MARYLAND GEOLOGICAL SURVEY

REPORT OF INVESTIGATIONS NO. 7

KENNETH N. WEAVER, DIRECTOR

GEOPHYSICAL LOG CROSS-SECTION NETWORK OF THE CRETACEOUS SEDIMENTS OF SOUTHERN MARYLAND

By

Harry J. Hansen, III

Prepared in cooperation with the Geological Survey

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GEOPHYSICAL LOG CROSS-SECTION NETWORK

OF THE

CRETACEOUS SEDIMENTS

OF

SOUTHERN MARYLAND

by

Harry J. Hansen, III

ABSTRACT

Deep geophysically logged wells are used to demonstrate the lateral and vertical changes in lithology that characterize the nonmarine Cretaceous sediments of Southern Maryland. The correlation network consists of four cross-sections subparallel to the strike of the Cretaceous formations and 12 cross-sections subparallel to the dip. Correlation is based on geophysical (electric and gamma ray logs) and lithological data; selected well samples were studied palynologically.

This network suggests that *groups of sands,* such as those comprising the Patuxent Formation, can be correlated along strike in the Anne Arundel - Prince Georges County area for distances exceeding 20 miles. This occurrence is not fully compatible with a concept of individually isolated, channel or "shoestring" sands; rather the *sand groups* characteristic of the subsurface Potomac Group approximate the fluvial model of Visher (1965) (i. e., zones of blanket sands which are broadly correlative).

Sand counts indicate that both the Patuxent and the Raritan(?)-PatapscoFormation (undivided) exhibit a southerly decrease in sand percentage. In the Anne Arundel-northern Prince Georges County area these formations contain greater than 45 percent sand; in Charles County sand percentages characteristically are less than 30 percent. The mottled clays associated with these sediments change from predominantly red-brown in the north to predominantly gray-green in the south.

In the absence of core samples electric logs may be used to identify the different types of sediments associated with fluvial deposition. Ideally, a meander sequence exhibits a resistivity curve having a sharply defined erosive base overlain by a fining-upwards cycle of inchannel and point bar sediments. Capping this sequence are fine-grained deposits, the product of overbank sedimentation.

INTRODUCTION

The purpose of this report is to document the subsurface distribution of the Cretaceous sediments of Southern Maryland. To accomplish this a stratigraphic cross-section network was prepared showing the areal variations in thickness and facies that characterize these sediments; for the first time in the Southern Maryland area geophysical logs(electric and gamma ray) are used to illustrate vertical and horizontal changes of lithology. In addition several generalized structure-contour and sand-percentage maps are included to supplement the stratigraphic relationships shown on the cross-section network.

Primarily, the cross sections and maps were prepared for use in ground-water oriented studies. By documenting the occurrence of aquifers, both depthwise and areally, it is believed that more realistic water-management decisions can be made. In addition, the exploration for new, deeper sources of ground water should be benefited because the subsurface data contained in this report will enable more reasonable projections of the geohydrology from areas where conditions are known to areas where deeper subsurface information is limited or absent.

Acknowledgments

The writer wishes to thank K. N. Weaver (Director), E.T. Cleaves, and J. D. Glaser of the Maryland Geological Survey; and W.F. White, E.G. Otton and G. DeBuchananne of the U. S. Geological Survey (Water Resources Division) for their support and suggestions during the preparation of the manuscript. The figures were drafted by Catherine Manly and Anna Adamski; the manuscript was typed by J. Elizabeth Smith.

THE CORRELATION CROSS-SECTION NETWORK

Sources of Unpublished Data

Most of the electric logs used in this report were obtained from the following well drilling companies: Layne-Atlantic Co., Sydnor Hydrodynamics, Inc., Gulfstan Co., and Shannahan Artesian Well Co. All of the gamma ray logs were made by the U. S. Geological Survey. Table 1 summarizes the record of the wells used in the correlation network; only references are cited for wells having records already published.

In areas where geophysical logs were not available, well logs were used in constructing the cross-section network. The well logs used in the correlation network are contained in the Appendix of this report; for those already in print, references are cited.

Sources of Published Data

The Southern Maryland area has been the subject of a continuing series of ground-water investigations. While basically water-resources oriented, these studies have contributed valuably to the understanding of the subsurface geology. The reports can be conveniently divided into two groups, those published prior to 1956 and those published after. Beginning in 1948 a series of county reports were published by the Maryland Department of Geology, Mines and Water Resources[1] covering the following areas: Charles County (Dryden and others, 1948), Anne Arundel County (Brookhart and others, 1949), Calvert County (Overbeck and others, 1951), Baltimore Industrial Area (Bennett and Meyer, 1952), Prince Georges County (Meyer *in* Cooke and others, 1952), and St. Marys County (Ferguson and others, 1953). This series of investigations was culminated in 1955 when E. G. Otton published "Ground-Water Resources of the Southern Maryland Coastal Plain". This work synthesized all of the geohydrologic information that was then known of the area and has been since its publication, a very useful source of subsurface geologic data.

Beginning in 1962 a series of reports were published that were primarily intended to examine quantitatively the supply and demand conditions

1/ The name of this agency was changed to the Maryland Geological Survey in July 1964.

TABLE 1. SELECTED RECORD OF WELLS USED IN THE CORRELATION NETWORK

County or City	Well Number	State Permit Number	Owner	Driller or Logger	Date	Total Depth (feet)	Cross section	Geophysical Log Type	Geophysical Log Scale 1/
ANNE ARUNDEL	AA-Ac 14	(See Otton, 1955, p. 192, 248)					C-C′ Z-Z′	None	
	AA-Ac 60	AA-66-W-326	Parkway Industrial Center	Layne-Atlantic Co.	10/65	186	D-D′ Z-Z′	Electric	R = ?
	AA-Ad 11	(See Brookhart, 1949, p. 56, 87)					B-B′ Y-Y′	None	
	AA-Ad 29	(See Brookhart, 1949, p. 58, 89)					C-C′ Y-Y′	None	
	AA-Ad 43	(See Otton, 1955, p. 194, 250)					B-B′ Z-Z′	None	
	AA-Ad 87	39,464	Anne Arundel Dept. Public Works	Layne-Atlantic Co.	6/60	249	C-C′ Y-Y′	Electric	R = 25
	AA-Ae 35	45,409	Manganese Chemical Corp.	Shannahan Well Co.	11/61	567	B-B′	None	
	AA-Bb 21	(See Brookhart, 1949, p. 60, 95)					E-E′ Z-Z′	None	
	AA-Bb 65	47,687	Anne Arundel Dept. Public Works	Layne-Atlantic Co.	7/62	184	F-F′ Z-Z′	Electric	R = 50
	AA-Bc 161	AA-65-W-777	Anne Arundel Dept. Public Works	Gulfstan Corp.	3/65	458	D-D′	Electric	R = 10
	AA-Bd 98	57,226	do.	U. S. Geological Survey (logger)	6/64	625	X-X′	Electric	R = 20
	AA-Be 58	(See Otton, 1955), p. 198)					C-C′ W-W′	None	
	AA-Bf 49	15,772	Charles Missler	Layne-Atlantic Co.	1954	661	D-D′	None	
	AA-Cb 2	35,694	U. S. Army	Layne-Atlantic Co.	12/59	659	F-F′ X-X′	Electric	R = 50
	AA-Cc 78	45,085	Anne Arundel Dept. Public Works	Layne-Atlantic Co.	3/62	916	E-E′ X-X′	Electric	R = 50
	AA-Cc 86	56,079	Crofton Corp.	Gulfstan Corp.	7/64	1,058	F-F′ X-X′	Electric	R = 20
	AA-Cd 43	12,737	Crownsville State Hospital	Shannahan Well Co.	9/53	494	E-E′	Schlumberger electric log	
	AA-Ce 80	38,680	Anne Arundel Dept. Public Works	Layne-Atlantic Co.	5/60	602	D-D′	Electric	R = 50
	AA-Cf 22	(See Otton, 1955, p. 292, 277)					C-C′	None	
	AA-Cf 61	14,758	Anne Arundel Dept. Public Works	Layne-Atlantic Co.	3/54	1,008	D-D′	None	
	AA-Cg 18	AA-66-W-1439	Westinghouse Co.	Layne-Atlantic Co.	5/66	545	D-D′	Electric	R - 25
	AA-Dd 36	41,099	Davidsonville Elem. School	Layne-Atlantic Co.	12/60	344	G-G′	Electric	R = 25
	AA-De 91	41,125	Fred's Drive-In	Layne-Atlantic Co.	11/60	229	E-E′	Electric	R = 50
	AA-De 92	AA-65-W-821	City of Annapolis	Layne-Atlantic Co.	3/65	1,054	E-E′	Electric	R = ?
	AA-Df 79	37,867	U. S. Naval Academy	Layne-Atlantic Co.	2/60	710	E-E′	Electric	R = 10
BALTIMORE CITY	1S4E-19	(See Bennett and Meyer, 1952, p. 212, 316)					A-A′ Z-Z′	None	
	3S5E-30	(See Bennett and Meyer, 1952, p. 236, 329)					A-A′ Y-Y′	None	
	5S3E-46	(See Bennett and Meyer, 1952, p. 278, 396)					Y-Y′	None	
BALTIMORE	Bal.-Gc 18	(See Bennett and Meyer, 1952, p. 278, 396)					B-B′	None	
	Bal.-Gf 10	(See Bennett and Meyer, 1952, p. 280, 400)					A-A′ W-W′	None	
	Bal.-Gf 177	(See Bennett and Meyer, 1952, p. 300, 427)					A-A′	None	
CHARLES	Ch-Bc 61	56,515	Potomac Heights Home owners Assoc.	U.S.Geological Survey (logger)	4/64	875	X-X′	Electric	R = 50
	Ch-Bf 97	29,945	Waldorf Drive-In Theatre	Sydnor Hydrodynamics	3/58	602	W-W′	Electric	R = 10
	Ch-Bf 127	42,571	Charles Co. Sanitary Comm.	Sydnor Hydrodynamics, Inc.	5/61	602	W-W′	Electric	R = ?

TABLE 1. SELECTED RECORD OF WELLS USED IN THE CORRELATION NETWORK (Continued)

County or City	Will Number	State Permit Number	Owner	Driller or Logger	Date	Total Depth (feet)	Cross section	Geophysical Log Type	Geophysical Log Scale 1/
CHARLES	Ch-Bf 131	Ch-65-W-52	St. Charles Utilities	Layne-Atlantic Co.	1/65	935	K-K′ W-W′	Electric	R = 10
	Ch-Cb 8	11,932	U. S. Navy	Shannahan Well Co.	1/53	615	X-X′	Schlumberger electric log	
	Ch-Cd 24	33,114	U. S. Army	Sydnor Hydro-dynamics, Inc.	3/55	1,003	L-L′	None	
	Ch-Ce 35	Ch-65-W-13	Town of La Plata	do	1/65	1,250	L-L′ W-W′	Electric	R = ?
	Ch-De 32	52,502	Am. Telephone & Telegraph Co.	Layne-Atlantic Co.	8/63	759	W-W′	Electric	R = 5
DISTRICT OF COLUMBIA	D. C. -2	(See Otton, 1955, p. 246, 306)					I-I′ Y-Y′	None	
	WE-Ca 6		Chesapeake & Potomac Tel. Co.	Washington Pump & Well Co.	3/40	340	J-J′ Y-Y′	None	
	WW-Cc 26		Hamilton Hotel	Washington Pump & Well Co.	1935	85	J-J′ Z-Z′	None	
DORCHESTER	Dor-Ce 77	D-65-W-117	U. S. Geological Survey	U. S. Geological Survey (logger)	7/65	1,488	E-E′	Electric Gamma ray	R = 50
PRINCE GEORGES	PG-Ad 14	(See Cooke, 1952, p. 128, 227)					G-G′ Z-Z′	None	
	PG-Bc 1	(See Cooke, 1952, p. 128, 165)					Z-Z′	None	
	PG-Bc 8	(See Cooke, 1952, p. 128, 166)					H-H′ Z-Z′	None	
	PG-Be 22	52,827	U. S. Fish and Wildlife Service	Layne-Atlantic Co.	8/63	290	G-G′ Y-Y′	Electric	R = 25
	PG-Cc 13	(See Cooke, 1952, p. 134, 229)					I-I′ Z-Z′	None	
	PG-Cd 23	37,401	Nat. Aeronautics and Space Admin.	Layne-Atlantic Co.	2/60	454	I-I′ Y-Y′	Electric	R = 50
	PG-Ce 16	(See Cooke, 1952, p. 138, 230)					H-H′ X-X′	None	
	PG-Ce 39	53,109	Board of Ed. Prince Geo. Co.	Layne-Atlantic Co.	8/63	575	H-H′ X-X	Electric	R = 50
	PG-Cf 53	48,109	Levitt and Sons, Inc.	Sydnor Hydro-dynamics, Inc.	8/62	1,173	G-G′ W-W′	Electric	R = 50
	PG-Dd 3	(See Cooke, 1952, p. 140, 232)					I-I′ X-X′	None	
	PG-Df 34	PG-65-W-98	First Maryland Utilities, Inc.	Sydnor Hydro-dynamics, Inc.	6/65	540	H-H′	Electric	R = 50
	PG-Eb 1	(See Cooke, 1952, p. 144, 197)					J-J′	None	
	PG-Ec 5	(See Cooke, 1952, p. 146, 200)					X-X′	Gamma ray	
	PG-Ec 41	38,527	Wash. Suburban Sanit. Comm.	Layne-Atlantic Co.	4/60	875	J-J′ X-X′	Electric	R = ?
	PG-Ec 48	PG-66-W-64	Md. Nat. Cap. Park & Plan. Comm.	Shannahan Well Co.	2/66	291	None	Electric	R = 25
	PG-Ee 49	Roberts (No. 2)	Wash. Gas Light Co.	Eakle-Holder Drilling Co.	2/55	1,746	I-I′ W-W′	Schlumberger electric log	
	PG-Ee 52	PG-66-W-13	Valley Devel. Co.	Layne-Atlantic Co.	11/65	924	I-I′ W-W′	Electric	R = 25
	PG-Fb 4	(See Cooke, 1952, p. 152, 217)					X-X′	None	
	PG-Fb 13	(See Cooke, 1952, p. 154, 218)					K-K′ X-X′	Gamma ray	
	PG-Fc 31	48,904	Board of Ed. Prince Geo. Co.	Douglas and Dickinson, Inc.	10/62	710	K-K′	None	
	PG-Fd 62	Robinson (No. 3)	Wash. Gas Light Co.	Eakle-Holder Drilling Co.	2/55	1,812	J-J′ W-W′	Schlumberger electric log	
	PG-Hf 23	47,061	Potomac Electric Power Co.	Shannahan Well Co.	5/62	676	J-J′	Electric	R = ?
TALBOT	Tal-Cb 89	(See Rasmussen and Slaughter, 1957, p. 219, 317)					E-E′	Electric	R = 10
	Tal-Ce 62	T-65-W-111	Easton Utilities Comm.	Shannahan Well Co.	3/65	1,099	E-E′	Electric	R = ?
	Tal-De 16	T-65-W-155	U. S. Geol. Survey	Delaware Geol. Survey (logger)	6/65	1,523	E-E′	Electric gamma ray	R = 25
	Tal-De 18	T-66-W-7	U. S. Geol. Survey	U. S. Geol. Survey (logger)	7/65	1,493	E-E′	Electric	R = 50

1/ For electric logs R (Resistivity) scale is measured in ohms

characteristic of the current ground-water situation in Southern Maryland and vicinity. These reports cover the following areas: Anne Arundel County (Mack, 1962), Baltimore area (Otton and others, 1964), Washington, D.C. area (Johnson, 1964), Prince Georges County (Mack, 1966), and Charles County (Slaughter, 1966; 1968).

Method of Construction

The objective during construction of the correlation network was to incorporate as many lithologic, stratigraphic, and hydrologic details as practical in order that the individual plates could be used as "working" illustrations by geologists, engineers, and water-well contractors.

Most of the geophysical logs used in the correlation network were originally recorded at a vertical scale of 1 inch =20 feet. At this scale the logs were too large for effective cross-section work. To facilitate the handling of the logs they were reduced manually by means of a Saltzman projector to a vertical scale of 1 inch =50 feet. Reduction by this method is sufficiently accurate for the intended use of the logs.

The cross sections were originally drawn at a horizontal scale of approximately 1 inch = 1.33 miles. This resulted in a vertical exaggeration of about 1:140. The cross sections were reduced in half for publication. Thus, as presented in this report, the vertical scale is 1 inch = 100 feet and the horizontal scale is approximately 1 inch = 2.7 miles, the vertical exaggeration remaining the same.

Electric Logs

Most of the geophysical logs used in the correlation network are electric logs. An electric log is a dual-curve, graphical plot of resistivity and self-potential versus depth. The curve is obtained by lowering an electrode down the bore hole while simultaneously recording appropriate electrical measurements at the surface. The resistivity curve is essentially a measurement of the resistance per unit volume of the formations penetrated by the well (Bryan, 1950) and is directly related to the nature, quantity, and distribution of the formation water (Guyod, 1957). Typically, clays have low resistivities; brackish water and silty sands, moderately low resistivities; fresh water, silt-free sands, relatively high resistivities; and dense "rock", very high resistivities. Figure 1 shows an idealized electric log run in a bore hole containing fresh drilling fluid.

The amplitude of the resistivity curve (the size of the individual "kicks") is chiefly dependent upon two factors; these are the calibration of the instrument which is preselected by the operator and the bore-hole condition which is a composite of many different factors.

The scale-selector switch on most single electrode logging units varies between 2.5 and 200 ohms. Under the same bore-hole conditions the resistivity "kick" recorded at a 2.5 ohm setting will have a much larger amplitude than a "kick" recorded at 200 ohms (fig. 2). The scale settings for the electric logs used in the correlation network are tabulated in table 1; in some cases these data were not known.

The effect of bore-hole conditions on the absolute amplitude of the resistivity curve is very difficult to evaluate because the data needed for this determination are seldom recorded during the electric logging of a water well. Needed are measurements of the resistivity (or conductivity) of the drilling mud, the temperature of the drilling mud, and the size variation of the bore hole. These factors vary significantly between wells. *Therefore, it must be emphasized that the amplitudes of the resistivity "kicks" shown on the correlation network are not directly comparable.* In other words a strong "kick" on one log does not necessarily mean that the formation is a "cleaner" sand than a lower amplitude "kick" on another log. The qualitative distinction between silt-clay and sand-gravel can be made with confidence. However, quantitative estimates of the silt content of sands, the porosity of sands, and the resistivity of formation waters should not be attempted.

The curve on the left side of an electric log measures the natural electric potentials or voltages

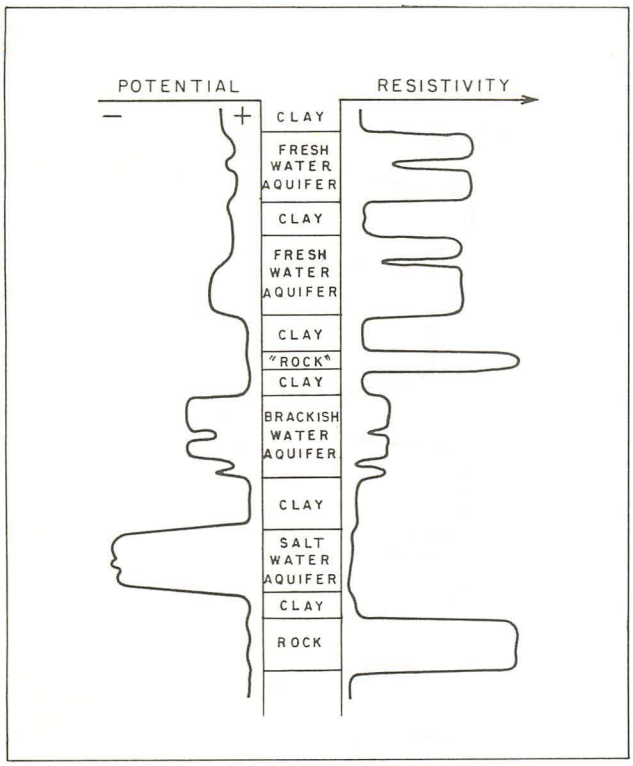

Figure 1. Idealized electric log in a bore hole containing fresh mud (after Guyod, 1957)

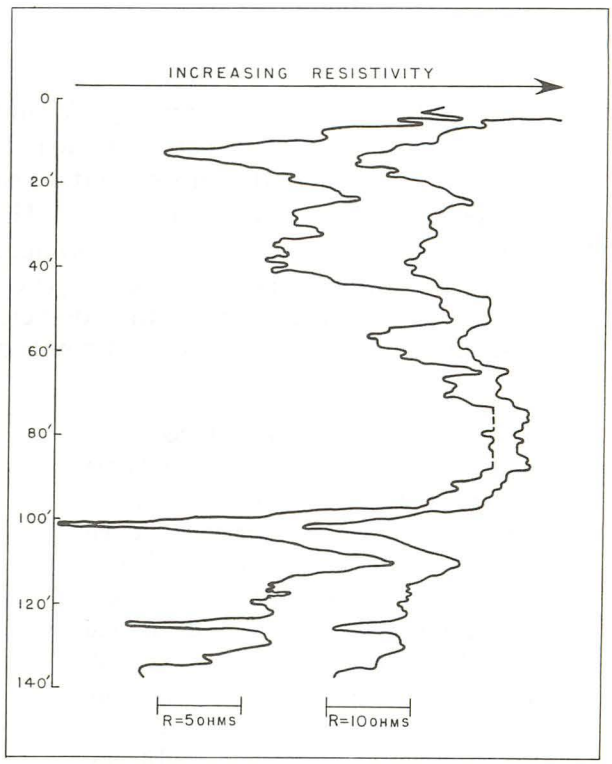

Figure 2. Five ohm and 10 ohm resistivity curves run in the same bore hole

that exist between formations (fig. 1). These potentials, generally called S. P. (self-potential) are measured in millivolts and vary according to the nature of the beds penetrated by the bore hole (Guyod, 1957) (fig. 1).

To quantitatively evaluate an electric log the self potential and resistivity curves should be used in concert (Bryan, 1950). However, for use as a correlation tool in areas where brackish water aquifers are not important, the resistivity curve can be successfully used alone. In the construction of the correlation network this has been done; the self-potential curve was eliminated because its presence in many cases would have unduly cluttered the cross sections.

In order to emphasize the lithic significance of the resistivity curve, the electric logs used in the correlation network are annotated with the standard lithologic symbols. To do this the lithologic spectrum was reduced to four main categories; these are gravel; sand; mixtures of clay, silt, and sand; and clay. The resulting annotation is called a *litho-electric log.*

In most cases the lithologic descriptions used in the correlation network were obtained from drillers' logs (Appendix). As a rule these logs are generalized approximations of the formations penetrated by the bore hole. As a result, the *litho-electric logs* do not in all cases correspond in detail to the drillers' logs contained in the Appendix of this report.

The electric log is used primarily as a correlation tool in this publication. If properly applied, it can be used for other purposes such as estimating the salinity of water-bearing strata. For the reader interested in learning more about the electric logging of water wells, reference should be made to Bryan (1950), Guyod (1957), and Todd (1959, p. 238-248) who provide excellent introductory discussions. A more thorough treatment of the subject is contained in Wyllie (1957), Schlumberger (1958), and Lynch (1962, p. 83-226).

Gamma Ray Logs

Several of the geophysical logs used in the correlation network are gamma-ray logs. A gamma-ray log is a graphical plot of natural radioactivity versus depth. Nearly all sediments exhibit, to some degree, measurable traces of radioactivity. This is due to trace occurrences of uranium, thorium, and the radioactive isotope of potassium. Clays generally have higher radioactivity counts than do "clean" quartz sands. As Lynch (1962, p. 243) points out:

> "The clay minerals formed during the decomposition of igneous rocks have very high absorption and ion exchange capacities. They are therefore able to absorb the heavy radioelements released during the decomposition of other minerals, as well as to hold those originally contained in the feldspars and micas from which the clays are derived. This process results in the unusually heavy concentration of radioelements in shales (clays) as compared to sandstones (sands)."

Gamma-ray logs, unlike electric logs, can be run in cased wells because gamma rays are capable of penetrating cement, steel, and plastic. Thus it is possible to obtain geophysical logs from old wells when their pumps have been removed.

Figure 3 illustrates an idealized gamma-ray log. Radioactivity on the standard gamma-ray log increases from left to right, thus the "kicks" to the right generally represent clays. *Except where noted the gamma-ray logs used in the correlation network have been reversed; as a result, radioactivity increases from right to left.* This was done in order that the clay base line of both the resistivity and gamma-ray logs would be consistently on the left-hand side of the log.

The gamma-ray logs appearing in the correlation network have also been annotated with the standard lithologic symbols. The result is referred to as a *litho-gamma ray* log on the correlation network.

The reader is referred to Lynch (1962, p. 227-267) and Schlumberger (1958, p. 83-101) for a much more thorough discussion of radioactivity logging.

