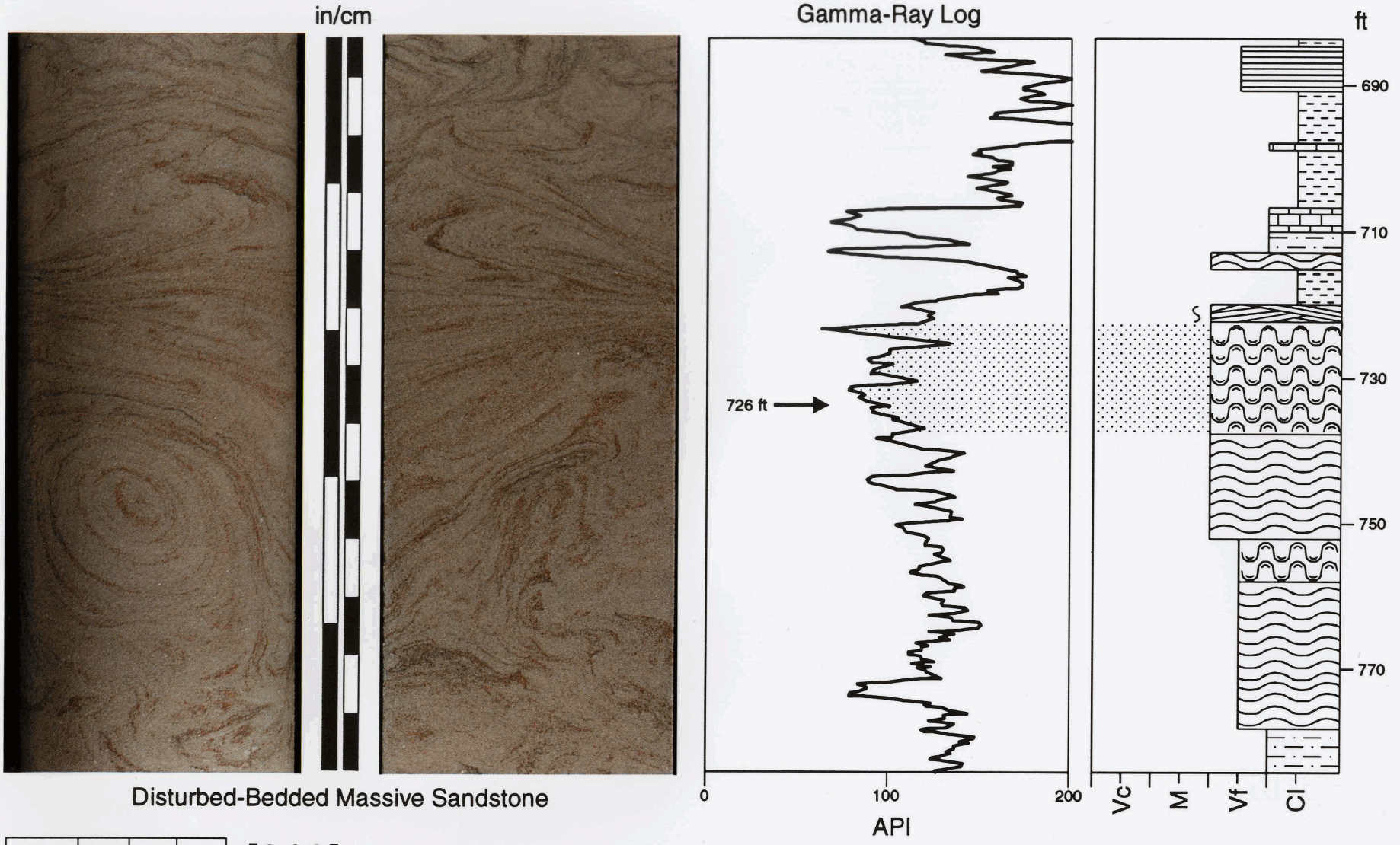
Borehole No. 594
Sec. 19 - M - 21
Webster County, Kentucky




