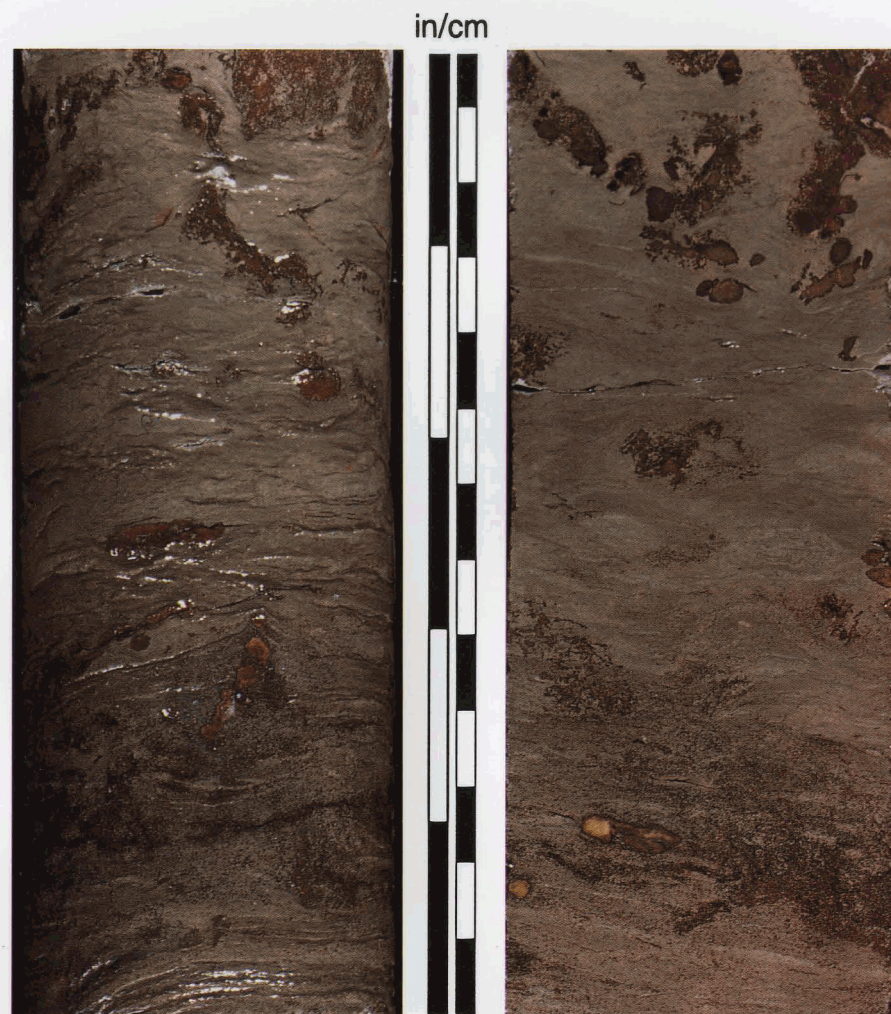
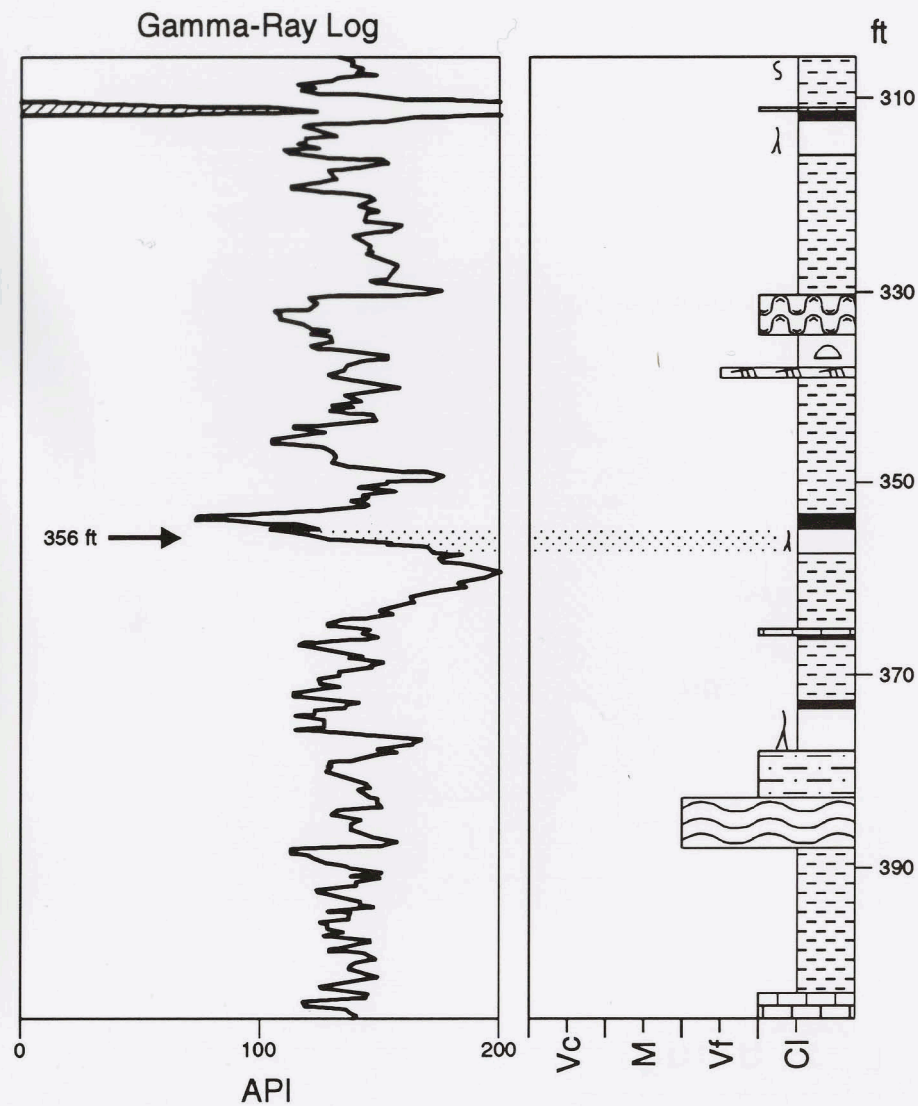


Borehole No. 594
 Sec. 19 - M - 21
 Webster County, Kentucky



Rooted Horizontal-Laminated Mudstone

Fm h r 1 [137]



I. NAME: Rooted horizontal-laminated
mudstone

Formation: Bond

Fm	h	r	1
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II. DESCRIPTION:

Texture: Clay – (less than 0.0039 mm)
Minor silt – (0.0039 - 0.0625 mm)