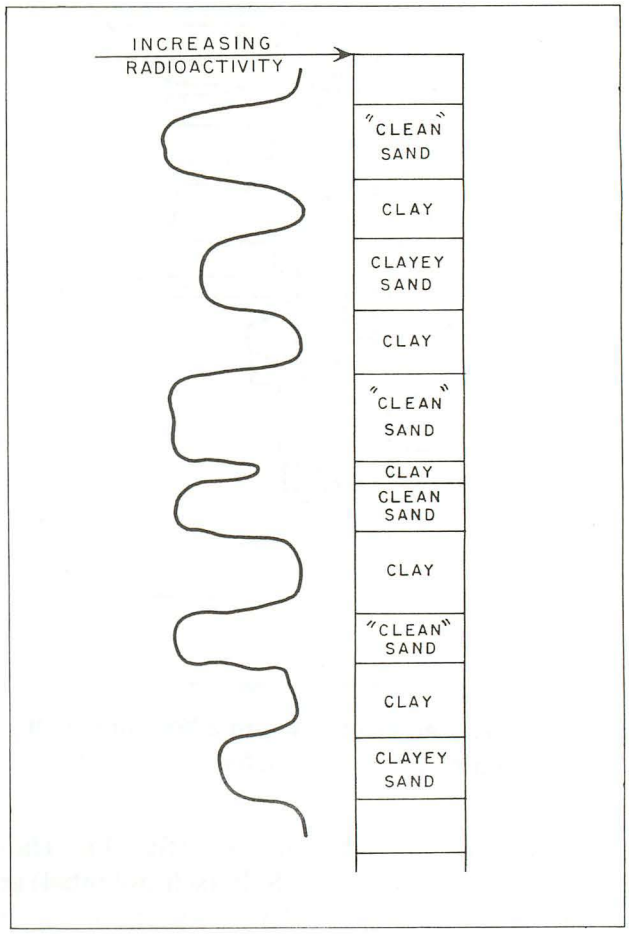

Figure 3. Idealized gamma-ray log.

Lithologic logs

In order to make the correlation network more complete, wells lacking geophysical logs were used in some cases. An attempt was made to select only those wells having adequate sample descriptions. Reference to these wells can be found in table 1 and in the Appendix. This well information is presented diagrammatically in the form of columnar sections that show rock lithologies by the standard symbols. On the correlation network these wells are referred to as *lithologic logs.* Leroy and Low (1954, p. 35-46) discuss the graphical

techniques used in the construction of lithologic logs as well as the broader subject of stratigraphic cross-sections (1954, p. 64-76).

Summary

By using key *litho-electric, litho-gamma ray,* and *lithologic logs* a correlation network was prepared for the Cretaceous sediments of Southern Maryland. Overlying formations of Quaternary and Tertiary age are identified in the cross sections where they constitute a major part of the geologic column.[2] The network consists of four stratigraphic cross sections subparalleling the regional strike of the Cretaceous sediments and twelve stratigraphic cross sections subparalleling the regional dip. Plate 1 is a well-location map of Southern Maryland showing the location of the wells used in the correlation network. Table 2 contains a list by county of localities in or near which the key wells are located.

The twelve stratigraphic cross sections subparalleling the regional dip extend approximately from northwest to southeast and are spaced between Baltimore City and central Charles County. These cross sections are lettered from A-A′ to L-L′ and appear in this report as plates 2 through 13.

The four stratigraphic cross sections subparallel to the strike trend northeast- southwest. These illustrations are lettered W-W′ to Z-Z′ and appear in this report as plates 14 through 17.

When the correlation network was constructed, geophysically logged wells sufficiently deep to penetrate Cretaceous sediments were not available in either Calvert or St. Marys Counties. As a result, the correlation network (pl. 1 to 17) does not extend into these areas[3]. Included in the correlation network are Anne Arundel, Prince Georges, and Charles Counties as well as neighboring areas of Washington, D.C., Baltimore City, and Baltimore Country. One cross section (pl. 6) extends across the Chesapeake Bay to include five deep wells drilled in Talbot and Dorchester Counties; additional data for these wells are contained in Mack (in preparation).

The datum for the cross sections is sea level. The well altitudes, in most instances, are approximations based upon elevations shown on U. S. Geological Survey topographic maps. Because the cross sections were designed primarily to demonstrate subsurface stratigraphic relationships, the topographic profiles normally shown on structural cross sections were omitted from the correlation network.

TABLE 2. LOCALITIES IN OR NEAR WHICH KEY WELLS APPEARING ON THE CORRELATION NETWORK ARE SITUATED

ANNE ARUNDEL COUNTY	
LOCALITY	WELL NO.
Annapolis	AA-De 91
Annapolis (near)	AA-De 92
Belvedere Heights	AA-Cf 61
Bodkin Point (near)	AA-Bf 49
Crofton	AA-Cc 86
Crownsville	AA-Cd 43
Davidsonville	AA-Dd 36
Dorsey (near)	AA-Ac 60
Fort George G. Meade	AA-Cb 2
Fort Meade Junction	AA-Bb 21
Gibson Island	AA-Cf 22
Glen Burnie	AA-Ad 29
Glen Burnie	AA-Ad 87
Glen Burnie (near)	AA-Bd 98
Kings Heights	AA-Cc 78
Maryland City	AA-Bb 65
Odenton (near)	AA-Bc 161
Sandy Point	AA-Cg 18
Severndale	AA-Ce 80
Solley Neck	AA-Ae 35
U. S. Naval Academy	AA-Df 79

BALTIMORE COUNTY AND CITY	
LOCALITY	WELL NO.
Baltimore City	1S4E-19
Baltimore City	3S5E-30
Baltimore City	5S3E-46
Old Bay Shore Park	Bal-Gf 177
St. Denis (near)	Bal-Gc 18
Sparrows Point	Bal-Gf 10

CHARLES COUNTY	
LOCALITY	WELL NO.
Indian Head	Ch-Cb 8
La Plata	Ch-Ce 35
Mattawoman (near)	Ch-Bf 127
Popes Creek Road	Ch-De 32
Potomac Heights	Ch-Bc 61
Waldorf	Ch-Bf 97
Waldorf (near)	Ch-Bf 131
District of Columbia	D.C.-2
	WE-Ca 6
	WW-Cc 26

DORCHESTER COUNTY	
LOCALITY	WELL NO.
Cambridge (near)	Dor-Ce 77

PRINCE GEORGES COUNTY	
LOCALITY	WELL NO.
Bowie-Belair	PG-Cf 53
Brandywine (near)	PG-Fd 62
Chalk Point	PG-Hf 23
Forest Heights	PG-Eb 1
Fort Washington	PG-Fb 13
Glenn Dale (near)	PG-Ce 16
Greenbelt	PG-Cd 23
Marlboro Meadows	PG-Df 34
Maryvale	PG-Ee 52
Muirkirk (near)	PG-Bc 8
Oak Crest	PG-Ad 14
Patuxent Wildlife Refuge	PG-Be 22
Rosaryville (near)	PG-Ee 49
Rosecroft	PG-Ec 5
South Lawn	PG-Ec 41
Takoma Park	PG-Cc 13
Woodmore	PG-Ce 39

TALBOT COUNTY	
LOCALITY	WELL NO.
Easton (near)	Tal-Ce 62
Easton (near)	Tal-De 18
Hambleton	Tal-De 16
Wades Point	Tal-Cb 89

2/ Following previous usage (Shifflett, 1948) the Aquia Greensand is classified Eocene in the cross-section network. Recent paleontological data suggest that it may be, in part, Paleocene (e.g. Nogan, 1964).

3/ Subsequently, the U.S. Geological Survey, in cooperation with the Maryland Geological Survey, drilled a 1508-foot test well near Great Mills (St. Marys County) and a 1515-foot test well near Prince Frederick (Calvert County); data from these wells are currently being evaluated.

GEOLOGY

General Statement

To provide a descriptive framework for the cross-section network brief discussions relating to regional geology, previous investigations, and Cretaceous nomenclature are included. In addition, the geologic implications of the correlation network are briefly discussed, particularly those relating to the Potomac Group of Southern Maryland.

Regional Relationships

In North America the Cretaceous System is exposed in several broad belts. As noted by Kay and Colbert (1965, p. 416-418):

> "The Cretaceous System in North America can be described in terms of several principal areas of its exposure and subsurface distribution. Very gently dipping Cretaceous sediments underlie the Gulf and Atlantic coasts and extend seaward to undetermined distances. A very large area beneath the Great Plains from Kansas and New Mexico to northeastern British Columbia and the Yukon has gently dipping beds that become folded and faulted westward as an effect of the Laramian Orogeny that took place within the later Cretaceous and thereafter. A third principal area of Cretaceous rocks is in northern Mexico, extending into southeastern Arizona, in which the Cretaceous rocks are considerably folded and faulted. The Arctic Coast from Alaska to Ellesmereland has extensive Cretaceous rocks that are gently dipping, but locally the rocks form folded mountains. And another belt of Cretaceous of quite complex structure and distribution follows along the Pacific Coast from Baja, California to Alaska".

The continental distribution of the Cretaceous rocks described above is shown on the revised geologic map of North America (Goddard and others, 1965).

Along the East Coast of the United States the Atlantic Coastal Plain extends 2,400 miles from Florida to Newfoundland in a belt 150 to 300 miles wide (Maher, 1965, p. 1). It is underlain by a seaward-dipping wedge of Cretaceous and Tertiary sediments. Three-fourths of this belt, which covers an area of 400,000 to 450,000 square miles, is covered by the Atlantic Ocean (Maher, 1965, p. 1, and Uchupi, 1965).

The emerged part of the Atlantic Coastal Plain extends northward from Florida to Cape Cod, Massachusetts, achieving its maximum width of 200 miles in southern Georgia (LeGrand, 1961, p. 1557). The thickness of the Coastal Plain sediments varies from a feather edge on the west to over 15,000 feet at the terminus of the Continental Shelf (Maher, 1965, p. 7).

In Maryland the Coastal Plain area is bounded on the west by the Piedmont provice and the east by the edge of the Continental Shelf which occurs about 100 miles offshore. The emerged portion of the Coastal Plain is over 100 miles wide at its broadest point and includes almost 5,000 square miles (Vokes, 1961, p. 45). Cretaceous sediments underlie the entire Coastal Plain of Maryland, but crop out only in a band extending along the edge of the Piedmont. As shown on the geologic map of Maryland (Weaver and others, 1968) this belt has a maximum width of approximately 15 miles.

Because the Cretaceous sediments generally slope southeasterly at dips less than one degree, a maximum of only about 1,030 feet of sediments is exposed along the 15-mile wide outcrop belt (Weaver and others, 1968). The thickness of the Cretaceous sediments increases downdip, reaching 1,150 feet at Bowie-Belair and 1,490 feet at Brandywine (pl. 8 and 11). On the Eastern Shore three oil test wells drilled to basement reveal the Cretaceous sediments to be about 4,000 feet thick

beneath Salisbury, 4,890 feet thick beneath Berlin, and 5,630 feet thick beneath Ocean City (Anderson and others, 1948, fig. 20; Vokes, 1961, fig. 12).

Previous Investigations and Nomenclature

Beginning in the nineteenth century the outcropping Cretaceous sediments of Maryland have been periodically studied. An excellent review and bibliography of the earlier studies can be found in the Lower Cretaceous and Upper Cretaceous Systemic Reports published by the Maryland Geological Survey (Clark and others, 1911, p. 34-56; Clark and others, 1916, p. 34-50).

During this era of activity the nomenclature used to identify the time-stratigraphic and rock-stratigraphic units of the Cretaceous System in Maryland was adopted. Table 3 summarizes these data. At this time exhaustive floral and faunal paleontologic studies were undertaken. The results of this work are summarized in the Systemic Reports cited above (Clark and others, 1911; 1916).

During subsequent years additional studies were undertaken to reevaluate both the physical stratigraphy and paleontology of the outcropping Cretaceous sediments of Maryland. Important contributions to this body of work include Spangler

TABLE 3. NOMENCLATURE OF THE CRETACEOUS SYSTEM OF MARYLAND

Time-Stratigraphic Units		Rock-Stratigraphic Units		Origin of Nomenclature	
System	Series	Group	Formation	Author[2]	Date
Cretaceous	Upper Cretaceous	No Generally Recognized Name	Monmouth	Clark, W. B.	1897
			Matawan	Clark, W. B.	1895
			Magothy	Darton, N. H.	1893
			Raritan	Clark, W. B.	1893, 1897
	Lower Cretaceous	Potomac[1]	Patapsco	Clark, W. B. and Bibbins, A. B.	1897
			Arundel		
			Patuxent		

1/ McGee, W. J., 1886

2/ See reference list for publications

and Peterson (1950), Overbeck (1950), Dorf (1952),Cooke (1952), Richards and others (1957), Groot and Penny (1960), and Brenner (1963). Glaser (1967) contains an extensive review and bibliography of these and other investigations.

Subsurface studies of the Cretaceous formations of Maryland were initiated relatively recently, although Woolman (1895), Darton (1896) and Clark and others (1918) made early contributions in this field. Since 1948 the Southern Maryland area has been the object of a continuing series of ground-water resources investigations; as a result, basic subsurface relationships have been established. An enumeration of these studies is given elsewhere in the report.

Age of the Cretaceous Formations

It is not the purpose of this publication to reconcile questions concerning the relative ages of the Cretaceous formations of Southern Maryland. The problem of properly establishing the Upper Cretaceous-Lower Cretaceous boundary, for example, cannot be resolved by a physically oriented stratigraphic study of a relatively small area. The optimum solution of this problem rests on worldwide paleontological evidence involving invertebrate, vertebrate, and paleobotanical correlations.

The Cretaceous classification used in the cross-section network of this report is a slight modification of the one proposed by Clark and Berry in 1911 and 1916 (Clark and others, 1911, p. 27; 1916, p. 27) (see table 4). In their classification the Potomac Group was assigned to the Lower Cretaceous and consisted of three formations which were from oldest to youngest the Patuxent, the Arundel, and the Patapsco. The Upper Cretaceous was believed to consist of four units, being from oldest to youngest the Raritan, Magothy, Matawan, and Monmouth Formations. The time-stratigraphic designations of these units were based on floral and faunal correlations with the type European stages (Berry, in Clark and others, 1911, pp. 99-172; 1916, pp. 183-341). Because the Patuxent through Raritan Formations are continental deposits in Southern Maryland, reptilian and plant fossils were used.

As reported by Berry (Clark and others, 1911, p. 63, 66) the floras of the Lower Cretaceous Potomac Group can be subdivided into two major units. The older unit encompassing the Patuxent and Arundel Formations is characterized by a flora containing ferns, cycads, and gymnosperms (conifers); flowering plants (angiosperms) are extremely rare or absent. The upper unit or Patapsco Formation has a less ancient aspect, containing a flora with a 30 percent angiosperm population.

In contrast,the flora of the Upper Cretaceous Raritan Formation, particularly in New Jersey where it is well developed, has a relatively modern appearance; it exhibits a population consisting of 75 percent angiosperms (Dorf, 1952, p.2162) and contains precursors of such modern trees as willow, tulip, and magnolia (Knowlton, 1927, p.166). In Maryland definitive floras from the Raritan Formation are restricted to the outcrop belt north of Baltimore (Clark and others, 1911, p. 60). In Southern Maryland where diagnostic floral suites have not been described the Raritan Formation is, if present at all, indistinguishable lithologically from the underlying Patapsco Formation (Cooke, 1952, p.7; Meyer, in Cooke, 1952, p. 97; Brookhart, 1949, p. 44; Otton, 1955, p. 38).

The early paleobotanical studies of Berry were macrofloral investigations concerned with detached plant parts such as leaves, wood, cones, stems, and roots. Recently Brenner (1963) investigated the microfloral (palynological) content of the Potomac Group. He found that the stratigraphic occurrences of different types of pollen and spore grains showed the same trend as Berry had previously recognized (Brenner, p. 28); no angiosperm species were found in the Patuxent and

Arundel Formations. Likewise, study of core samples from two deep test wells (see PG-Cf 53, pl. 14) in the Bowie-Belair area (pl. 1) revealed no pollen and spore species (triporates or tricolporates) relatable to the Upper Cretaceous Raritan Formation of New Jersey (Brenner, 1963, p. 17).

Vokes (in Anderson, 1948), Spangler and Peterson (1950), and Overbeck(1950) favored a reclassification of the Cretaceous Formations in which only the Patuxent Formation is assigned to the Lower Cretaceous Series (see fig. 4). However, as Dorf (1952) pointed out this change appears to be premature because the overwhelming paleobotanical evidence still supports the earlier conclusions of Berry (in Clark and others, 1911; 1916). Therefore, the age assignments of the subsurface correlation network of this report conform to Berry's classification. An exception to this is that the lithologically indistinguishable Raritan (?) and Patapsco Formations are undifferentiated; as a result, the Upper Cretaceous-Lower Cretaceous boundary is questionably placed between the Magothy Formation and the Raritan(?)-Patapsco Formation (undivided). In accordance with the

TABLE 4. PREVIOUSLY PROPOSED CLASSIFICATIONS OF THE CRETACEOUS FORMATIONS OF MARYLAND

Clark, W. B., Bibbins, A. B. and Berry, E. W. (1911)				Vokes, H. E. (in Anderson, 1948)				Overbeck, R. M. (1950)				This Report (1968)[1]			
Cretaceous	Upper Cretaceous		Monmouth Formation	Cretaceous	Upper Cretaceous		Monmouth Formation	Cretaceous	Upper Cretaceous		Monmouth Formation	Cretaceous	Upper Cretaceous		Monmouth Formation
			Matawan Formation				Matawan Formation				Matawan Formation				Matawan Formation
			Magothy Formation				Magothy Formation				Magothy Formation				Magothy Formation
			Raritan Formation				Raritan Formation				Raritan Formation		—?—		Raritan(?) and Patapsco Formation (Undivided)
	Lower Cretaceous	Potomac Group	Patapsco Formation			Potomac Group	Patapsco and Arundel (Undivided)			Potomac Group	Patapsco Formation		Lower Cretaceous	Potomac Group	
			Arundel Formation								Arundel Formation				Arundel Formation
			Patuxent Formation		Lower Cret.		Patuxent Formation		Lower Cret.		Patuxent Formation				Patuxent Formation

1/ This classification pertains only to the subsurface Cretaceous units of Southern Maryland.

revised geologic map of Maryland (Weaver and others, 1968) the undivided Raritan (?) - Patapsco Formation is placed in the Potomac Group.

The significance of this assignment should be clearly understood by the reader. *In no way should it be construed that the Raritan Formation is being reassigned to the Lower Cretaceous. The lumping of the Patapsco and Raritan Formations in this report is merely an attempt to facilitate subsurface correlations in the absence of a mappable Raritan unit.* A systematic palynological investigation of this undifferentiated unit would be required to satisfactorily reconcile the problems of subdividing it on a time-stratigraphic basis.

It should be borne in mind that the cross-section network was intended primarily to show vertical and horizontal changes in lithology occurring within the Cretaceous Series of Southern Maryland. Because the relative age of the Cretaceous Formations is basically a paleontological question, the cross-section network does not directly bear on it. It was recognized, however, that the establishment of time lines by paleobotanical methods was necessary to corroborate the facies changes that were postulated by means of electric log correlations.

To accomplish this, key samples were selected for palynological study from several wells contained in the cross-section network. The samples were preponderantly rotary drill cuttings and therefore were subject to contamination by either drilling mud or bore hole materials; study of the samples was made with this particular problem in mind. Insofar as feasible, Dr. G. J. Brenner, currently associated with the State University of New York, assigned each sample to one of the standard microfloral zones characteristic of the Potomac Group sediments in Southern Maryland (Brenner, 1963). The results of Dr. Brenner's investigation are summarized in the Appendix of this report (table 6). On the cross-section network each of the studied intervals is identified by a star symbol adjacent to the appropriate well.

Stratigraphy

Beginning with Clark and others (1911, 1916) the lithologic details of the outcropping Cretaceous Formations of Southern Maryland have been described and mapped. Notable contributions to this body of knowledge include those by Darton (1947), Dryden (1948), Overbeck (1950), Cooke (1952), and Glaser (1967). Detailed lithologic descriptions of the subsurface portions of the Cretaceous formations have been published by Bennett and Meyer (1952) and Otton (1955); this information is summarized in table 5.

The purpose of the cross-section network (pl. 1-17) is to document the areal variations in thickness and facies characteristic of the subsurface Cretaceous formations of Southern Maryland. Thus it represents a geometric and lithologic study of larger scale sedimentary units. Study of their internal parameters, such as mineralogy and fabric, was not undertaken.

Correlation: Correlation between wells in the cross-section network was based chiefly on lithologic similarities that could be determined by means of geophysical logs and drill cuttings; supplemental use of palynological data was also employed (table 6). To construct a correlation network at least one, and preferably several, horizons must be correlated from cross section to cross section. In this network three contacts were selected for correlation; these are the Patuxent and basement rock contact, the Raritan (?) - Patapsco (undivided) and Arundel contact, and the Magothy

and Raritan(?)-Patapsco (undivided) contact. These unconformities appear to have continuity over much of the area and can be traced in many cases without corroborating paleontological data. In areas where lithologic differentiation is weak or absent the horizons were tentatively carried as "phantoms" in order to establish a degree of continuity. "Phantom" horizons of questionable significance are identified on the correlation network by question marks. Figures 4 and 5 are generalized structure contour maps drawn on the Raritan(?)-Patapsco (undivided) and Arundel contact and the Patuxent and basement rock contact respectively. Contour maps containing more detail can be found in Mathews (1935), Bennett and Meyer (1952, pl. 5, 17), Mack (1962, pl.2, 5, 6, 7), Mack (1966, fig. 4, 6, 12), and Slaughter and Otton (1968, figs. 10 to 15).

In constructing a correlation network depositional history must be considered because it bears directly on the areal distribution of the various stratigraphic units. The Potomac Group as used in this report consists of the Patuxent, Arundel and Raritan(?)-Patapsco (undivided) Formations. It is nonmarine in origin and represents the depositional product of a coalescing, fluvio-deltaic complex. As recently reviewed by Potter and Pettijohn (1963, p. 178-182) the sand bodies appearing in fluvial sequences are generally visualized as "good examples of elongation parallel or nearly so to transport direction." Thus the geometry of fluvial sands is often viewed as being channel-like or "shoestring" in nature. Because of the extremely lensoidal character of this type of sand body, areal correlations based on lithologic continuity are generally viewed as either impossible or, if attempted, misleading. The result is that the fluvial sequence is either "lumped" into a single Group (Richards and others, 1957, p. 189) or some internal parameter, generally microscopic, is sought to establish areal correlation. In the latter case heavy minerals have been utilized (Anderson, 1948; Bennett and Meyer, 1952, Groot, 1955). Zonation by this method, however, generally fails to establish useful stratigraphic units because they do not meet the accepted standard of practicable mappability (Amer. Comm. Stratigraphic Nomenclature, 1961, p. 650).

TABLE 5. GENERALIZED LITHOLOGIC DESCRIPTION OF THE SUBSURFACE CRETACEOUS FORMATIONS OF SOUTHERN MARYLAND (AFTER BENNETT AND MEYER, 1952; OTTON, 1955).

System	Series	Group	Formation	Generalized Lithologic Character	Depositional Environments
Cretaceous	Upper Cretaceous		Monmouth and Matawan	Gray to dark gray, glauconitic, micaceous silty and sandy clay with interbedded gray silty sand.	Neritic marine
			Magothy	Light gray to white sand and fine gravel with interbedded clay layers; lignitic.	Littoral and shallow neritic marine (strand-base sand)
	——?——	Potomac	Raritan (?) and Patapsco (Undivided)	Varicolored, interbedded sands, silts, and clays; predominately hues of red and yellow, except in Charles County where shades of gray prevail.	Fluvial consisting of in-channel, point bar, and over-bank deposits; see figure 5.
	Lower Cretaceous		Arundel	Predominately a dark gray, brown, and red clay occasionally containing lignite, leaf impressions, and indurated layers of siderite.	Swampy consisting of interfluvial flat deposits; see figure 5.
			Patuxent	Predominately white, yellow, gray, and brown sand with gray, white, and red clayey interbeds; in Charles County gray, argillaceous beds predominate.	Fluvial consisting of inchannel, point bar and overbank; see figure 5.

