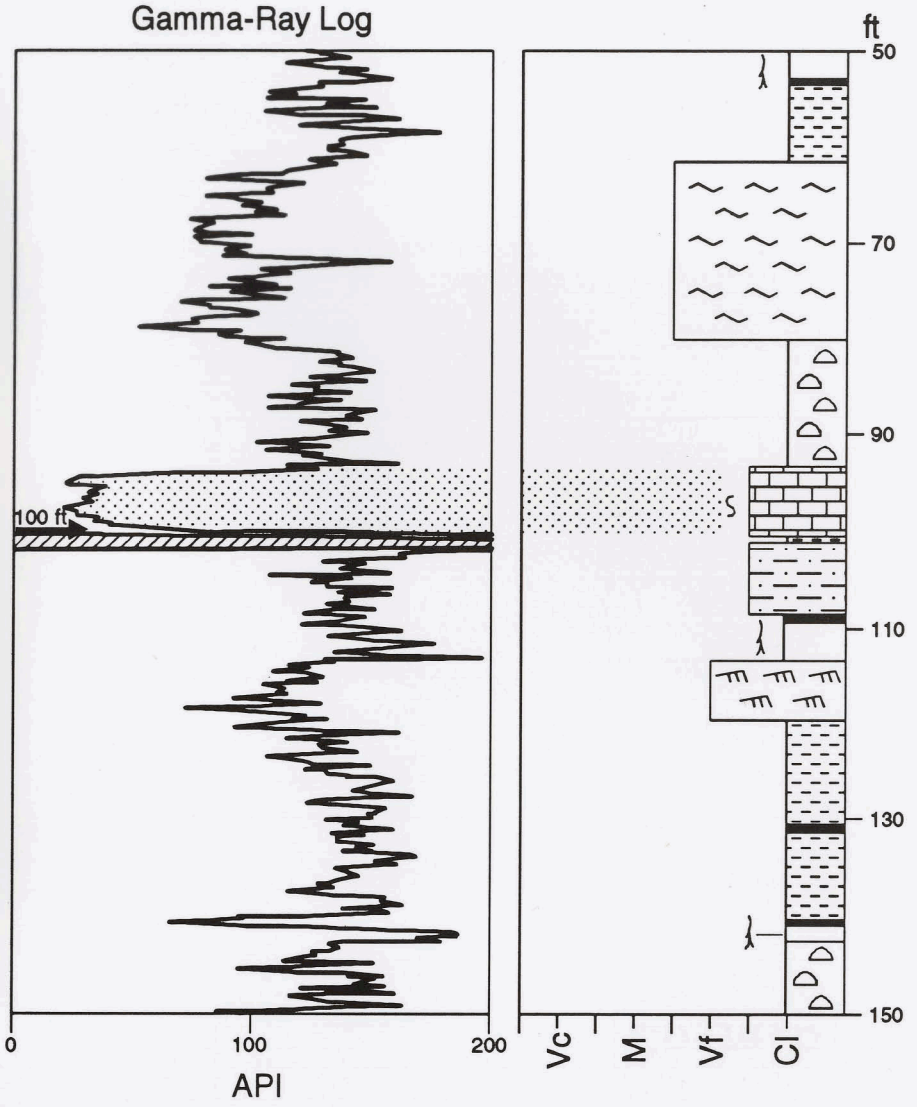
Borehole No. 555
Sec. 16 - M- 21
Webster County, Kentucky

Bioturbated Massive Packstone (Limestone)



Cp m b 1 [998]

Cp	m	b	1

I. NAME: Bioturbated massive packstone (Limestone)

Formation: Bond

II. DESCRIPTION:

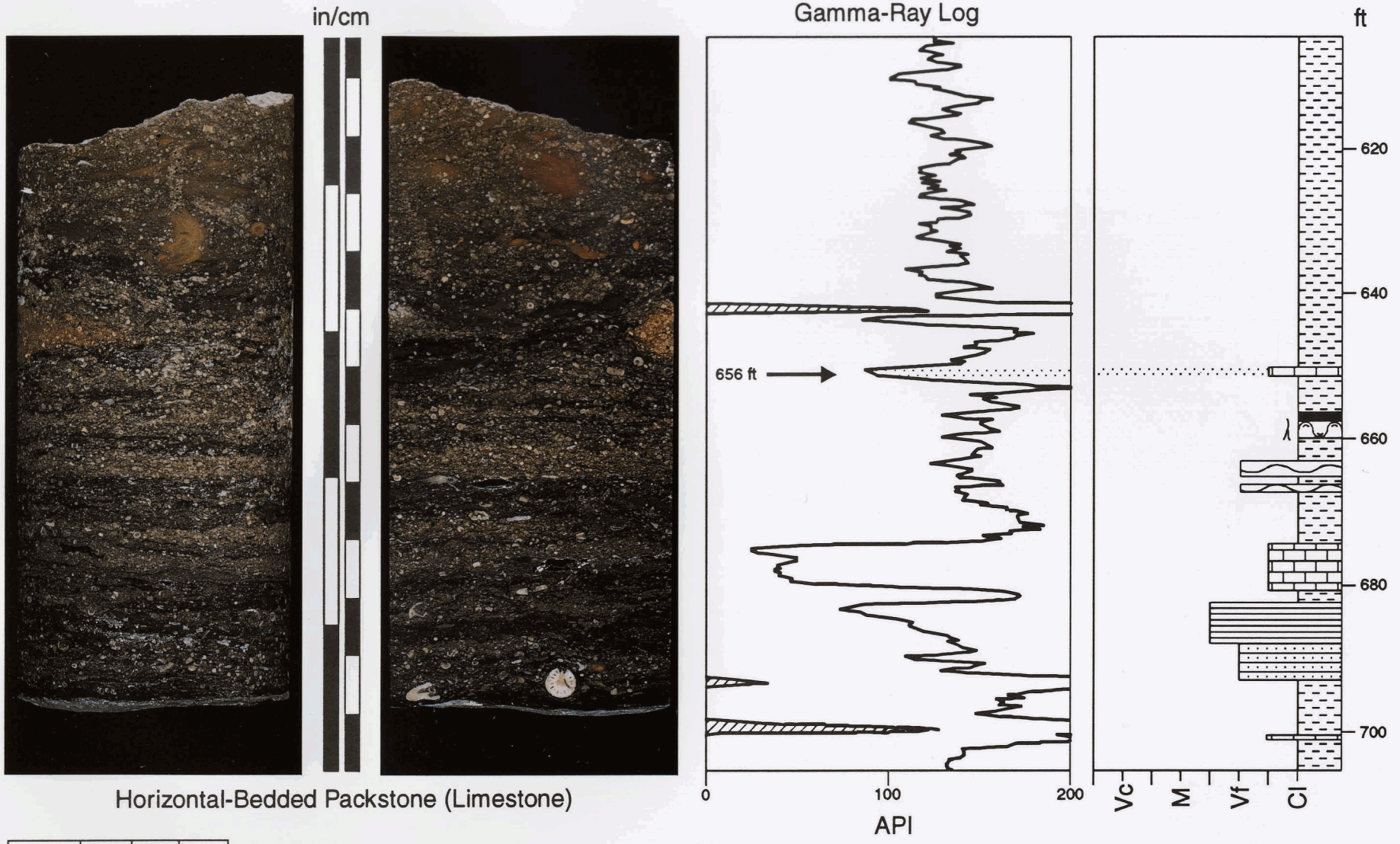
Bioturbated skeletal packstone with estimated 80 to 85 percent skeletal grains consisting of crinoids, brachiopods, and foraminifera.