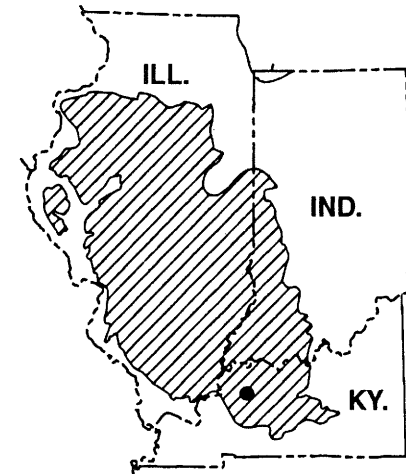
Composition: Clay – unknown
Silt – quartz; scattered siderite
nodules and patches

Sedimentary structures and features:
Bioturbation from rooting, horizontal
lamination

Fossils: Fossil roots

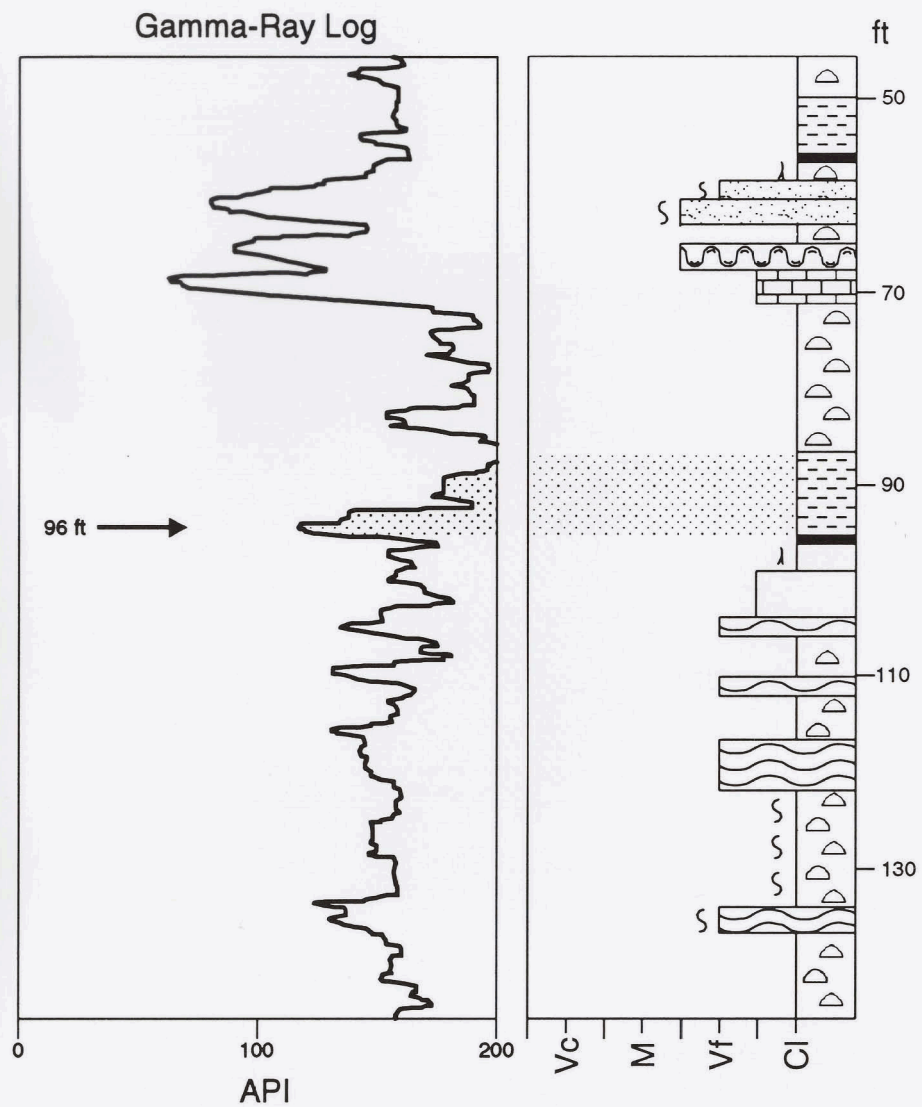
III. GAMMA-RAY WELL-LOG CHARACTERISTICS:

The succession shown on the columnar profile is dominated by fine-grained rocks that result in an overall high gamma activity. The consistently fine-grained nature of the succession results in a gamma-ray curve with no consistent upward-coarsening or upward-fining trend, and a gamma-ray signature best described as irregular.



Map showing area of Pennsylvanian rocks
and location of corehole.

Illinois State Geological Survey COGEO MAP S-2
 Sec. 29 - T10S - R5E
 Saline County, Illinois



Fs z z 1 [119]

I. NAME: Shale
Formation: Tradewater

Fs	z	z	1
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II. DESCRIPTION:

Texture: Clay – (less than 0.0039 mm)

Composition: Clay – unknown, finely disseminated
pyrite, high organic content

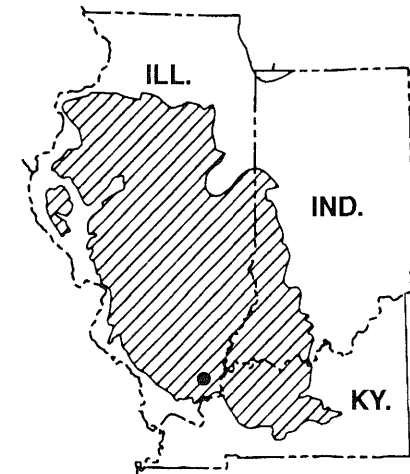
Sedimentary structures and features:

Lamination

Fossils: Brachiopod and possible bryozoan
skeletal debris, plant debris,
Chondrites trace fossil