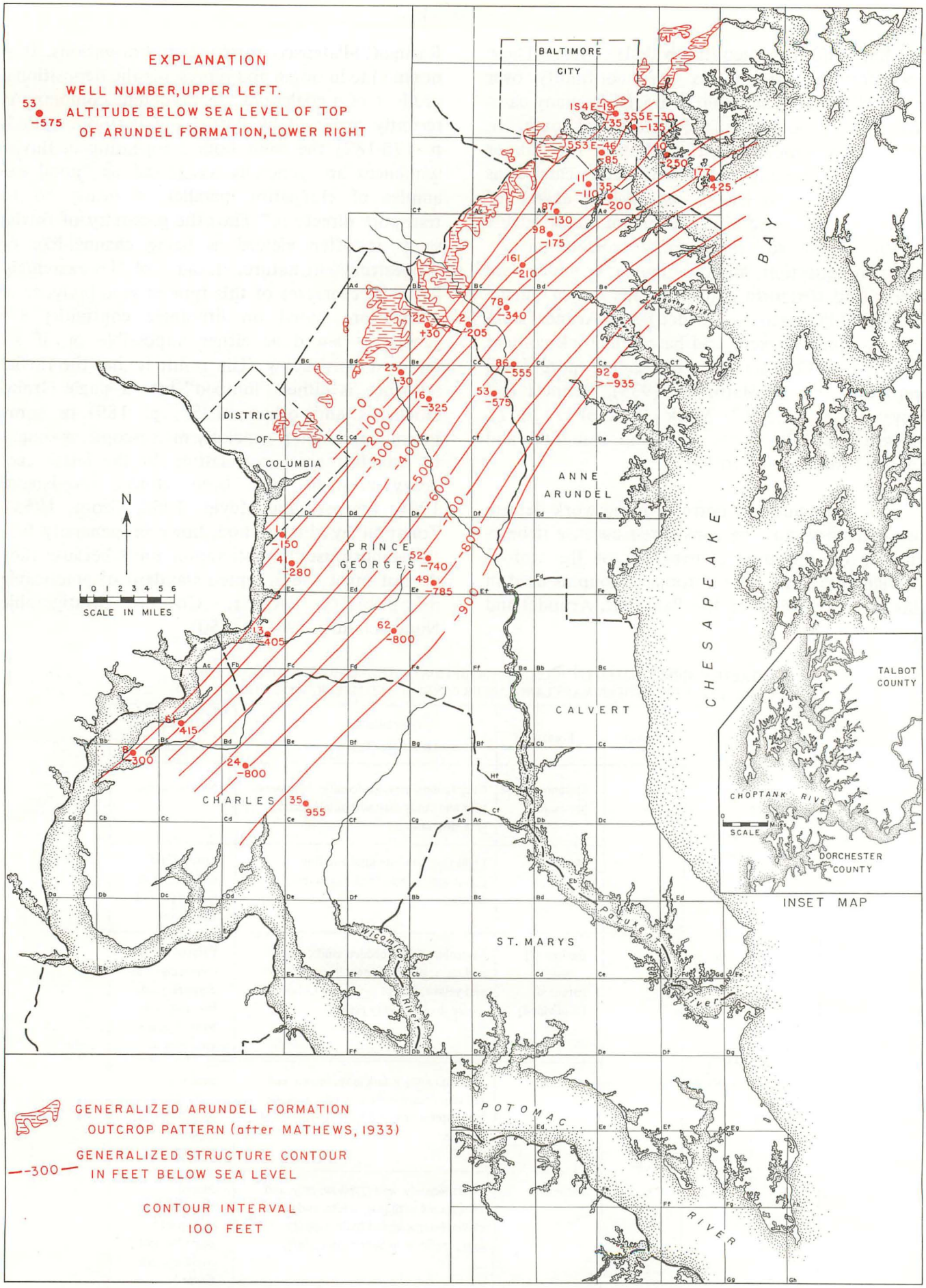

Figure 4. Generalized structure contour map of the top of the Arundel Formation in Southern Maryland.

A contrasting view advocating the areal continuity of fluvial sands has been promulgated by Visher (1965, p. 116-117):

> "Data collected by Wolman and Leopold (1957) on a number of recent rivers have interesting applications to fluvial sedimentation. A comparison of rates of accretion on flood plains, as compared to rates of lateral migration of meandering streams, has demonstrated that sedimentation by overbank flow is probably of only minor significance in the development of most fluvial valley-fill sequences. From these (data) it is apparent that the volume of sediment comprising a flood plain may be primarily a product of in-channel sedimentation. The area of channel sedimentation can be related to the extent the stream has meandered, which commonly includes the entire width of the flood plain. By this process a meandering river develops a similar sequence of deposits over a broad area. This process produces blanket sands, which are broadly conformable to both underlying and overlying sedimentary units. Consequently a channel geometry is not adequate for the identification of fluvial deposits."

As shown by the correlation network, neither of these two extreme views is totally applicable to the fluvial Potomac Group sediments of Southern Maryland. Individual sand beds 25 feet or less in thickness cannot be traced with certainty from well to well over distances measured in miles; this appears to be true both along the strike and down the dip. However, suites of subsurface sands such as those comprising the Patuxent Formation or those comprising members of the Raritan (?) - Patapsco Formation (undivided) can be traced along strike in Anne Arundel County and northern Prince Georges County for distances exceeding 25 miles (pl. 14 and 15). Similar correlations can be traced down dip, although some difficulties are encountered because of a general thickening of the section (see, for example, pl. 5 to 8).

The Cretaceous formations overlying the Potomac Group are the depositional product of a littoral to neritic marine environment. The distribution of these formations tends to be tabular or blanketlike, a geometry generally resulting in more continuous areal correlations (see for example, pl. 6 and pl. 14).

Vertical Changes of Lithology: Fluvial deposits are the product of inchannel, point bar, and overbank sedimentation. Because rivers characteristically migrate laterally across their valleys the deposits exhibit, as Visher (1965, p. 116) points out, "systematic vertical variation in grain size, sedimentary structures, bedding characteristics, and morphology of sedimentary units". As viewed in outcrop the "ideal" vertical sequence consists of:

1) A lowermost cross-bedded zone related to sand wave or dune transport.

2) A current laminated zone deposited in low amplitude sand waves or on a plane bed.

3) A fine-grained symmetrical ripple zone containing sediment formerly transported in suspension.

4) An uppermost laminated clay and fine-grained sand zone deposited from suspension as an overbank deposit (Visher, 1965, fig. 13).

In the subsurface the fabric of the depositional sequence cannot be studied unless continuous oriented cores are obtained. Since these data are presently unavailable in Southern Maryland, ditch samples and geophysical logs must be used to define the fluvial cycles that occur within the Potomac Group. This being the case a simplified definition of the fluvial cycle is needed for subsurface identification. Friend (1965, p. 42) suggests that the criteria necessary to vertically delimit a fluvial cycle can be reduced to two key points:

1) The cycle should be limited above and below by an erosive surface of lateral extent.

2) The cycle should consist of laminae of relatively coarse grade (inchannel deposits) at the

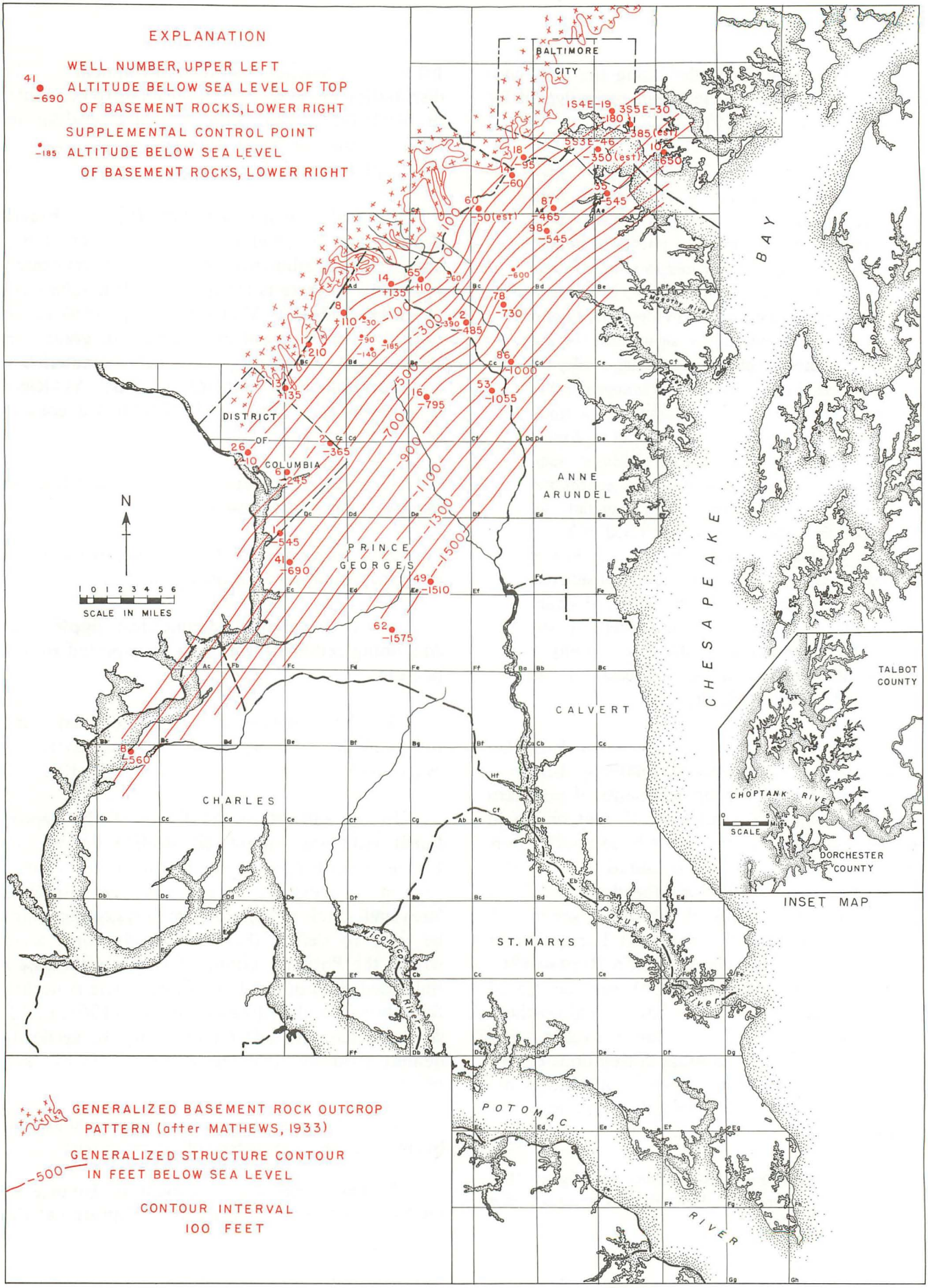

Figure 5. Generalized structure contour map of the top of the basement rocks in Southern Maryland.

base and laminae of relatively fine grade (overbank deposits) near the top.

This sedimentary sequence, which is characteristic of modern river deposits (Leopold and others, 1964, p. 322-328), has been widely associated in time and space with ancient fluvial sediments (Allen, 1965a, p. 229). Similar fluvial sequences characterize the subsurface Potomac Group of Southern Maryland. Only rarely, however, can the "ideal" cycle be observed in geophysical logs. This is due in part to the erosive nature of the fluvial process; fluvial cycles once formed are subjected to later modification or destruction by subsequent flood events. In addition identification is made difficult in some cases because of mechanical deficiencies in the electric logging operation; in these cases either the clay-base or sand-base line is truncated due to recording the log at an overly sensitive scale. With the clay-base line missing the identification of fining-upwards cycles is often inconclusive.

Figure 6 is part of an electric log of well PG-Ec 48 (pl. 1). It represents an excellent geophysical analog of the fining-upwards cycle typically associated with fluvial deposits. The sand in figure 6 is underlain by a sharply defined erosive base. As suggested by Visher's "ideal vertical sequence" the sand fines upward from coarser grained inchannel deposits to finer grained point bar deposits. Capping this sequence is a silt or clay unit that represents the depositional product of overbank sedimentation.

The thickness of the combined inchannel and point bar sequence illustrated in figure 6 is approximately 45 feet. By way of comparison the thickness of the point bar deposits associated with the Mississippi River range between 40 and 80 feet; those characteristic of the Niger Delta, West Africa, are 30 to 40 feet thick (Allen, 1965b, p. 138; 1965c).

Overlying the sandy inchannel and point bar deposits in a normal fining-upwards cycle are fine-grained sediments representative of overbank sedimentation. As defined by Allen (1965b, p. 150) these deposits "represent the long-continued accumulation of fines suspended in flood waters that became stilled after reaching low-lying basins flanking alluvial ridges". Citing data accumulated by Fisk, (1944, 1947), Allen observed that the overbank deposits characteristic of the Recent Mississippi River are 5 to 50 miles in length, 2 to 15 miles in width, and 25 to 140 feet in thickness. Thus, in a major river system these deposits are areally extensive and by analogy should be widely correlatable in ancient deposits such as the Potomac Group.

Although a good example, the fluvial cycle illustrated in figure 6 is not the only example of fining-upwards shown on the correlation network. Other examples, albeit somewhat composite in nature, appear in the Kings Heights well (AA-Cc 78; pl. 15) between -500 and -550 feet subsea; in the Glen Burnie well (AA-Ad 87; pl. 16) between -15 and -120 feet subsea; in the Crofton well (AA-Cc 86; pl; 14) between -40 and -550 feet subsea; and in the Waldorf well (Ch-Bf 131; pl. 14) between -370 and -405 feet subsea.

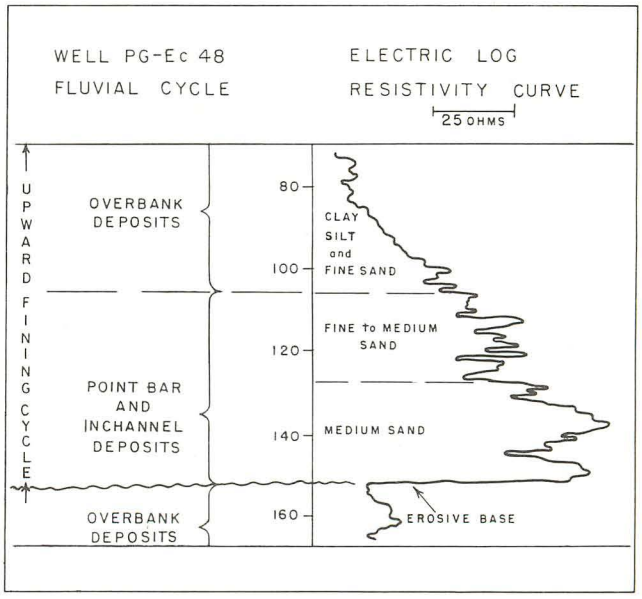

Figure 6. Electric log of well PG-Ec 48 showing fining upwards cycle characteristic of fluvial deposition in the Raritan(?)-Patapsco Formation (undivided)

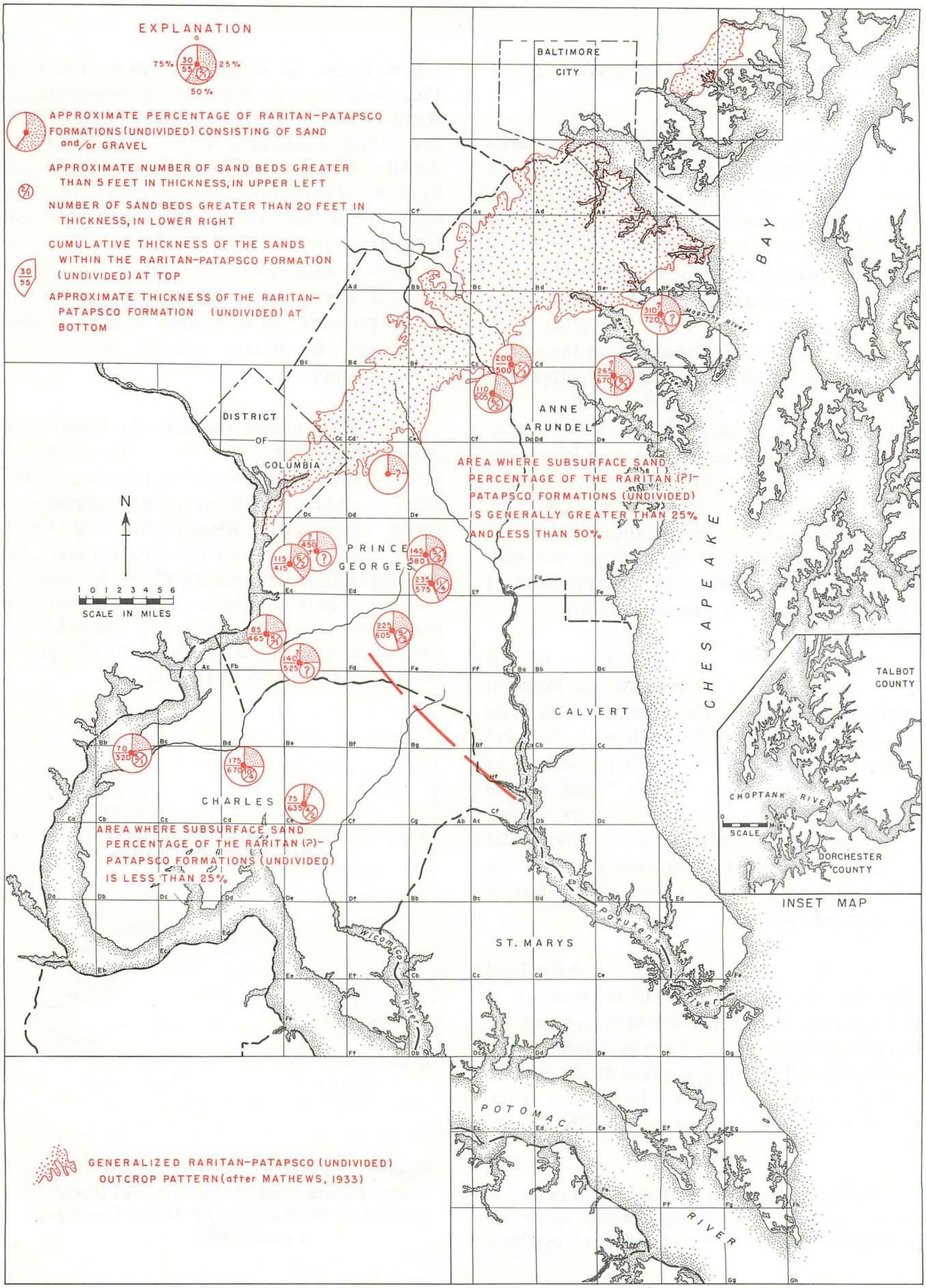

Figure 7. Generalized sand percentage map of the Raritan(?)-Patapsco Formation (undivided) of Southern Maryland.

Major Facies Changes: In addition to the vertical changes of lithology described above, lateral (i.e., facies) changes also occur. Because of the cut-and-fill nature of fluvial sedimentation local unconformities abound, making detailed correlation of individual units very difficult. However, as previously emphasized, suits of sands can be traced in the subsurface for distances measured in miles. Only the major facies changes occurring in formational size units are treated in this report.

Along strike, major subsurface facies changes take place in both the Raritan(?)-Patapsco Formation (undivided) and the Patuxent Formation. These facies changes are depicted in cross sections W-W′ (pl. 14) and X-X′ (pl. 15) where sand percentages decrease from north to south. The change is most abrupt in a zone encompassing southern Prince Georges County and northern Charles County.

Sand percentages calculated for the wells comprising cross sections W-W′ and X-X′ (pls. 14 and 15) are schematically shown in figures 7 and 8. The sand percentages shown in these maps are approximate values and are intended to illustrate major lithologic trends.

For most wells the sand counts necessary for calculating percentage were tabulated from geophysical logs; the inflection point method was used. In cases where the sand-clay contacts are sharply expressed, points of inflection on a geophysical log define individual sand bodies. The sum of these increments represents the net sand thickness (Lynch, 1962, p. 168). As discussed previously, however, sand beds characteristic of the Potomac Group often exhibit fining-upward cycles; as a result, sand percentages obtained by the inflection point method are approximate values.

Along cross section W-W′ (pl. 14) the Patuxent Formation is an easily correlated unit from Sparrows Point to Bowie-Belair, sand percentages ranging between 45 and 65; the field coefficients of permeability range from 100 to 1,000 gpd/ft^2 (Bennett and Meyer, 1952, table 8; Mack, 1966, table 3). Between Bowie-Belair and Rosaryville a significant lithologic change occurs. The deep basement wells (PG-Ec 49 and PG-Fd 62) drilled near Rosaryville and Brandywine contain a Patuxent section having 30 percent or less sand; this is appreciably less than that encountered in either the Crofton well (AA-Cc 86) or the Bowie-Belair well (PG-Cf 53). In addition the few Patuxent sands that are present in the Rosaryville-Brandywine area appear to be, as suggested by electric-log data, silty and low in permeability. Mack (1966, table 13), utilizing data obtained from gas injection tests conducted during a gas storage feasibility study (Ball and Winer, 1958), corroborated the electric log data. He calculated that permeability values for a typical Patuxent sand in the Rosaryville-Brandywine area ranged between 0.08 and 32 gpd/ft^2, values much lower than those characterizing the Patuxent Formation from Sparrows Point to Bowie-Belair (fig. 8). It is apparent, therefore, that the Patuxent Formation exhibits along cross section W-W′ (pl. 14) a marked decrease in both sand percentage and permeability between Bowie-Belair and Rosaryville.

A southerly decrease in Patuxent sand percentages is also evident along cross section X-X′ (pl. 15). Sand percentages between Glen Burnie and Glenn Dale (pl. 1) range between 50 and 90 percent (table 6). At South Lawn the sand percentage is approximately 35 percent. Farther south along cross section X-X′ in the Potomac Heights-Indian Head area of Charles County the Patuxent Formation characteristically contains less than 25 percent sand (fig. 8).

Similar north to south trends characterize the subsurface Raritan(?)-Patapsco Formation (undivided). These changes are depicted in cross sections W-W′ (pl. 14) and X-X′ (pl. 15) and in plan-view in figure 7. On cross section W-W′ the Raritan (?) - Patapsco sand percentage from

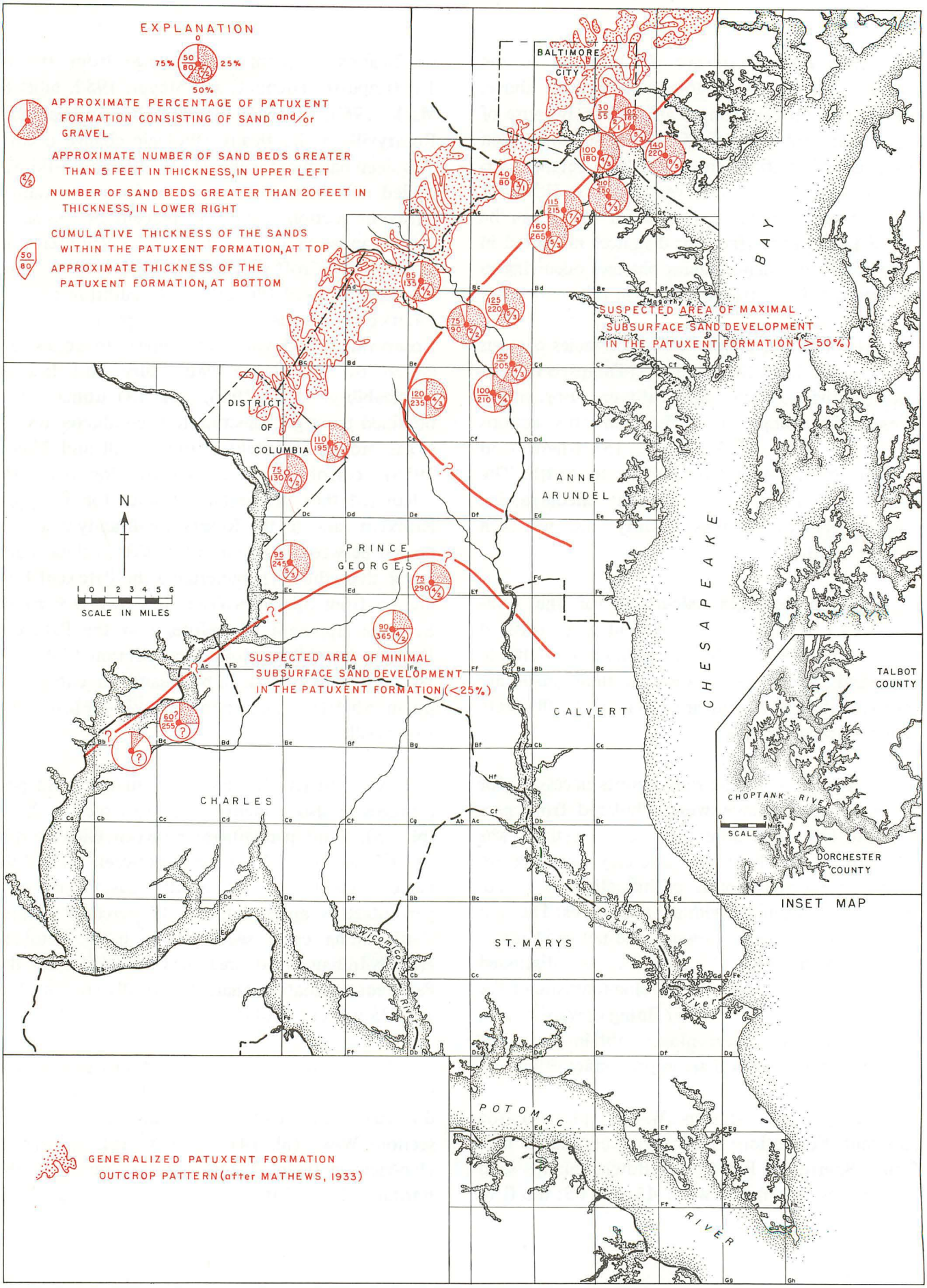

Figure 8. Generalized sand percentage map of the Patuxent Formation of Southern Maryland.