Disturbed-Bedded Massive Sandstone

**Ss m d 1** [019]

| Ss | m | d | 1 |
|---|---|---|---|

**I. NAME:** Disturbed-bedded massive sandstone
**Formation:** Shelburn

**II. DESCRIPTION:**

**Texture:** **Sand** – fine-grained (0.125 - 0.250 mm) subangular to subrounded

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

**Sedimentary structures and features:** Contorted bedding

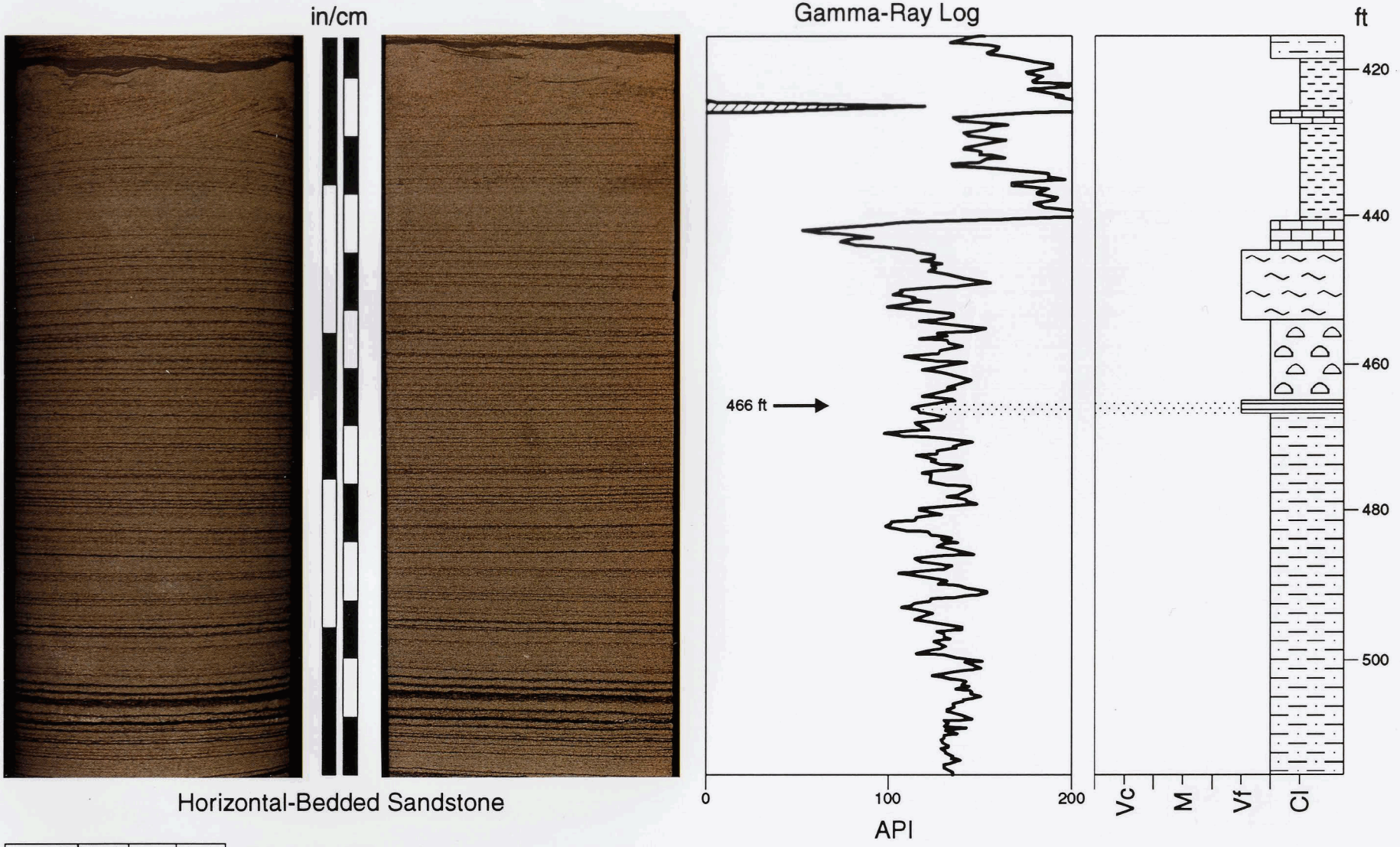
**Fossils:** None observed

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

The disturbed-bedded sandstone represents part of a generally upward-coarsening grain-size trend followed by an upward-fining grain-size trend (784 ft to 690 ft). The resultant gamma-ray well-log curve reflects this grain-size profile by showing a gradual deflection of the curve towards the "clean" sandstone baseline, followed by a gradual increase in gamma activity and resultant gradual deflection of the curve towards the shale baseline. The result is a poorly developed symmetrical to irregular gamma-ray well-log signature.


Map showing area of Pennsylvanian rocks and location of corehole.

Borehole No. 545
Sec. 16 - M - 21
Webster County, Kentucky




Horizontal-Bedded Sandstone

**Ss | h | z | 1** [563.6]

| Ss | h | z | 1 |
|---|---|---|---|

**I. NAME:** Horizontal-bedded sandstone
**Formation:** Shelburn

**II. DESCRIPTION:**

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

**Composition:** **Sand** – quartz with silica, kaolinite, and siderite cement; carbonaceous material concentrated along bedding planes and pyrite scattered throughout

**Sedimentary structures and features:** Horizontal bedding

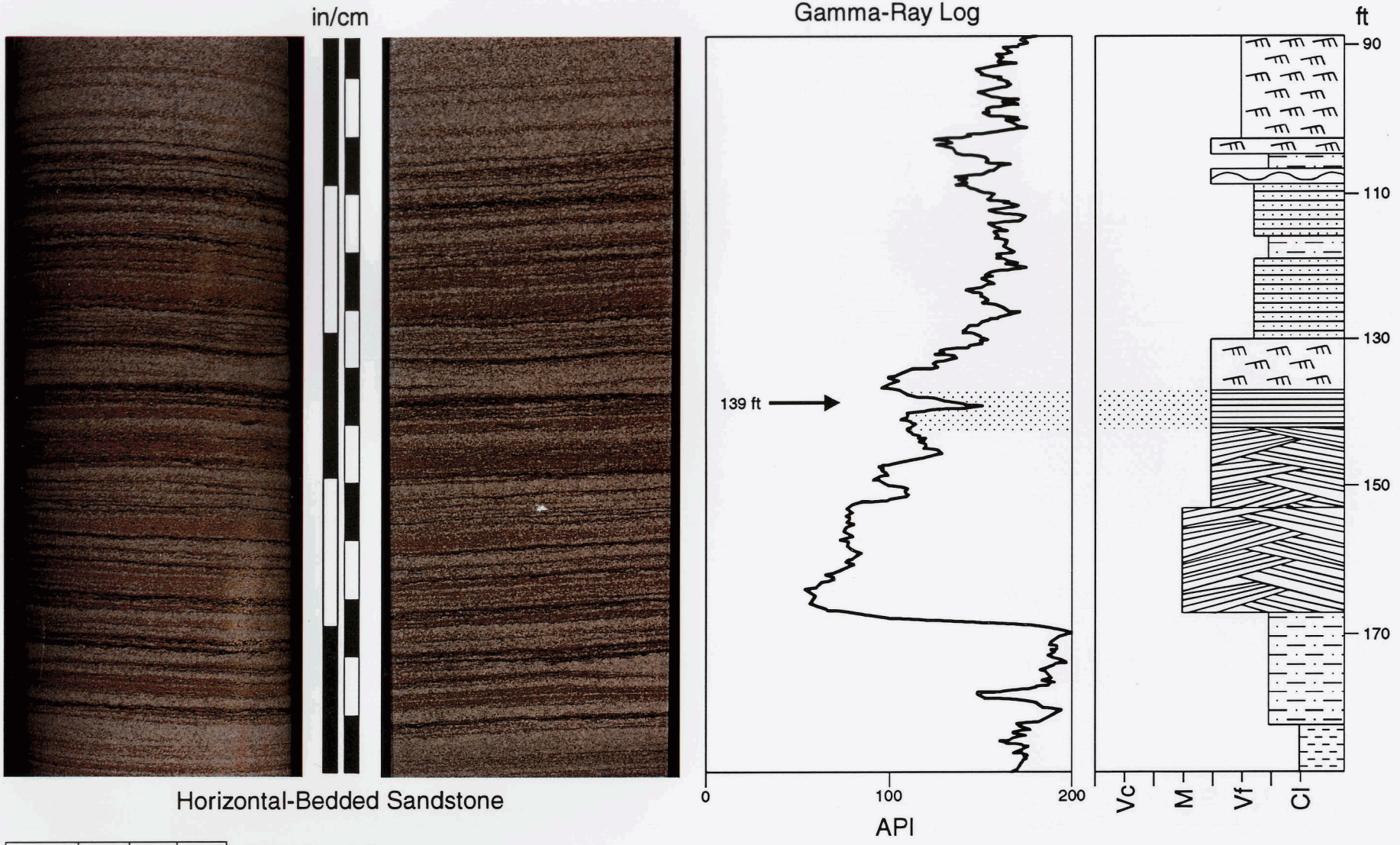
**Fossils:** None observed

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

The horizontal-bedded sandstone facies is associated with a slight upward-fining grain-size trend consisting of structureless siltstone below and lenticular-bedded siltstone and wavy-bedded sandstone above (516 ft to 444 ft). The subtle grain-size increase across this interval results in an irregular to slightly funnel-shaped gamma-ray well-log signature. The high gamma-ray spike at 424 ft is a radioactive black shale.