III. GAMMA-RAY WELL-LOG CHARACTERISTICS:

The columnar profile shows a vertical succession consisting of abruptly alternating lithologies of sandstone, shale, limestone, coal, and underclay. The result is an irregular gamma-ray trend.

Map showing area of Pennsylvanian rocks and location of corehole.

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



Horizontal-Bedded Packstone (Limestone)

Cp h f 1 [992]

Cp	h	f	1

I. NAME: Horizontal-bedded packstone (Limestone)

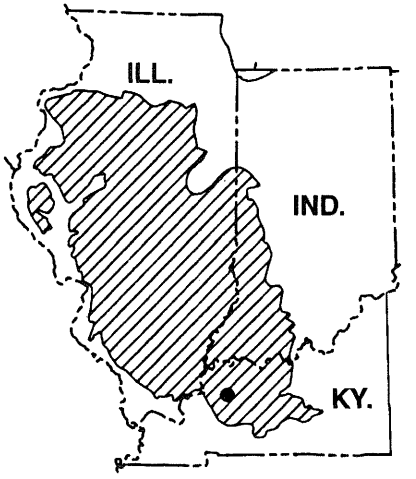
Formation: Patoka

II. DESCRIPTION:

Argillaceous skeletal packstone. Estimated 90 percent skeletal grains made up mostly of echinodermal debris, a minor amount of foraminiferal debris, and one small coral. Minor bioturbation and pyritization of skeletal grains.

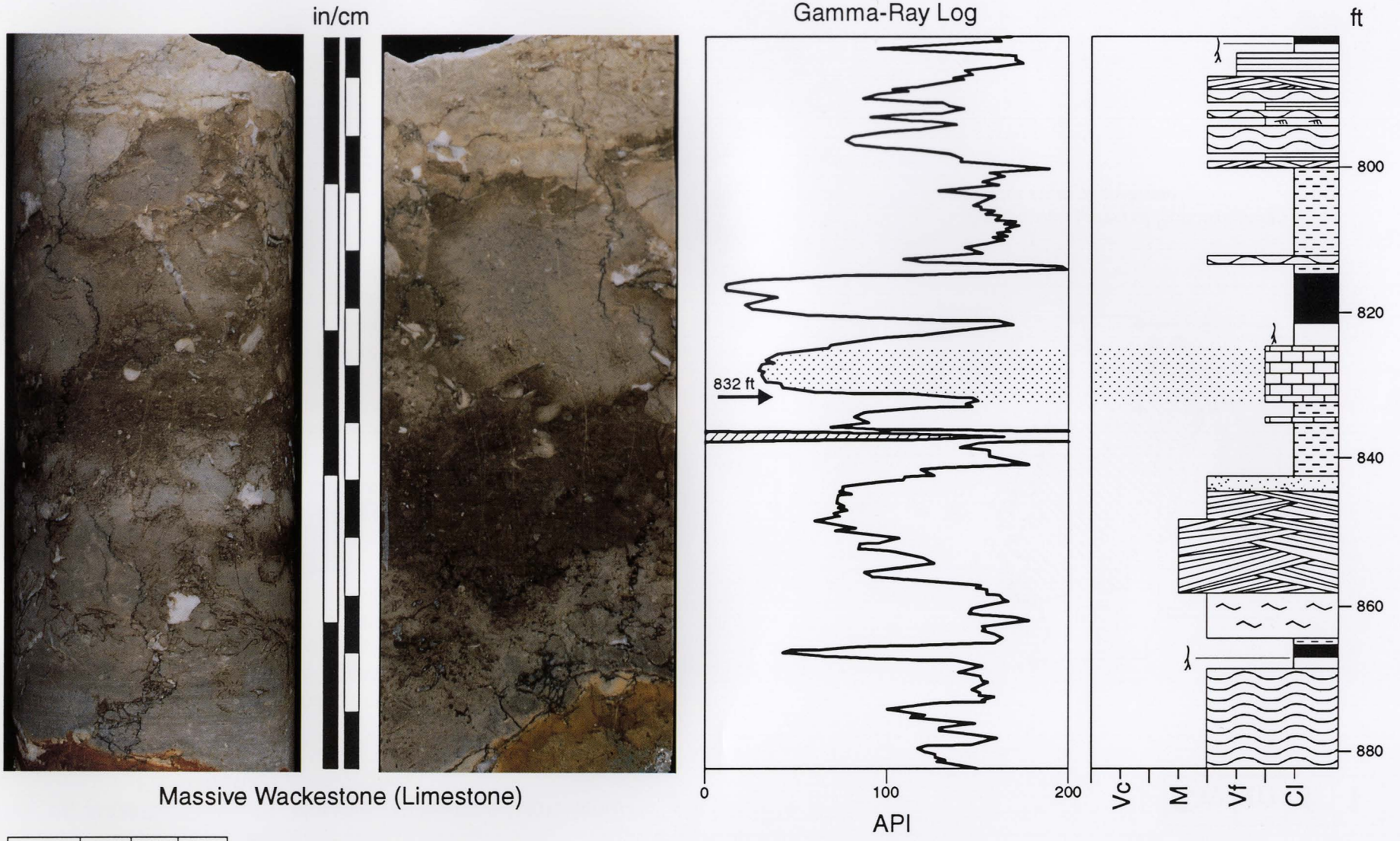
III. GAMMA-RAY WELL-LOG CHARACTERISTICS:

The gamma-ray well-log shows two distinct signatures across the columnar profile. The grain-size increase from the base of the section to the top of the horizontal-bedded sandstone at 683 ft results in an irregular funnel-shaped gamma-ray signature. The relatively constant grain size from the top of the limestone at 675 ft to the top of the columnar profile results in a gamma-ray curve reading at or near the shale baseline. Thinly interbedded limestones, sandstones, coals, and radioactive shales result in an irregular gamma-ray well-log signature.



Map showing area of Pennsylvanian rocks and location of corehole.

Borehole No. 571
Sec. 14 - M - 21
Webster County, Kentucky



Massive Wackestone (Limestone)

Cw m f 1 [997]

I. NAME: Massive wackestone (Limestone)
Formation: Carbondale

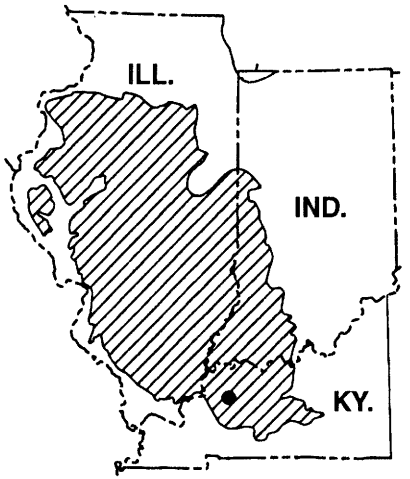
Cw	m	f	1

II. DESCRIPTION:

Slightly argillaceous, nodular, skeletal wackestone. Estimated 40 to 50 percent skeletal grains consisting of echinodermal debris, foraminifera, and possible bryozoan debris. Organic material is abundant in the lower middle part of core sample. Sample is possibly bioturbated or rooted.

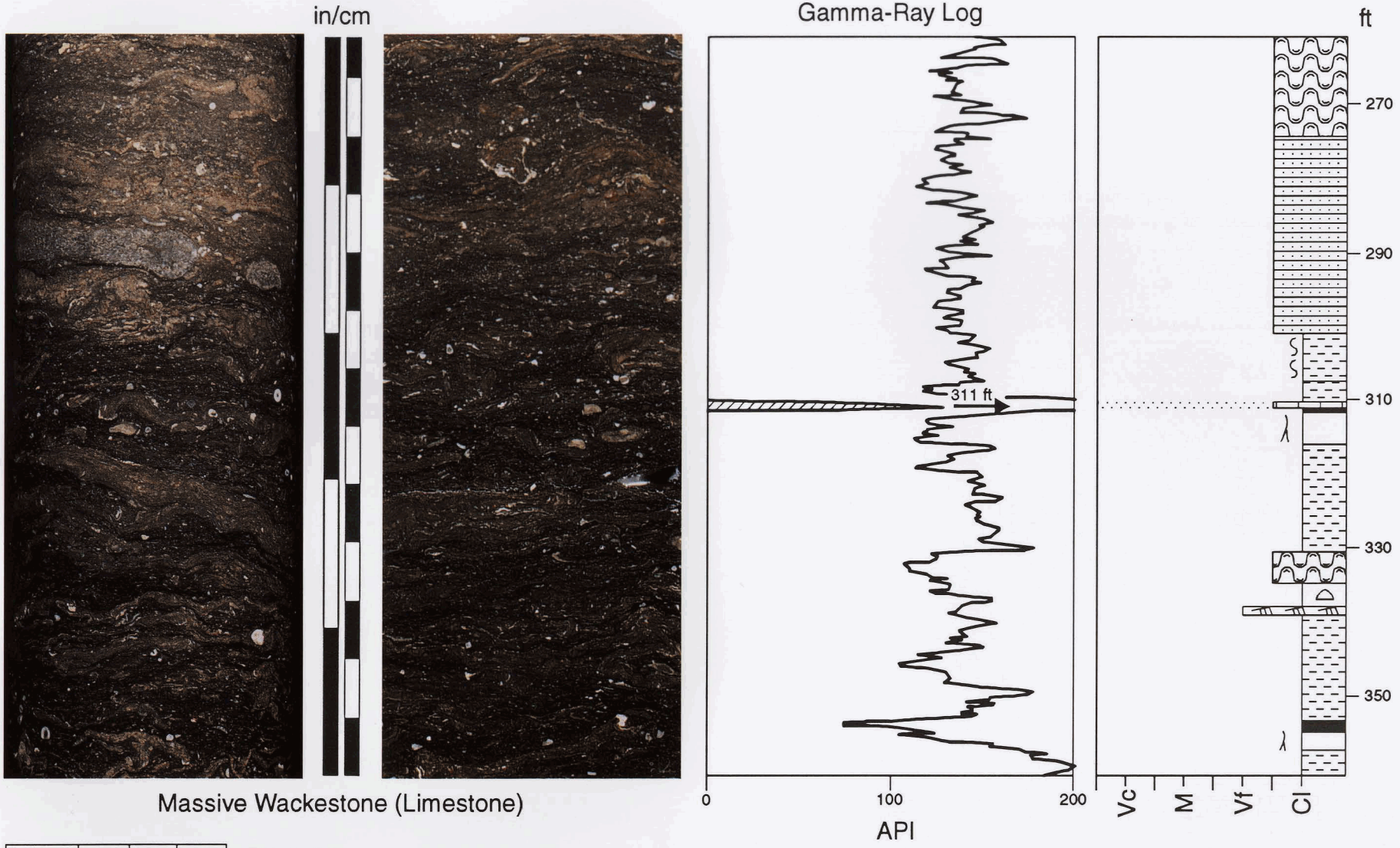
III. GAMMA-RAY WELL-LOG CHARACTERISTICS:

The gamma-ray well-log signature from the bottom to the top of the log displays an irregular gamma-ray signature as a result of abrupt vertical changes in lithology. The presence of limestone, coal, and thin, relatively quartz-rich sandstones result in leftward deflections of the gamma-ray curve, whereas the presence of shales (some of which are radioactive) and underclays result in high API gamma counts.



Map showing area of Pennsylvanian rocks and location of corehole.

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



Massive Wackestone (Limestone)

Cw | m | f | 2 [992]

Cw	m	f	2

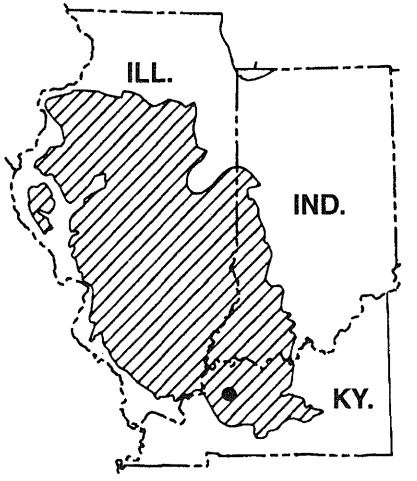
I. NAME: Massive wackestone (Limestone)
Formation: Bond

II. DESCRIPTION:

Argillaceous skeletal wackestone. Estimated 50 to 60 percent skeletal grains which consist of nubecularid foraminifera debris, associated algal material, and echinodermal debris. Abundant organic material.

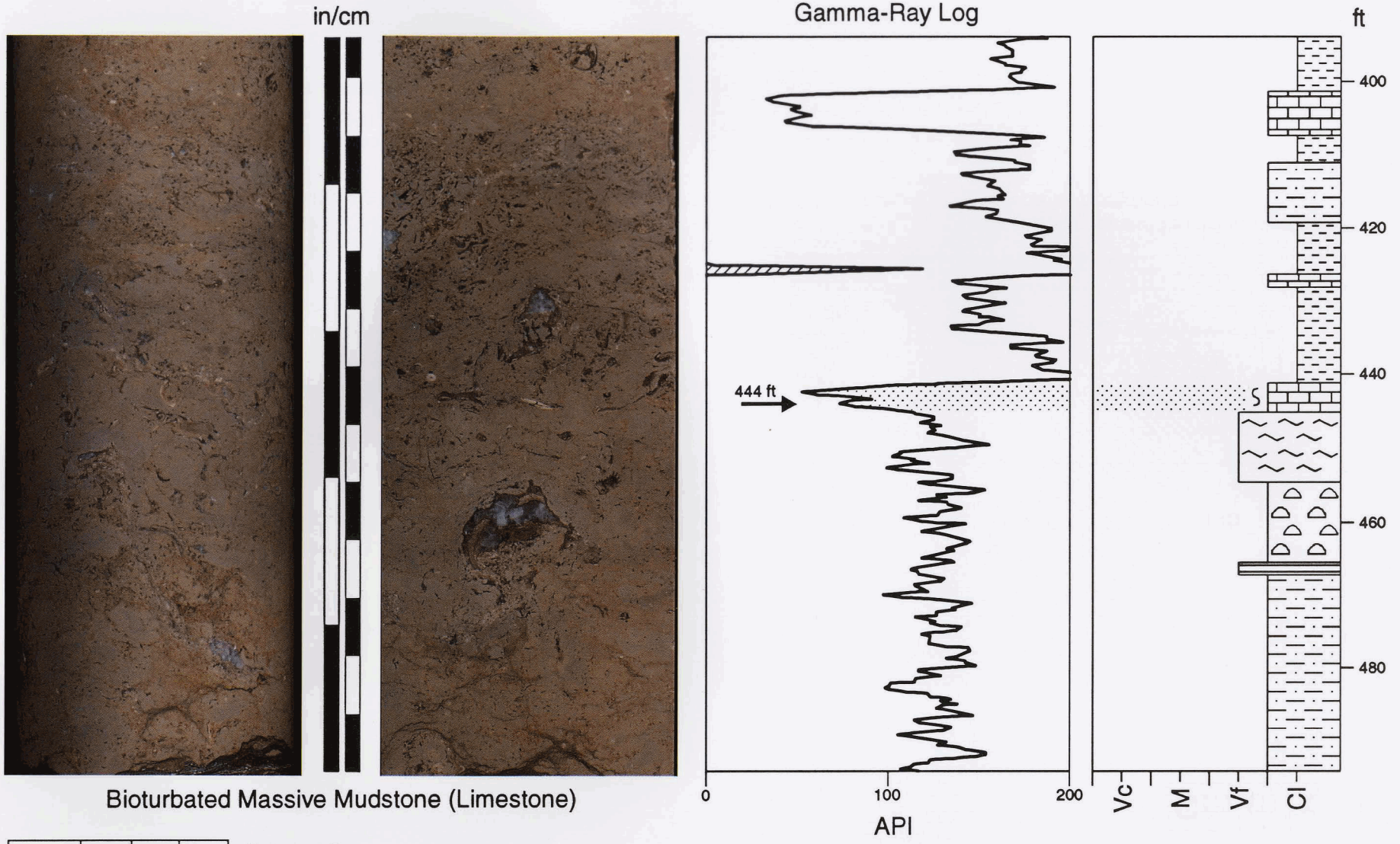
III. GAMMA-RAY WELL-LOG CHARACTERISTICS:

The columnar profile from the base to the top of the succession is dominated by fine-grained shale and siltstone. The result is a gamma-ray well-log curve that reads at or near the shale baseline throughout most of the succession, having no consistent upward-fining or upward-coarsening trend. The gamma-ray well-log signature for the entire succession shown in the columnar profile is best described as irregular. The high gamma-ray spike is due to a thin radioactive black shale directly on top of the limestone.



Map showing area of Pennsylvanian rocks and location of corehole.

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



Bioturbated Massive Mudstone (Limestone)

Cmmb1 [908]

Cm	m	b	1

I. NAME: Bioturbated massive mudstone (Limestone)

Formation: Shelburn

II. DESCRIPTION:

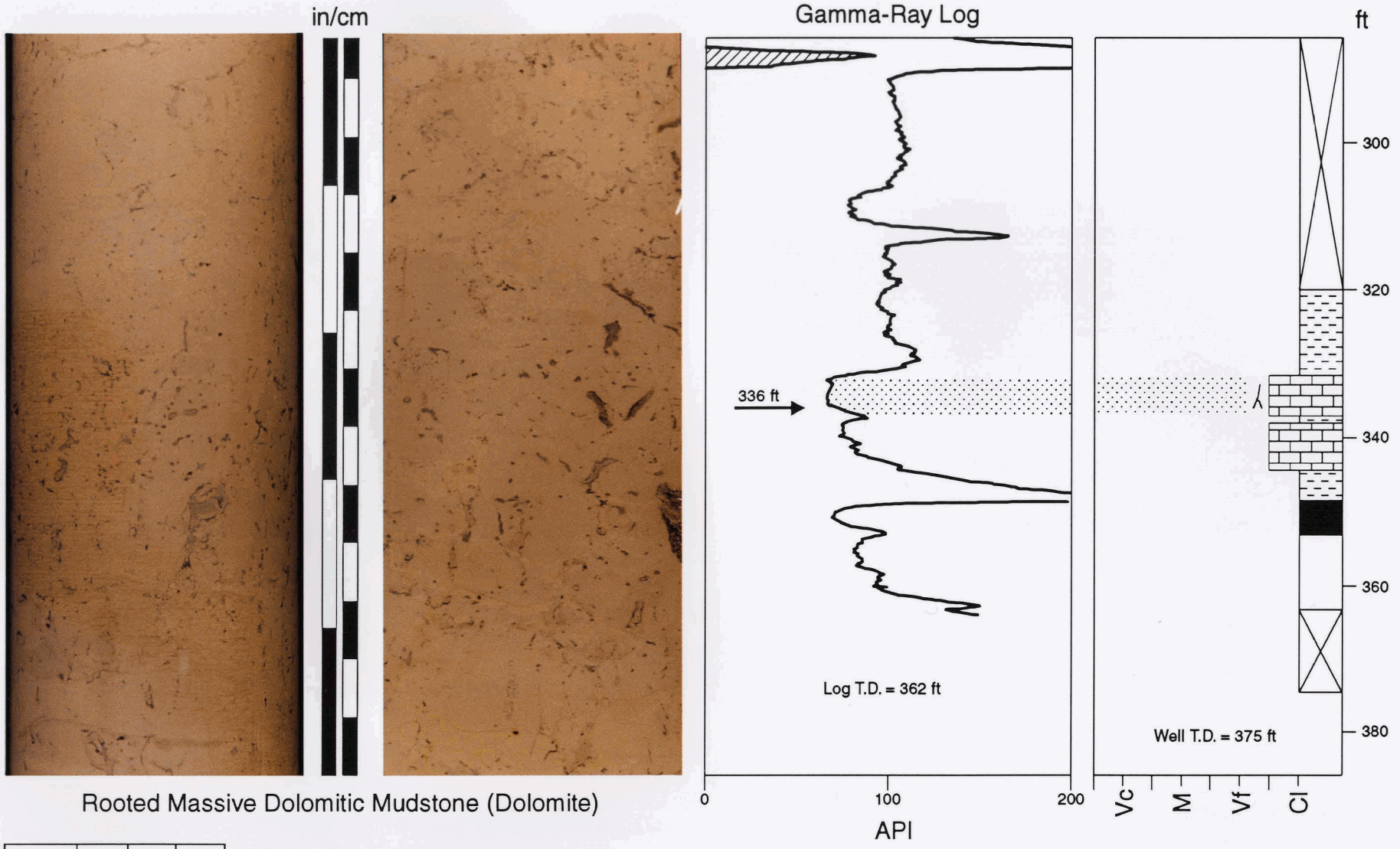
Mottled, bioturbated, and possibly rooted skeletal (lime) mudstone having a clotted texture. Skeletal grains are less than 10 percent, but patches of clear calcite might represent recrystallized skeletal material. Skeletal material consists of foraminiferal debris, some of which is observed lining burrows, and minor echinodermal debris.

III. GAMMA-RAY WELL-LOG CHARACTERISTICS:

The gamma-ray well-log shows two distinct patterns which correspond to the distinct grain-size shift that occurs above the limestone at 442 ft. From the base of the succession to the top of the limestone (494 ft to 442 ft), the gamma-ray curve reads intermediate between the shale baseline and the "clean" sand baseline in response to this siltstone-dominated interval. From the limestone at 442 ft to the top of the columnar profile, the gamma-ray well-log reads near the shale baseline (with the exception of the limestone at 408 ft to 402 ft) in response to the shale-dominated nature of this interval. The two intervals described both have gamma-ray well-log signatures that are best described as irregular.