Crofton to Brandywine varies between 25 and 40 (pl. 14). From Brandywine to Waldorf a discernable decrease in sand percentage occurs. Well Ch-Bf 131 located near Waldorf penetrates about two-thirds of the formation and has a sand content of 25 percent or less. A marked reduction in sand percentage occurs south of Waldorf as evidenced by well Ch-Ce 35. This deep well at La Plata penetrates the complete Raritan(?)-Patapsco section and has a sand percentage of approximately 10 percent, a value significantly below that characteristic of the Rosaryville-Brandywine area.

In cross section X-X′ (pl. 15) many of the wells penetrate only a portion of the Raritan(?)-Patapsco Formation (undivided), making sand percentage estimates for the entire interval impossible. The general trend appears, however, to approximate that shown in cross section W-W′, that is, a general southerly decrease in sand content. At Potomac Heights (well Ch-Bc 61), for example, sand content does not exceed 20 percent.

WELL DATA

Aquifer test data are available for many of the wells in the correlation network. Most of this information is contained in plates 14 to 17; aquifer test data for the few wells in the network not shown on these cross-sections are tabulated in plates 2 through 13. The following data are included: static water level, pumping water level, screened interval, well diameter, yield, length of test, specific capacity, and date of test.

The transmissibility (T) and storage coefficient (S) values necessary for quantitative time-yield-drawdown analyses have been determined for some of the wells contained in the correlation network. These data can be obtained from the following reports published by the Maryland Geological Survey: Baltimore Industrial Area (Bennett and Meyer, 1952); Anne Arundel County (Mack, 1962); Prince Georges County (Mack, 1966); and Charles County (Slaughter and Otton, 1968 Additional values for the general Southern Maryland area are contained in Otton (1955).

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APPENDIX

TABLE 6. PALYNOLOGICAL ANALYSES OF SELECTED SAMPLES TAKEN FROM WELLS CONTAINED IN THE CORRELATION CROSS-SECTION NETWORK OF SOUTHERN MARYLAND.

Palynological Sample Report
by
Gilbert J. Brenner

The following frequency symbols are used with the microfloral lists:

A abundant
C common
R rare

ANNE ARUNDEL COUNTY

Well: AA-Cb 2 (Fort George Meade)
Interval: 173′-177′ (drill cuttings)
Cross-Section: F-F′, X-X′
Formation: None
Microflora: Barren

Well: AA-Cg 18 (Sandy Point)
Interval: 284′-290′ (drill cuttings)
300′-310′ (drill cuttings)
361′-372′ (drill cuttings)
Cross-Section: D-D′
Formation: Magothy Formation (Turonian)

Microflora:	Frequency
Important sporomorphs	
Turonipollis americanus	C
Plicapollis serta	C
Trudopollis conrector	C
Rugubivesiculites reductus	C
Vacuopollis sp.	A
Latipollis normis	C

Discussion:

The microflora in these three samples are extremely rich. There is no doubt in my mind that these horizons are within the Magothy Formation. The pollen is typical of the surface Magothy in Maryland and New Jersey. The microflora in each sample are essentially the same.

The ditch material does not appear to contain uphole contamination.

Well: AA-De 92 (near Annapolis)
Interval: 1044′-1054′ (drill bit sample)
Cross-Section: E-E′
Formation: Patapsco - Zone IIA (Brenner, 1963)

Microflora:	Frequency
Abietineaepollenites microreticulatus	R
Apiculatisporites babsae	R
Cicatricosisporites patapscoensis	R
Cicatricosisporites species	A
Classopollis torosus	A
Converruscosisporites platyverrucosus	R
Converrucosisporites proxigranulatus	R
Cyathidites minor	R
Exesipollenites tumulus	A
Densoisporites perinatus	R
Lycopodiacidites intraverrucatus	R
Lycopodiacidites triangularus	R
Taurocusporites reduncus	C
Taurocusporites segmentus	C
Tricolpopollenites micromunus	R
Vitreisporites pallidus	R

Discussion:

The sample appears homogeneous and does not seem to be contaminated by uphole material.

The spores *Apiculatisporites babsae, Tricolpopollenites micromunus,* and *Cicatricosisporites patapscoensis* are indicative of Zone II. The various species of *Taurocusporites,* although found in both Zones I and II are more common in Zone II. The absence of significant numbers and types of angiosperms suggests Zone II subzone A.

Well: AA-Df 79 (U. S. Naval Academy)
Interval: 705′ (drill bit sample)
Cross-Section: E-E′
Formation: None
Microflora: Barren

BALTIMORE CITY

Well: 3S5E-30
Interval: 182′-187′ (drill cuttings)
Cross-Section: A-A′, Y-Y′
Formation: Arundel (Brenner, 1963)

Microflora:	Frequency
Trilobosporites marylandensis	*A*
Pilosisporites trichopapillosus	*C*
Concavissimisporites variverrucatus	*C*
Concavissimisporites punctatus	*A*
Densoisporites perinatus	*C*
Cyathidites minor	*C*
Classopollis torosus	*C*
Ephedripites multicostatus	*R*
Cicatricosisporites brevilaesuratus	*C*
Abietineaepollenites microreticulatus	*C*
Peromonolites perorecticulatus	*C*

Discussion:

This sample is definitely older than Patapsco and the assemblage is very similar, both in species and percentages, to the type found in the Arundel Formation of the United Clay Mine No. 2 in Baltimore County, Maryland.

Well: 3S5E-30
Interval: 333′-338′ (drill cuttings)
Cross-Section: A-A′, Y-Y′
Formation: Patuxent (?) Zone I (Brenner, 1963)

Microflora:	Frequency
Abietineaepollenites microreticulatus	*C*
Cicatricosisporites brevilaesuratus	*A*
Eucommidites troedsaonii	*C*
Classopollis torosus	*A*
Clavitipollenites hughesi	*R*
Kulylisporites lunaris	*R*
Cicatricosisporites aralica	*C*
Cingulatisporites reticingulus	*R*
Parvisaccites radiatus	*C*
Circulina parva	*R*
Exesipollenites tumulus	*R*
Trilobosporites marylandensis	*R*

Discussion:

The high frequency of *Classopollis torosus, Cicatricosisporites aralica* and other cicatricose species suggests the Patuxent Formation; however, the separation of the Arundel from the Patuxent by palynology is weak at this time. The rarity of *Trilobosporites marylandensis* also suggests the Patuxent.

CHARLES COUNTY

Well: Ch-Cb 8 (Indian Head)
Interval: 200′-210′ (drill cuttings)
Cross-Section: X-X′
Formation: Lower Patapsco Zone 11A (Brenner, 1963)

Microflora:	Frequency
Abietineaepollenites microoreticulatus	*A*
Cicatricosisporites species	*R*
Cirratriradites spinulosus	*R*
Concavissimisporites punctatus	*R*
Cyathidites minor	*R*
Peromonolites allensis	*R*
Shizosporis reticulatus	*C*
Tricolpate reticulate type	*R*
Trilobosporites apibaculatus	*C*

Discussion:

Trilobosporites apibaculatus, P. allensis, and C. punctatus form an ecological association typically found in the thick black unctuous clay lenses common in the upper part of the Arundel and lower Patapsco Formations. *Cirratriradites spinulosus, S. reticulatus* are more common in the Patapsco. The high percentage of bisaccate pollen *(A. microreticulatus)* is also suggestive of Patapsco horizons. The rarity of angiosperm pollen in addition to the above considerations is suggestive of Zone II-Subzone A.

Well: Ch-Cb 8 (Indian Head)
Interval: 330′-340′ (drill cuttings)
Cross-Section: X-X′
Formation: Lower Patapsco Zone IIA (Brenner, 1963)

Microflora:	Frequency
Abietineaepollenites microreticulatus	*A*
Araucariacites australis	*C*
Cicatricosisporites species	*C*
Cirratriradites spinulosus	*R*
Concavissimisporites punctatus	*A*
Cyathidites minor	*C*
Exesipollenites tumulus	*R*
Parvisaccites amplus	*C*
Peromonolites allensis	*C*
Peromonolites peroreticulatus	*R*
Pilosisporites brevipapillosus	*R*
Shizosporis reticulatus	*C*
Tricolpate reticulate type	*R*

Discussion:

The same spores and pollen that suggested Zone IIA in Sample Ch-Cb 8 (200-210) are found in this sample.

Well: Ch-Cb 8 (Indian Head)
Interval: 470'-480' (drill cuttings)
Cross-Section: X-X'.
Formation: Zone I upper part (Arundel) (Brenner, 1963)

Microflora:	Frequency
Abietineaepollenites microreticulatus	*A*
Concavissimisporites punctatus	*A*
Parvisaccites amplus	*R*

Discussion:

The absence of Zone II types and the abundance of *Concavissimisporites punctatus* suggests the Arundel horizon of Zone I.

Well: Ch-Cb 8 (Indian Head)
Interval: 590'-600' (drill cuttings)
Cross-Section: X-X'
Formation: Upper part of Zone I (Arundel)(Brenner, 1963)

Microflora:	Frequency
Abietineaepollenites microreticulatus	*A*
Classopollis torosus	*R*
Concavissimisporites punctatus	*C*
Trilobosporites apibaculatus	*R*
Parvisaccites amplus	*R*
Peromonolites allensis	*R*

Discussion:

The spores *Trilobosporites apibaculatus, P. allensis, and C. punctatus* are common spores in the Arundel Formation; however, the sample is not particularly good palynologically.

Well: Ch-Ce 35 (La Plata)
Interval: 668'-678' (drill cuttings)
Cross-Section: L-L', W-W'
Formation: None
Microflora: Barren

Well: Ch-Ce 35 (La Plata)
Interval: 918'-928' (drill cuttings)
Cross-Section: L-L', W-W'
Formation: Patapsco (?)
Microflora:
Bisaccites sp.
Tricolpopollenites retiformis
Discussion:

The pollen recovery is very scarce and the few grains of *Tricolpopollenites retiformis* suggests the Patapsco Formation; but this is uncertain.

A reworked pollen grain from the Magothy is present.

Well: Ch-Ce 35 (La Plata)
Interval: 1242'-1252 (drill cuttings)
Cross-Section: L-L', W-W'
Formation: None
Microflora:

Essentially barren - a single grain that is probably a contaminant.

PRINCE GEORGES COUNTY

Well: PG-Ec 41 (South Lawn)
Interval: 183'-194' (drill cuttings)
Cross-Section: J-J', X-X'
Formation: Patapsco Zone II-B (Brenner, 1963)

Microflora:	Frequency
Tricolpopollenites retiformis	*A*
Tricolpopollenites micromunus	*A*
Classopollis torosus	*A*
Tricolpopollenites minutus	*C*
Matonisporites excavatus	*C*
Perotriletes pannuceus	*R*
Psilatriletes circumundulatus	*R*
Cicatricosisporites patapscoensis	*R*
Eucommiidites troedsonni	*R*
Abietineaepollenites microreticulatus	*R*
Araucariacites australis	*C*

Discussion:

The presence of angiosperm pollen and typical spores of the Patapsco define this sample. The assemblage suggests subzone B of the Patapsco Formation.

Well: PG-Ec 41 (South Lawn)
Interval: 383'-406' (drill cuttings)
Cross-Sectionn: J-J', X-X'
Formation: Patapsco - Zone II (Brenner, 1963)

Microflora:	Frequency
Cicatricosisporites species	*A*
Cingulatisporites cf. eukirchensoides	*R*
Cyathidites minor	*R*
Lycopodiacidites irregularis	*C*
Psilatriletes circumundulatus	*R*
Taurocusporites reduncus	*A*

Discussion:

Lycopodiacidites irregularis is restricted to Zone II and *Psilatriletes circumundulatus* is most commonly found in Zone II.

Well: PG-Ec 41 (South Lawn)
Interval: 577'-620' (drill cuttings)
Cross-Section: J-J', X-X'
Formation: None
Microflora: Barren

Well: PG-Ec 41 (South Lawn)
Interval: 802'-822' (drill cuttings)
Cross-Section: J-J', X-X'
Formation: None
Discussion:

The pollen is very sparse and all that was found was a single tricolpate grain. No age determination was made.

Table 7. Drillers logs of the wells used in the correlation cross-section network of Southern Maryland

The well logs published below are presented as a supplement to the correlation cross-section network. A large majority of these logs were made by the well drillers. In most cases the logs lack detailed color and textural descriptions. They do, however, reveal major lithologic changes, particularly when used in conjunction with the geophysical logs.

The well altitudes given below are approximate in the sense that they were determined from topographic maps and were not actually surveyed.

Only unpublished well logs appearing in the correlation cross-section network are tabulated below. For well logs previously published references are cited in all cases.

Because all the well logs in the appendix are included in the cross-section correlation network, the logs are not subdivided into formations. This geological information is easily obtained by cross-reference to the applicable cross-section (plates 2-17).

Well		Thickness (feet)	Depth to base (feet)
	ANNE ARUNDEL COUNTY		
AA-Ac 14	(Otton, 1955, p. 248)		
AA-Ac 60	(Altitude: 165 feet)		
	Fill, gravel	1	1
	Clay, white and yellow	8	9
	Sand, fine; yellow	15	24
	Sand, medium to coarse; white	22	46
	Clay, hard; red and white	2	48
	Clay, medium hard; gray	12	60
	"Sandrock", hard; red	.5	60.5
	Clay, hard; gray	39.5	100
	Clay, hard; white	10	110
	Clay, hard; red and white	8	118
	Sand, coarse, white; and gravel	31	149
	Clay, hard; white and gray	37	186
AA-Ad 11	(Brookhart, 1949, p. 87)		
AA-Ad 29	(Brookhart, 1949, p. 89)		
AA-Ad 43	(Otton, 1955, p. 250)		
AA-Ad 87	(Altitude: 70 feet)		
	Sand, soil	6	6
	Sand, medium to coarse; white	9	15
	Sand, coarse and gravel	2	17
	Clay, white	6	23
	Sand, coarse; white	36	59
	Sand, light brown	15	74
	Sand, medium to coarse; white	6	80
	Sand, coarse; brown	30	110
	Clay, white and sand	7	117
	Sand, fine; white	7	124
	Gravel, large	11	135
	Clay, white	1	136
	Sand, coarse; white	17	153
	Clay, white	3	156
	Sand, coarse; white	10	166
	Clay, hard; red	6	172
	Clay, hard; red and white	5	177
	Sand, medium to coarse; white	4	181
	Clay, white	1	182
	Sand, coarse; white	6	188
	"Rock"	1.5	189.5
	Clay, hard; gray and wood	22.5	212
	Clay, white	2	214
	"Rock", hard; gray	1.5	215.5
	Clay, gray	3.5	219
	"Rock", hard; gray	1	220
	Clay, gray	5	225
	"Rock", gray	1	226
	Clay, soft; gray	23	249
AA-Ae 35	(Altitude: 30 feet)		
	Clay, sandy; brown	15	15
	Clay, white and red	24	39
	Sand, white	4	43
	Clay, sandy, white	43	86
	Sand, coarse	15	101
	Clay	6	107
	Sand, coarse	15	122
	Clay, white and red	30	152
	Sand, coarse	12	164
	Clay, white; sand "streaks"	18	182
	Sand, white	14	196
	Clay, sandy	18	214
	Clay, hard; red	8	222
	Sand, coarse	13	235
	Clay, very hard; red	91	326
	Sand, fine, white	96	422
	Clay, sandy	13	435
	Sand, coarse; white and brown	19	454
	Sand, medium; white and brown	21	475
	Sand, medium to coarse; white and brown	31	506
	Sand, coarse; clay "streaks"	10	516
	Sand, coarse; white and brown	8	524
	Clay	4	528
	Sand, medium to coarse; white and brown	9	537
	Sand, coarse; white and brown	10	547
	Sand and gravel; wood	10	557
	Clay and sand; micaceous	10	567
AA-Bb 21	(Brookhart, 1949, p. 95)		
AA-Bb 65	(Altitude 240 feet)		
	Clay, hard; gray	3	3

Table 7. Drillers logs of the wells used in the correlation cross-section network of Southern Maryland--Continued

Well		Thickness (feet)	Depth to base (feet)
	Clay, hard; red	29	32
	Clay, soft; red and white	24	56
	Sand, fine	9	65
	Clay, medium hard; white	13	78
	Clay, medium hard; sand "streaks"	21	99
	Sand, fine, to coarse	7	106
	Clay, medium hard; red	11	117
	Clay, medium hard; white	4	121
	Clay, medium hard; brown	5	126
	Clay, medium hard; gray	10	136
	Sand, medium to coarse	32	168
	Clay, hard; blue	10	178
	Rock, weathered	6	184
AA-Bc 161	(Altitude: 85 feet)		
	Fill, marshy sand; roots	5	5
	Sand, coarse; brown and gravel	7	12
	Clay, medium hard; white	5	17
	Sand, fine to medium and clay, white	12	29
	Sand, fine and layers of clay, white	13	42
	Clay, medium hard, sandy; white	5	47
	Sand, medium to coarse; brown	29	76
	Sand, fine to medium	19	95
	Clay, hard; white	7	102
	Sand; hard; brown	7	109
	"Sandstone"; "streaks" of sand	12	121
	"Sandstone" and sand layers; traces of clay, red	6	127
	Sand, medium soft; yellow; hard "streaks"	11	138
	Sand, medium hard; yellow; "rocks streaks"	9	147
	Sand, fine to medium; brown	4	151
	Clay, hard; white; sand "streaks"	22	173
	Sand, fine; clay "streaks"	23	196
	Sand, fine; traces of clay, white	10	206
	Sand, fine	20	226
	Sand, fine to medium	21	247
	Clay, medium hard; white; sand layers	16	263
	Sand, fine to medium; traces of clay, white	33	296
	Sand, medium to coarse, clay "streaks"	7	303
	"Rock"	-	303
	Clay, hard, sandy; gray and white	7	310
	Clay, medium hard, sandy; abundant wood	20	330
	Clay, medium hard, sandy; layers of sand, fine	36	366
	Clay, medium hard, sandy; white; sand layers	24	390
	Sand, fine, muddy; white	12	402
	Clay, hard; gray, traces of wood	28	430
	Clay, soft, sandy; gray to black; wood	17	447
	Clay, hard; red and gray	11	458
AA-Bd 98	(Altitude: 75 feet)		
	Soil, sand; brown	4	4
	Clay, medium soft, sandy; white	8	12
	Sand, medium to coarse; brown	8	20
	Sand, medium to coarse and gravel; clay white layers	47	67
	Clay, hard; white	2	69
	Sand and some gravel; clay, white layers	6	75
	Sand, fine to medium; clay, white layers	10	85
	Sand, fine to medium, brown	7	92
	Clay, hard; white; thin sand "streaks"	13	105
	Sand, fine to medium; brown; thin clay "streaks"	10	115
	Sand, fine to coarse	10	125
	Sand, medium to coarse; brown	12	137
	Clay, hard; white; thin sand "streaks"	14	151
	Sand, hard, medium to coarse, brown	9	160
	Clay, white and sand, fine to medium; brown; "streaks"	11	171
	Clay, hard, sandy; red and gray	14	185
	Clay, hard, sandy; brown and red	15	200
	Sand, fine to medium; brown	24	224
	Clay, hard; red, brown, and grey; sand traces	17	241
	Clay, hard; mixed colored	4	245
	Clay, medium hard; "changing to blue"	20	265
	Clay, hard; blue; soft "streaks"	20	285
	Clay, medium hard; red, gray, white	41	326
	Clay, medium hard; mixed colored; wood	20	346
	Clay, hard; mixed colored; wood	18	364
	Clay, medium soft; and "streaks", wood	20	384
	Clay, hard; red and gray	24	408
	Clay, medium hard; brown and white; sand "streaks"	52	460
	Clay, sandy; white	5	465
	Clay, white; layers of sand, fine	15	480
	Clay, hard; mixed colored	10	490
	Clay, hard; mixed colored; soft "streaks"	39	529
	Clay, medium soft; gray and white	9	538
	Clay, gray and white; traces of sand and wood	7	545
	Clay, hard; mixed colored	5	550
	Sand, medium to coarse; gray and gravel, small	15	565
	Clay, white	2	567
	Sand, medium to coarse; gravel, small	21	588
	Clay and sand "streaks"	8	596
	Sand, medium to coarse; gravel, small	5	601
	Sand and clay "streaks"	11	612
	Clay, hard, sandy; gray to green	13	625
	Rock, hard	-	625
AA-Be 58	(Brookhart, 1949, p. 107)		
AA-Bf 49	(Altitude: 50 feet)		
	Clay, sandy	6	6
	Sand, brown	10	16
	Clay, hard; white	17	33
	Sand, medium to coarse	18	51
	Sand, medium to coarse; clay "streaks"	8	59
	Clay, hard; white	3	62
	Clay, hard; pink	3	65
	Clay, hard, white	10	75
	Clay, hard; pink	10	85
	Sand, fine to medium	9	94

Table 7. Drillers logs of the wells used in the correlation cross-section network of Southern Maryland--Continued

Well	Thickness (feet)	Depth to base (feet)
Clay, soft; white	3	97
Sand, fine	7	104
Clay, soft; white, wood "streaks"	4	108
Sand, fine	8	116
Clay, soft; white; sand, fine "streaks"	17	133
Sand, fine	18	151
Sand, coarse	9	160
Clay, soft; white; sand, fine "streaks"	7	167
Sand, fine to coarse	11	178
Clay, medium hard; white	9	187
Clay, soft; white	8	195
Sand, fine	5	200
Clay, medium hard, white	4	204
Sand, fine	3	207
Clay, hard; red	9	216
Clay, hard; white	4	220
Sand, very fine	8	228
Sand, fine to coarse	16	244
Clay, hard; red	6	250
Clay, hard; gray and white	13	263
Sand, fine; white	7	270
Clay, soft; white; "streaks" of sand, fine and wood	15	285
Clay, hard; gray	9	294
Sand, fine to coarse; gravel, small	20	314
Clay, hard; red and white	8	322
Clay, soft; white	5	327
Clay, medium hard; gray	34	361
Sand, fine, "dirty"	6	367
Sand, fine; clay, white "streaks"	9	376
Sand, fine; "clean"	32	408
Clay, hard; red, white, and gray	15	423
Sand, medium to coarse	11	434
Clay, hard; red, white, and gray	27	461
Clay, hard; gray and white; and "streaks" of sand, fine; gray	9	470
Sand, fine to medium; gray; wood	20	490
Clay, soft; gray and sand "streaks"	14	504
Clay, hard; mixed colored	11	515
Clay, soft; mixed colored and sand "streaks"	50	565
Sand, fine to coarse; gravel, small	11	576
Clay, hard; mixed colored	31	607
Sand, fine to medium; clay "streaks"	48	655
Clay, very hard, red	6	661
AA-Cb 2 (Altitude: 170 feet)		
Clay, sandy; brown	19	19
Clay, white	2	21
Sand, brown	24	45
Sand, yellow	3	48
Clay, red and white	10	58
Clay, red	22	70
Clay, red and white	22	92
Clay, white	28	120
Clay, white and yellow	6	126
Clay, brown	7	133
Clay, red and white	4	137
Clay, white	3	140
Clay, red and white	13	153
Clay, dark red and white	17	170
Clay, green and white	7	177
Clay, greenish brown	4	181
Clay, white and "streaks" of sand, fine	8	189
Clay, white	4	193
Sand, medium to coarse; white	35	228
Clay, white	5	233
Clay, white; and "streaks" of sand	3	236
Sand, medium to coarse	16	252
Clay, red and brown	17	269
Clay, white	1	270
Sand, fine	2	272
Clay, red and brown	23	295
Clay, brown; and sand "streaks"	8	303
Clay, brown	14	317
Clay, sandy; white	2	319
Clay, red; and "streaks" of sand	7	326
Sand, coarse	3	329
Clay, red and hite; "streaks" of sand	11	340
Sand, coarse; white	28	368
Clay, red and white and "streaks" of sand	11	379
Sand, fine to medium	3	382
"Rock"	1	383
Clay, gray; and wood	14	397
Clay, red and white	33	430
Clay, brown and white	34	464
Clay, red and white	38	502
Clay, brown; and sand "streaks"	4	506
"Rock", sandy	10	516
Clay, red, yellow, and white	30	546
Clay, white and brown	26	572
Clay, white	1	573
Sand, fine; white	8	581
Clay, white	1	582
Sand, fine to medium; white	16	598
Sand, coarse; white	15	613
Clay, white and "streaks" of sands	10	623
Sand, coarse; white; wood	27	650
Clay, green	9	659
Rock	-	659
AA-Cc 78 (Altitude: 178 feet)		
Fill	10	10
Clay, white and yellow	7	17
Clay, red and white	3	20
Clay, hard; red	12	32
Clay, hard; red, yellow, and white	6	38
Clay, white	4	42
Clay, brown and white	4	46

Table 7. Drillers logs of the wells used in the correlation cross-section network of Southern Maryland--Continued

