Appendix 1: Descriptions of Core

Hinthorn CW#1
Colt Energy and Kansas Geological Survey
SE SE SE 14-T32S-R16E

Legend
- Coal Bands
- Syneresis Cracks
- Soft Sediment Def.
- Stylolite
- Bioclasts, Whole
- Bioclastic Fragments
- Algae
- Brachiopods
- Bryozoa
- Corals, Colonial
- Crinoids
- Foraminifera
- Bioturbation
- Burrowing
- Caliche
- Slickensides
- Ped Structures
- Rhizoliths
### Texture, Grain Size and Structures

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Clastics</th>
<th>Lithology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sand</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Silt</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clay</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Limestone</td>
<td></td>
</tr>
</tbody>
</table>

### Description

- **Lithology**
  - Color
  - Comp., Cement, or Matrix
  - Shape and Sorting
  - Bedding
  - Sed. Structures
  - Upper Contact
  - Fossils

### Remarks, Interpretation

- **Top of Fort Scott - Higginsville Limestone**
  - Bioclastic packstone facies
  - Shallowing upward, regressive upper limestone
  - Above wave base

- **Bioclastic mudstone facies**
  - Transgressive muddy limestone

- **Flooding Surface**

- **Exposure Surface**

- **Peloidal grainstone facies**
  - Open marine
  - Above wave base

- **Peloidal and non-fossiliferous from 631' - 640'**

---

**Location**: SE SE SE 14-T32S-R16E

**Structural Setting**: Cherokee Basin

**Name**: HINTHORN CW-1

**Described by**: JONATHAN LANGE

**Date**: June 2002

**Unit**: Fort Scott

**Page**: 01 of 24 Pages
Underclay
- Light Gray
- Pedogenic
- Stickensides
- Sharp Contact
- Bioturbated

Summit Coal is not present in this core
- Blocky mudstone facies
- Paleosol

Limestone
- Dark to medium gray
- Calcareous
- Medium bedded
- Caliche
- Calcrete
- Rip up clasts in lower part of section
- Gradational contact
- Bioclasts of enodids, bryozoa, brachiopods, corals, and algae
- Slightly oil stained

Blackjack Creek Limestone
- Bioclastic packstone facies
- Regressive upper limestone
- Top contact is an exposure surface
- Shallowing upward sequence
- Above wave base

Bioclastic wackestone facies
- Open marine
- Below wave base

Whole Bioclasts
Shale
- Dark gray
- Micaceous with a calcareous cement
- Thinly laminated, very fissile from 703.5'-708.8'
- Planar bedding
- Abundant pyrite
- Sharp contact
- Abundant bioclastic fragments of brachiopods, fusulinids and crinoids

Dark gray shale facies
- Offshore transition
- Shoaling upward

Near the anaerobic - anoxic zone

Concave down shells

Higher energy, storm deposits
- Mean storm wave base

Graded bedding

Pyritic black shale facies
- Coastal swampmarsh

Black Shale
- Micaceous with a slightly calcareous cement
- Thinly laminated
- Planar bedded
- Gradational contact
- Pyritic bioclastic fragments

Iron Post coal
- Coal facies

Flooding surface

Underclay
- Gray
- Pedogenic, siderite nodules
- Slickensides and bioturbated

Exposure surface

Blocky mudstone facies
- Paleosol
Sandy Shale
- Light brown from 721' - 723'
- Medium gray from 723' - 736'
- Micaceous and siliceous with a slightly calcareous cement
- Rounded and well sorted sand
- Thickly laminated
- Lenticular and planar bedded
- Starved wave ripples
- Sparse pyrite and siderite
- Gradational contact
- Brachiopods in lower portion

Graded bedding
Transgressive lag or storm deposits

Limestone
- Dark gray
- Calcareous
- Thiloid to medium bedded
- Gradational contact
- Bioclasts of brachiopods and bryozoans