Map showing area of Pennsylvanian rocks and location of corehole.

Indiana Geological Survey SDH-293
Sec. 34 - T3S - R9W
Gibson County, Indiana




Horizontal-Bedded Sandstone

**Ss | h | z | 2** [563.6]

| Ss | h | z | 2 |
|---|---|---|---|

**I. NAME:** Horizontal-bedded sandstone
**Formation:** Dugger

**II. DESCRIPTION:**

**Texture:** **Sand** – fine-grained (0.125 - 0.250 mm) subangular to subrounded

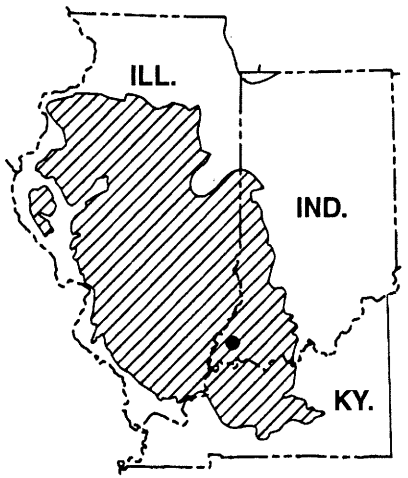
**Composition:** **Sand** – quartz with silica, siderite, and kaolinite cement; abundant, very fine-grained coalified plant fragments concentrated along bedding planes.

**Sedimentary structures and features:** Horizontal bedding

**Fossils:** None observed

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

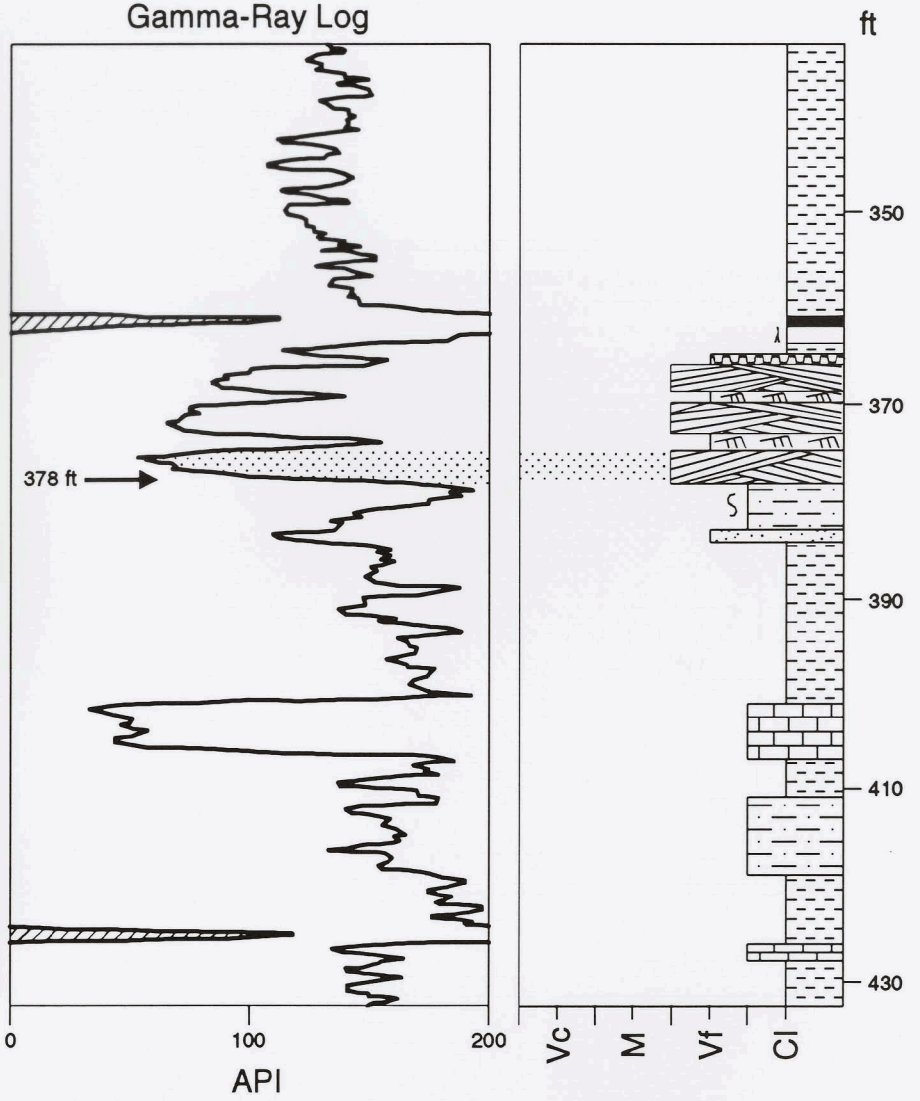
This facies represents part of a sandstone-dominated upward-fining succession (167 ft to 116 ft). The overall succession results in an excellent example of a bell-shaped gamma-ray well-log signature.




Map showing area of Pennsylvanian rocks and location of corehole.