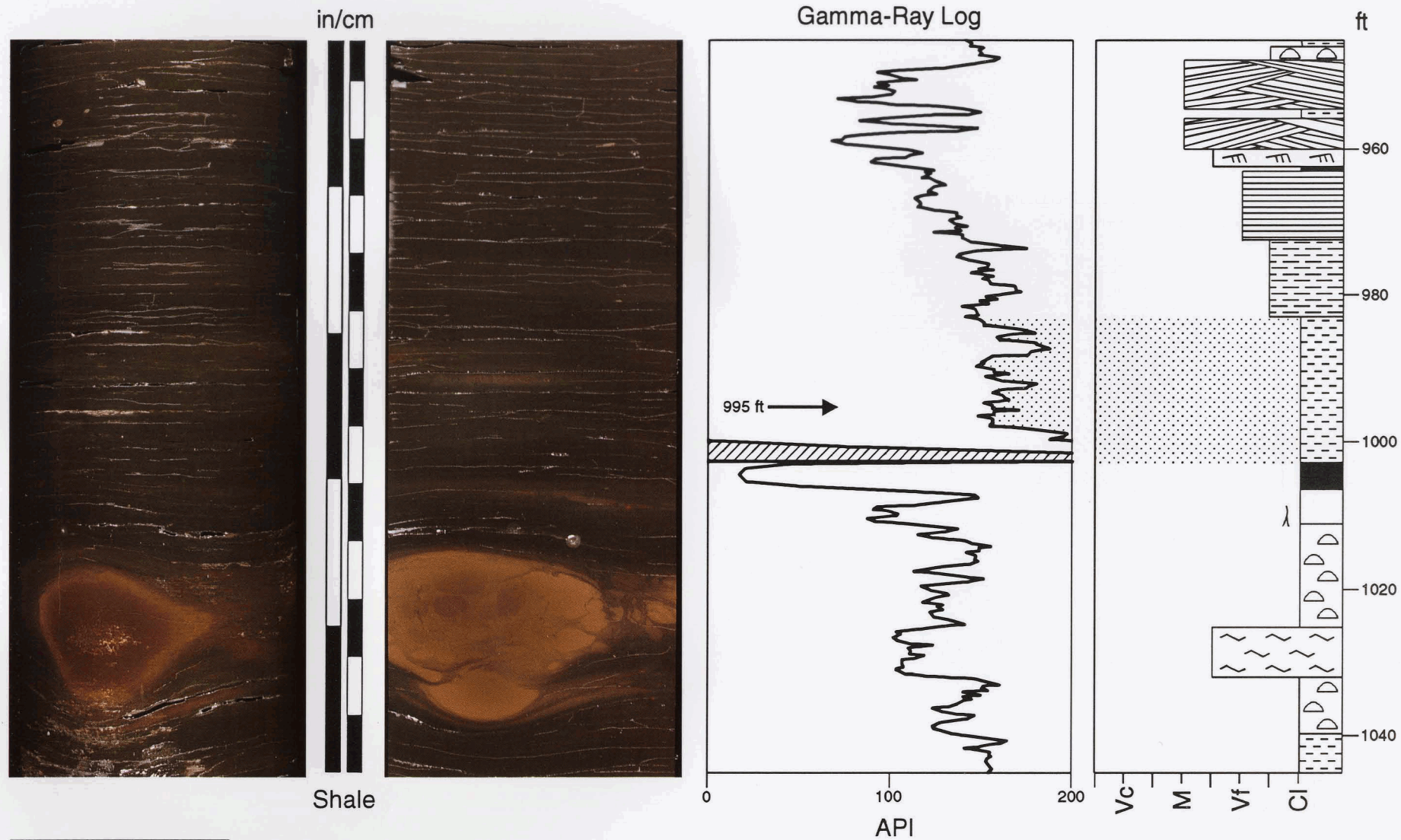
III. GAMMA-RAY WELL-LOG CHARACTERISTICS:

The gamma-ray curve for this well is of poor quality, making interpretation difficult. The overall fine-grained nature of the succession shown on the columnar profile results in a gamma-ray well-log that reads at or near the shale base line. The alternating wavy-bedded sandstones and lenticular-bedded shales common throughout much of the lower part of the succession results in an irregular gamma-ray well-log signature.



Map showing area of Pennsylvanian rocks and location of corehole.

Borehole No. 593
 Sec. 19 - M - 21
 Webster County, Kentucky



Fs z z 2 [124]

I. NAME: Shale
Formation: Carbondale

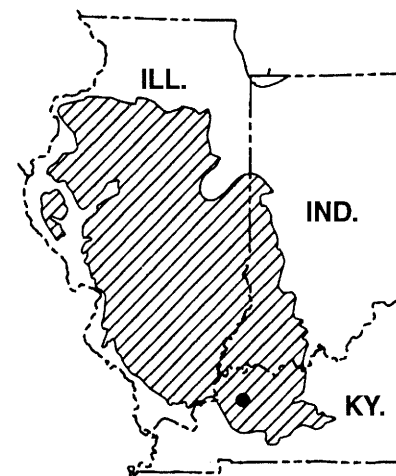
Fs	z	z	2
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II. DESCRIPTION:

Texture: Clay – (less than 0.0039 mm)
Composition: Clay – unknown, abundant organic material, siderite
Nodules – siderite
Sedimentary structures and features:
Lamination
Fossils: None observed

III. GAMMA-RAY WELL-LOG CHARACTERISTICS:

The clay-rich nature of this rock results in an overall gamma-ray well-log curve that reads at or near the shale baseline. The unit from 983 to 1,003 ft is a shale that is dark gray and silty at the top becoming finer-grained downward resulting in a well-developed funnel-shaped signature. The high gamma-ray spike at the base of the unit (1,001 ft to 1,003 ft) is a radioactive black shale.