Verdigris Limestone
- Bioclastic wackestone facies
- Upper regressive limestone
Shelf edge
- Open marine
- Below wave base
Shale, same as above
Graded bedding

Dark gray shale facies
- Offshore transition
- Storm deposits

Pyritized burrows
Firmground
Pyritized bioclasts

Ravinement surface

Rip-up clasts
Transgressive lag

Coal and carbonaceous shale
- Calcite mineralization in cleats
- Good gas show

Mineral Coal
- Coal facies

Flooding surface
Underclay
- Light to medium gray
- Pedogenic
- Plant fragments
- Sharp contact
- Bioturbation

Sandy Shale
- Light gray
- Micaeous with siliceous laminae
- Thickly laminated
- Wavy to lenticular bedding
- Rip-up clasts
- Gradational contact
- Actively filled vertical burrows
- Heavily bioturbated

Shale
- Dark gray that lightens upward to a medium gray
- Micaeous
- Thinly laminated
- Planar bedding
- Pyritized plant fragments
- Siderite nodules in lower portion
- Gradational contact
- Burrowing

Black Shale
- Micaeous/ slightly calcareous
- Thinly laminated
- Planar bedding
- Gradational contact
- Braided fragments

Coal
- Sharp contact
- Gas show

Underclay
- Medium gray
- Pedogenic
- Plant fragments
- Siderite nodules
- Sharp contact

Blocky mudstone facies
- Paleosol

Cross-laminated muddy sandstone facies
- Muddy Tidal flat

Dark gray shale facies
- Offshore transition

Transgressive lag
- Flooding surface

Seammon coal
- Coal facies
- Exposure surface
Blocky mudstone facies
- Paleosol
**Sandstone**
- Light gray sand with medium gray muddy laminae
- Well rounded and well sorted
- Thickly laminated
- Flaser bedding on top to wavy, lenticular and planar bedding
- Wave ripples
- Soft sediment deformation
- Rip-up clasts
- Siderite crystals
- Gradational contact
- Actively filled vertical burrows

**Skinners/Helena Sandstone**
Interlaminated sandstone and siltstone facies
- Bay head delta - upper estuarine
- Incised valley fill
- Bimodal flow
- Tidalites

**Very fissile to friable**

805
810
815
sandstone
- light brown
- siliceous with muddy laminae
- well rounded and well sorted
- thickly laminated
- wavy bedding
- current ripples
- siderite crystals
- erosional contact
- bioturbated
- actively filled vertical and horizontal burrows

interlaminated sandstone and siltstone facies
- bay head delta - upper estuarine
- incised valley fill
- bimodal flow
- sequence boundary on bottom

shale
- dark gray, darkens downward
- micaceous
- thinly laminated with a few siliceous laminae
- planar bedding with wavy bedding in transition
- siderite bands
- gradational contact
- non-fossiliferous

exposure surface
- dark gray shale facies
- offshore transition
- shoaling upward

black shale, description on next page

shelf shale
**Black shale**
- Micaceous w/ a calcareous cement
- Thinly laminated
- Planar bedding
- Phosphatic
- Gradational contact
- Bioelastic fragments
- Burrowing

**Tebo marker**
- Phosphatic black shale facies
- Transgressive marine core shale

**Transgressive lag**
- Flooding surface
- Exposure surface

**Tebo coal - coal facies**
- Pyrite black shale
- Salt water marsh

**Laminated muddy sandstone facies**
- Muddy tidal flat or coastal plain

**Dark gray shale facies**
- Offshore transition
TEXTURE, GRAIN SIZE AND STRUCTURES

CARBONATES

LITHOLOGY

DETH (FT)

UNIT: Cherokee Group

PAGE 13 OF 24 PAGES

DESCRIPTION

- Lithology
- Color
- Comp., Cement, or Matrix
- Shape and Sorting
- Bedding
- Sed. Structures
- Upper Contact
- Fossils