Map showing area of Pennsylvanian rocks and location of corehole.

Mobile Oil Corporation MOS-77-11
Sec. 15 - T10N - R6W
Macoupin County, Illinois



Rooted Massive Dolomitic Mudstone (Dolomite)

Cmmr1 [907]

Cm	m	r	1

I. NAME: Rooted massive dolomitic mudstone (Dolomite)

Formation: Carbondale

II. DESCRIPTION:

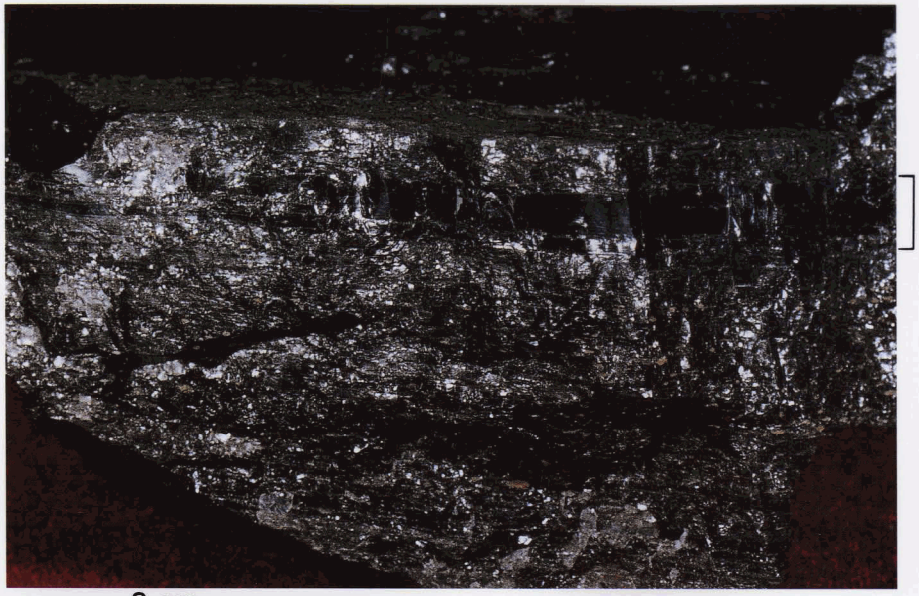
Rooted, dense, dolomitic mudstone with broken texture and fenestral fabric. No organic matter preserved. Finely laminated layer at base of sample.

III. GAMMA-RAY WELL-LOG CHARACTERISTICS:

The gamma-ray well-log from its base at 362 ft to the top of the log reflects the lack of a consistent upward-fining or upward-coarsening grain-size trend as shown by the columnar profile. Leftward deflections in the gamma-ray curve are the result of carbonates or coal being present. The high gamma-ray spikes are probably due to radioactive black shales. The spikes along with the presence of carbonates and coal, combined with the lack of an upward-fining or upward-coarsening grain-size trend, result in a gamma-ray well-log signature that is best described as irregular.

Map showing area of Pennsylvanian rocks and location of corehole.

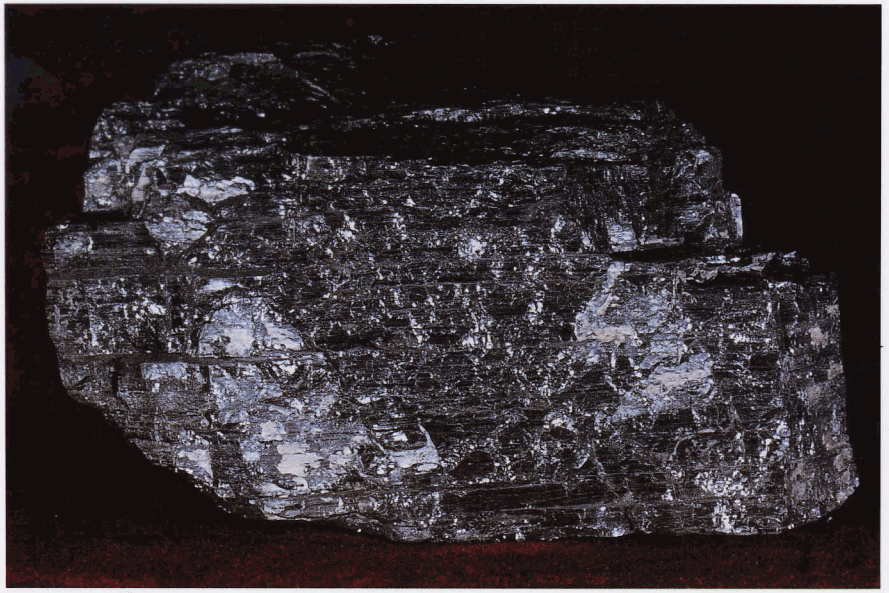
Humic Coal



Bright Coal (Vitrain)

Ov z z 1 [021]

Humic Coal



Banded Coal (Clarain)

Oc z z 1 [021]

Ov	z	z	1

I. NAME: Bright coal (Vitrain)
[Vitrain band is indicated by brackets.]

II. DESCRIPTION:

Black, very bright lustre, usually brittle, thin, and limited lateral extent layers that break cubically. Thick vitrain layers can show conchoidal fractures. After clarain, vitrain is the most widely distributed constituent in humic coals.

III. INTERPRETATION:

Vitrain originates from the wood, bark, and leaves due to gelification processes on a wetland. Its abundance suggests forested wetlands.