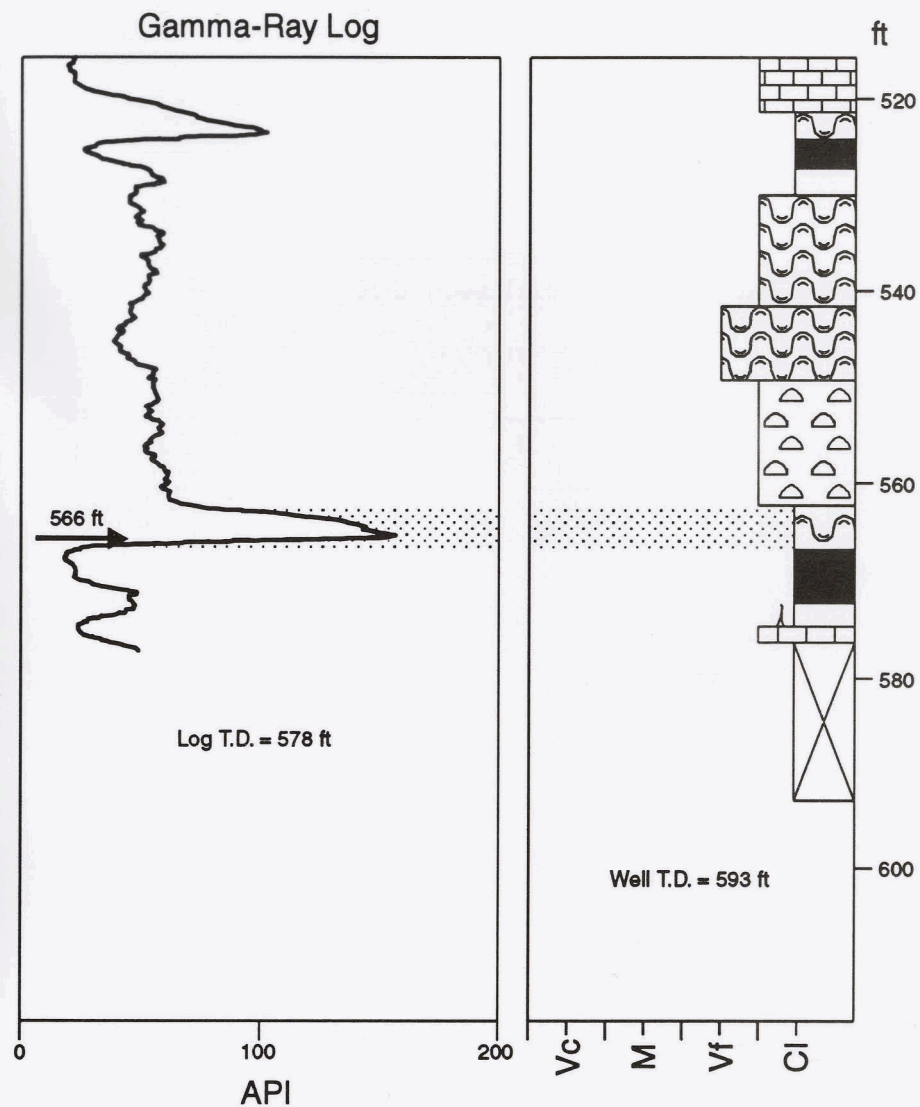


Map showing area of Pennsylvanian rocks and location of corehole.

Nicor Minerals Inc. M-7
 Sec. 2 - T14N - R1E
 Macon County, Illinois



Disturbed-Bedded Shale



Fs z d 1 [010]

I. NAME: Disturbed-bedded shale
Formation: Carbondale

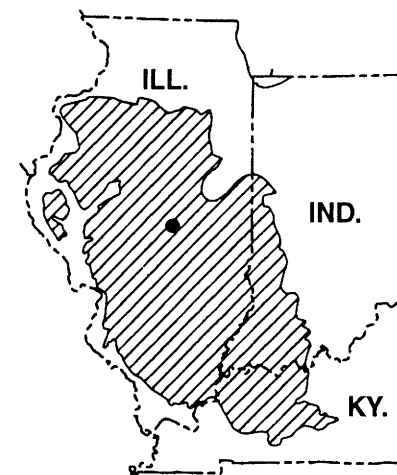
Fs	z	d	1
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II. DESCRIPTION:

Texture: Clay – (less than 0.0039 mm)
Silt – (0.0039 - 0.0625 mm)
Composition: Clay – unknown, abundant organic material
Silt – quartz
Sedimentary structures and features:
Inclined bedding, minor lenticular bedding
Fossils: None observed

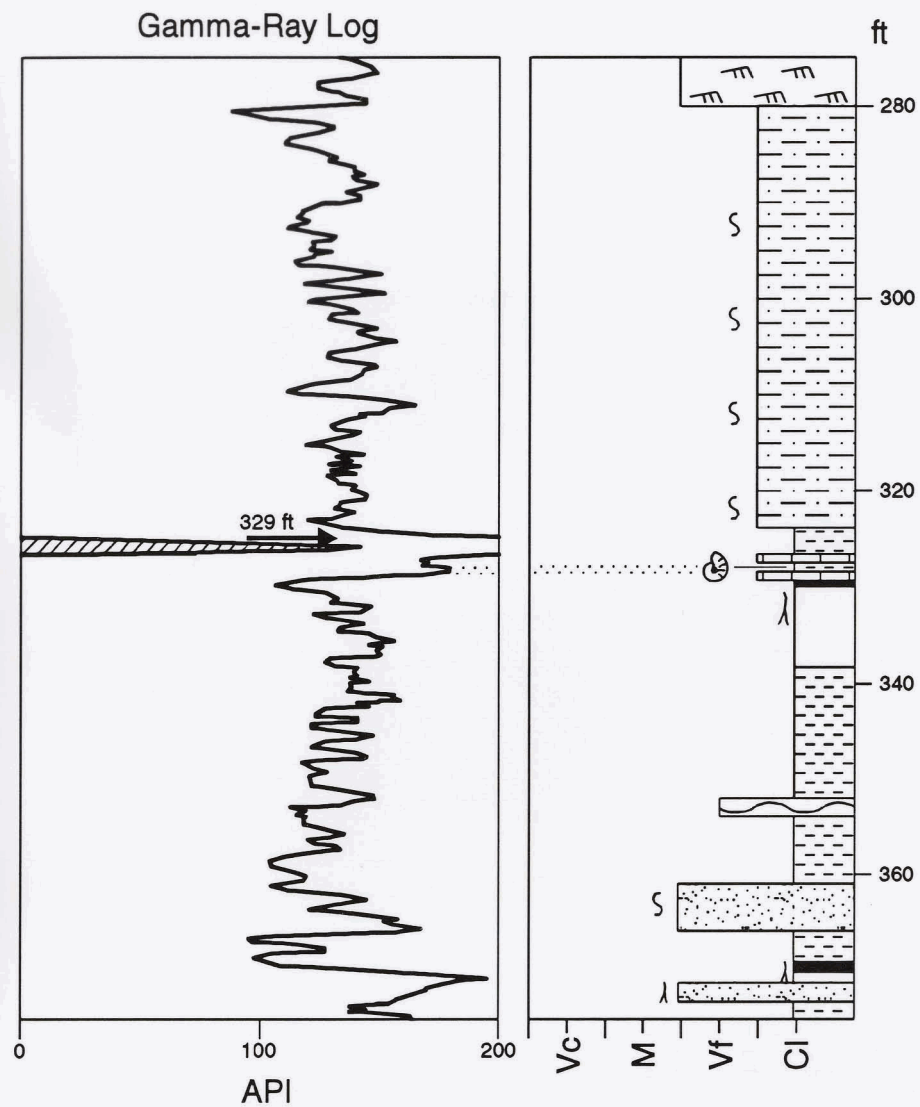
III. GAMMA-RAY WELL-LOG CHARACTERISTICS:

The gamma-ray profile for this facies is deflected to the right, beyond the shale baseline which indicates a high radioactive element concentration related to organic content. The increase in grain size of the rocks above the disturbed-bedded shale results in deflection of the gamma-ray curve towards the sand baseline. The gamma-ray signature across the succession shown in the columnar profile is best described as irregular.



Map showing area of Pennsylvanian rocks and location of corehole.