DATE JUNE 2002

- Shale, same as above
- Black Shale
  - Micaceous
  - Diagonally laminated
  - Planar bedding
  - Phosphatic
  - Gradational contact
  - Gas show
- Coal
  - Black
  - Well developed cleating
  - Sharp contact
  - Gas show
- Underclay
  - Brown to gray
  - Fissile
  - Pedogenic
  - Rooting and plant fragments
  - Siderite nodules
  - Sharp contact
  - Bioturbated
- Sandy shale
  - Dark gray
  - Micaceous
  - Thinnly laminated
  - Cross laminae
  - Few plant fragments
  - Siderite nodules
  - Gradational contact
  - Bioturbated

- Phosphatic black shale facies
  - Shelf shale

- Weir-Pittsburg coal
  - Coal facies
  - Coastal coal

- Exposure surface
  - Blocky mudstone facies
  - Paleosol

- Laminated mudy sandstone facies
  - Muddy tidal flat or coastal plain
Shale
- Lightens upward from black to medium gray
- Micaceous
- Very thinly laminated
- Fissile
- Siderite bands
- Sharp contact
- Non-fossiliferous

Dark gray shale facies
- Offshore transition

Dark gray shale facies
- Shelf shale

Transgressive lag

Underclay
- Medium gray
- Pediogene
- Plant fragments
- Siderite nodules
- Sharp contact
- Boturbated

Shale
- Dark gray
- Micaceous
- Thinly laminated
- Planar bedded
- Siderite bands
- Sparse pyrite
- Sharp contact
- Non-fossiliferous

Flooding surface

Blocky mudstone facies
- Paleoxol

Pyritic shale facies
- Coarsening upward lagoonal shale
Shale, same as above
- Coarsening upward lagoonal shale

Pyrite black shale facies
- Blocky mudstone facies
  - Paleosol
  - Possibly sequence boundary

Underclay
- Brown
- Pedogenic
- Fossil
- Plant fragments
- Siderite nodules
- Gradational contact
- Bioturbated

945
950
955

Flooding surface
Exposure surface

Black shale, described on next page
<table>
<thead>
<tr>
<th>#</th>
<th>Black Shale</th>
</tr>
</thead>
<tbody>
<tr>
<td>#</td>
<td>- Black</td>
</tr>
<tr>
<td>#</td>
<td>- Micaceous</td>
</tr>
<tr>
<td>#</td>
<td>- Thinly laminated</td>
</tr>
<tr>
<td>#</td>
<td>- Planar bedding</td>
</tr>
<tr>
<td>#</td>
<td>- Fissile from 985'-990'</td>
</tr>
<tr>
<td>#</td>
<td>- Pyrite and Siderite bands</td>
</tr>
<tr>
<td>#</td>
<td>- Soft sediment deformation</td>
</tr>
<tr>
<td>#</td>
<td>- Gradational contact</td>
</tr>
<tr>
<td>#</td>
<td>- Non-fossiliferous</td>
</tr>
</tbody>
</table>

Pyritic black shale facies
- Coastal marsh - brackish water marsh
Sandstone
- Siliceous with micaceous laminae
- Very fine-grained, well sorted and well rounded
- Thickly laminated
- Wavy bedded in upper half and lenticular bedded on bottom half
- Starved wave ripples
- Siderite bands
- Syncretic cracks
- Slumping
- Gradational contact
- Arenicolites and Diplocraterion burrows

Warner Sandstone
Interlaminated sandstone and siltstone facies
- Bayhead delta - upper estuarine
- Incised valley fill
- Bimodal flow
- There are several 1-5cm silting upward packages representing tidal cycles
- Low trace fossil diversity indicates a stressed environment
Sandstone, same as above

Black Shale
- Black
- Micaeous
- Thinly laminated
- Planar bedded on top and cross ripple laminae on bottom
- Sharp contact
- Bioclastic fragments
- Pyritized burrows

Phosphatic black shale facies
- Transgressive marine core shale
- Maximum flooding around 1067'