Borehole No. 545
Sec. 16 - M - 21
Webster County, Kentucky


Cross-Bedded Sandstone




**Ss | x | z | 1** [561]

| Ss | x | z | 1 |
|---|---|---|---|

**I. NAME:** Cross-bedded sandstone
**Formation:** Patoka

**II. DESCRIPTION:**

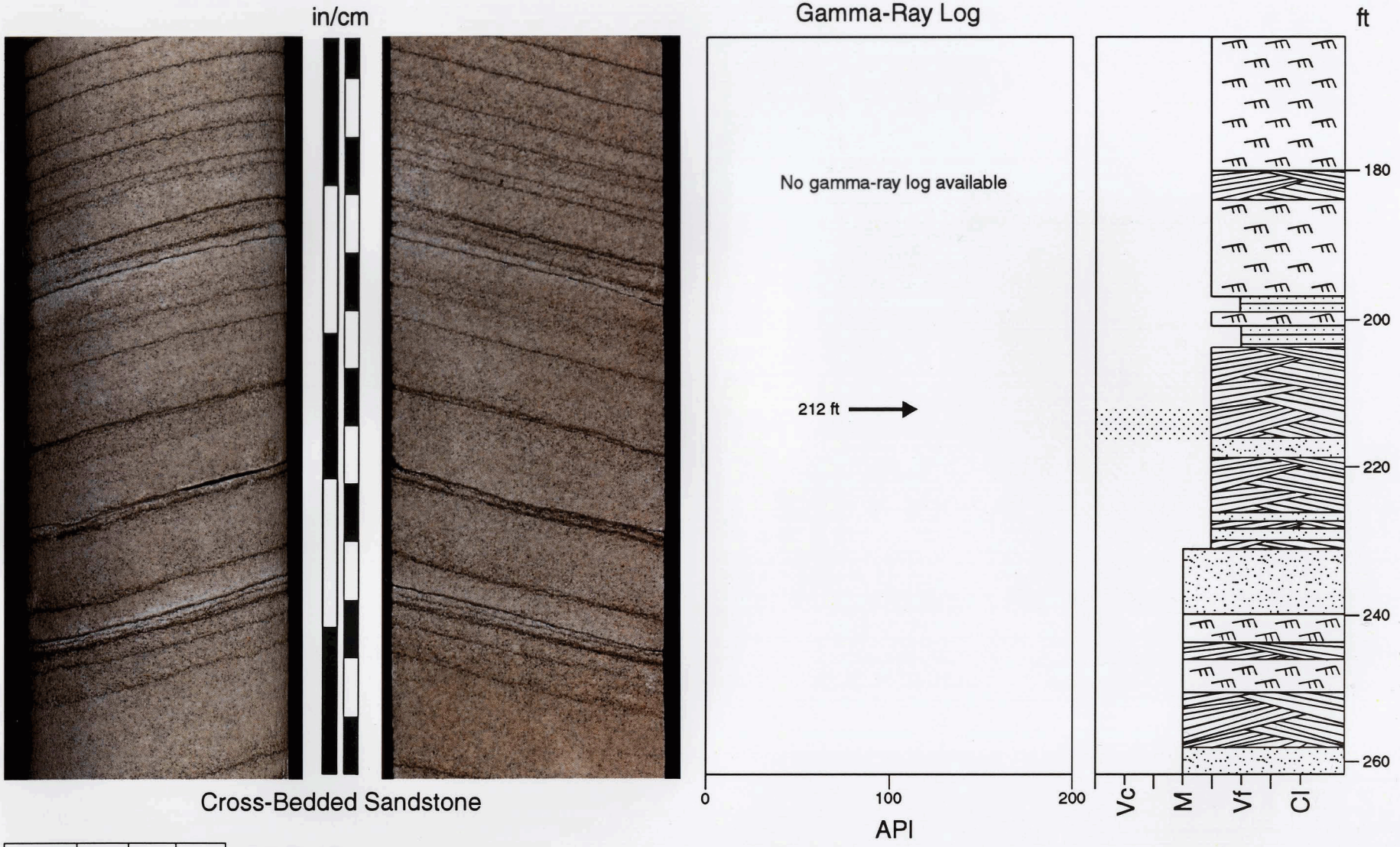
**Texture:** **Sand** – fine-grained (0.125 - 0.250 mm) subangular
**Composition: Sand** – quartz with siderite cement
**Sedimentary structures and features:** Cross-bedding
**Fossils:** None observed

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

With the exception of the cross-bedded sandstone (with minor ripple-bedded units) from 378 ft to 366 ft, the vertical succession shown by the columnar profile is dominated by fine-grained silicaclastic rocks. Therefore, the gamma-ray well-log reads at or near the shale baseline across most of the succession. The high gamma-ray spikes at 361 ft and 424 ft are radioactive black shales. The gamma-ray curve shows an overall upward-fining trend from 378 ft to 362 ft resulting in an irregular bell-shaped gamma-ray signature. The entire section is a good example of an irregular signature.


Map showing area of Pennsylvanian rocks and location of corehole.

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




Cross-Bedded Sandstone

| Ss | x | z | 2 | [551] |
|---|---|---|---|---|

| Ss | x | z | 2 |
|---|---|---|---|

**I. NAME:** Cross-bedded sandstone
**Formation:** Tradewater

**II. DESCRIPTION:**

**Texture:** **Sand** – fine-grained (0.125 - 0.250 mm) subangular to subrounded

**Composition:** **Sand** – quartz with silica and kaolinite cement with carbonaceous material concentrated along bedding planes