Well	Thickness (feet)	Depth to base (feet)
Clay, gray and sand, white "streaks"	34	80
Sand, white	2	82
Sand, and clay, white "streaks"	16	98
Sand, medium, white	22	120
Sand, and clay, white "streaks"	30	152
Sand, coarse	14	166
"Rock"	1	167
Clay, red	7	174
Clay, red, yellow, and red	44	218
Clay, gray and sand "streaks"	10	228
Clay, hard; red and white	18	246
Clay, hard; red, yellow, brown, and white	19	255
Clay, red and gray	5	260
Clay, red and gray and sand "streaks"	5	265
Sand, fine; brown	8	273
Sand, medium; brown	10	283
Sand, coarse, brown	7	290
Sand and clay, white, "streaks"	12	302
Clay, hard, red and white	10	312
Sand, coarse; brown	18	330
Sand, white and red	6	336
Sand, brown and clay, white "streaks"	17	353
Clay, hard; red and white	6	359
Clay, hard, brown	27	386
Clay, hard; brown and white	14	400
Clay, hard; mixed colored	19	419
Sand, medium, white	12	431
Clay, sandy; gray	12	443
Clay, sandy; sand "streaks"; wood	13	456
Sand, medium, white; wood	17	463
Clay, gray	11	474
Clay, white and sand "streaks"	32	506
Sand, coarse, white	11	517
Clay, hard, brown, red and white	53	570
Clay, hard; red, white, yellow; "rock streaks"	24	594
Clay, hard; red and yellow	42	636
Clay, hard; brown and green	44	680
Sand	2	682
Clay, white	6	688
Sand, fine to medium; white	43	731
Clay, sandy; gray and white	35	766
Sand and "streaks" of clay, gray; wood	79	845
Sand, fine and "streaks" of clay, white	10	855
Sand, fine to medium and "streaks" of clay	15	870
Sand, coarse and clay, white	10	880
Clay, very hard; gray; wood	28	908
Clay, green and rock, weathered	8	916
Rock	-	916
AA-Cc 86 (Altitude: 53 feet)		
Clay, sandy, brown and gravel	5	5
Sand and gravel; some clay, white	45	50
Clay, hard; gray; gravel "streaks"	16	66
Sand and gravel layers; "streaks" of clay, white	15	81
Sand and "rock streaks"	5	86
Clay, red and gravel	9	95
Clay, medium hard; red and gray	27	122
Clay, medium hard; red and gray; gravel "streaks"	28	150
Sand, fine;gray; clay, gray "streaks"; wood	22	172
Clay, sandy, gray; thin sand layers	11	183
Clay, sandy; gray and red	10	193
Clay, hard, sandy; red	10	203
Clay, hard, sandy; red and white	10	213
Clay, hard, sandy; red, white, and gray; sand "streaks"	10	223
Sand, fine; gray	8	231
Clay, hard, sandy; red, white, and gray; sand "streaks"	8	239
Clay, hard, mixed colored; wood	9	248
Sand, fine to medium; brown; wood	26	274
Sand, fine to medium; brown	10	284
Clay, medium hard, sandy; red and white	10	294
Clay, medium hard; red, white, and brown; traces of sand	10	304
Clay, hard; mixed colored; some sand	20	324
Clay, medium hard; mixed colored; red, white, and gray; some sand	8	332
Sand, fine and clay, mixed colored	10	342
Sand, fine to medium; gray; wood	23	365
Sand, fine to medium; brown; wood	18	383
Sand, fine to medium; clay "streaks"	29	412
Sand and clay layers; wood	8	420
Clay, hard, sandy; red	18	438
Clay, hard, sandy; red; and sand layers	13	451
Sand, fine, clayey; gray; and wood	40	491
Clay, hard; red, brown, and gray	59	550
Clay, hard, sandy; red; wood "streaks"	25	575
Sand, medium to coarse; brown	29	604
Sand and clay layers	6	610
Clay, medium to hard; gray; "rock streaks"	6	616
Clay, medium hard, red and gray	50	666
Clay, red, gray, and brown; sand and wood "streaks"	32	698
Clay, soft; sand layers	18	716
Clay, hard to very hard; mixed colored	81	797
Clay, hard, sandy; brown; wood "streaks"	32	829
Sand and clay "streaks"	20	849
Sand, medium to coarse; brown	20	869
Sand, medium to coarse; brown, clay layers	20	889
Clay, medium soft; layers of sand, fine	16	905
Sand, medium to coarse; layers of clay	15	920
Clay, medium hard; "rock streaks"	4	924
Sand, medium to coarse; gray	12	936
Sand, medium to coarse; gray; clay layers; wood	26	962
Clay, red, white, and brown; sand layers	54	1016
Sand, medium to coarse; clay "streaks"	24	1040
Sand, fine, hard	18	1058

Table 7. Drillers logs of the wells used in the correlation cross-section network of Southern Maryland--Continued

Well	Thickness (feet)	Depth to base (feet)
AA-Cd 43 (Altitude: 130 feet)		
Clay, sandy; brown; and gravel	20	20
Clay, sandy; brown	20	40
Clay, sandy; gray	30	70
Clay, gray	65	135
Clay, gray; and sand	20	155
Clay and gravel	5	160
Sand, clay, and wood	7	167
Sand and gravel	13	180
Sand and gravel; some clay	7	187
Sand and gravel	17	204
Sand and clay	7	211
Sand	7	218
Clay	11	229
Sand	7	236
Clay	12	248
Sand	9	257
Clay, sandy	2	259
Sand	28	287
Clay, sandy and clay	33	320
Clay, red	20	340
Clay and sand; pink and white	154	494
AA-Ce 80 (Altitude: 60 feet)		
Sand, brown	14	14
Clay, gray and white	8	26
Clay, white	28	54
Sand, fine; some clay, white	10	64
Sand, coarse	12	76
Clay, white	2	78
Sand, coarse	14	92
Sand, fine and some clay, white	16	108
Clay, red and white	8	116
Sand, fine; white	14	130
Sand, coarse	9	139
Sand, red; and clay, white	14	153
Clay, white; and some sand, fine	13	166
Sand, fine	12	178
Sand, fine; and clay, red and white	12	186
Sand, coarse	23	209
Sand, coarse; clay, white "streaks"	9	218
Clay, red and white	4	222
Sand, fine, white; and clay, brown and white	27	249
Sand, coarse	14	263
Sand and clay, white "streaks"	2	265
Sand, coarse	6	271
Sand and clay "streaks"	8	279
Sand, coarse; some clay, red	10	289
Clay, red and white	129	418
Sand; some clay, red	5	423
Sand, fine; some clay, red	10	433
Sand, coarse	14	447
Clay, white	1	448
Sand, coarse	12	460
Clay, red and white	6	466
Sand; clay "streaks"	10	476
Sand, coarse	14	490
Clay, white	3	493
Sand, fine	4	497
Clay, white and red	2	499
Sand, coarse	6	505
Sand, medium	10	515
Clay, red and white	13	528
Clay, gray	5	533
Gravel, coarse	20	553
Clay, hard; red	25	578
Clay, red; and "sandstone"	7	585
Clay, hard; red	17	602
AA-Cf 61 (Altitude: 58 feet)		
Clay, sandy; red	10	10
Clay, soft, sandy; blue	11	21
Clay, soft, sandy; brown	24	45
Clay, medium hard; gray	45	60
Clay, soft, sandy; gray	15	75
Clay, medium hard; dark gray	10	85
Sand, fine to coarse; wood	20	105
Sand, medium to coarse; wood	27	132
Clay, hard; black	8	140
Clay, medium hard; white; some sand, fine	7	147
Clay, medium hard; dark gray	5	152
Sand, coarse and gravel, small	7	159
Clay, white; some sand, fine	9	168
"Ironstone Formation"	6	174
"Rock"	1	175
"Ironstone Formation", soft	5	180
"Ironstone Formation", hard	2	182
Clay, medium hard; gray; some sand, fine	28	210
Sand, fine; "dirty"	10	220
Sand, fine; clay "streaks"	8	228
Sand, fine; brown	12	240
Sand, fine; "streaks" of clay, pink	9	249
Clay, white; some sand, fine	17	266
Clay, medium hard, white	14	280
Sand, fine	11	291
Clay, hard, pink	8	299
Sand, fine, "streaks" of clay, white	11	310
Sand, fine to coarse and gravel, small	15	325
Sand, fine; "streaks" of clay, gray	20	345
Sand, medium to coarse	4	349
Clay, soft; white; and sand, fine "streaks"	21	370
Clay, medium hard, pink	5	375
Sand, fine; brown	4	379
"Rock", hard	3	382
Clay, very hard; gray	18	400
Clay, very hard; red	66	466
Clay, hard; red; soft in spots	54	520

Table 7. Drillers logs of the wells used in the correlation cross-section network of Southern Maryland--Continued

Well		Thickness (feet)	Depth to base (feet)
	Sand, fine	5	525
	Clay, medium hard; mixed colored	5	530
	Sand, very fine; "dirty"	20	550
	Clay, hard; red	16	564
	Sand, fine; "streaks" of clay, red	23	587
	Clay, hard; red and gray	16	603
	Sand, fine	7	610
	Clay, hard; red	8	618
	Clay, very hard; red	16	634
	Sand, fine	23	657
	Clay, hard; pink	115	672
	Clay, hard; pink; "rock streaks"	12	684
	Clay, hard; red	10	694
	Sand, fine to medium	11	705
	Clay, medium hard; red and white	5	710
	Sand, fine to coarse; "streaks" of clay, white	12	722
	Sand, fine	42	764
	Clay, hard; red and white	7	771
	Sand, fine	12	783
	Clay, very hard; red	49	832
	Sand, fine, "dirty"; brown	13	845
	Clay, medium hard; mixed colored	20	865
	Sand, fine; white	20	885
	Clay, medium hard; red; "streaks" of sand	10	895
	Clay, medium hard; red	25	920
	Clay, very hard; red	8	928
	Clay, hard; soft spots	42	970
	Sand, fine; white	9	979
	Clay, medium soft; red; "streaks" of sand fine	7	986
	Clay, hard; red	22	1008
AA-Cf 22	(Otton, 1955, p. 277)		
AA-Cg 18	(Altitude: 8 feet)		
	Clay, yellow and gray	10	10
	Sand, medium-coarse; brown	30	40
	Sand, fine; brown	30	70
	Sand, fine; green	50	120
	Sand, fine; green and clay, yellow	30	150
	Clay, sandy; green	20	170
	Sand, fine; green	20	190
	Clay, soft, sandy; green	48	238
	Sand, fine-medium; freen	12	250
	Sand, coarse and gravel	34	284
	Clay, hard; gray and black	36	320
	Clay, hard, gray and white	41	361
	Clay, hard; red and white	11	372
	Sand, fine to medium; white	10	382
	Sand, medium to coarse; white	20	402
	"Rock", red	-	402
	Clay, very hard; red	64	466
	Clay, hard, white	13	479
	Sand, fine, white	10	489
	Sand, medium to coarse; white	40	529
	Clay, red and white	16	545
AA-Dd 36	(Altitude: 145 feet)		
	Clay, soft; yellow	7	7
	Sand, fine; white	7	14
	Clay, hard; gray; thin layers of sand	40	54
	Clay, hard, light gray	11	65
	Clay, light brown	18	83
	Sand, fine; "salt and pepper"	44	127
	Sand, medium to coarse; "salt and pepper"	23	150
	"Rock"; light green	1	151
	Sand, fine; "salt and pepper"	16	167
	Sand, fine; "salt and pepper"; clay, brown layers	15	182
	Sand, medium to coarse; "salt and pepper"; clay, brown layers	18	200
	Sand, "salt and pepper"; shell layers	9	209
	Sand, medium to coarse; "salt and pepper"	13	222
	Clay	5	227
	Sand, fine, muddy; black	29	256
	Clay, soft; dark gray	44	300
	Sand, coarse; white; wood	38	338
	Sand, coarse; white	13	351
AA-De 91	(Altitude: 70 feet)		
	Clay, sandy; brown	3	3
	Sand, greenish brown	15	18
	Sand, brown and "sandrock"	9	27
	Sand, brown and black	15	42
	Sand, brown and "sandrock"	18	60
	"Sandrock streaks"	.6	66
	Clay, green and sand, black	29	95
	Clay, green; sand, brown; and "sandrock"	10	105
	Clay, sandy; black	55	160
	Clay, black	53	213
	Sand, fine to medium	5	218
	Sand, coarse; white; and gravel	11	229
	Clay, black	-	229
AA-De 92	(Altitude: 120 feet)		
	Clay, hard; brown	10	10
	Sand, black and white; "sandrock"	12	22
	Sand, black and white	9	31
	Sand, brown and "sandrock"	7	38
	"Sandrock", hard; brown	8	46
	Sand, brown; "sandrock streaks"	21	67
	Sand, coarse; brown	21	88
	Sand, coarse; brown; "streaks" of clay, white	18	106
	Sand, coarse; green; "streaks" oc clay, white	9	115
	Sand, brown and white	11	126
	Sand, black and white; "streaks" of clay, black	30	156
	Clay, black; sand "streaks"	29	185
	Clay, sandy, black	4	189
	Sand; coarse, gray	12	201
	Sand, gray and clay, black	15	216
	Clay, hard, sandy; black	7	223
	Sand, coarse, gray	11	234

Table 7. Drillers logs of the wells used in the correlation cross-section network of Southern Maryland--Continued

Well	Thickness (feet)	Depth to base (feet)
Clay, black, sand "streaks"	14	248
Sand, coarse; wood	10	258
Sand, coarse; wood "streaks"	19	277
Sand, coarse; clay "streaks", wood	14	291
Sand, fine and clay, gray	11	302
Sand, medium; gray; wood	10	312
Sand, coarse; gray; wood	21	333
Sand, coarse; gray; hard "streaks"	10	343
"Shellrock and sand streaks"	5	348
Sand, fine and clay, white	8	356
Sand, medium; white	13	369
Sand, white and "streaks" of white clay	13	382
Clay, hard, red	15	397
Clay, red and white	18	415
"Rock"	1	416
Clay, red and white; sand "streaks"	17	433
Clay, mixed colored	12	445
Clay, mixed colored; sand "streaks"	7	452
Sand, medium to coarse; white	11	463
Clay, white	2	465
Sand, coarse; white	10	475
Clay, white	4	479
Sand, medium to coarse; white; "streaks" of clay, white	10	489
Sand, medium to coarse; white	40	529
Sand, coarse; white	11	540
Clay, pink and white	3	543
Sand, fine white and clay "streaks"	10	553
Clay, brown and sand "streaks"	10	563
Sand, brown; clay, red; and "sandrock"	13	576
Clay, red and white; "streaks" of sand and "sandrock"	10	586
Clay, red and white and sand "streaks"	13	599
Sand, coarse; brown; hard "streaks"	9	608
Clay, red and "sandrock"	5	613
"Sandrock", hard	1	614
Clay, hard; mixed colored	28	642
"Rock"	11	653
Clay, soft; mixed colored; sand, fine"streaks"	42	695
Sand; soft, blue and clay	38	733
Clay, hard; mixed colored	7	740
Clay, hard; brown	30	770
Clay, hard; mixed colored	17	787
Clay, mixed colored and sand "streaks"	22	809
Clay, hard; mixed colored	28	837
"Rock", hard	2	839
Clay, hard; mixed colored	14	853
Clay and "streaks" of sand, fine	8	861
Clay, hard	18	879
Sand, "dirty"; hard	15	884
Clay, very hard	23	907
Sand, medium; brown; "streaks" of clay, white	15	922
Clay, hard; red and white	13	935
Sand, medium to coarse; white	32	967
Sand and clay "streaks"	13	980
Sand, medium to coarse; white; hard spots	25	1005
Sand, medium to coarse; white; "clean"	22	1027
Sand, fine to medium; white	17	1044
Clay, very hard; gray	10	1054
AA-Df 79 (Altitude: 5 feet)		
Fill	45	45
"Sandrock" and sand, muddy	19	64
Clay, sandy; green	7	71
Clay, sandy; black	5	76
Sand, "dirty"; black and white	40	116
Clay, sandy; black	33	149
Clay, black; shells	14	163
Clay, black and sand	19	182
Sand, coarse; white	10	192
Sand, coarse; white; wood	16	208
Clay, soft; white and gray	30	238
Clay, sandy; white and gray	4	242
Sand, fine	6	248
Sand, coarse; white	10	258
Sand, coarse; white; wood	16	274
Clay, white and sand "streaks"	6	280
Sand, coarse; white	40	320
Clay, white	4	324
Sand and clay, red and white	6	330
Clay, red and white	10	340
Sand, fine; white	10	350
Sand, medium; white	10	360
Clay, red	20	380
Clay, red and white	2	382
Sand, coarse; brown	20	402
Clay, red and white	4	406
Clay, fine sandy; red and white	6	412
Sand, medium to coarse; red	13	425
Clay, red	9	434
Clay, red and gray	14	448
Clay, red	7	455
Sand, fine; white	20	475
Sand, medium; white	13	488
Clay, red and white and sand	10	498
Sand, and clay, red and white	5	503
Sand, medium; white	7	510
Sand and "streaks" of red and white clay	14	524
Sand, medium; white	8	532
Clay, red and white; sand "streaks"	30	562
Sand; traces of clay, red	8	570
"Rock"	2	572
Sand; traces of clay, red	10	582
Clay, red	3	585
Sand, coarse; brown	7	592
Clay, white	3	595
"Rock"	1	596
Clay, red	18	614

Table 7. Drillers logs of the wells used in the correlation cross-section network of Southern Maryland--Continued

Well		Thickness (feet)	Depth to base (feet)
	Clay, red and white	6	620
	Clay, gray and white; wood	20	640
	Clay, yellow and red	8	648
	"Rock"	1	649
	Clay, green	26	675
	Sand, brown	24	699
	Clay, brown	11	710
	BALTIMORE CITY		
1S4E-19	(Bennett and Meyer, 1952, p. 316)		
3S5E-30	(Bennett and Meyer, 1952, p. 329)		
5S3E-46	(Bennett and Meyer, 1952, p. 345)		
	BALTIMORE COUNTY		
Bal-Gc 18	(Bennett and Meyer, 1952, p. 396)		
Bal-Gf 10	(Bennett and Meyer, 1952, p. 400)		
Bal-Gf 177	(Bennett and Meyer, 1952, p. 427)		
	CHARLES COUNTY		
Ch-Bc 61	(Slaughter and Laughlin, 1966, p. 7)		
Ch-Bf 97	(Altitude: 220 feet)		
	Soil	4	4
	Clay, mixed colored	9	15
	Sand, brown and gravel	22	37
	Gravel, large	10	47
	Clay, blue	5	52
	Marl, green	50	102
	Clay, green	13	115
	Clay, green; sand "streaks"	12	127
	Clay, green; shell "streaks"	25	152
	Clay, gray	50	202
	Clay, "sticky"; brown	45	247
	Sand, fine; shells	13	260
	"Shellrock"	3	263
	Clay and shells	14	277
	Sand and shells; hard	25	302
	Sand, black; shells	50	352
	Clay and shells; some sand	25	377
	Sand, coarse; gray	11	388
	Clay, gray	14	402
	Clay, black and gray	14	416
	Sand, coarse; gray	9	427
	Sand, hard; gray	25	452
	Clay, dark	5	457
	Sand, coarse; white gray, and brown	33	490
	Clay, dark	12	502
	Clay, hard; brown	44	546
	Sand, fine; gray	6	552
	Sand, gray and clay "streaks"	38	590
	Clay, brown; "tough"	12	602
Ch-Bf 127	(Altitude: 215 feet)		
	Clay, brown	11	11
	Sand, gray	9	20
	Gravel, coarse; brown	7	27
	Gravel, coarse; brown; clayey	18	45
	Marl, silty; green	20	65
	Marl, silty; green; some sand, coarse	11	76
	Marl, silty; green	56	132
	Sand, hard; black	4	136
	Clay, green and sand, black	15	151
	Clay, gray	75	226
	Clay, pink	37	263
	Sand, green; clay; and shells	11	274
	"Shellrock"	6	280
	"Shale", hard and sand, green	21	301
	Sand, fine; green, black, and gray	25	326
	Sand, fine; hard; gray, black, and green	35	361
	Sand, fine, silty; gray, black, and green	30	391
	Sand, fine, silty; gray and black	50	441
	Clay, gray, wood; sand "streaks"	4	445
	Sand, gray	6	451
	Sand, hard; gray	34	485
	Sand, gray; clay; and wood "streaks"	16	501
	Sand, hard; gray; some gravel	16	517
	Clay, "tough"; yellow	10	527
	Clay, gray	20	547
	Clay, "tough"; red and yellow	10	557
	Clay, yellow and gray	10	567
	Clay, "tough"; brown	10	577
	Clay, silty; gray	25	602
Ch-Bf 131	(Slaughter and Laughlin, 1966, p. 7)		
Ch-Cb 8	(Altitude: 38 feet)		
	Clay, brown	12	12
	Clay, sandy; brown	2	14
	Sand and gravel	5	19
	Clay, blue	3	22
	Clay, light green	19	41
	Clay, gray; wood	7	48
	Clay, brown; wood	15	63
	Clay, sandy; gray	20	83
	Sand, coarse	11	94
	Clay, sandy; gray	29	123
	Sand, coarse	2	125
	Clay, sandy	5	130
	Sand, coarse	2	132
	Clay, sandy	7	139
	Sand	1	140

Table 7. Drillers logs of the wells used in the correlation cross-section network of Southern Maryland--Continued

Well		Thickness (feet)	Depth to base (feet)
	Clay, sandy	3	144
	Sand	2	146
	Clay, sandy	2	148
	Sand, coarse	4	152
	Clay, green	6	158
	Clay, brown	12	170
	Clay, hard; green	44	214
	Clay, sandy; green	5	219
	Sand, coarse, "free"	10	229
	Clay, green	3	232
	Sand, coarse	10	242
	Unknown	28	270
	Clay, sandy; green	25	295
	Clay, dark red	7	302
	Clay, dark brown	14	316
	Clay, sandy; green	74	390
	Clay, dark brown	38	428
	Clay, sandy; green	24	452
	Clay, gray	12	464
	Clay, sandy; green	42	506
	Clay, gray	31	537
	Clay, sandy; gray; some sand, coarse	23	560
	Clay, sandy; gray	17	577
	Clay, sandy; green	27	604
	Rock, brown and green; mica	9	615
Ch-Cd 24	(Slaughter and Laughlin, 1966, p. 8)		
Ch-Ce 35	(Slaughter and Laughlin, 1966, p. 9)		
Ch-De 32	(Slaughter and Laughlin, 1966, p. 9)		
	DISTRICT OF COLUMBIA		
D.C. 2	(Otton, 1955, p. 306)		
We-Ca 6	(Altitude: 80 feet)		
	Sand, brown and gravel	35	35
	Clay, brown	40	75
	Clay, brown and sand	25	100
	Sand, yellow and clay	5	105
	Clay, blue	53	158
	Clay, sandy; blue	17	175
	Sand, blue and clay	21	196
	Clay, "tough"; blue	46	242
	Sand	14	256
	Clay, "tough"; blue	16	272
	Sand	16	288
	Clay, "tough"; blue	19	307
	Sand and gravel	21	328
	Granite (?)	12	340
WW-Cc 26	(Altitude: 65 feet)		
	Clay, sandy; yellow	23	23
	Clay, sandy; blue	18	41
	Sand, medium and gravel	4	45
	Sand, coarse and gravel	8	53
	Clay, "tough"; blue and black	12	65
	Sand, coarse and gravel	3	68
	Gravel	9	77
	Rock, "rotten"; grading into hard rock	8	85
	DORCHESTER COUNTY		
Dor-Ce 77	(Mack, in preparation)		
	PRINCE GEORGES COUNTY		
PG-Ad 14	(Cooke, 1952, p. 227)		
PG-Bc 1	(Cooke, 1952, p. 165)		
PG-Bc 8	(Cooke, 1952, p. 166)		
PG-Be 22	(Altitude: 130 feet)		
	Clay, sand, and gravel	6	6
	Gravel	2	8
	Sand, and clay, white	3	11
	Clay, red and sand	16	27
	Clay, hard; red	27	54
	Clay, red and white; hard	6	60
	Clay, hard; red and white	6	66
	Sand and gravel, hard spots; brown	19	85
	Sand, white	14	99
	Sand, hard	6	105
	Clay, hard; red	122	227
	Clay, red and white; sand "streaks"	4	231
	Sand, fine; clay "streaks"	13	244
	Sand, fine to medium	25	269
	Sand, coarse; white	11	280
	Sand; layers of clay	10	290
PG-Cc 13	(Cooke, 1952, p. 229)		
PG-Cd 23	(Altitude: 183 feet)		
	Clay, hard; brown	5	5
	Clay, hard; red and white	10	15
	Clay, hard; yellow	14	29
	Clay, light to dark gray	5	34
	Clay, red and white	9	43
	"Sandrock"	1	44
	Sand, medium to coarse; white	20	64
	Clay, white; sand layers	9	73
	Sand, medium to coarse; white	8	81
	Clay, hard; red	11	92
	Clay, yellow	3	95
	Clay, red, white, and yellow	6	101
	Clay, soft, light gray	4	105

Table 7. Drillers logs of the wells used in the correlation cross-section network of Southern Maryland--Continued