Pyritic black shale facies
- Salt water marsh

Flooding Surface

Riverton coal - coal facies
- Marsh coal

Pyritic black shale facies
- Salt water marsh
- Swamp environment
- Rich in organics

Coal
- Organic
- Well developed cleating
- Calcite mineralization in cleats
- Pyrite
- Good gas show

Shale
- Black to medium gray
- Micaeous, very organic rich
- Thinly laminated
- Planar bedding
- Fissile
- Coal bands
- Abundant pyrite
- Sharp contact
- Non-fossiliferous
Appendix 1: Descriptions of Core

Cooper CW#1
Kansas Geological Survey
SE SW SW 11-T35S-R18E

Legend
- Coal
- Black Shale
- Sandstone
- Shale
- Interbedded Sh and Ss
- Calcareous Shale
- Underclay
- Limestone
- Planar Bedding
- Flaser Bedding
- Wavy Bedding
- Lenticular Bedding
- Cross-Lamination
- Wave Ripples
- Siderite Nodules
- Phosphatic Nodules
- Pyrite
- Chert
- Coal Bands
- Syneresis Cracks
- Soft Sediment Def.
- Stylolite
- Bioclasts, Whole
- Bioclastic Fragments
- Algae
- Brachiopods
- Bryozoa
- Corals, Colonial
- Crinoids
- Foraminifera
- Bioturbation
- Burrowing
- Caliche
- Slickensides
- Ped Structures
- Rhizoliths
**TEXTURE, GRAIN SIZE AND STRUCTURES**

<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>SAND</th>
<th>CLAY</th>
<th>FINE</th>
<th>SLT</th>
<th>MUDST</th>
<th>IMUSST</th>
<th>WKE</th>
<th>PK</th>
<th>GN</th>
</tr>
</thead>
<tbody>
<tr>
<td>265</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>270</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>275</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DESCRIPTION**

- Limestone
  - Light gray to tan
  - Calcium carbonate
  - Medium bedded
  - Stylolites and horsetail stylolites
  - Calcite veins
  - Rooting
  - Gradational upper contact
  - Bioclasts of brachiopods, echinoids, fusulrids, and bryozoans
  - Bioturbated

- Top of Fort Scott - Higginsville Limestone
  - Biostratigraphic packstone facies
  - Open marine
  - Above wave base
  - Shallow upward sequence

- Heavily fractured with calcite crystals

- Shale parting
- Rip-up clasts and rooting
- Peloidal and non-fossiliferous

**DATE:** JANUARY 2003

**UNIT:** Fort Scott

**PAGE:** 01 of 30 PAGES

**REMARKS, INTERPRETATION:**
Limestone
- Same as above

Bioelastic packstone facies
- Above wave base
- Shoaling upward sequence

Whole bioeclasts

Bioelastic wackestone facies
- Open marine
- Below wave base
Black Shale
- Black
- Micaceous
- Very thinly laminated
- Planar bedding
- Phosphatic nodules
- Gradational Contact
- Non-fossiliferous
- Gas show

Little Osage Shale
- Phosphatic black shale facies
- Transgressive marine core shale

Limestone
- Light gray to tan
- Calcareous
- Medium bedded
- Stylolites
- Caliche
- Gradational upper contact
- Bioclasts of brachiopods, crinoids, fusulinds, bryozoans
- Burrowed

Blackjack Creek Limestone
- Bioclastic packstone facies
- Open marine
- Regressive limestone
- Shunting upward sequence
- Top portion is an exposure surface
- Above wave base

Peloidal and non-fossiliferous
- Peloidal packstone facies
- above wave base

Summit coal not present at this location
Exposure Surface
Flooding Surface
Black Shale
- Black
- Micaceous
- Very thinly laminated
- Planar bedding
- Phosphatic nodules
- Gradational Contact
- Bioelastic fragments condensed
- Gas show

Top of Cherokee Group -
Excellio Shale
- Phosphatic black shale facies
- Transgressive marine core shale