Borehole No. 593
 Sec. 19 - M - 21
 Webster County, Kentucky



Fs z f 1 [119]

I. **NAME:** Fossiliferous shale
Formation: Bond

Fs	z	f	1
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II. **DESCRIPTION:**

Texture: **Clay** – (less than 0.0039 mm)
Minor silt – (0.0039 – 0.0625 mm)
Skeletal grains – approximately
10 - 15 percent
Composition: **Clay and silt** – unknown, probable
high organic carbon
content, slightly
calcareous, approxi-
mately 25 percent of
skeletal grains
pyritized

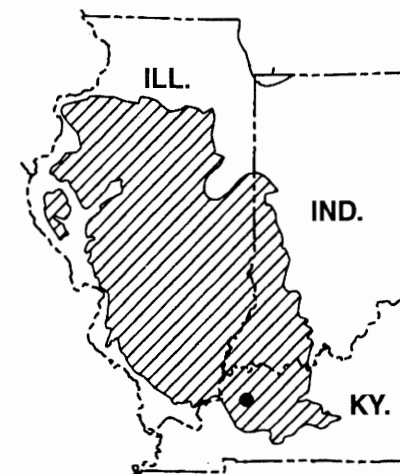
Sedimentary structures and features:

Faint bioturbation

Fossils: Molluscan and brachiopod skeletal
debris (approximately 25 percent
pyritized), faint bioturbation

III. **GAMMA-RAY WELL-LOG CHARACTERISTICS:**

The high gamma values from 329 ft to 331 ft are in response to a radioactive black shale above the upper thin limestone and the black fossiliferous shale below the limestone. The presence of fine-grained rocks from 362 ft to 280 ft result in a gamma-ray curve that reads consistently at or near the shale baseline. The gamma-ray signature across the entire succession shown on the columnar profile is irregular. Below 360 ft there appears to be an approximate 5 ft offset (core is higher) between the log and the core.

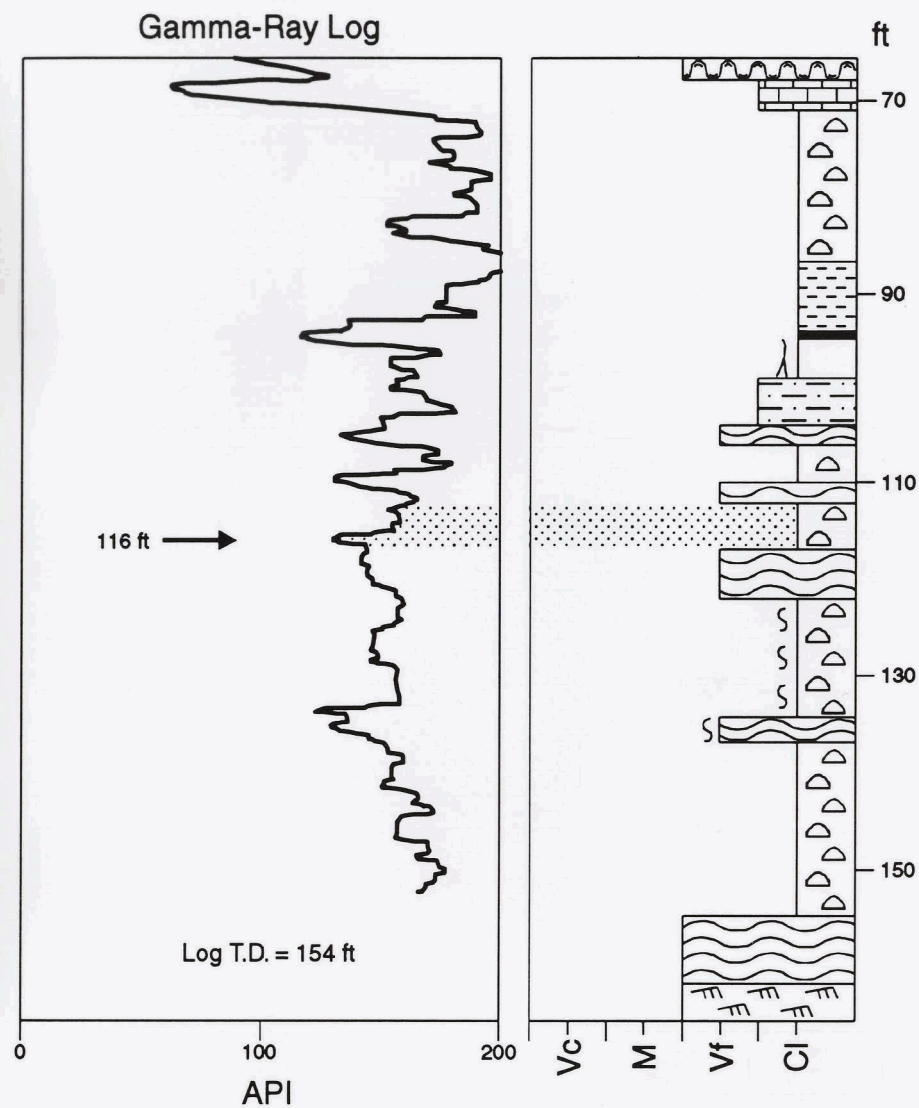


Map showing area of Pennsylvanian rocks and location of corehole.

Illinois State Geological Survey COGEOMAP S-2
 Sec. 29 - T10S - R5E
 Saline County, Illinois



Lenticular-Bedded Shale



Fs | **I** | **z** | **1** [322.8]

I. NAME: Lenticular-bedded shale
Formation: Tradewater

Fs	I	z	1
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I. DESCRIPTION:

Texture: **Clay** – (less than 0.0039 mm)
Sand – very fine-grained
(0.0625 - 0.125 mm)

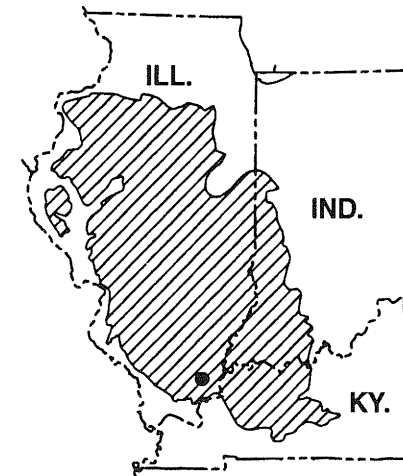
Composition: **Clay** – unknown, scattered pyrite and mica
Sand – quartz sand with silica, kaolinite, and siderite cement

Sedimentary structures and features:
Lenticular bedding, small load-casted ripples, possible horizontal burrows

Fossils: Possible horizontal burrows

III. GAMMA-RAY WELL-LOG CHARACTERISTICS:

The vertical succession of facies from the base of the gamma-ray well-log at 154 ft to the base of the limestone at 72 ft is dominated by fine-grained rocks consisting predominantly of lenticular bedding and somewhat coarser-grained wavy bedding. As a result, the gamma-ray curve reads at or near the shale baseline across most of the interval, and has an irregular signature.