Oc	z	z	1

I. NAME: Banded coal (Clarain)

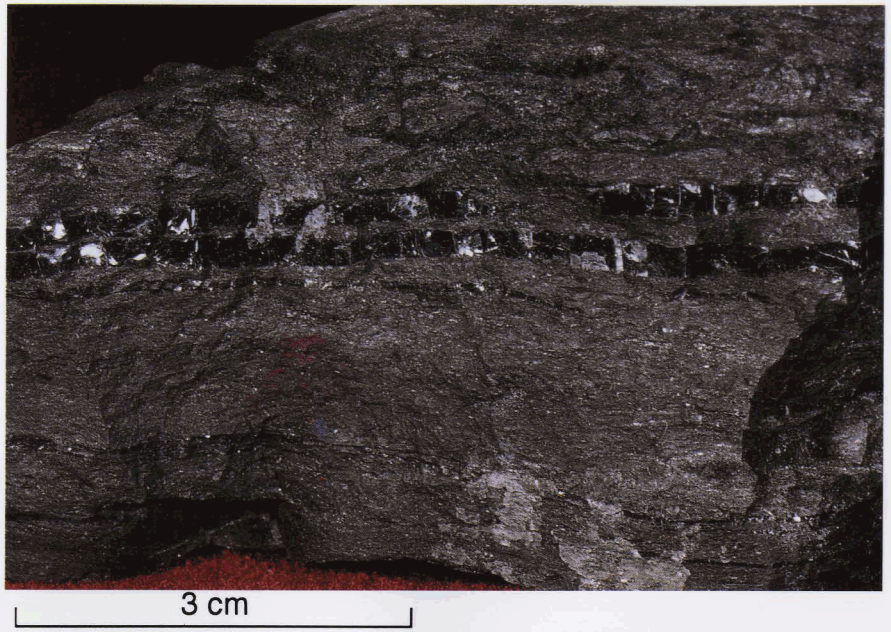
II. DESCRIPTION:

Very finely stratified coal layers having a lustre between that of vitrain and durain. Clarain consists of alternating thin layers of vitrain, durain, and occasionally, a fusain. Clarain is the most common constituent of humic coals.

III. INTERPRETATION:

As a combination of bright and dull layers, it originates from the combination of woody tissues, from more resistent parts such as resins, cuticles, spores, and fusinized material.

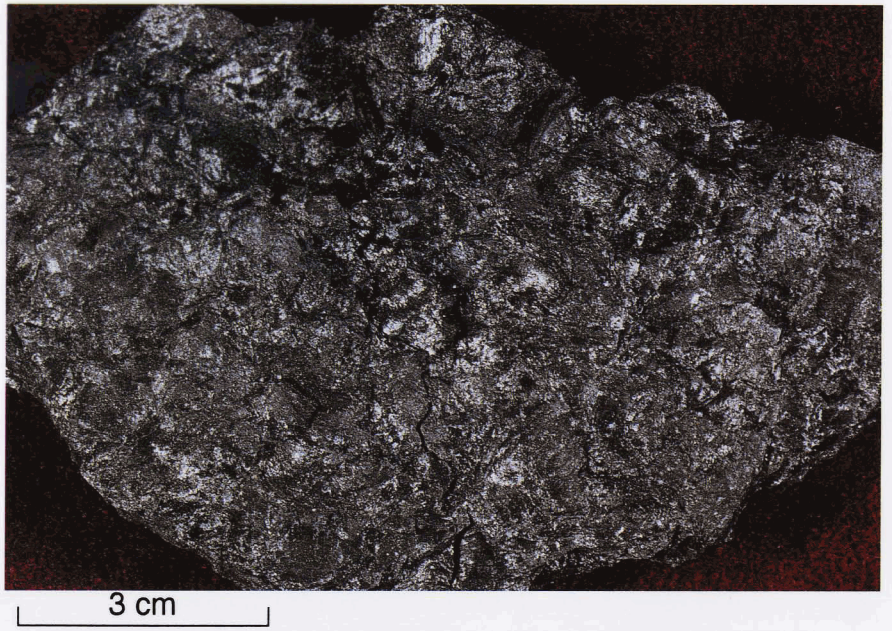
Humic Coal



Dull Coal (Durain)

Od	z	z	1	[024]

Humic Coal



Fusain

Of	z	z	1	[021 fus]

Od	z	z	1

I. NAME: Dull coal (Durain)
[Durain comprises the entire specimen in photograph except for the two bright vitrain bands.]

II. DESCRIPTION:

Gray to brownish-black color and rough surface having a dull or greasy lustre. Durain is usually less fissured than vitrain and usually shows granular fracture with very fine stratification. Durain layers are, in general, thin and laterally persistent and may be enriched in mineral matter.

III. INTERPRETATION:

Durain originates from spores, pollens, and inertinitic constituents that are, in most cases, reworked and transported; therefore, durain usually represents relatively high water level on a wetland. Some durains, however, may form in relatively dry conditions as a result of preferential degradation of less resistant woody material.

IV. REMARKS:

Durains are good marker horizons for correlation and identification of coal seams, therefore their presence, thickness, and position within the seam should be carefully marked.