Mulky coal not present at this location

Limestone
- Medium gray to dark gray
- Calcereous
- Medium bedded
- Caliche
- Gradational upper contact
- Bioelastic of brachiopods, fusilinids, and bryozoan
- Burrowed

Breezy Hill Limestone
- Bioelastic packstone to wackestone facies
- Open marine
- Regressive limestone
- Exposure surface at top contact
- Shuffling upward sequence
- Above wave base

Whole bioelastic

Bioelastic wackestone facies
- Open marine
- Below wave base
Limestone
- Same as above

Shale
- Dark gray lighten upward
- Micaceous with a slightly calcareous cement
- Thinly laminated
- Gradational contact
- Planar bedding
- Abundant pyrite
- Bioclasts of brachiopods, crinoids, brzyozoans and fusulinds

Graded bedding and concave down shells
Black Shale
- Dark Gray
- Micaceous with a calcareous cement
- Thinly laminated
- Planar bedding
- Gradational contact
- Bioclastic fragments

Dark gray shale facies
- Offshore transition
- Shouring upward
- Near anaerobic - disaerobic zone

Dark gray shale facies
- Higher energy, storm deposits
- Near mean storm wave base
<table>
<thead>
<tr>
<th>Layer</th>
<th>Characteristics</th>
<th>Facies Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shale</td>
<td>Dark gray, lightens upward, micaceous with slightly calcareous cement, very thinly laminated, planar bedding, graded bedding, gradational contact, bioclastic fragments.</td>
<td>Dark gray shale facies, offshore transition.</td>
</tr>
<tr>
<td>Limestone</td>
<td>Medium to dark gray, calcareous, thinly bedded, gradational contact, bioclasts of crinoids, bryozoans, and brachiopods.</td>
<td>Verdigris Limestone, bioclastic wackstone facies, open marine, below wave base, shallowing upward.</td>
</tr>
<tr>
<td>Black Shale</td>
<td>Black, micaceous and calcareous, thinly laminated, planar bedding, phosphatic nodules, gradational contact, bioclastic fragments?</td>
<td>V-shale, phosphatic black shale facies, transgressive marine, core shale.</td>
</tr>
<tr>
<td>Shale</td>
<td>Dark gray, micaceous, very thinly laminated, planar bedding, siderite nodules, non-fossiliferous.</td>
<td>Croweburg coal not present at this location, siderite gray shale facies, inner estuarine - Central basin.</td>
</tr>
<tr>
<td>Layer</td>
<td>Characteristics</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-----------------</td>
<td></td>
</tr>
</tbody>
</table>
| **Black Shale** | - Black  
- Micaceous  
- Thinly laminated  
- Planar bedding  
- Phosphatic, siderite nodules  
- Gradational contact  
- Bioclastic fragments conodonts |
| **Dark gray shale facies** | - Offshore transition |
| **Phosphatic black shale facies** | - Transgressive marine core shale  
- Transgressive lag |
| **Mineral coal** | - Coal facies  
- Flooding surface  
- Exposure surface  
- Blocky mudstone facies  
- Paleosol |
| **Shale** | - Medium gray  
- Micaceous  
- Pedogen and plant fragments  
- Siderite nodules  
- Sharp contact  
- Bioturbated |
| **Sideritic gray shale facies?** | - Similar to an underlay |
Shale, same as above

Black Shale

Underlay
- Light gray
- Pedogenic
- Rooting and plant fragments
- Sharp contact
- Siderite and clastic nodules
- Bioturbated

Sandstone
- Light brown
- Siliciclastic with micaeous luminae
- Fine to medium-grained, well rounded, and well sorted
- Thickly laminated
- Wavy, lensitic, and planar bedded
- Bimodal crossbedding
- Siderite crystals
- Gradational contact
- Slightly bioturbated, passively filled horizontal burrows