**Sedimentary structures and features:** Cross-bedding, may also be rhythmic bedded

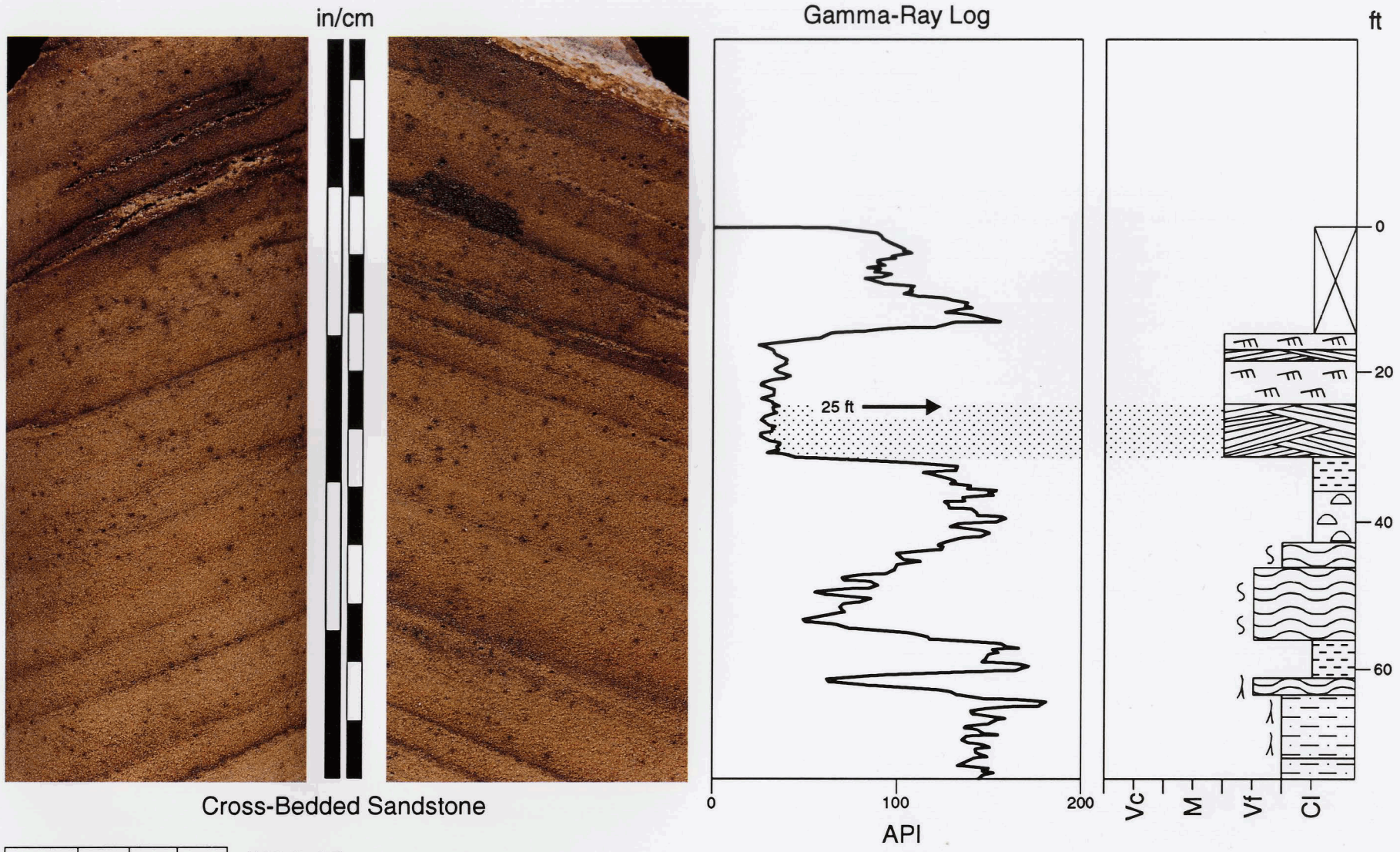
**Fossils:** None observed

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

No gamma-ray well-log available.


Map showing area of Pennsylvanian rocks and location of corehole.

NSWC Crane IGS(G)2
Sec. 17 - T5N - R3W
Martin County, Indiana




Cross-Bedded Sandstone

**Ss | x | z | 3** [561]

| Ss | x | z | 3 |
|---|---|---|---|

**I. NAME:** Cross-bedded sandstone
**Formation:** Mansfield

**II. DESCRIPTION:**

**Texture:** **Sand** – fine-grained (0.125 - 0.250 mm) subangular to subrounded

**Composition:** **Sand** – quartz with silica, kaolinite, and masses of pore-filling (poikilotopic) siderite cement

**Sedimentary structures and features:** Cross-bedding

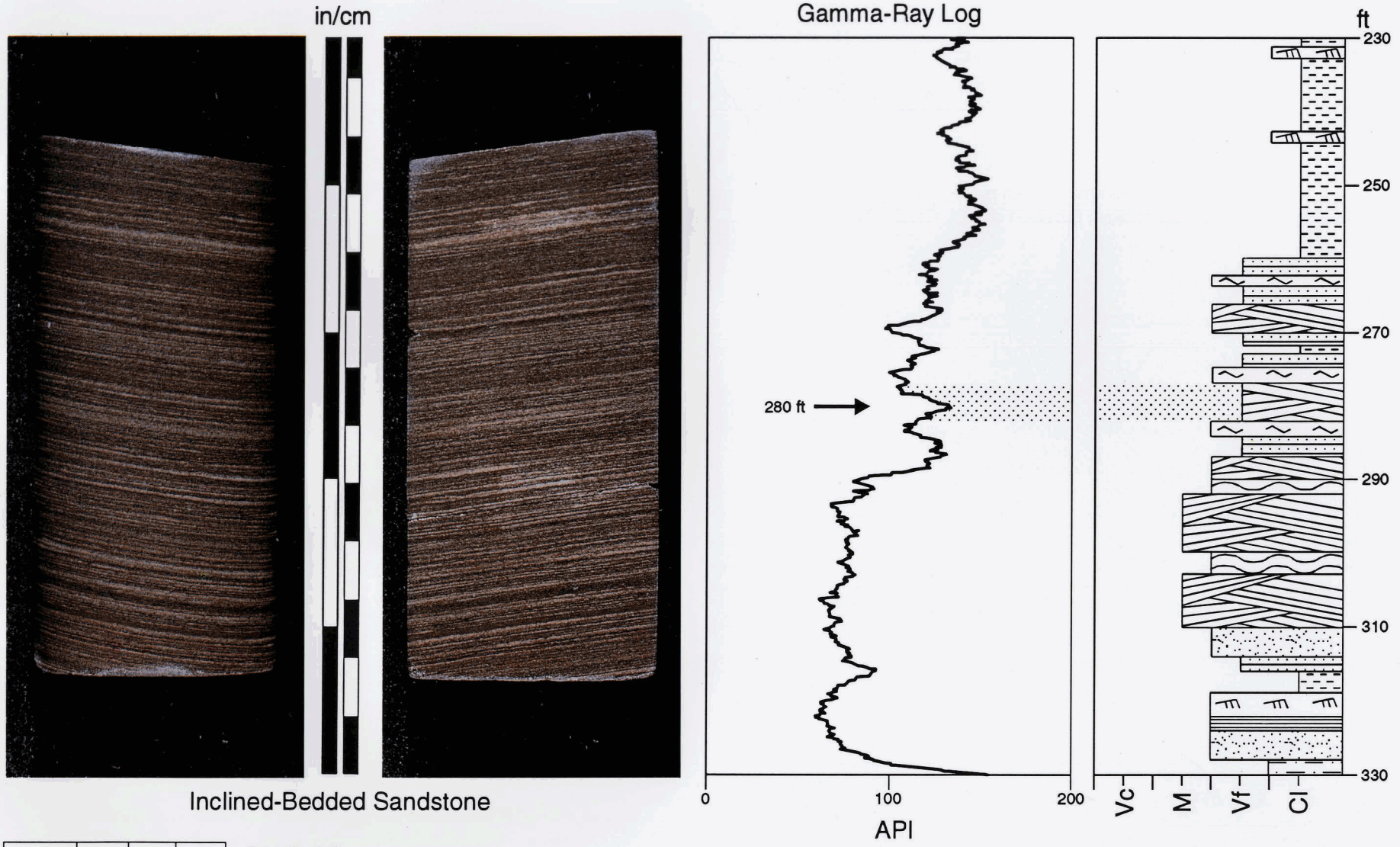
**Fossils:** None observed

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

The sharp contact of the cross-bedded sandstone with the underlying shale results in abrupt decrease in the gamma count and deflection of the gamma-ray curve towards the "clean" sand baseline. The overall constant grain size of the cross-bedded sandstone and associated ripple-bedded sandstone results in a cylindrical gamma-ray well-log signatures for the interval from 15 to 30 ft.


