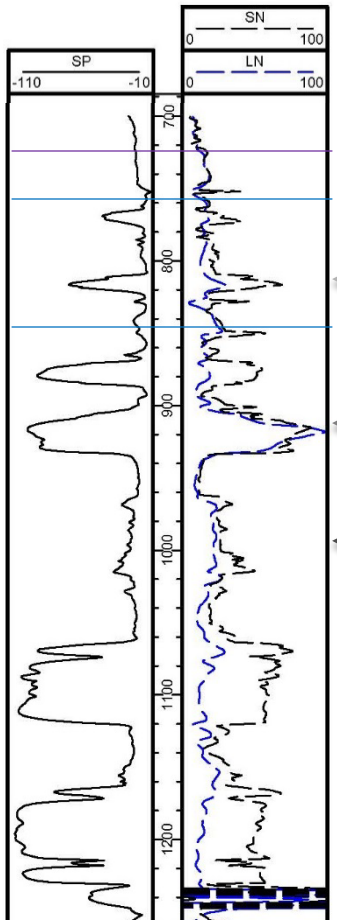
Lateral variations



From Heckel et al., 1998

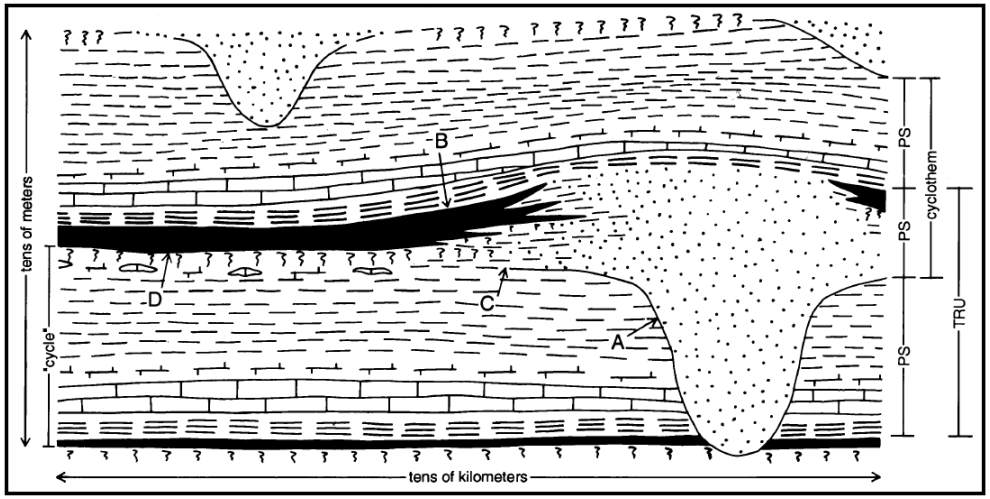
- Continuity of marker beds is difficult to confirm with logs alone
  - Accommodation limited setting