Of	z	z	1

I. NAME: Fusain

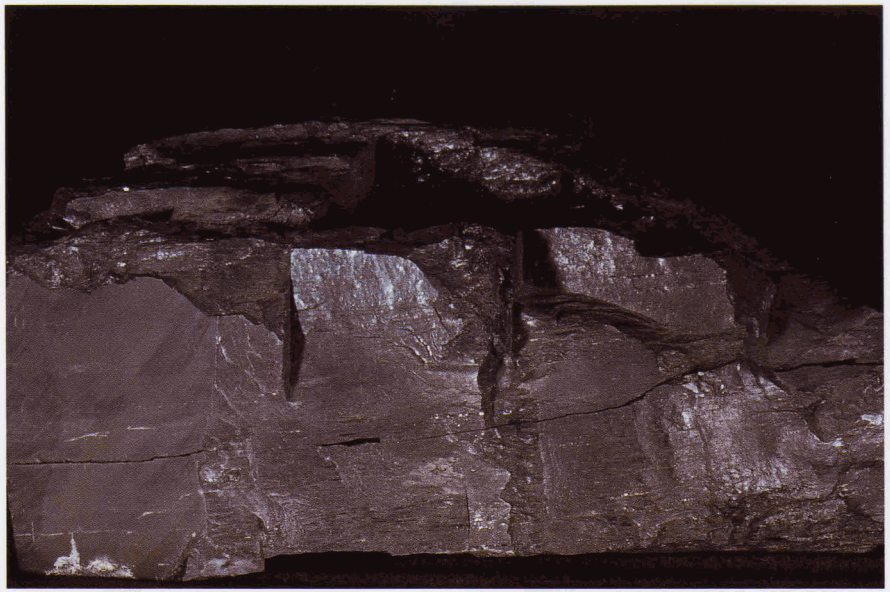
II. DESCRIPTION:

Fusain closely resembles wood charcoal. It has a silky lustre, fibrous structure, and is very soft and friable so that the hands become very dirty if it is handled roughly. (It is the only coal constituent that marks and blackens objects with which it comes in contact). In most coals, fusain is a minor constituent.

III. INTERPRETATION:

Fusain can originate from all parts of plants as a result of rapid enrichment in carbon in a depositional or very early postdepositional stage. Extensive fusain horizons represent wildfire on a wetland. Thin lenses of fusain are most likely also of fire origin; for example, they may be the remains of crown fires. The presence of these *in situ* fusain concentrations suggests subaerial exposure of the peat and seasonality, and testifies against everwet conditions. Fine, dispersed fusain may be transported (washed in or blown) onto the wetland, so no depositional interpretations can be made without more detailed studies.

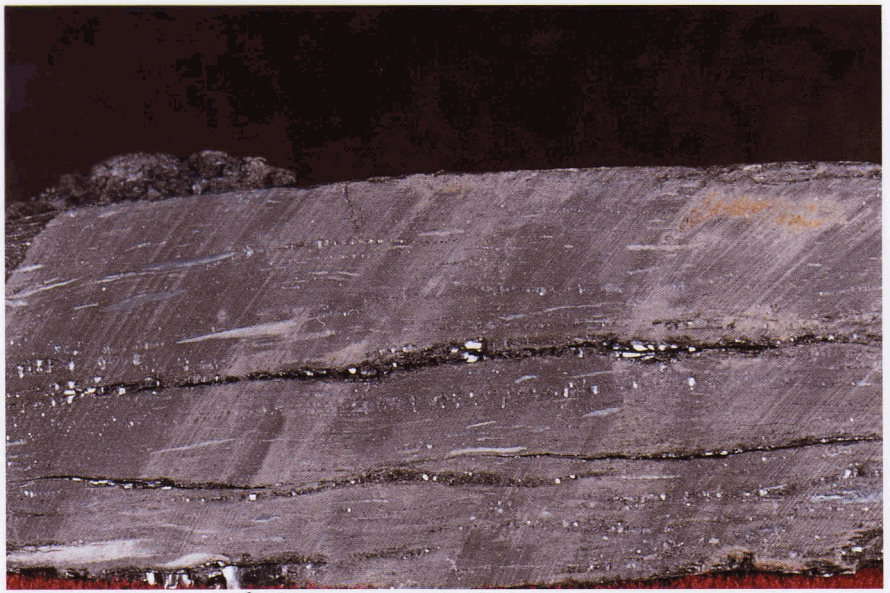
Mixed Organic / Siliciclastic Rocks



Bone (Impure) Coal

Oi	z	z	1	[034]

Mixed Organic / Siliciclastic Rocks



Carbonaceous Shale

Os	z	z	1	[113]

Oi	z	z	1

I. NAME: Bone (impure) coal

II. DESCRIPTION:

Bone coal is a rock that is transitional between coal and carbonaceous shale with regard to the abundance of mineral matter. Megascopically it resembles dull coal, because mineral matter is finely dispersed in a carbonaceous groundmass. It differs from the coal by higher density.

III. INTERPRETATION:

Bone coal represents mixed organic and inorganic deposition, usually in ponds on wetlands. As such, it represents deposition in deeper water than coal, but of a lower energy regime than carbonaceous shale.

IV. REMARKS:

Bone (impure) coal represents change in depositional conditions on a wetland and, therefore, is a valuable marker horizon.

Os	z	z	1

I. NAME: Carbonaceous shale

II. DESCRIPTION:

The term "carbonaceous shale" in this classification applies to a fine-grained rock that has abundant carbonaceous matter. The carbonaceous matter can be dispersed or occur as distinct coaly layers surrounded by fine-grained sediments. Consequently, rocks described as coaly shale or shaly coal will be included in this lithology.

III. INTERPRETATION:

Carbonaceous shale represents mixed organic/inorganic sedimentation and signifies termination of peat deposition. It may reflect drowning of a mire, influx of clastic sediments, increase in subsidence rate, and so on.

IV. REMARKS:

Carbonaceous shale, if occuring as a parting within a coal, is a useful horizon in seam correlation and identification.

Sapropelic Coal

Cannel Coal

Ok	z	z	1

I. NAME: Cannel coal

II. DESCRIPTION:

Black to gray, uniformly dull and compact appearance, the absence of stratification, rather greasy lustre. Typically shows conchoidal fracture (lower left-hand part of the photograph).

III. INTERPRETATION:

Cannel coal is a sapropelic coal. It is deposited as subaquatic muds under more anaerobic conditions than humic coals. This coal is composed of plankton and detritus of water plants, spores washed and blown into the ponds, and reworked terrestrial plants.

IV. REMARKS:

Cannel coal is rare and it occurs as relatively thin and laterally extensive layers. It is very helpful in seam correlation and identification as a marker horizon and therefore its presence, thickness, and location within the seam should be carefully marked.