Map showing area of Pennsylvanian rocks and location of corehole.

Indiana Geological Survey SDH-327
Sec. 18 - T1S - R9W
Gibson County, Indiana




Inclined-Bedded Sandstone

**Ss | x | z | 4** [561]

| Ss | x | z | 4 |
|---|---|---|---|

**I. NAME:** Inclined-bedded sandstone
**Formation:** Petersburg

**II. DESCRIPTION:**

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

**Composition:** **Sand** – quartz with silica, kaolinite and siderite cement; abundant fine-grained carbonaceous material along bedding planes

**Sedimentary structures and features:** Low-angle cross-bedding

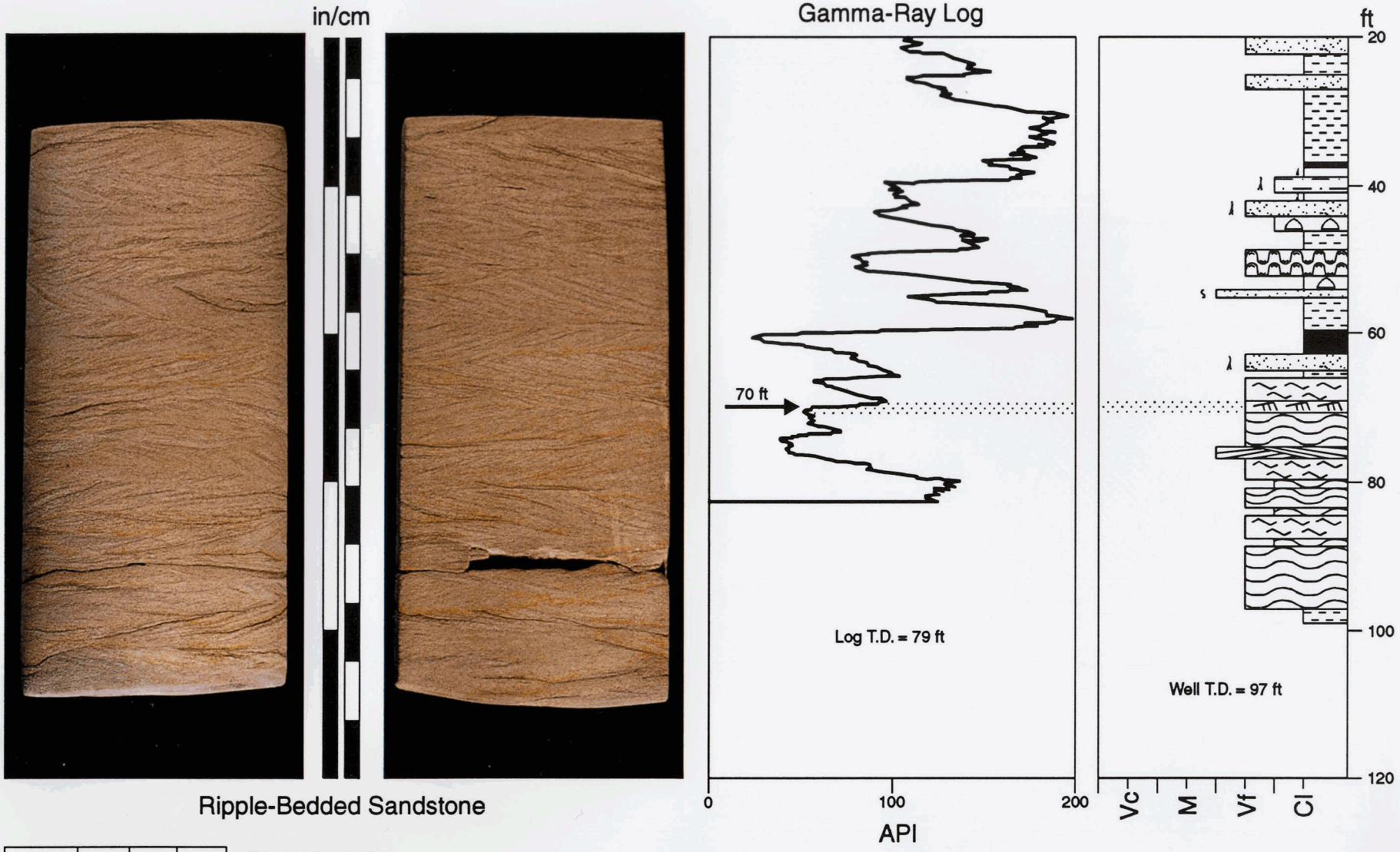
**Fossils:** None observed

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

From the base of the columnar profile to the top of the sandstone-dominated succession (261 ft), the gamma-ray well-log shows a well-developed bell-shaped signature.


Map showing area of Pennsylvanian rocks and location of corehole.

NSWC Crane WES-10C-35
Sec. 5 - T5N - R3W
Martin County, Indiana




Ripple-Bedded Sandstone

**Ss | r | z | 1** [553.5]

| Ss | r | z | 1 |
|---|---|---|---|

**I. NAME:** Ripple-bedded sandstone
**Formation:** Mansfield

**II. DESCRIPTION:**

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

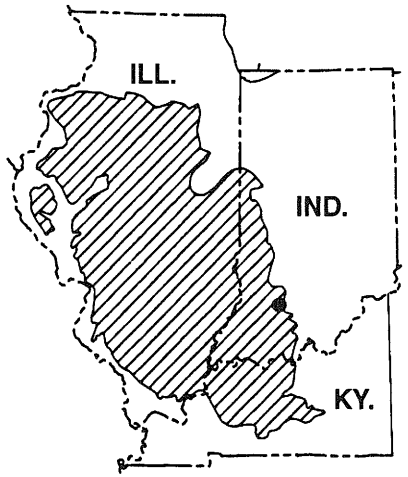
**Composition:** **Sand** – quartz with silica and kaolinite cement