Well		Thickness (feet)	Depth to base (feet)
	Clay, light gray; thin sand layers	6	111
	Clay, light brown and white	5	116
	Clay, hard; red	27	143
	Clay, white	3	146
	Clay, brown and white; thin lignite layers	13	159
	Clay, hard; red	18	177
	Clay, soft, sandy; red	10	187
	Clay, sandy; red	18	205
	Clay, red	4	209
	Sand	4	213
	Clay, hard; red and white	15	228
	Clay, very hard; red	106	334
	Clay, soft, sandy; red and brown	7	341
	Clay, soft, red and brown	30	371
	Sand, fine	8	379
	Clay, purple and white; sand layers	19	398
	Sand, fine; white	20	418
	Clay, white; sand layers	12	430
	Sand, white and gravel, small	14	444
	Clay, hard; red	10	454
PG-Ce 16	(Cooke, 1952, p. 230)		
PG-Ce 39	(Altitude: 158 feet)		
	Sand, brown and clay	19	19
	Sand, muddy, gray	2	21
	Sand, silty; black; and clay	38	59
	Clay, hard; dark gray	26	85
	Sand, coarse; white	4	89
	Clay, hard; white	8	97
	Sand, coarse; white; thin clay layers	20	117
	Sand, fine; white; and clay, gray	20	137
	Clay, very hard; gray	11	148
	Sand, coarse; white; "streaks" of clay, red	19	167
	Clay, very hard; red	34	201
	Clay, red and white; wood	17	218
	Sand, hard; "dirty"	19	237
	Clay, very hard; red and white	32	269
	Clay, hard; red; layers of gravel, fine	39	308
	Clay, gray and red	9	317
	Sand, fine to medium; white	16	333
	Clay, hard; red and gray	16	349
	Clay, very hard; red	70	419
	Clay, soft; red; layers of sand	40	459
	Sand, fine, "dirty"; brown; hard spots	14	473
	Clay, hard; gray, red and white, sand and wood layers	20	493
	Clay, very hard; red, gray, and yellow	20	513
	Clay, hard; red and gray; wood layers	20	533
	Sand, coarse; "clean"	10	543
	Clay, soft and sand layers	16	559
	Sand, medium to coarse, silty; brown	14	573
	Clay	4	577
PG-Cf 53	(Altitude: 115 feet)		
	Topsoil and brown clay	12	12
	Silt and clay, brown, gravel and some very fine to very coarse sand, some ironstone concretions	7	19
	Silt and very fine to fine sand, greenish gray, glauconitic, some ironstone concretions	9	28
	Sand, medium to fine, brown	11	39
	Clay, silt and very fine to medium sand, dark gray, appears to have some glauconite	21	60
	Clay, gray and very fine to fine gray sand, some lignite	16	76
	Sand, fine to medium, gray	25	101
	Sand, medium, some coarse and some fine, gray with a few orange grains, a few thin clay streaks	25	126
	Sand, medium to fine, gray	14	140
	Sand, coarse to very coarse, some medium, gray	11	151
	Sand, fine to medium, some very fine, gray	25	176
	Sand, very coarse to fine, light gray, some orange grains	8	184
	Clay, red and very coarse to fine sand, gray	42	226
	Clay, dark gray and some red, some sand	50	276
	Clay, dark gray and some red, some sand	18	294
	Sand, coarse to medium and some clay, red	7	301
	Sand, fine to very coarse, brown, little gravel, few ironstone concretions, drilled soft	23	324
	Same as above with hard streaks	4	328
	Clay, red and dark gray and fine to coarse sand	59	387
	Clay, red, very coarse to fine brownish red sand and some gravel, many ironstone concretions, streaky	14	401
	Clay, red and streaks of sand	5	406
	Sand, very coarse to fine, brownish red, little gravel, a few streaks of clay and little lignite	32	438
	Silt and very fine sand, brown	13	451
	Same as above	8	459
	Sand, medium to fine, some coarse, some very coarse, tan, some lignite and ironstone concretions, drilled soft	12	471
	Same as above with some gravel, drilled hard	3	474
	Clay, silt and fine to coarse sand, red	37	511
	Sand, coarse to fine, tan, a little lignite, some ironstone concretions	17	528
	Sand, red and fine to medium sand	29	557

Table 7. Drillers logs of the wells used in the correlation cross-section network of Southern Maryland--Continued

Well	Thickness (feet)	Depth to base (feet)
Sand, very coarse to medium, some fine, tan, and some gravel, some iron exide	8	565
Sand and clay, hard streaks, drilled like rock	5	570
Sand, fine to medium, some coarse, tan, and a little gravel, a little lignite, a few pieces of pyrite and some iron oxide	10	580
Clay and silt, brownish red and some very fine to fine sand	21	601
Same as above with less sand	25	626
Clay and silt, red	31	657
Sand and clay streaks	8	665
Same as above	5	670
Sand, medium, coarse, to very coarse; some gravel at the top and much fine at the bottom, tan, a little iron oxide at the bottom	17	687
Silt and very fine sand, reddish brown	18	705
Clay, brick red and gray, some silt in places, a few thin indurated zones	83	788
Clay, brick red and gray and streaks of fine to very fine gray sand and silt	5	793
Clay, brick red, gray, brown and mustard	64	857
Sand, fine, silt and clay, brown	4	861
Clay, drilled tough	6	867
Sand, fine to medium some silt and some clay, yellowish brown, micaceous, drilled like sand is tightly packed	6	873
Clay, gray, brownish red and brick red, very tough	33	906
Clay, reddish brown, much silt and much fine sand, micaceous, streaky	8	914
Silt, very fine sand and clay, brownish red, micaceous, streaky	9	923
Sand, fine to very fine, silt and clay, brownish red, micaceous	6	929
Silt, clay and very fine sand, reddish brown and gray, micaceous, packed tight, drilled like thin indurated zones at the bottom	11	940
Clay, silt and some very fine sand, dark gray, micaceous, some lignite, drilled like thin indurated zones at the top, possibly microfossils at the base	21	961
Sand, medium, gravel and streaks of dark gray silt and clay, a little lignite	5	966
Clay, gray, light red, mustard and brick red, very hard	7	973
Sand, medium, some gravel and a few white clay lumps, at the top sand contains much coarse and some very coarse grains and at the bottom much fine sand is present, drilled like streaks of clay are present from 973 feet to 976 feet	20	993
Clay, varicolored, brick red, brown, mustard and gray, extremely tough, a few thin indurated zones	19	1013
Clay, silt and very fine to fine sand, reddish brown and gray, some mica	20	1033
Sand, fine to very fine, silt and some clay, light gray, micaceous, slightly lignitic at the bottom	9	1042
Clay, varicolored, gray, brick red, mustard, brown and heliotrope, some very coarse sand imbedded in clay, extremely tough	36	1078
Sand, fine, silt and some clay, white, much medium sand at the top, much very fine sand and some medium sand at the bottom	9	1087
Clay, silt and very fine to fine sand, purple, micaceous, possibly some microfossils	11	1098
Silt, very fine sand and clay, light gray, micaceous, very lignitic, some pyrite	6	1104
Sand, medium to fine, some coarse, silt and clay, white, some mica, drilled like clay streaks in sand from 1110 feet to 1115 feet	11	1115
Sand, very coarse to coarse, gravel and considerable white silt and clay	3	1119
Clay and silt, brown, very micaceous, very little lignite	13	1132
Clay, silt and fine to coarse sand white, very little gravel, drilled like indurated or gravel zone at 1132 feet	5	1137
Sand, medium to fine, some coarse, considerable silt, white, some gravel at bottom	9	1146
Clay, and silt, dark gray, some mica	4	1150
Sand, medium, some fine, little silt, gray, some mica, some streaks of lignite	1	1151
Gravel consisting mainly of milky quartz, sand, medium to fine at the top and coarse to very coarse at the bottom, some silt and clay, gray	11	1162
Granite, highly weathered at the top and only partially weathered at the bottom, drilled progressively harder at depth, contains quartz, white and light green feldspar mostly weathered to clay biotite and other black minerals	10	1172
PG-Dd 3 (Cooke, 1952, p. 232)		
PG-Df 34 (Altitude: 81 feet)		
Clay, brown and sand, silty	5	5
Clay, hard; pink	32	37
Sand, black; layers of shells and clay	7	44
Sand, black and gray; "streaks" of shell and "rock"	29	73
Sand, brown and gray	5	78
Sand, brown and green, hard; shell and clay	43	121
Sand, hard; brown; clay "streaks"	43	164
Clay, dark gray; shells	53	217

Table 7. Drillers logs of the wells used in the correlation cross-section network of Southern Maryland--Continued

Well		Thickness (feet)	Depth to base (feet)
	Clay, silty	1	218
	"Rock"	2	220
	Clay, silty; gray	16	238
	Sand, coarse; gray and white	27	265
	Sand, coarse; gray and white; clay streaks	32	297
	Sand, gray; "streaks" of clay, white	19	316
	Sand, fine; white; and clay	101	417
	Sand, coarse; brown and gray; wood	13	430
	Clay, "tough", red	10	440
	Clay, "tough"; red and white	16	456
	Sand, clay "streaks"	3	459
	Clay, "tough"; red	19	478
	Clay, silty; red; and sand	18	496
	Sand, coarse, muddy; brown and white	44	540
PG-Eb 1	(Cooke, 1952, p. 197)		
PG-Ec 5	(Cooke, 1952, p. 200)		
PG-Ec 41	(Altitude: 180 feet)		
	Clay, brown	4	4
	Sand, brown and gravel, large	16	20
	Clay, black	34	54
	Clay, gray and white	14	69
	"Rock"	-	69
	Clay, red and white	22	91
	Clay, hard; red	27	118
	Clay, red, gray, and white	20	138
	Sand, dark brown	22	160
	Sand, medium to coarse; brown	23	183
	Clay, gray	11	194
	"Rock"	-	194
	Sand, coarse; brown; and gravel, small	6	200
	Clay, brown and gray	18	218
	Clay, soft, green and gray	10	228
	Sand, coarse; white	31	259
	Clay	1	260
	Sand, coarse; white	6	266
	Clay, hard; brown and gray	21	287
	Sand, medium to coarse; white	3	290
	Clay, light gray	11	301
	Clay, hard; red	20	321
	Clay, very hard; red	11	332
	Clay, soft; red and gray	10	342
	Clay, soft, sandy; gray	20	362
	Clay, medium hard, sandy; gray	21	383
	Clay, soft; gray	23	406
	Clay, sandy; light green	16	422
	Clay, medium hard; brown	16	438
	Clay, very hard; brown and white	8	446
	Clay, hard; red, brown, and white	9	455
	Clay, red, brown, white; layers of sand, fine	9	464
	Clay, brown, red, and white	42	506
	Clay, hard; dark brown and gray	11	517
	Clay, brown and gray; sand, fine	22	539
	Clay, sandy; pink, brown and gray	16	555
	Clay, brown and light green	22	577
	Clay, brown, light green; thin sand layers	43	620
	Sand, medium to coarse; gray	12	642
	Clay "streak"	1	643
	Sand, coarse; gray	12	655
	Clay, dark brown and light green	64	719
	Clay, brown and white	20	739
	Clay, soft; brown, white, and light green	21	760
	No sample	2	762
	Clay, brown, red, and light green	40	802
	Clay, light green; thin sand layers	20	822
	Clay, brown and light green; thin sand layers	20	842
	Clay, hard; brown and dark green	29	871
	Rock	4	875
PG-Ec 48	(Altitude: 75 feet)		
	Clay	3	3
	Gravel	4	7
	Clay, "tough", red	104	111
	Sand, fine; brown	50	151
	Clay	27	178
	Sand	36	214
	Clay, "tough"; gray	50	264
	Sand	1	265
	Clay, "tough", gray	26	291
PG-Ee 49	(Altitude: 215 feet)		
	No sample	25	25
	Sand, very fine; olive green; clayey clauconitic; some gravel	20	45
	Clay, sandy; olive green; plastic	10	55
	Clay, sandy; olive green; shells	15	70
	No sample	5	75
	Sand, fine, clayey; olive; glauconitic	20	95
	Clay, sandy; gray and green; clauconitic; micaceous; plastic	35	130
	Clay, soft, silty; tan; micaceous	25	155
	Sand, fine to coarse; subangular, clayey; dark gray; glauconitic; micaceous; shells	35	190
	Sand, fine to coarse; subangular; glauconitic; micaceous; gray	20	210
	Sand, coarse; greenish gray; clauconitic	10	220
	Sand, fine to coarse, silty; gray; clauconitic	15	235
	Sand, coarse, subrounded, clayey; greenish gray; clauconitic, micaceous, shells	55	290
	Clay, sandy, soft; dark gray; clauconitic; shells	60	350
	Sand, fine to coarse; gray; micaceous	50	400
	Sand, fine to medium, gravelly; "streaks" of clay, sandy; light gray	25	425
	Clay, sandy; orange-yellow, grey, tan; micaceous; gauconite; nodules	25	450

Table 7. Drillers logs of the wells used in the correlation cross-section network of Southern Maryland--Continued

Well	Thickness (feet)	Depth to base (feet)
Clay, very sandy and sand, clayey; variegated, micaceous, hematite nodules	55	505
Gravel, fine; quartzose, yellow, rose, purple; chert, brown; some clay, green, gray, tan; siderite nodules	25	530
Clay, sandy and gravelly; brown and gray; siderite nodules	15	545
Sand, fine to medium; subangular, gravelly; siderite nodules	10	555
Clay, very sandy, soft; brown; siderite nodules	20	575
Sand, coarse, rounded and angular; "clean"	20	595
Clay, sandy; tan, pink, brown; micaceous; pyritic; nodular	45	640
Sand, fine to coarse, angular to subrounded; "clean"	35	675
Sand, coarse, clayey; brownish gray; sandy clay "streaks"	30	705
Clay, sandy; brown; micaceous	5	710
Sand, "clean"; brown	20	730
Clay, sandy; brown, red, yellow; micaceous; hematite nodules	35	765
Sand, fine to coarse, subangular; some clay	40	805
Clay, sandy; brown, orange, red, yellow; hematite nodules	25	830
Sand, clayey, fine to coarse, subangular, brown, gray, orange; hematite nodules	50	880
Clay, sandy; brownish gray	20	900
Clay, soft; variegated	15	915
Sand, clayey; brown, variegated "streaks"	15	930
Clay, sandy; brown, red, yellow, gray, green	20	950
Clay, sandy and sand, clayey; interbedded; variegated	90	1040
Sand, coarse; very clayey; brown	5	1045
Clay, sandy; brown, red, gray; micaceous; sand "streaks"	60	1105
Sand, silty; variegated	5	1110
Clay, sandy; red, brown, yellow; micaceous hematite, nodules; sand "streaks"	60	1170
Sand, coarse, clayey; angular to subanguler; brown	25	1195
Clay, very sandy, variegated; sand "streaks"	45	1240
Sand, clayey; variegated	15	1255
Clay, sandy; brown, gray, red, tan, micaceous	40	1295
Sand, clayey, brownish gray; clay "streaks"	25	1320
Clay and silt; gray, brown, yellow	60	1380
Clay, silty and sandy; brown, yellow, gray	50	1430
Sand, fine to coarse, angular, clayey	45	1475
Sand, clayey and clay, sandy; interbedded; red, brown, gray, green; micaceous; carbonaceous	50	1525
Sand, clayey; reddish brown, olive brown	20	1545
Clay, sandy; micaceous; soft; variegated carbonaceous	15	1560
Clay, silty; soft; brown, greenish gray	15	1575
Clay, silty; soft; reddish brown olive green	20	1595
Clay, silty, soft; micaceous; greenish gray	25	1620
Sand, fine to coarse, angular to subangular, clayey; gray, brown, green; carbonaceous	35	1655
Clay, sandy, soft; greenish gray, brown; carbonaceous	30	1685
Sand, fine to coarse, clayey; greenish gray	25	1710
Sand, medium to coarse, clayey; brown, gray	10	1720
Clay, sandy; dark gray to light gray; carbonaceous fragments; siltstone reddish brown/micaceous	25	1745
Sand, very coarse, very clayey; gray to dark gray; carbonaceous	7	1752
PG-Ee 52 (Altitude: 175 feet)		
Soil	1	1
Clay, white and yellow	11	12
Clay, soft; light green	6	18
Sand, very fine; green	1	19
Clay, light green	3	22
Sand, fine; "salt and pepper"	14	36
Clay, light green; "streaks" of sand, fine	17	53
Sand, medium to coarse; "salt and pepper"	13	66
Clay, light gray	24	90
Clay, medium hard; red	20	110
Clay, hard; red and gray	16	126
Sand, fine; "salt and pepper"; shell	23	149
Clay, gray; "streaks of salt and pepper" sand; shell	9	158
"Rock"; hard	1	159
Salt, fine; "salt and pepper"; streaks of clay, hard; green	10	169
Sand, fine; salt and pepper	30	199
Sand, fine and clay; "shellrock"	2	201
Sand, fine and "shellrock"	48	249
Sand, fine and "streaks" of clay, gray	11	260
Clay, dark gray	29	289
Sand, fine; "salt and pepper"; "streaks" of clay, gray	30	319
Sand, coarse; white; wood	15	334
Clay, hard; red and gray	24	360
Clay, white and gray	5	365
Sand, fine; gray	15	380
Clay, hard; red, white and gray	56	436
Clay, hard; yellow and red	29	465
Sand, fine to medium; white and gray	29	494
Clay, hard; white	6	500
Clay, very hard	29	529
Clay, sandy; red and gray	28	557
Clay, hard; ray	13	570
Sand, medium to coarse; wood	20	590
Clay, hard; mixed colored	40	630

Table 7. Drillers logs of the wells used in the correlation cross-section network of Southern Maryland--Continued

Well		Thickness (feet)	Depth to base (feet)
	Clay, hard; sand "streaks"	18	648
	Clay, hard; red	22	670
	Sand, fine to medium	11	681
	"Rock"	1	682
	"Rock" and and	3	685
	Clay, hard; mixed colored	153	838
	Clay and "rock streaks"	10	848
	Clay, very hard; gray and red	35	883
	Clay, sandy, white; wood	41	924
	"Rock"	-	924
PG-Fb 4	(Cooke, 1952, p. 217)		
PG-Fb 13	(Cooke, 1952, p. 218)		
PG-Fc 31	(Altitude: 95 feet)		
	Clay, yellow	7	7
	Clay, greenish	5	12
	Clay, pink	9	21
	Clay, sandy; gray	10	31
	Clay, mixed colored	11	42
	Clay, pink	10	52
	Clay, pink and gray	13	65
	Clay, gray; shells	32	97
	"Rock"	1	98
	Clay, gray; shells	28	126
	Clay, sandy, gray	63	189
	Clay, white	9	198
	Clay, tan, pink, and white	22	220
	Sand, very fine	32	252
	Clays, mixed colored	21	273
	Clay, greenish yellow	10	283
	Clay, pink and gray	11	294
	Clay, mixed colored; "stick"	31	325
	Clay, mixed colored; hard	45	370
	Sand, fine and clay	99	469
	Sand, coarse sand	11	480
	Clay and sand	25	515
	Clay, sandy; hard	87	602
	Sand, fine	11	613
	Sand, fine; hard	33	646
	Sand, "water-bearing"	16	662
	Sand, fine to medium	4	666
	Clay	3	669
	Sand, medium to coarse	9	678
	Sand and clay; interbedded	7	685
	Sand, coarse	14	699
	Sand and clay; interbedded	11	710
PG-Fd 62	(Altitude: 236)		
	No sample	20	20
	Gravel, poorly sorted, sandy	15	35
	Clay, fine sandy, plastic; greenish gray	5	40
	Gravel, well sorted; very "clean"	5	45
	Clay, fine sandy; plastic; greenish gray	20	65
	Gravel, good sorting, sandy	10	75
	Clay, fine to medium sandy, calcaceous; grayish green; fossil	40	115
	Clay, soft; glauconitic; greenish	30	145
	Clay, sandy; gray; glauconitic; shells	35	180
	Clay, soft, silty; tonnish brown, pink	20	200
	Clay, very sandy; dark gray; glauconitic; shells	30	230
	Clay, silty; gray and tan; glauconitic, shells	15	245
	Sand, fine to coarse; green; "salt and pepper" glauconitic; some shell fragments	75	320
	Clay, fine sandy; light to dark gray; glauconitic; shells	25	345
	Gravel; sandstone and chert fragments	5	350
	Clay, fine sandy; gray; clauconitic; shells	45	395
	Clay, fine to coarse sandy; gray; interbedded sand and gravel; sandstone, quartz, and chert fragments	70	465
	Clay, sticky, yellow to tan	35	500
	Clay, coarsely sandy; light gray	10	510
	Clay, sandy; yellow to tan hematite nodules	35	545
	Clay, sandy; plastic; red to buff	5	550
	Clay, very sandy, yellowish brown to light gray	10	560
	Clay, silty; reddish brown, hematite nodules; "coal" fragments	25	585
	Sand, fine to coarse, gravelly; some clay	20	605
	Clay, sandy, yellowish brown to dark gray "coal"	15	620
	Gravel, fine, sandy; brownish gray	40	660
	Clay, sandy; grayish to yellowish brown, carbonaceous	20	680
	Clay, sandy, gray to brown; pyrite	25	705
	Clay, gravelly to sandy; reddish tan; hematite nodules	15	720
	Sand, fine to medium, clayey, yellow to brown	20	740
	Sand, fine to medium, well sorted; locally gravelly and clayey; carbonaceous fragments; hematite nodules	20	760
	Silt, very sandy; brownish gray	20	780
	Sand, medium; clayey; grayish brown	20	800
	Clay, very sandy; grayish brown; hematite nodules	10	810
	Sand, fine to medium, slightly gravelly; yellowish to grayish brown	25	835
	Clay, sandy; clay "streaks"; reddish to grayish brown	35	870
	Sand, coarse, well sorted; grayish brown	30	900
	Sand, fine to coarse, poor sorting, clayey; light brownish gray; carbonaceous	40	940

Table 7. Drillers logs of the wells used in the correlation cross-section network of Southern Maryland--Continued

Well	Thickness (feet)	Depth of base (feet)
Clay, sandy; tan to grayish brown; reddish	80	1020
Sand, medium to coarse, fair sorting; clayey; grayish brown	25	1045
Clay, sandy; locally plastic; variegated	20	1065
Sand, medium to coarse; "clean" to slightly clayey, gray to locally green	20	1085
Clay, very sandy; pinkish to grayish tan	50	1135
Clay, sandy; gray to brown; sand "streaks"	55	1190
Sand, gravelly, grayish brown	30	1220
Clay, sandy and sand, clayey; grayish brown	65	1285
Clay, sandy; brown, green, gray	10	1295
Clay, sandy; silt pebbles; grayish brown to tannish yellow, hematite nodules	30	1325
Clay, fine sandy; pinkish tan	25	1350
Clay, very sandy; brown, yellow, orange; hematite nodules; pyrite	25	1375
Clay, slightly sandy; pink, tan, green, yellow, few hematite nodules; "tough"	20	1395
Clay, slightly sandy; pinkish tan	25	1420
Clay, fine sandy; small hematite nodules; tan	10	1430
Clay, fine to coarse sandy; sandy layers grayish brown	25	1455
Sand, fine to coarse, clayey; grayish brown	10	1465
Clay, very sandy; grayish brown to pink	15	1480
Sand, medium to coarse, clayey; pinkish tan	25	1505
Clay, sandy; pinkish tan	20	1525
Clay, sandy; light to dark brown	25	1550
Sand, medium to coarse grained; grayish brown, interbedded clay, brown	30	1580
Sand, fine to coarse, clayey; brownish gray	20	1600
Clay, sandy, brownish gray	30	1630
Clay, soft, sandy; buff to tan and clay, salty, dark greenish gray	35	1665
Siltstone, grayish green and gray; clay "streaks"	10	1675
Clay, sandy, gray and brown; carbonaceous; pyrite	10	1685
Sand, coarse, fair sorting, subangular; light gray	10	1695
Clay, sandy; grayish green	15	1710
Sand, fine to coarse, angular to subangular; light gray and clay, dark brown to rusty; greenish	40	1750
Clay, sandy, soft; greenish gray	5	1755
Sand, medium to coarse, angular to subangular; light gray; and siltstone, greenish gray and rusty brown; carbonaceous; hematite nodules	25	1780
Clay, sandy; brown, gray and black, plastic; "coal"	20	1800
Clay, plastic, some sand; reddish brown	15	1815
Mudstone, hematite, red and green mottling; internal slickensides	3	1818

Well	Thickness (feet)	Depth to base (feet)
PG-Hf 23 (Altitude: 7 feet)		
Sand, brown and clay	18	18
Clay, green	210	288
Clay, brown and red "streaks"	8	296
Sand, black and brown	97	393
Sand, brown	41	434
Clay, sandy	96	530
Clay, mixed colored	25	555
Clay, sandy	37	592
Sand, white and gray; wood	31	623
Clay, mixed colors	40	663
Clay, red	14	676
TALBOT COUNTY		
Tal-Cb 89 (Rasmussen and Slaughter, 1957, p. 317)		
Tal-Ce 62 (Altitude: 55 feet)		
Clay, brown	20	20
Clay, green	45	65
Clay, white; crusty	44	109
Clay, sandy; green	66	175
Clay and shells	33	208
Clay, gray	103	311
Clay, sandy; green	82	493
Clay, "tough"; green	105	598
Clay, sandy	21	619
Sand, coarse; brown	30	649
Sand, coarse; brown and clay	20	669
As above; crusty layers	28	697
"Rock"	1	698
Clay, sandy; "rock" layers	45	743
Clay, sandy; green	103	846
Sand, medium; brown	31	877
Sand, brown and clay	10	887
Clay, sandy; green	103	990
Clay and sand, brown	20	1010
Clay, sandy; dark gray	48	1058
Sand, medium; white	34	1092
Clay, sandy	6	1098
Wood	1	1099
Tal-De 16 (Mack, in preparation)		
Tal-De 18 (Mack, in preparation)		