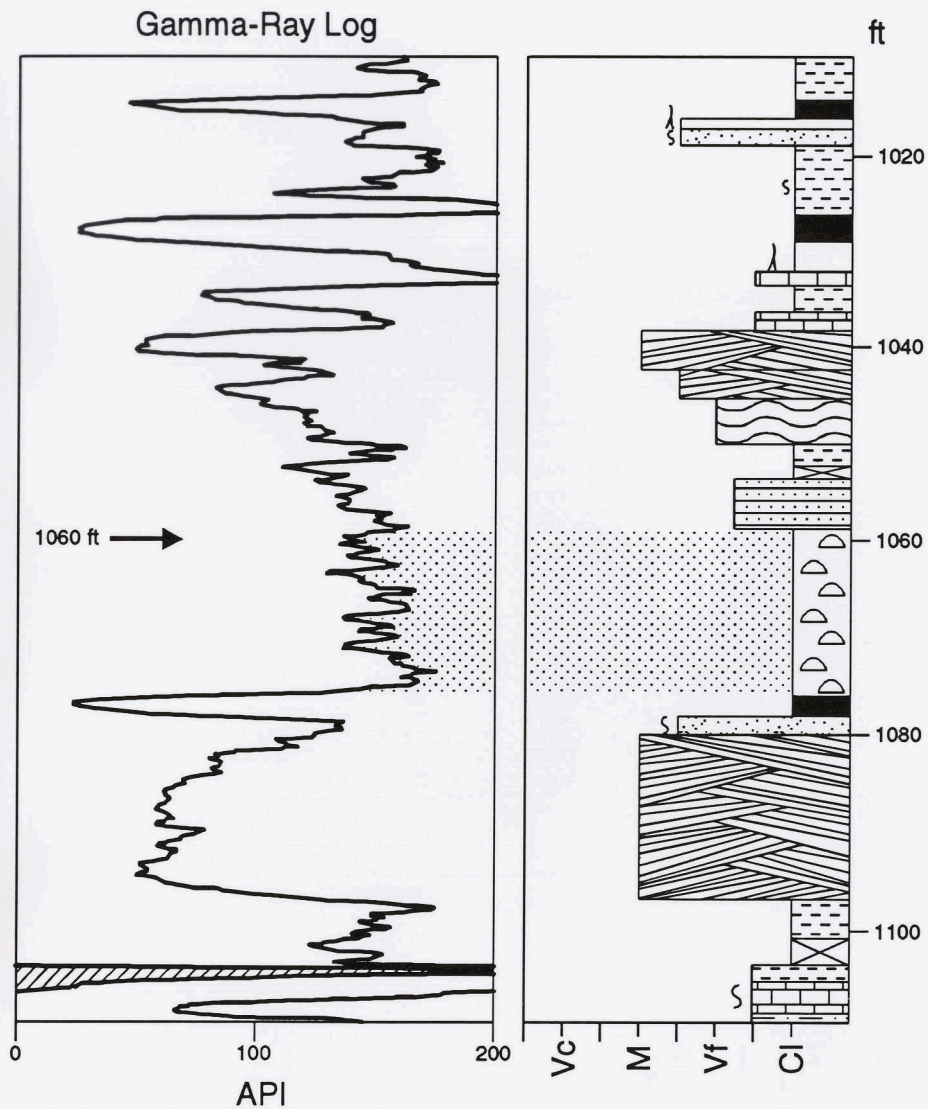


Map showing area of Pennsylvanian rocks and location of corehole.

Shot Point Services IN-4
 Sec. 15 - T5S - R13W
 Posey County, Indiana



Lenticular-Bedded Shale



Fs **I** **z** **2** [322.5 bio]

I. NAME: Lenticular-bedded shale
Formation: Staunton

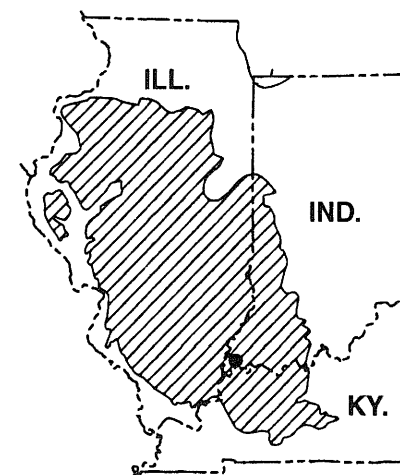
Fs	I	z	2
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II. DESCRIPTION:

Texture: Sand – very fine-grained
(0.0625 - 0.125 mm)
subangular to subrounded
Clay – (less than 0.0039 mm)
Composition: Sand – quartz and minor mica with
silica and kaolinite cement
Clay – (less than 0.0039)
Sedimentary structures and features:
Lenticular bedding (transitional to
wavy-bedded), load-casted ripples,
possible rhythmic bedding, possible
horizontal burrows
Fossils: Possible horizontal burrows

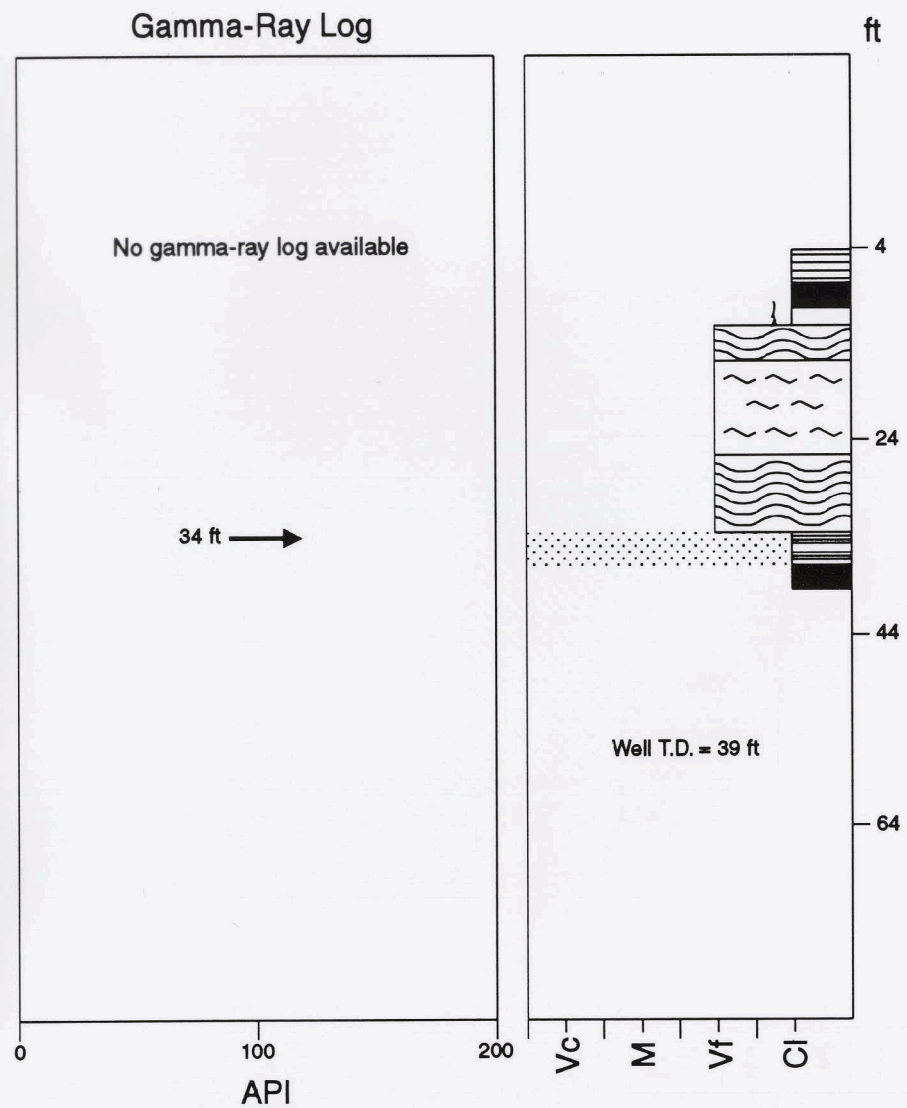
III. GAMMA-RAY WELL-LOG CHARACTERISTICS:

The high gamma-ray spikes at 1,023 ft and 1,104 ft are radioactive black shales. The high gamma-ray spike at 1,032 ft corresponds to a gray limestone and possibly a gray underclay above it. The lenticular-bedded shale facies forms the basal portion of an upward-coarsening succession that results in a serrated, funnel-shaped, gamma-ray well-log signature (1,077 to 1,038 ft).



Map showing area of Pennsylvanian rocks and location of corehole.

Little Sandy No. 1 Pit
 Sec. 24 - T3N - R6W
 Daviess County, Indiana



Fs **t** **z** **1** [323 rhy]

I. NAME: Rhythmic-bedded shale
Formation: Brazil

Fs	t	z	1
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II. DESCRIPTION:

Texture: Clay – (less than 0.0039 mm)

Silt – (0.0039 - 0.0625 mm)

Composition: Clay – unknown, sideritic at
top of sample

Silt – quartz

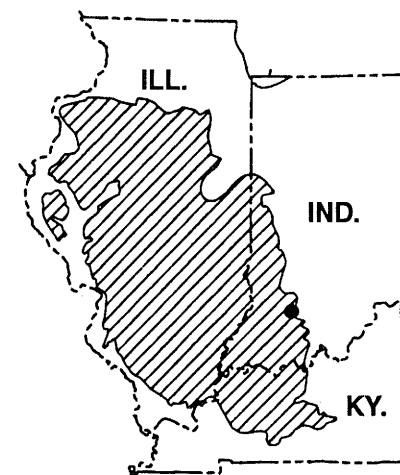
Sedimentary structures and features:

Rhythmic bedding

Fossils: None observed

III. GAMMA-RAY WELL-LOG CHARACTERISTICS:

This sample is from a measured section in a mine
wall. No gamma-ray well-log available.

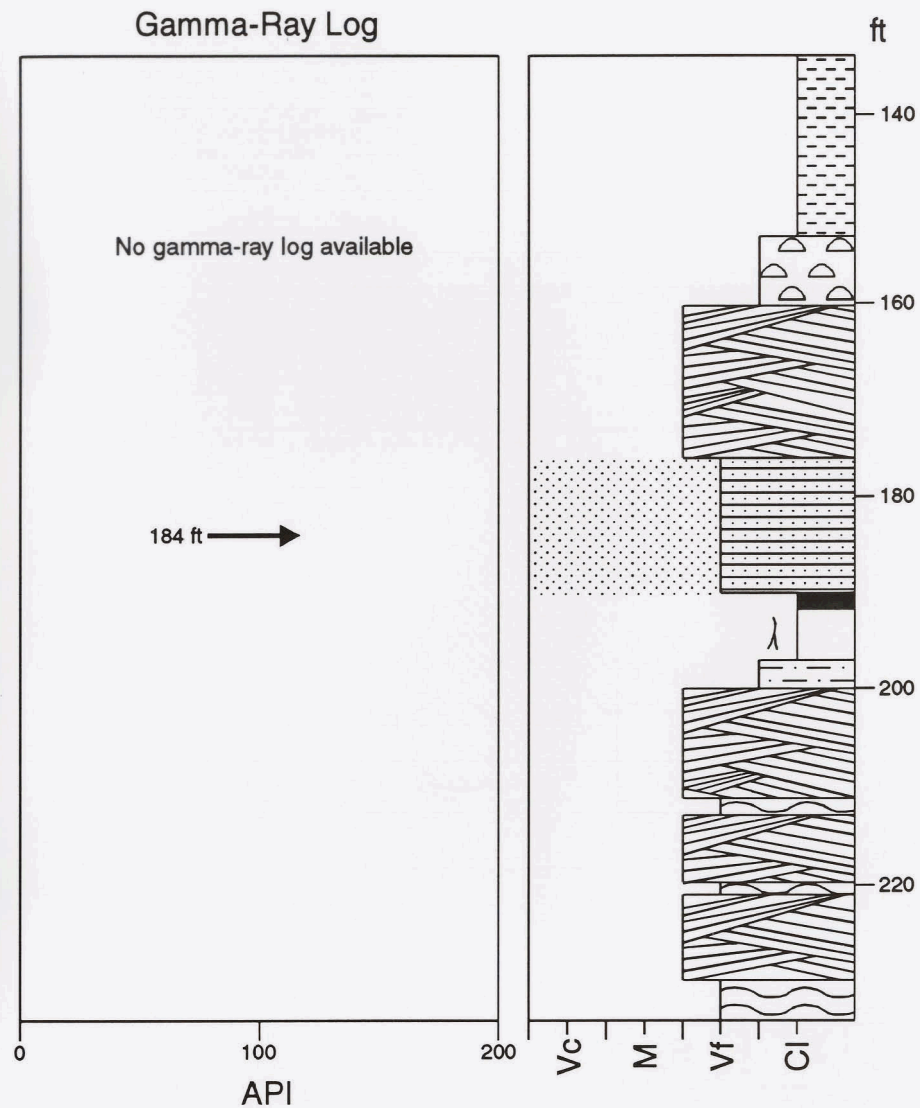


Map showing area of Pennsylvanian rocks
and location of corehole.