**Sedimentary structures and features:** Ripple bedding, herringbone cross-bedding

**Fossils:** None observed

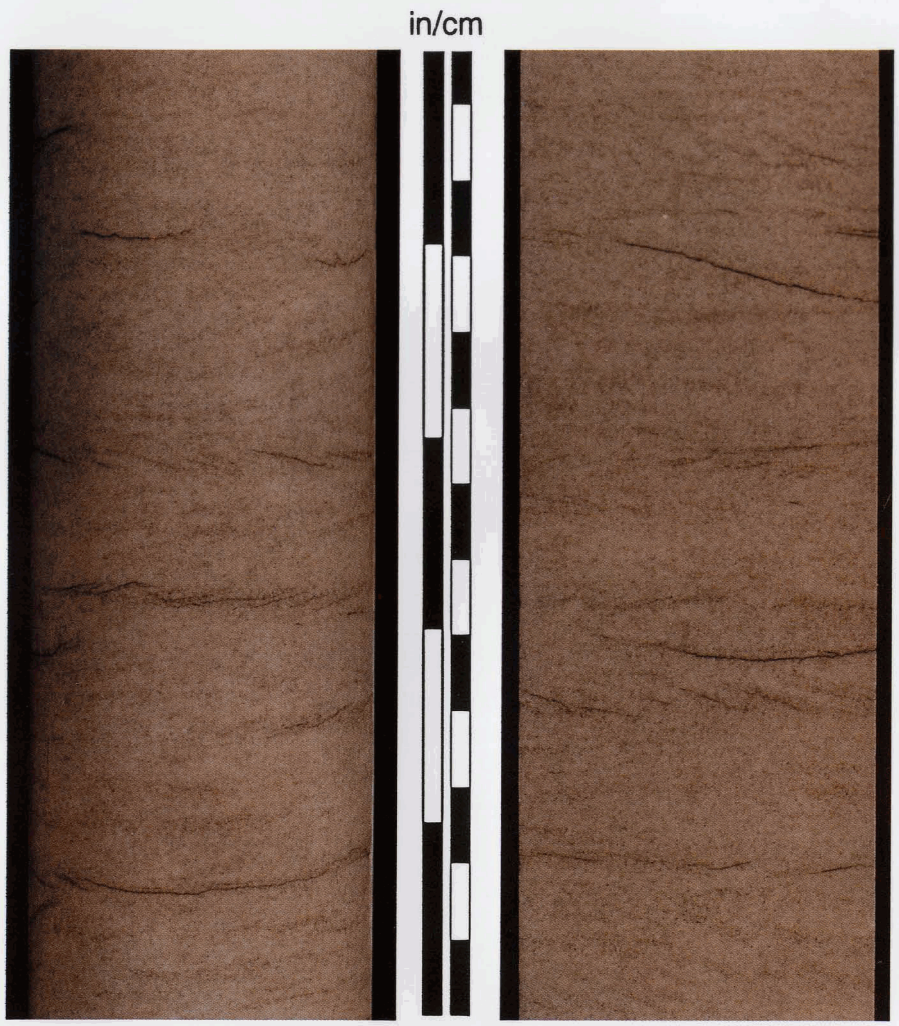
**III. GAMMA-RAY WELL-LOG CHARACTERISTICS:**

The ripple-bedded sandstone facies has a relatively low clay content. Therefore, the gamma-ray well-log reads near the "clean" sand baseline. The presence of associated wavy bedding and flaser bedding with higher clay content results in an irregular gamma-ray well-log signature.

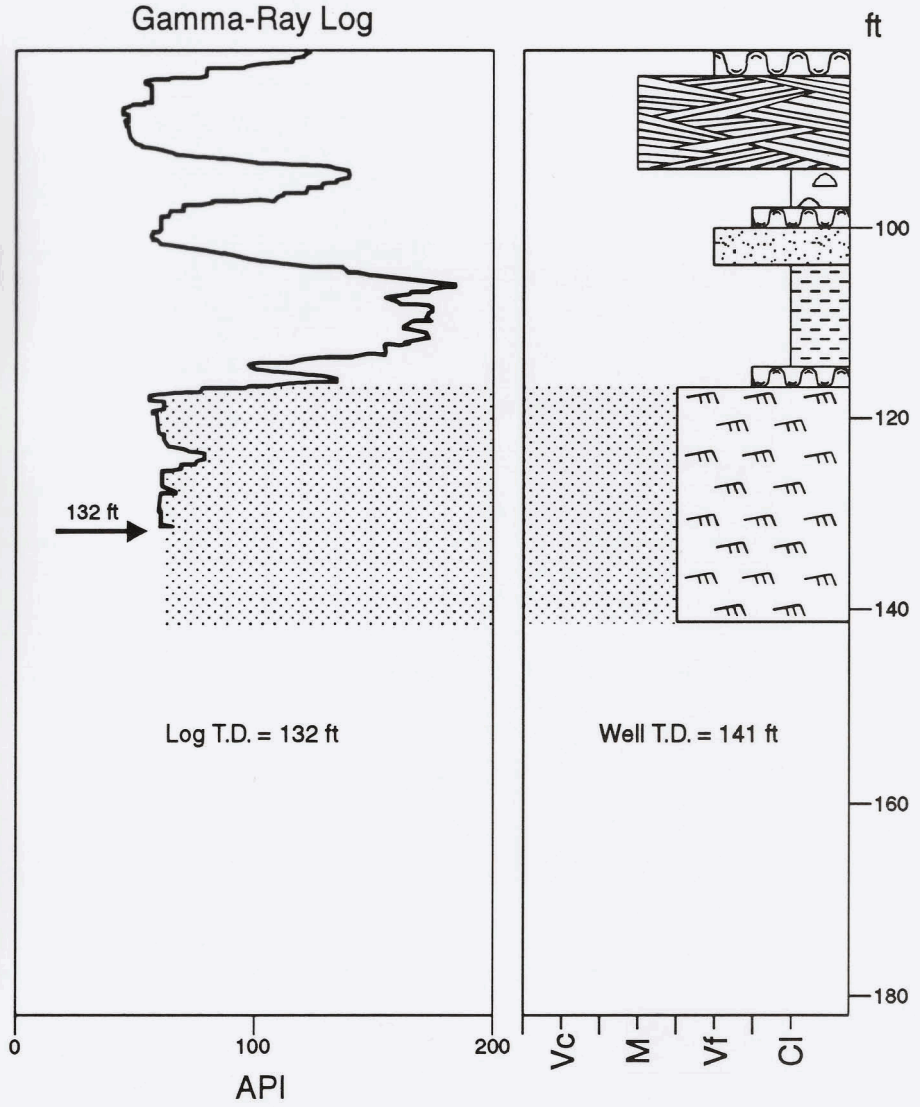



Map showing area of Pennsylvanian rocks and location of corehole.

