The Borden Delta

Early Mississippian

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Objectives

1. Late Devonian and Carboniferous rocks in Indiana
2. Borden group formations
3. Extinctions
4. Sea level changes, transgressions and regressions
5. Fluvial and deltaic depositional systems
6. Mississippi Delta
7. Borden Delta and Ontario River
8. Deltaic facies in the Borden Group
Late Paleozoic Events

<table>
<thead>
<tr>
<th>Era</th>
<th>Period</th>
<th>Epoch</th>
<th>Age (millions of years ago)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proterozoic</td>
<td></td>
<td></td>
<td>2.5 billion</td>
</tr>
<tr>
<td>Archean</td>
<td></td>
<td></td>
<td>4.6 billion</td>
</tr>
<tr>
<td>Paleozoic</td>
<td></td>
<td></td>
<td>542</td>
</tr>
<tr>
<td>Carboniferous</td>
<td>Pennsylvanian</td>
<td></td>
<td>318</td>
</tr>
<tr>
<td></td>
<td>Mississippian</td>
<td></td>
<td>359</td>
</tr>
<tr>
<td>Paleogene</td>
<td></td>
<td>Oligocene</td>
<td>65</td>
</tr>
<tr>
<td>Neogene</td>
<td></td>
<td>Pliocene</td>
<td>23</td>
</tr>
<tr>
<td>Quaternary</td>
<td></td>
<td>Pleistocene</td>
<td>2.6</td>
</tr>
</tbody>
</table>

- End-Permian mega-extinction
- Heyday of synapsids
- Assembly of Pangea
- More Orogenies
- Plant Suicide
- Conquest of Land
The Carboniferous
Mississippian and Pennsylvanian Periods

Devonian/Mississippian
New Albany Shale

Mississippian
Borden, Sanders, Blue River, West Baden, Stephensport, & Buffalo Wallow Groups

Pennsylvanian
Raccoon Creek, Carbondale, & McLeansboro Groups
The Borden Group

Early to Middle Mississippian
Sepkoski’s three Evolutionary Faunas
and five mass extinctions

Late Devonian extinction
Mostly affects marine organisms

Brachiopods
Trilobites
Corals
Global Sea Level through the Phanerozoic
From Hallam and Vail

- Sharp sea fall at end Silurian
- Sharp sea fall at end Devonian?
- Sea rise during Mississippian
- Sea levels generally lower than Ordovician
Sea level and stratigraphy
The rocks and their depositional context

<table>
<thead>
<tr>
<th>Group</th>
<th>Description</th>
<th>Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue River Group</td>
<td>Mostly carbonates, but significant gypsum, anhydrite, shale, chert, and calcareous sandstone.</td>
<td>Series of transgressions and regressions</td>
</tr>
<tr>
<td>Sanders Group</td>
<td>Limestones that lie unconformably over the Borden Group</td>
<td>Transgression of shallow sea over former delta</td>
</tr>
<tr>
<td>Borden Group</td>
<td>Siltstones, shales, fine sandstones and isolated carbonates from a large delta system.</td>
<td>Progradation through delta buildup</td>
</tr>
<tr>
<td>New Albany Shale</td>
<td>Shales representing deeper water mud facies.</td>
<td>Nearshore Marine</td>
</tr>
</tbody>
</table>
Bedrock Geology of Monroe and Brown Counties

- Edwardsville Fm. (Borden River Delta)
- Salem Limestone and others (Shallow tropical seas)
- Limestones, Sandstones, Shales, and Coals (Nearshore seas and Terrestrial Swamps)

Youngest (320 mya) Pennsylvanian

Oldest (360 mya) Earlier Mississippian
Two causes for transgression

- Sea level rise: Eustasy
- Continental depression: Isostasy
Two causes for regression

Sea level fall: Eustasy

Continental uplift: Isostasy
Terrestrial depositional environments

Fluvial – streams and rivers
Lacustrine – lakes
Deltaic – junction of river and sea
Beach – junction of land and sea
Fluvial systems

Deposits often ‘fine upwards’ or go from coarse to fine grained from the bottom of the deposit to the top.

Fossils often collect in point bars and channels because they are large ‘grains’.
Generalized marine and near-shore systems

Note that when water from a stream channel opens into a larger body of water, the rate of flow decreases dramatically because the rate of flow is determined by the volume of water and the cross-section of the channel through which it flows. The ocean has a very large cross-section...

Because of this, most particles settle almost immediately at the coast.
Progradation

Accumulation of sediments farther and farther out from the original shore. Growth of the shore.

A third cause for “regression”.

![Diagram showing Progradation processes](image)
The Mississippi River Delta
Topography
The Mississippi River Delta
Geology
The Mississippi River Delta

Geology
The Early Mississippian

(340 mya) “Brown County time”

Equatorial view, Western Hemisphere
Paleogeographic context

Mississippian Period
342 Million Years Ago
(“Brown County Time”)
Depositional Context
The ancient Ontario River
Illinois Basin facies during Borden time
Deposition of Borden rocks

Text-fig. 2—A depositional model for the Borden delta in southern Indiana. Deltaic rocks thin and disappear to the southwest in the subsurface and have been eroded to the north and east. The outcrop belt is judged to record a narrow, vertical slice through the major parts of the delta.

Borden formations are time transgressive delta facies
Crinoids (Echinodermata)

Typical fossils in east Monroe and Brown Counties