Transgressive lag
- Flooding surface
- Exposure surface

Blocky mudstone facies
- Palaeosol

The Scammon coal is absent in this location

Scammon marker
- Siderite gray shale facies
- Inner estuarine - central basin

Skinner/Chealsea Sandstone
Interlaminated sandstone and siltstone facies
- Bay head delta - upper estuarine
- Incised valley fill
- Bimodal flow
- Tidalites
- Sequence boundary on bottom of sand
Shale
- Brown from 505'-514'. And
dark gray from 514'-523'.
- Muccaceous with some silica
  laminae
  - Thinly laminated
  - Planar bedding
  - Siderite nodules
- Gradational contact
- Slightly bioturbated

Dark gray shale facies
- O/B/tore transition
- Shoaling upward

Exposure surface
Shale, same as above

Black Shale
- Micaceous
- Thinly laminated
- Planar bedding
- Slightly phosphatic
- Gradational
- Brachiopod fragments

Coal
- Well developed cleating
- Low mineralization
- Sharp contact
- Good gas show

Underclay
- Light gray
- Pedogenie
- Rooting
- Siderite, and pyrite nodules
- Sharp contact
- Bioturbated

Sandy shale
- Medium gray, lightens upward
- Micaceous
- Thinly laminated
- Wavy cross lamination and planar in upper portion
- Ripple cross-laminated
- Rooting and plant fragments
- Gradational contact
- Bioturbated and non-fossiliferous

Tebo coal - coal facies
- Flooding surface
- Exposure surface

Blocky mudstone facies
- Paleosol

Laminated muddy sandstone facies
- Shallow marine, probably a muddy tidal flat or coastal plain
Shale, same as above

Shaley Sandstone
- Brown
- Micaceous and some silica
- Thinly laminated
- Wavy bedded
- Gradational contact
- Bioturbated

Sandstone
- Light brown
- Siliceous
- Very fine-grained coarsening upward fine-grained well sorted and well rounded
- Thickly laminated to thinly bedded
- Planar, wavy and lenticular bedding
- Gradational contact
- Non-fossiliferous

Laminated muddy sandstone facies
- Muddy tidal flat - coastal plain

Crevasse splay
- Unidirectional flow in upper portion and bidirectional flow in lower portion
- Coarse upward
- Possibly a tidal splay
- Sand is in place of Weir-Pittsburg coal
Shale
- Dark brown to gray
- Micaceous with siliceous laminae
- Thinly laminated
- Lenticular bedded with planar bedding on top
- Plant fragments
- Gradational contact
- Bioclastic fragments on top

Sandstone, same as above

Dark gray shale facies
- Similar to an underclay
- Non-marine, outside shale

Phosphatic black shale facies
- Transgressive marine, core shale

Sandstone, description on next page

Flooding surface
Sandstone
- Light brown
- Siliceous
- Very fine-grained, well sorted and rounded
- Thinly bedded to thickly laminated
- Faser bedded
- Fractured on top
- Gradational contact
- Bioturbated on bottom

Shale
- Dark gray to black
- Thinly laminated and planar
- Diagonal fracturing
- Phaeplastic
- Gradational contact

Underclay
- Gray
- Pedogenic
- Abundant plant fragments and rooting
- Slickenlines
- Sharp contact
- Bioturbated

Shale
- Gray
- Micaceous
- Pedogenically altered
- Thinly laminated
- Planar bedded
- Siderite nodules
- Plant fragments
- Gradational contact
- Bioturbated

Sandstone
- Light brown to gray
- Siliceous w/ mica laminae
- Very fine-grained, well sorted and rounded
- Thickly laminated
- Faser, lenticular and wavy bedded
- Soft sediment deformation
- Siderite, and rip-up clasts
- Gradational contact
- Bioturbated

Crevase Splay
- Unidirectional flow
- Some tidal influence
- Coarsens upward

Flooding surface
Blocky mudstone facies
- Paleosol

Siderite gray shale facies
- Inner estuarine - central basin

Bartlesville/Bluejacket Sandstone
Interlaminated sandstone and siltstone facies
- Bay head delta, upper estuarine
- Incised valley fill
- Bimodal flow
- Tidal influenced
Sandstone, same as above