Vertical variations

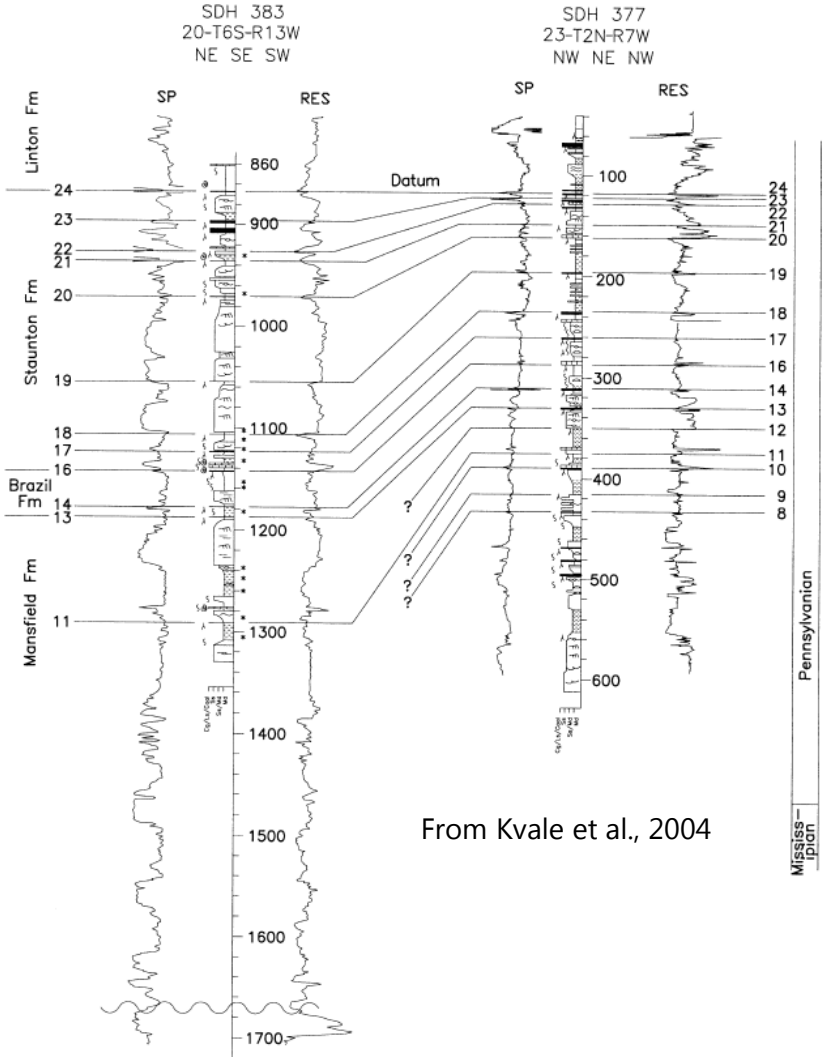


Sequence stratigraphy

- Techniques previously demonstrated in Illinois and Indiana



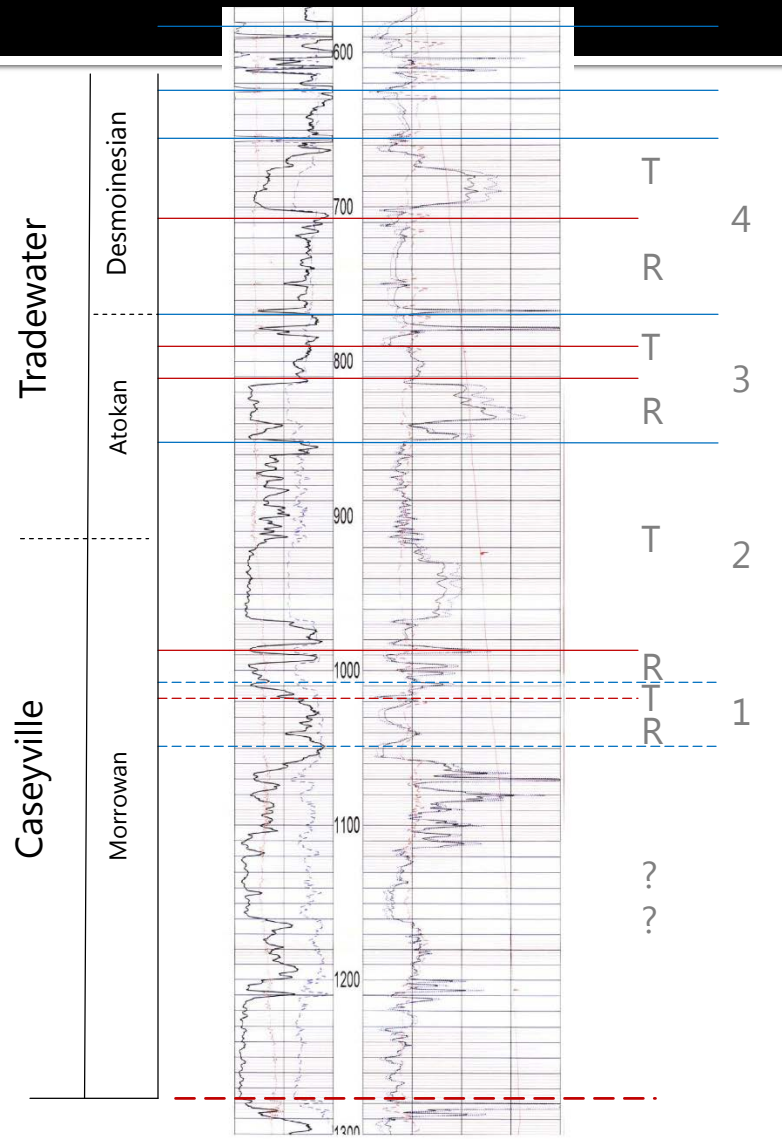
From Weibel 1996



From Kvale et al., 2004

Sequence stratigraphy

- T-R cycles
- Coals common in Tradewater
  - Very thin
- Multiple coals between flooding surfaces
  - Parasequence scale cycles



Observations

- Correlations most reliable outside of valleys where not interrupted by channels
  - Most disruption in Caseyville and lower Tradewater
  - Construct cross sections along interfluves?
- No black shales below Stonefort Ls. level
  - Marine zones in limestones and grey shales
- Possible change from fluvial/estuarine to deltaic deposition

Summary

- Regional correlations in the Tradewater (and Caseyville) appear possible
- Sequence stratigraphic techniques can help
  - Correlation of nondestinctive strata
  - Interpretation of deposits through time
- Construction of more long X-sections
  - Expand east to outcrop belt
  - Dip sections
- Correlations can give clues on how basin filled

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