Indiana Geological Survey SDH-213
Sec. 8 - T5N - R6W
Daviess County, Indiana



Interlaminated Shale and Sandstone



Fs i z 1 [322.5]

I. NAME: Interlaminated shale and sandstone
Formation: Brazil

Fs	i	z	1
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II. DESCRIPTION:

Texture: **Sand** – very fine-grained
(0.0625 - 0.125 mm)
subangular to subrounded

Clay – (less than 0.0039 mm)

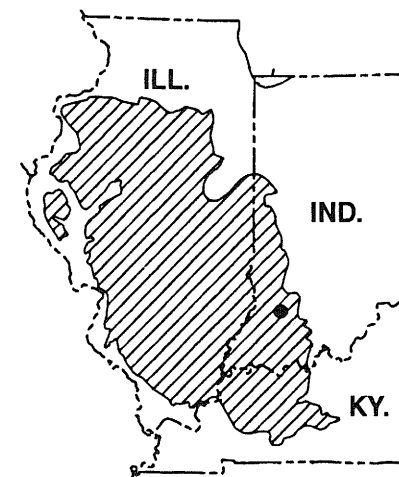
Composition: **Sand** – quartz with silica, kaolinite,
and siderite cement with
minor mica

Clay – unknown, disseminated plant
material and mica along clay
partings

Sedimentary structures and features:

Interlaminated shale and sandstone,
lenticular bedding, minor load-casted
ripples, some horizontal burrows

Fossils: Disseminated plant material,
horizontal burrows



Map showing area of Pennsylvanian rocks
and location of corehole.

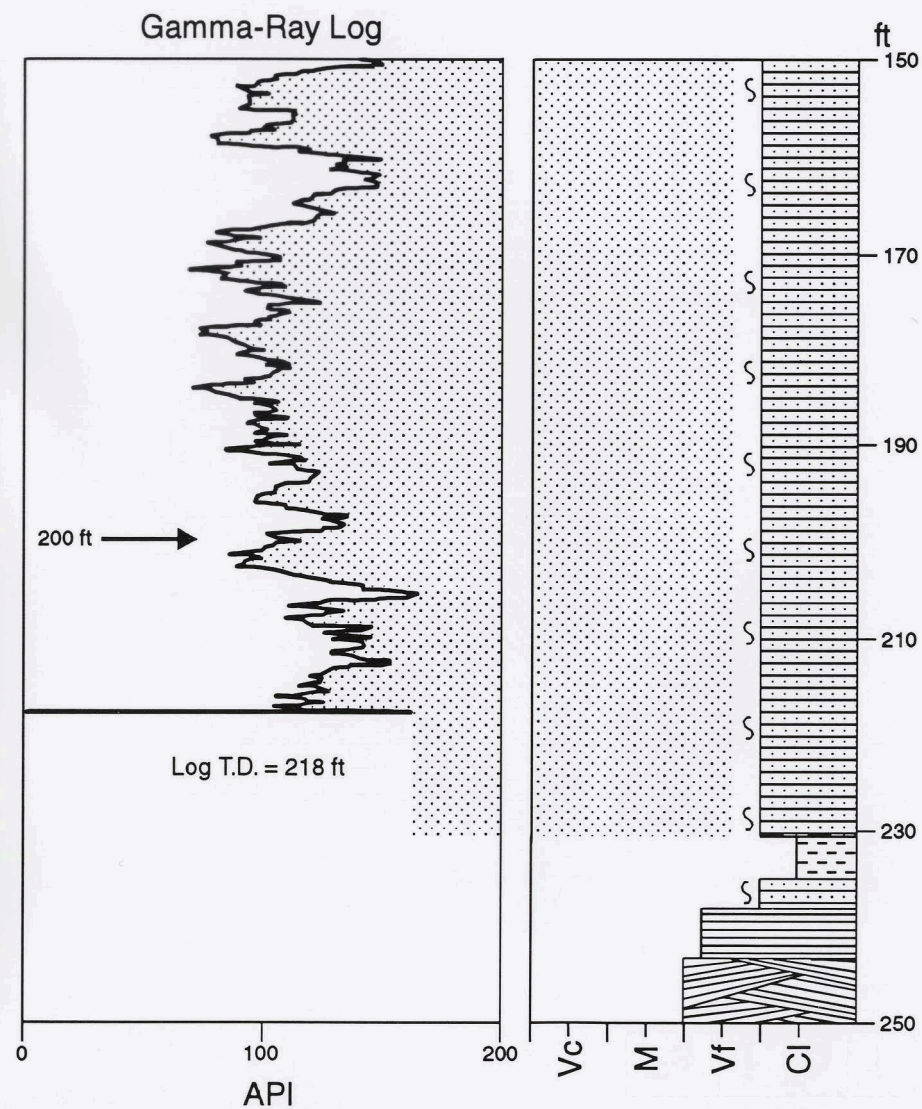
III. GAMMA-RAY WELL-LOG CHARACTERISTICS:

No gamma-ray well-log available

Illinois State Geological Survey COGEOMAP S-4
 Sec. 25 - T11S - R4E
 Johnson County, Illinois



Bioturbated Interlaminated Shale and Sandstone



Fs i b 1 [322.8]

I. NAME: Bioturbated interlaminated shale and sandstone
Formation: Tradewater

Fs	i	b	1
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II. DESCRIPTION:

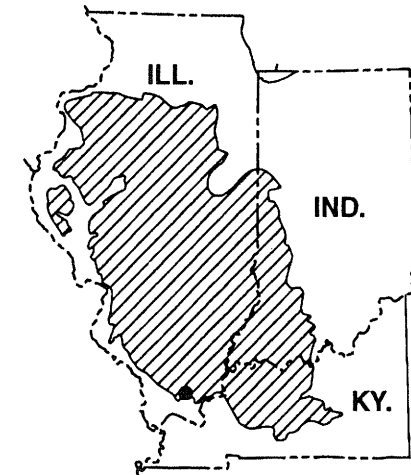
Texture: **Silt and clay** – (less than 0.0625 mm)
Sand – very fine-grained
(0.0625 - 0.125 mm)
subangular to subrounded

Composition: **Clay** – unknown
Sand and silt – quartz with silica,
kaolinite, and minor
siderite cement,
scattered pyrite,
abundant carbon-
aceous material

Sedimentary structures and features:

Bioturbation; interlaminated sand-
stone, siltstone and shale, lenticular
bedding, possible rhythmic bedding

Fossils: Trace fossils include *Planolites* and
possible *Teichichnus*



Map showing area of Pennsylvanian rocks
and location of corehole.

III. GAMMA-RAY WELL-LOG CHARACTERISTICS:

The columnar profile from the bottom of the gamma-ray well-log at 218 ft to the top of the columnar profile at 150 ft consists of bioturbated mudstone as shown in the photograph. Increases and decreases in gamma activity across this interval are probably the result of slight changes in the sand-to-shale ratio. The gamma-ray signature across this interval is best described as irregular.