Illinois State Geological Survey COGEOMAP E-2
Sec. 8 - T11S - R6E
Pope County, Illinois




Ripple-Bedded Sandstone




| Ss | r | z | 2 | [553.5] |
|---|---|---|---|---|

| Ss | r | z | 2 |
|---|---|---|---|

**I. NAME:** Ripple-bedded sandstone
**Formation:** Tradewater

**II. DESCRIPTION:**

**Texture:** **Sand** – fine- to very fine-grained (0.0625 - 0.250 mm) subangular to subrounded

**Composition:** **Sand** – quartz with silica and kaolinite cement

**Sedimentary structures and features:** Ripple bedding

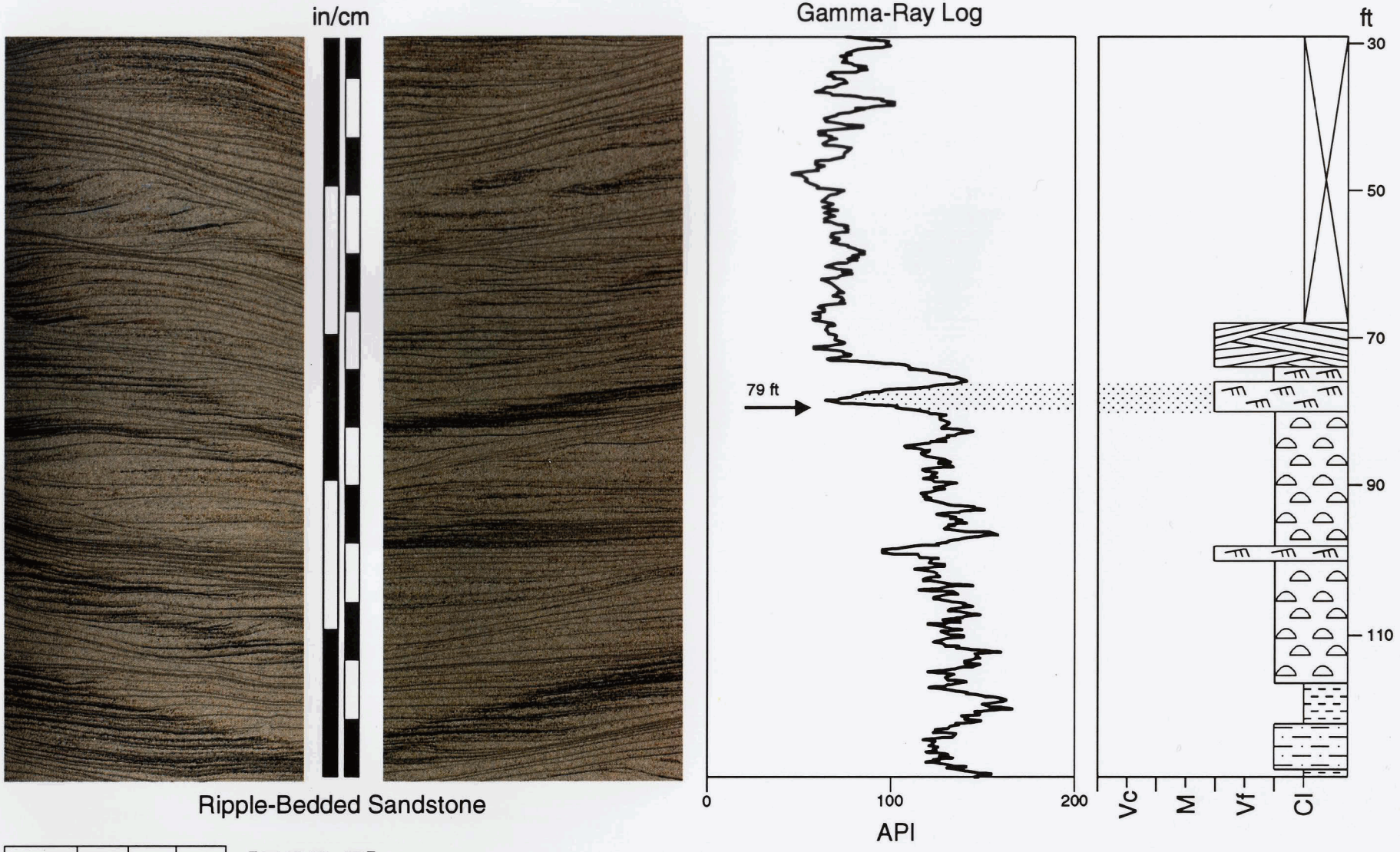
**Fossils:** None observed

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

This facies contains very little clay-sized material, therefore, the gamma-ray well-log reads at or near the "clean" sand baseline. The relatively rapid change from ripple-bedded sandstone to the overlying shale results in an abrupt deflection towards the shale baseline. The lack of well-log information below 132 ft makes the gamma-ray log signature across the ripple-bedded facies uncertain.


Map showing area of Pennsylvanian rocks and location of corehole.

Shot Point Services EIBIND-9
Sec. 3 - T1S - R9W
Pike County, Indiana




Ripple-Bedded Sandstone

**Ss | r | z | 3** [553.5]

| Ss | r | z | 3 |
|---|---|---|---|

**I. NAME:** Ripple-bedded sandstone
**Formation:** Shelburn

**II. DESCRIPTION:**

**Texture:** **Sand** – fine-grained (0.125 - 0.250 mm) subangular to subrounded
**Clay** – (less than 0.0039 mm)

**Composition:** **Sand** – quartz with silica, siderite, and kaolinite cement
**Clay** – unknown

**Sedimentary structures and features:** Climbing ripples and rhythmic bedding

**Fossils:** None observed

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

The increase in the sand/shale ratio from the interlaminated sandstone and shale facies to the ripple-bedded sandstone facies represented by the sample results in a leftward deflection of the gamma-ray curve towards the "clean" sand baseline. The lack of an upward-fining or an upward-coarsening trend from the base of the columnar profile to the top of the ripple-bedded sandstone results in an irregular gamma-ray well-log signature.


Map showing area of Pennsylvanian rocks and location of corehole.