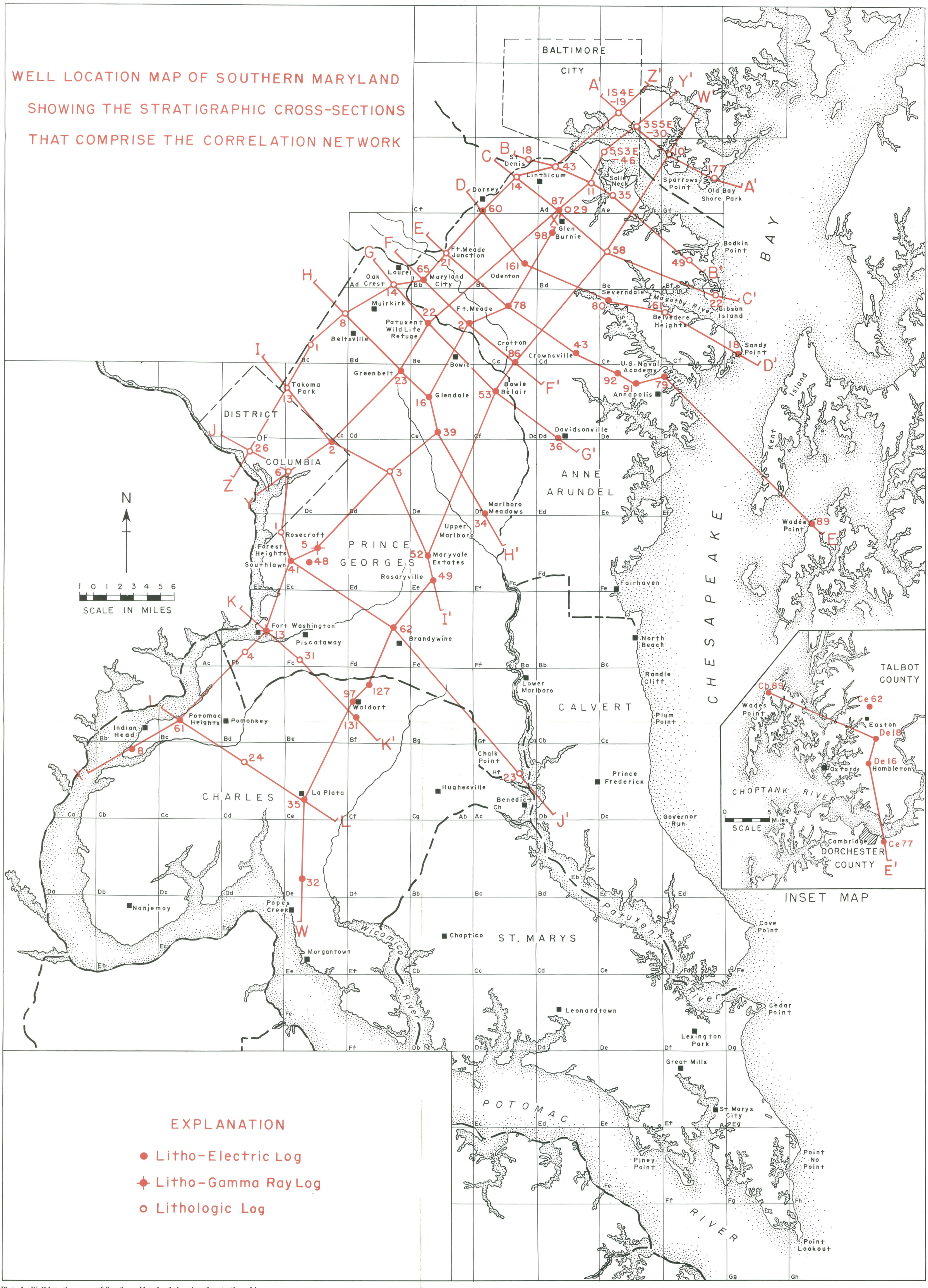

Plate 1. Well location map of Southern Maryland showing the stratigraphic cross sections that comprise the correlation network

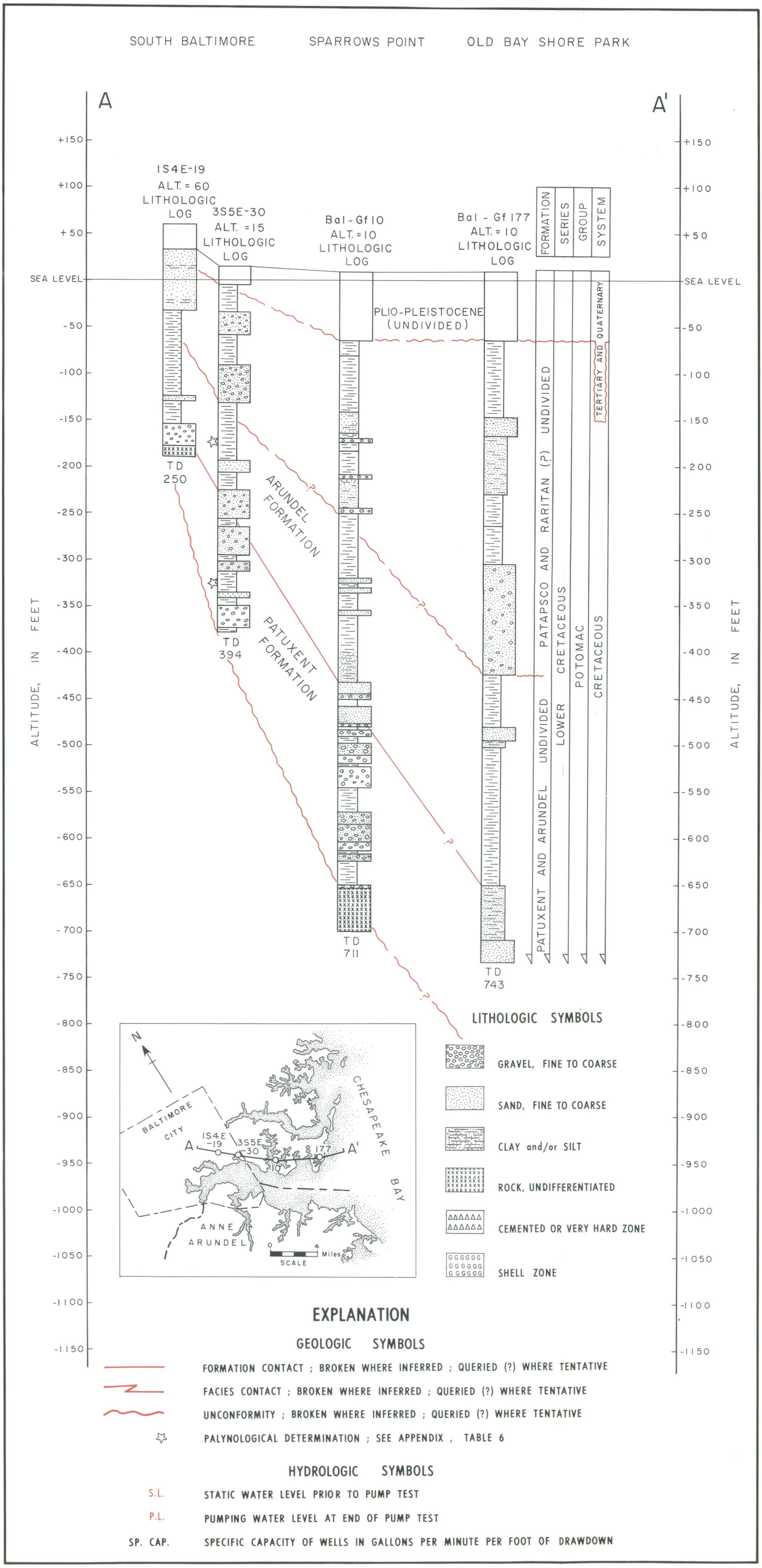

Plate 2. Stratigraphic cross section A-A′ extending from Baltimore to Old Bay Shore Park

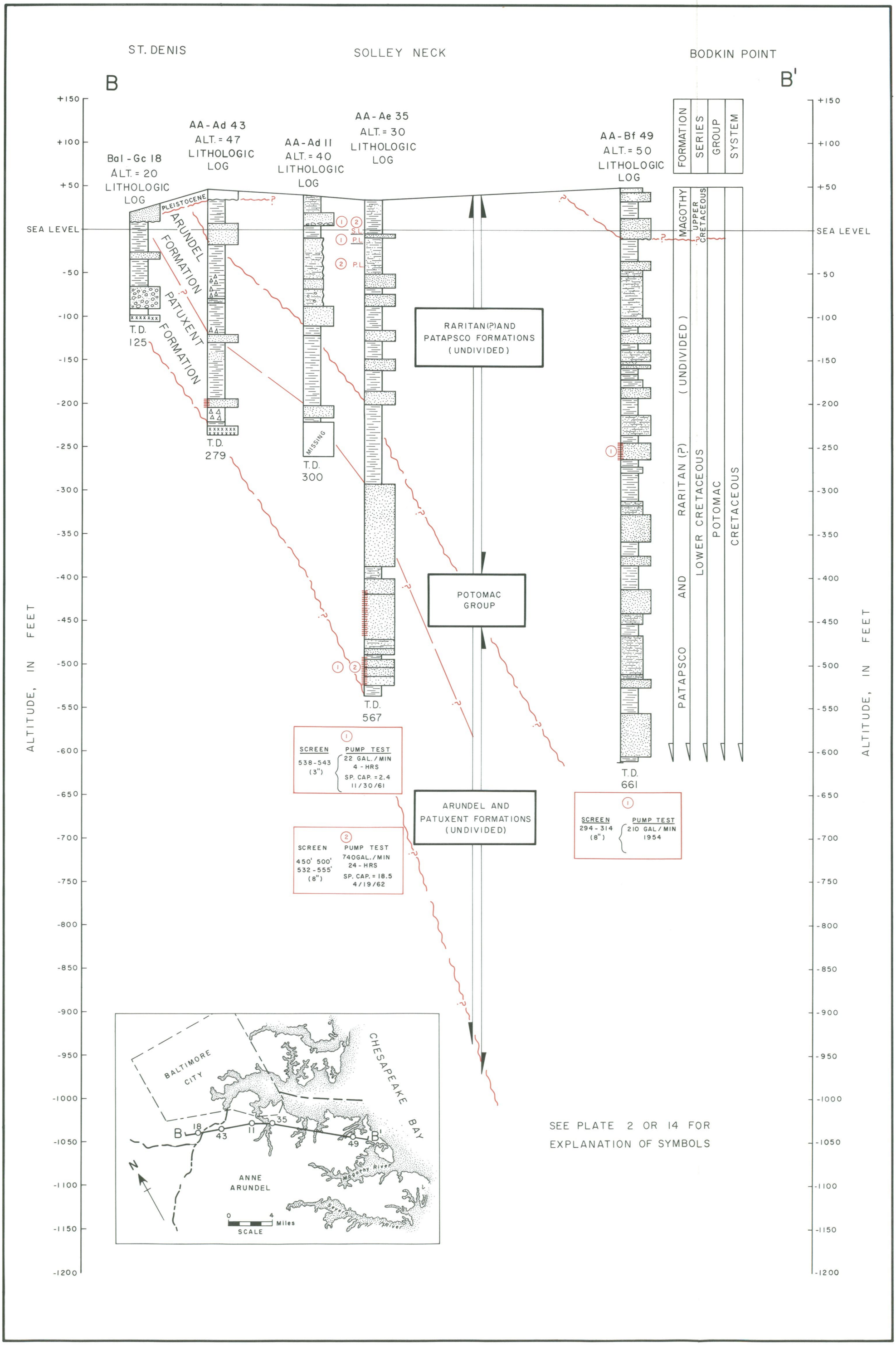

Plate 3. Stratigraphic cross section B-B′ extending from near St. Denis to near Bodkin Point

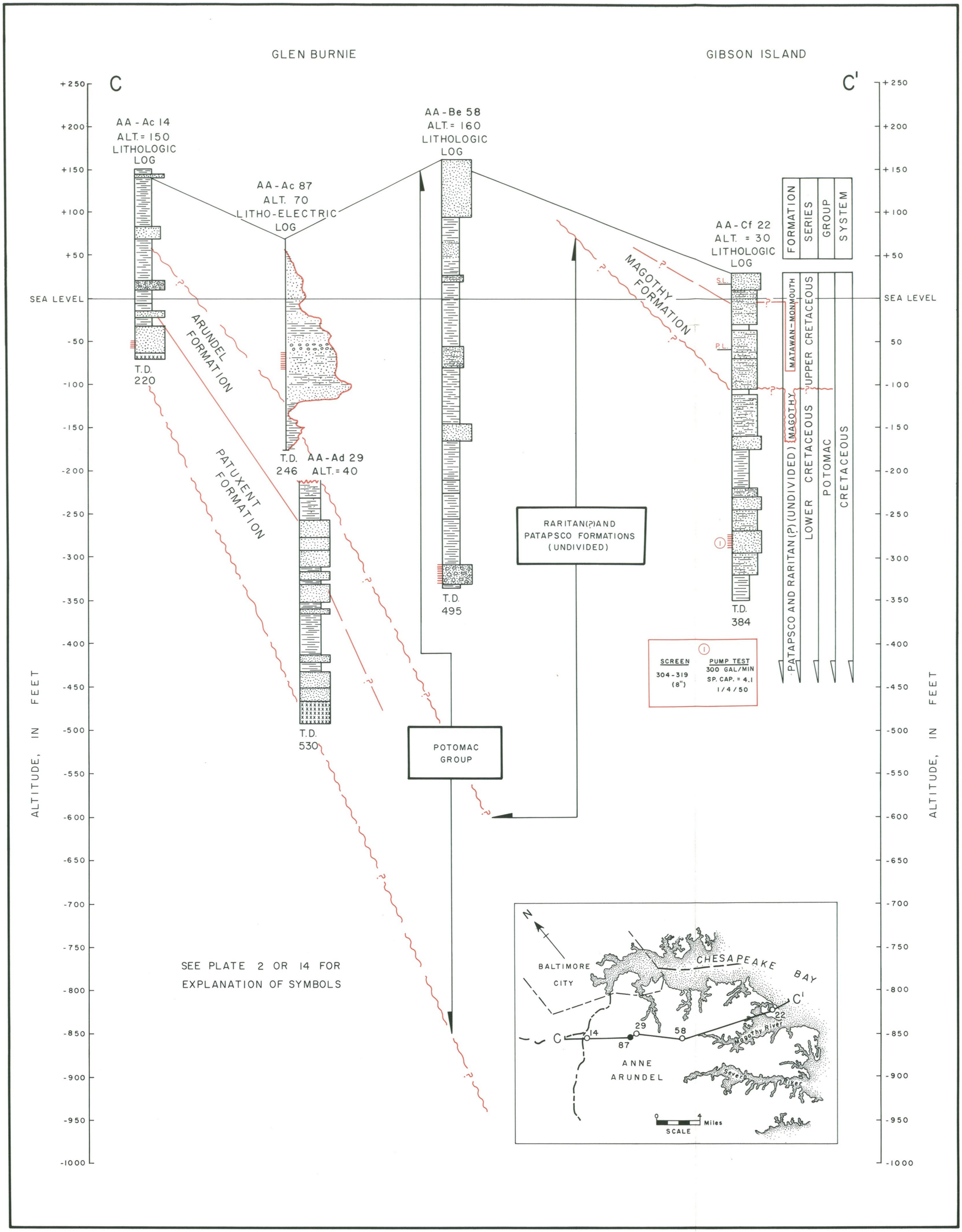

Plate 4. Stratigraphic cross section C-C′ extending from west of Linthicum to Gibson Island

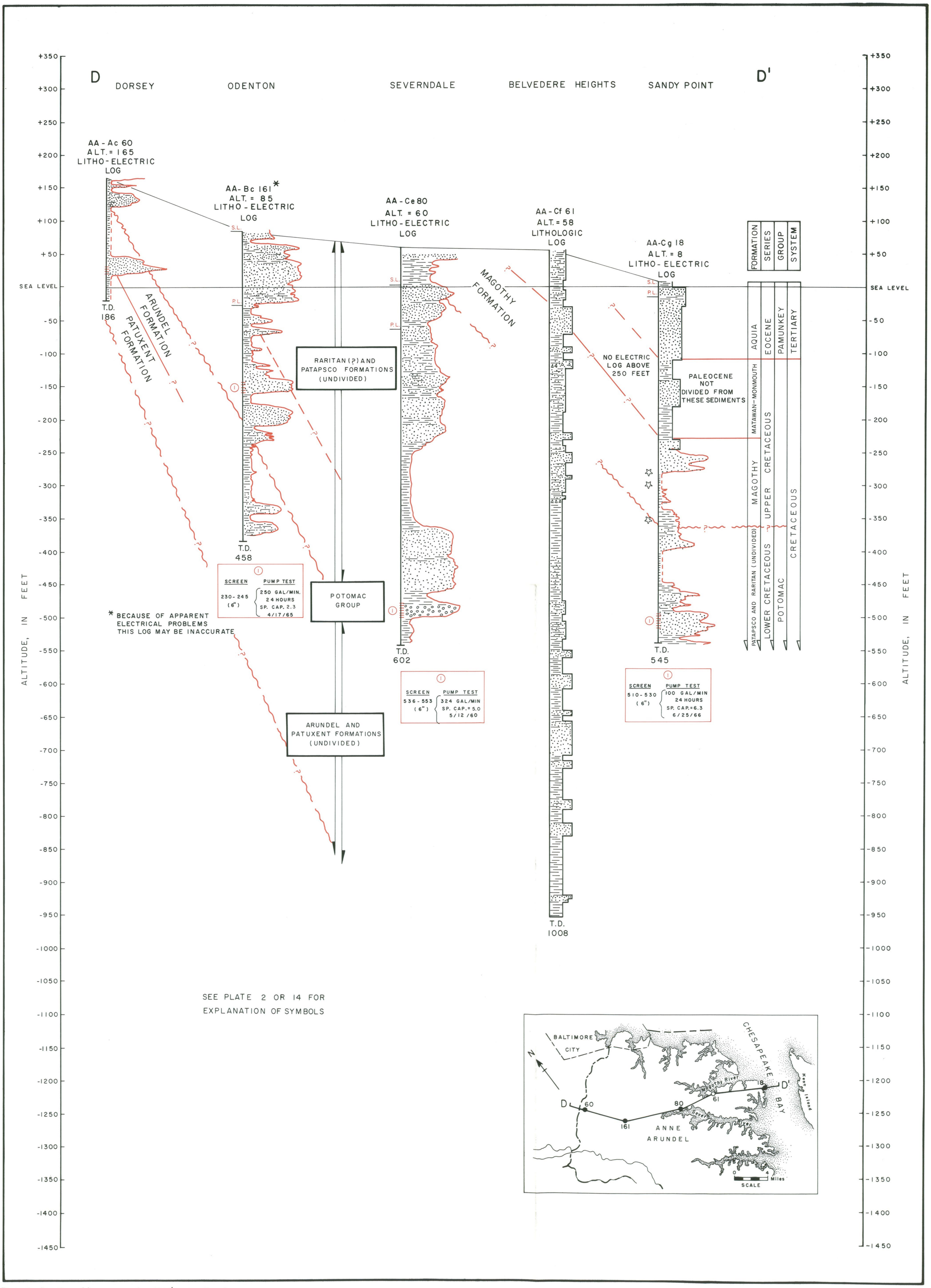

Plate 5. Stratigraphic cross section D-D′ extending from near Dorsey to Sandy Point

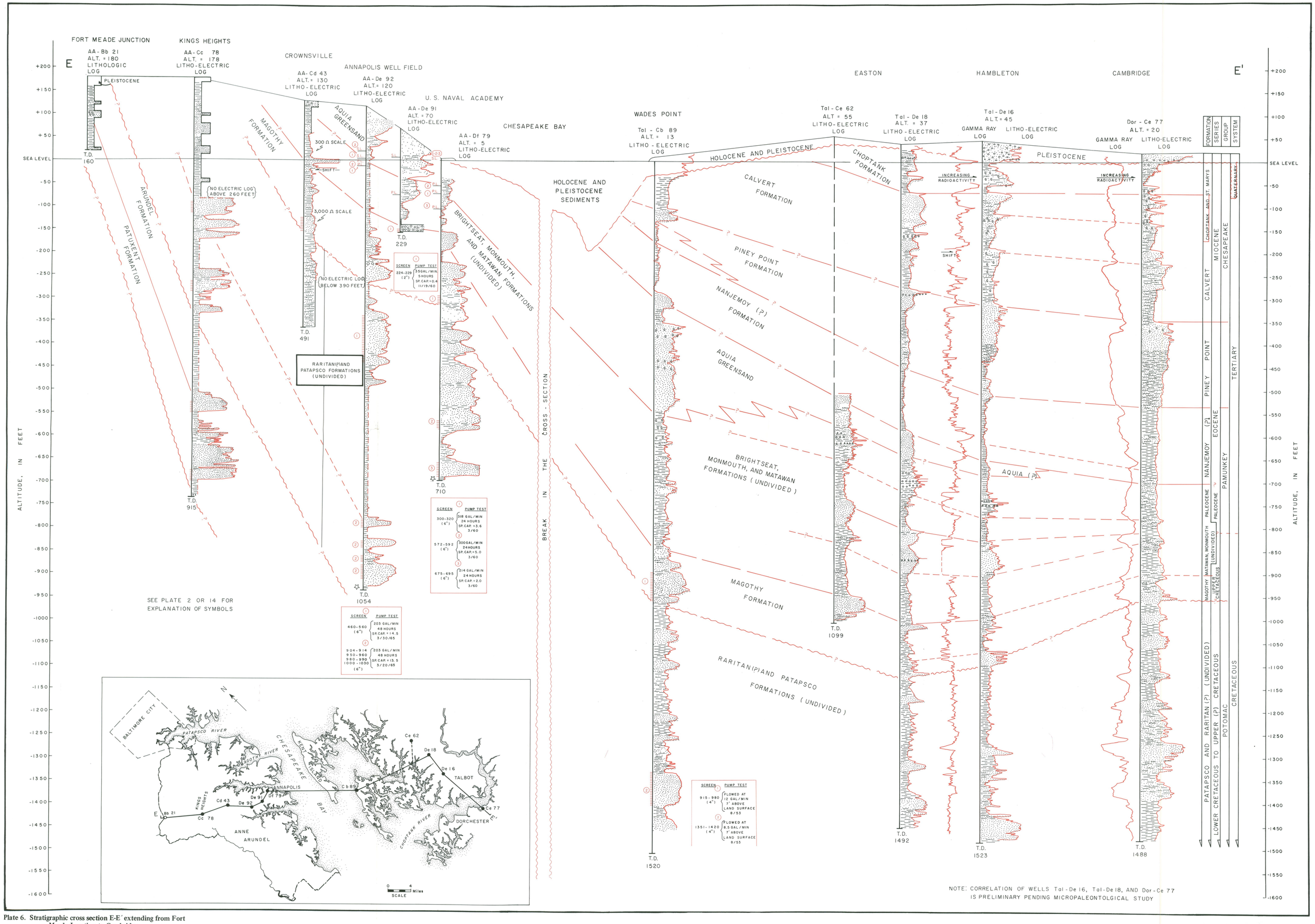

Plate 6. Stratigraphic cross section E-E′ extending from Fort Meade Junction to Cambridge