Escape structures

Rip-up clasts

Passively filled vertical burrows

Rip-up clasts

Erosional contact

Interbedded sandstone and siltstone facies

- Exposure surface (sequence boundary)
Shale
- Dark gray to black
- Micaceous
- Thinly laminated
- Planar to lenticular bedded
- Siderite bands
- Gradational contact
- Non-fossiliferous

Dark gray shale facies
- Offshore transition

Coal
- Well developed cleating
- Gray
- Pedogenic
- Rooting and plant fragments
- Siderite crystals
- Slickensides
- Sharp contact
- Bioturbated

Underclay
- Gray
- Pedogenic
- Rooting and plant fragments
- Siderite crystals
- Slickensides
- Sharp contact
- Bioturbated

Flooding surface
Exposure surface
Blocky mudstone facies
Palexosol

Siderite shale facies
- Lagovalial shale
Shale
- Dark gray to black
- Micaceous with a calcareous cement at 735' 
- Thinly laminated 
- Planar to lenticular bedded 
- Sparse siderite nodules 
- Sparse pyrite 
- Sparse plant fragments 
- Gradational contact 
- Bioelastic fragments at 735'

Pyritic black shale
- Non-marine, outside shale 
- Swamp/marsh
Shale, same as above

Underclay
- Gray
- Pedogenic
- Plant fragments and rooting
- Siderite nodules
- Laminated on bottom
- Sharp contact
- Bioturbated

- Dark gray to black
- Micaceous with a calcareous cement between 764.9' - 766.7' on top
- Planar bedding
- Plant fragments
- Siderite nodules
- Gradational contact
- Bioturbated on top
- Bioclastic fragments

Blocky mudstone facies
- Paleosol

Sideritic shale facies?
- Lagoonal shale

Exposure surface
Underclay
- Light gray
- Pedogenic
- Stalagmites
- Plant fragments
- Siderite crystals and nodules
- Sharp contact
- Bioturbated

Shale
- Dark gray lightens upward to a light gray
- Micaceous
- Thinly laminated
- Planar bedded
- Siderite bands and 1' of siderite at 800'
- Gradational
- Sparse microfossils
- Abundant bioclasts at 806'
- Heavily bioturbated at 798'

Blocky mudstone facies
- Paleosol

Dark gray shale facies
- Offshore transition
- Shoaling upward
Shale, same as above

Transgressive lag

- Floodling surface

- Exposure surface

- Blocky mudstone facies

- Paleosol

Gale chert

- Underclay
  - Light gray
  - Pedogenic
  - Slightly laminated between 809' - 811'
  - Slickensides
  - Siderite nodules
  - Rooting and plant fragments
  - Sharp contact
  - Bioturbated

Shale

- Dark gray
- Micaeous
- Thinly laminated
- Lenticular and planar bedded
- Soft sediment deformation
- Siderite nodules
- Gradational contact
- Passively filled horizontal burrows, *Planolites montanus?*

Sideritic gray shale facies

- Central basin - inner estuarine
- Low trace fossil diversity indicates a stressed environment

Floodling surface
| 浮生面 | 华尔纳砂岩

间层状砂岩和泥岩相

- 河口三角洲 - 上部潟湖
- 多个1-5cm向上沉积包络代表潮汐周期
- 低痕迹生物多样性表明受压环境
- 断谷填埋
- 序列边界在砂下

| 砂岩

- 浅褐色到深灰色
- 分选差的泥岩
- 非常细粒，很好分选和很好圆化的
- 厚层状分选
- 波状层理
- 分层波浪褶皱
- 含有水平洞穴、Arenicolites和Planoletes montanus？

| 露出面

灰色泥岩相

- 沿岸过渡
- 浅层向上
Appendix 2: Statistical distribution of coal thickness

Summit coal

Iron Post coal

Bevier coal

Croweburg coal

Mineral coal

Mulky coal

Fleming coal

Scammon coal