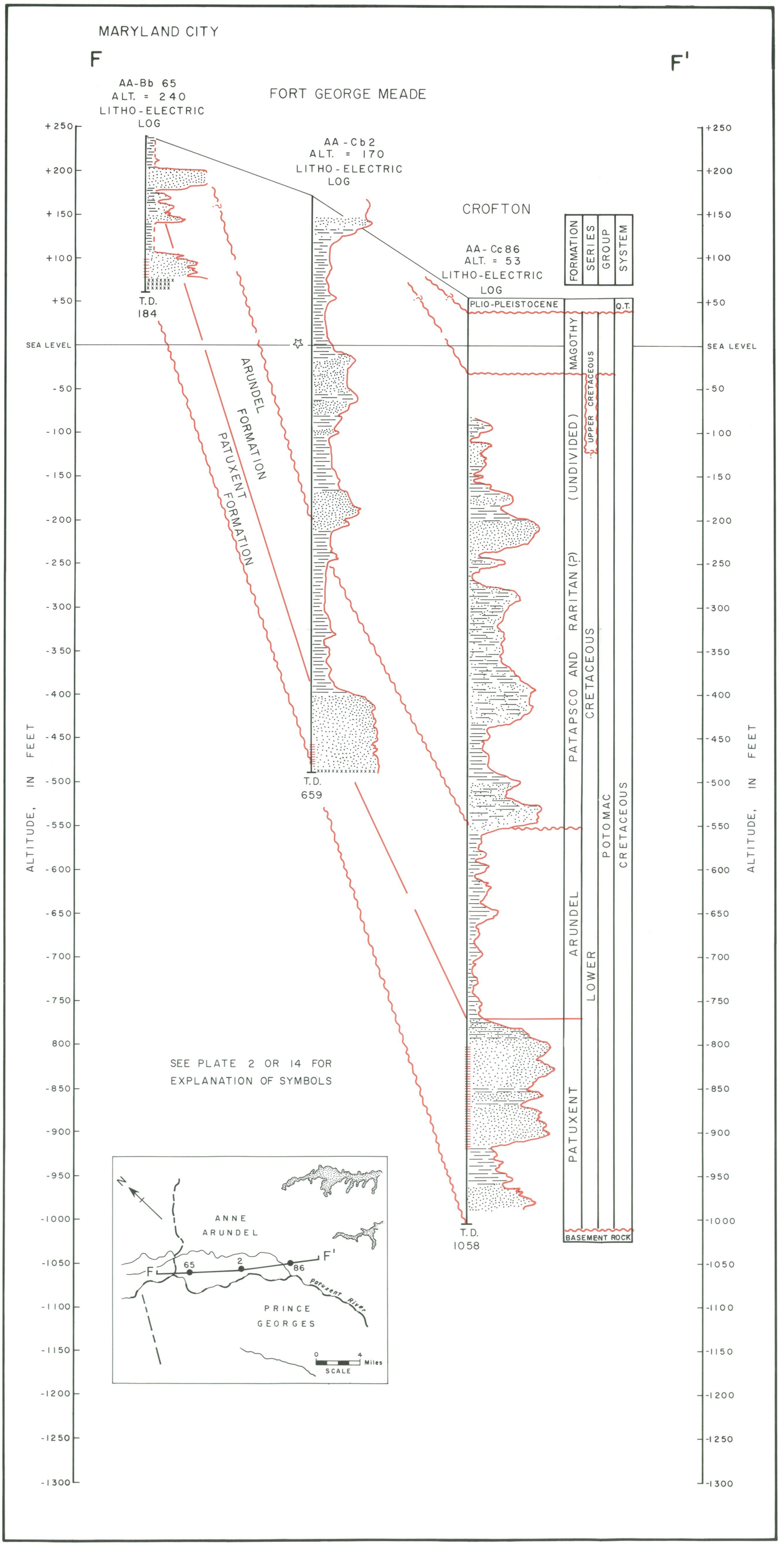

Plate 7. Stratigraphic cross section F-F′ extending from Maryland City to Crofton

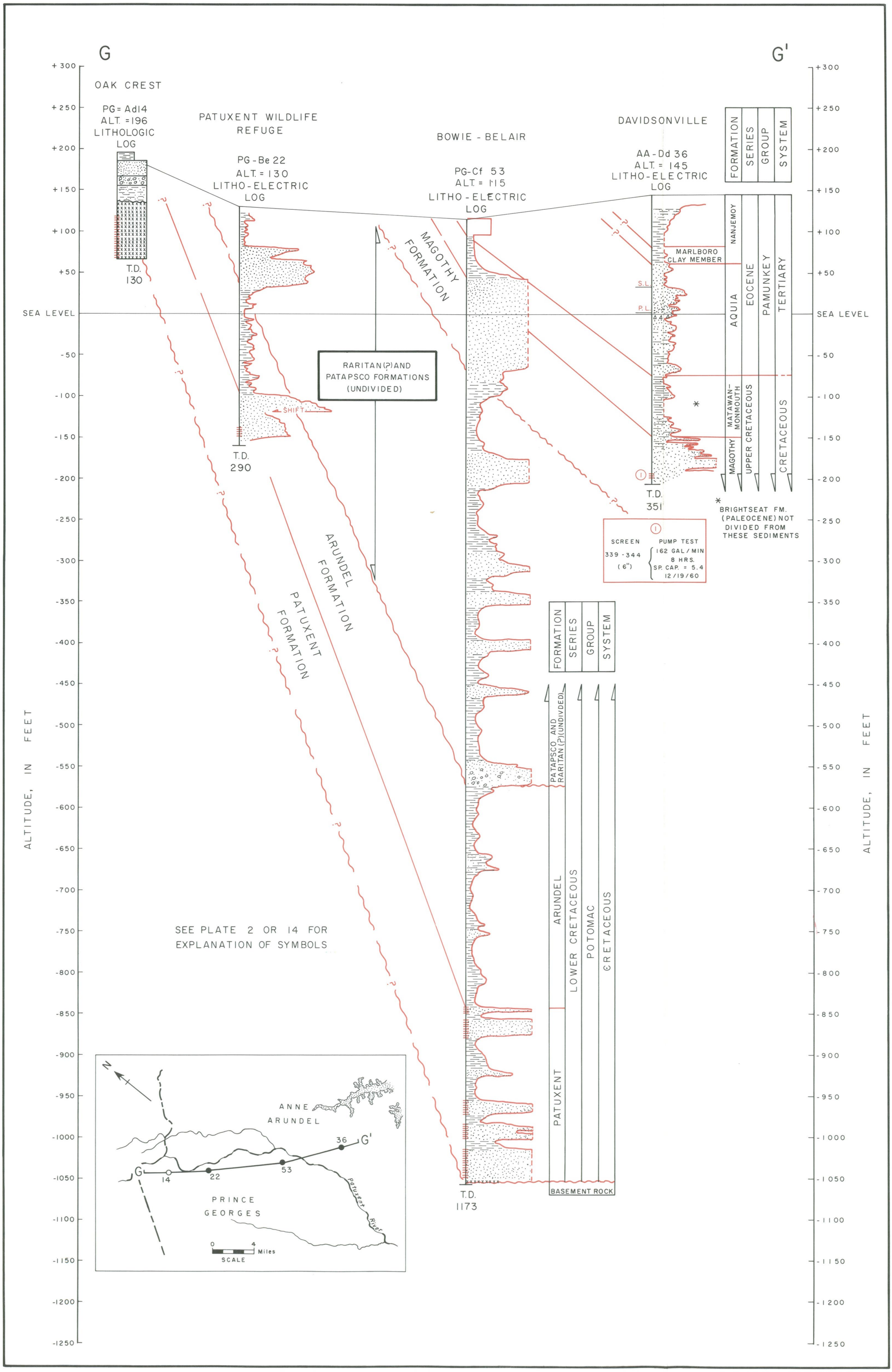

Plate 8. Stratigraphic cross section G-G′ extending from Oak Crest to Davidsonville

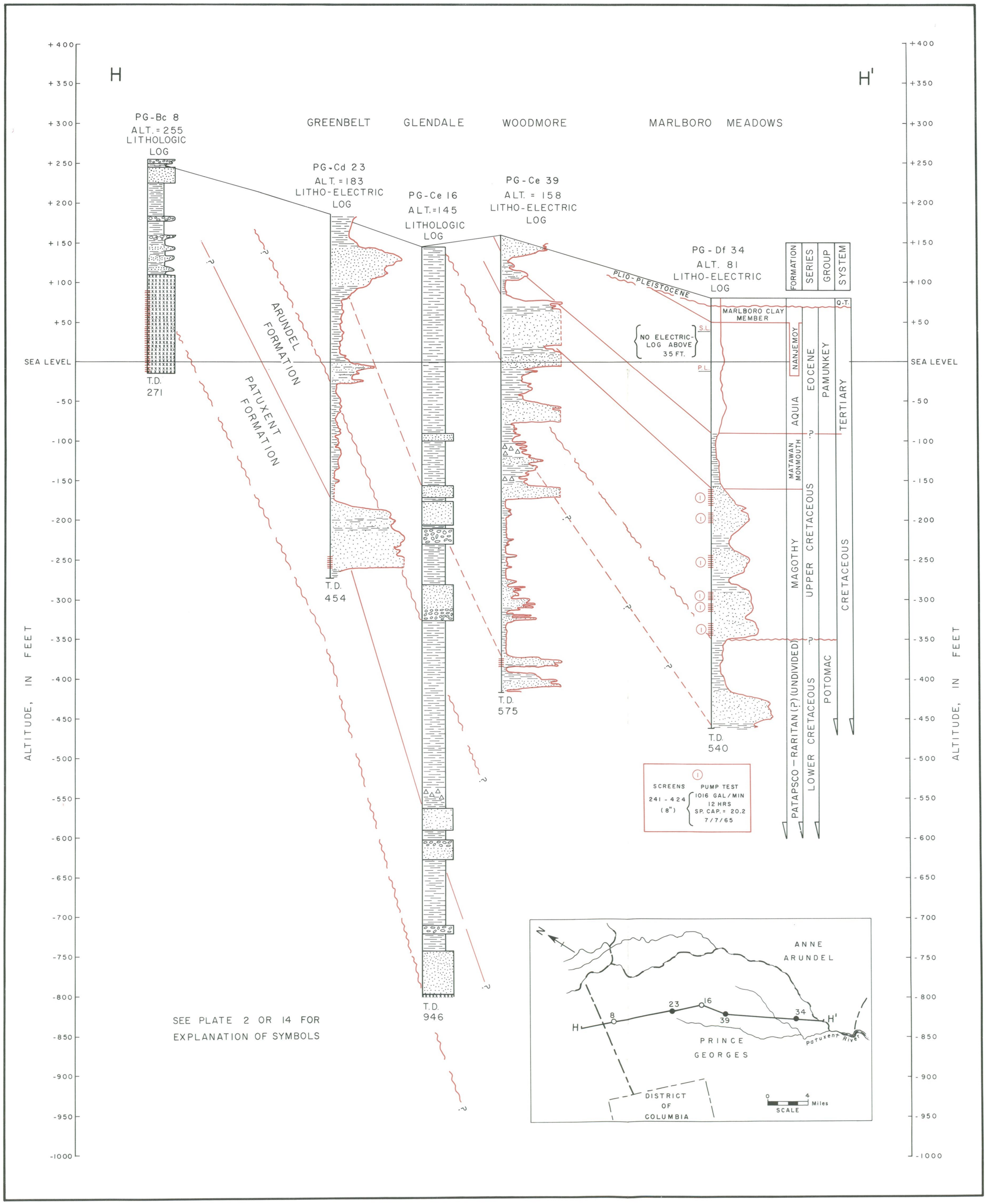

Plate 9. Stratigraphic cross section H-H′ extending from west of Muirkirk to Marlboro Meadows

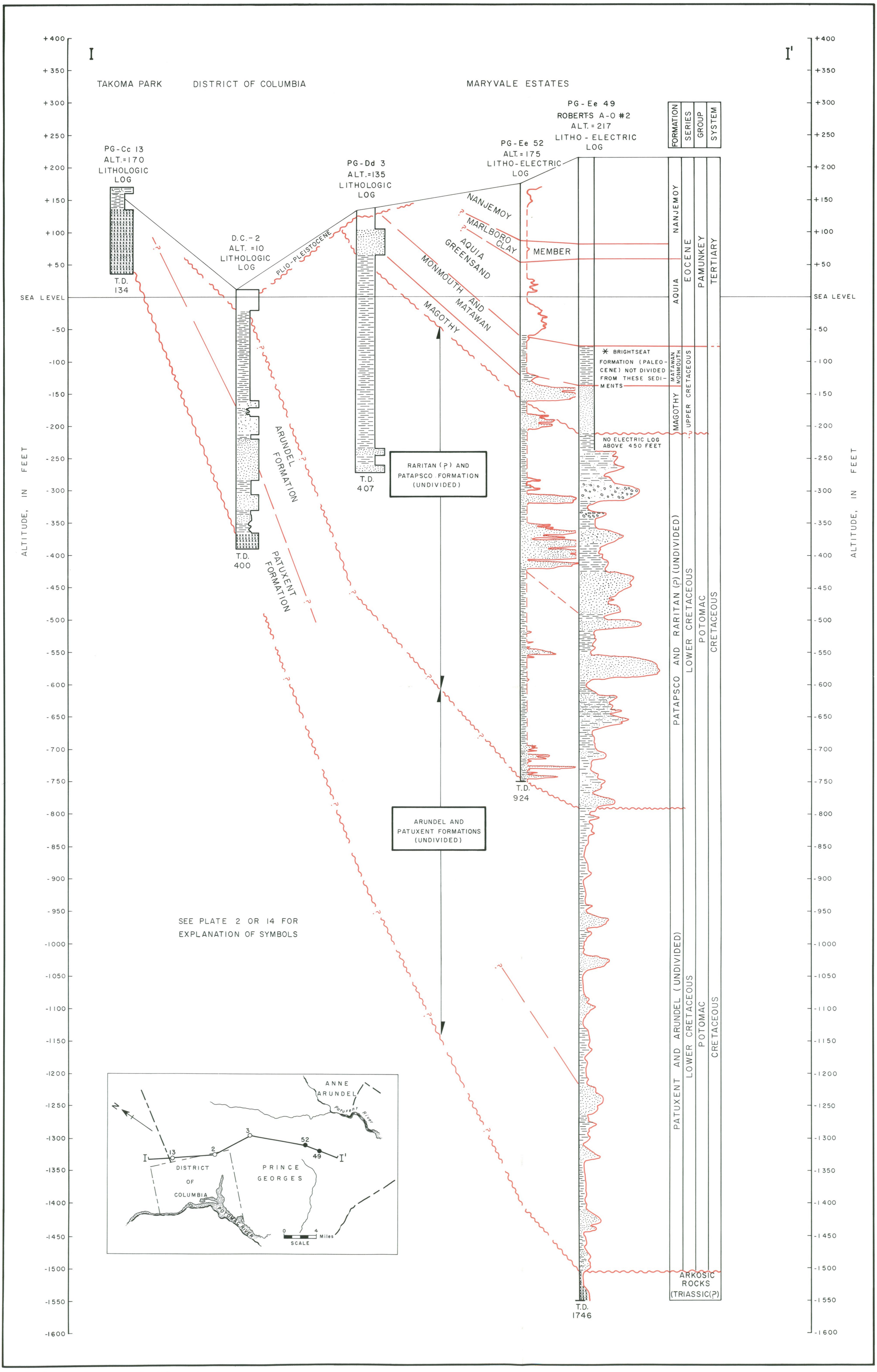

Plate 10. Stratigraphic cross section I-I′ extending from Takoma Park to near Rosaryville

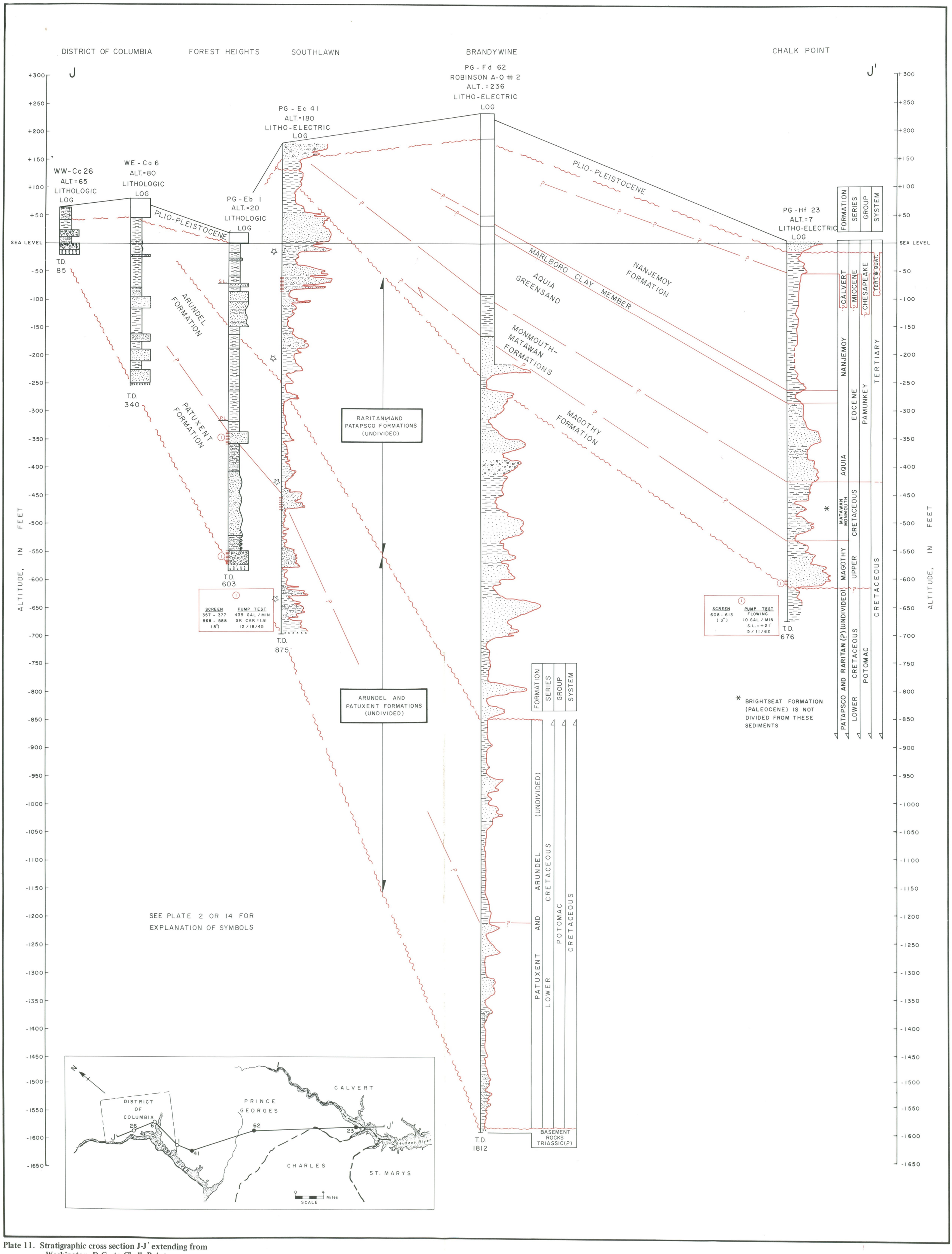

Plate 11. Stratigraphic cross section J-J′ extending from Washington, D.C., to Chalk Point

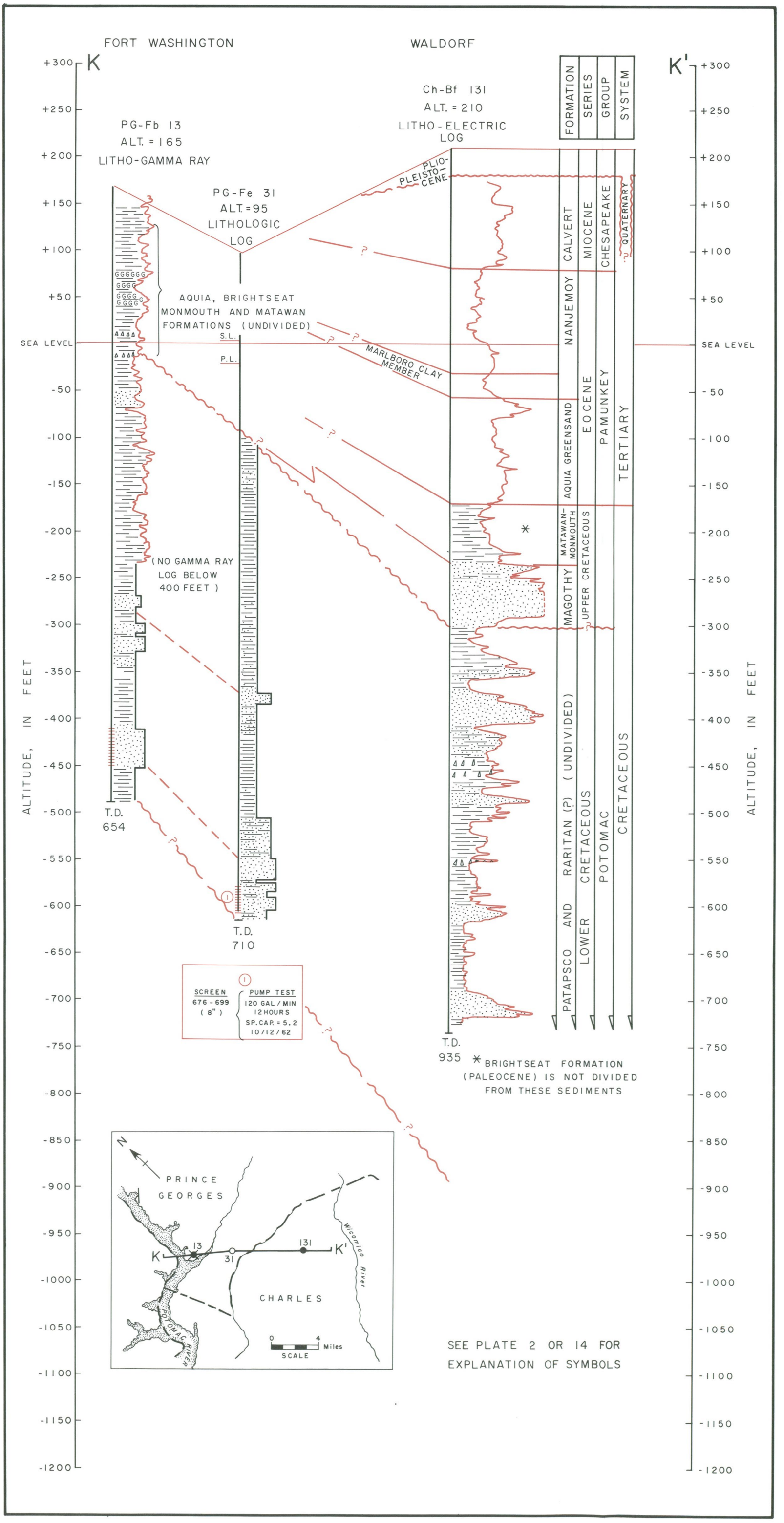

Plate 12. Stratigraphic cross section K-K′ extending from Fort Washington to near Waldorf

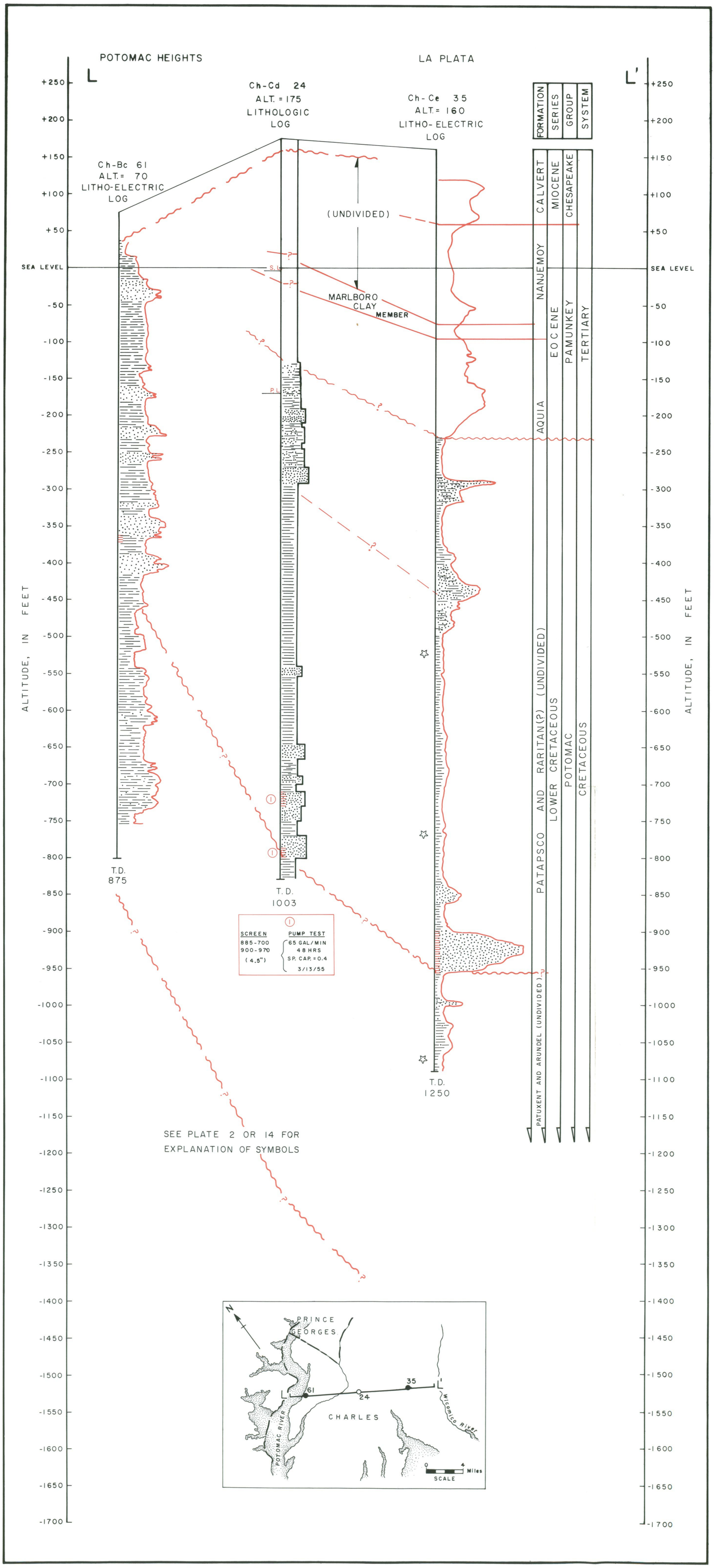

Plate 13. Stratigraphic cross section L-L′ extending from Potomac Heights to La Plata

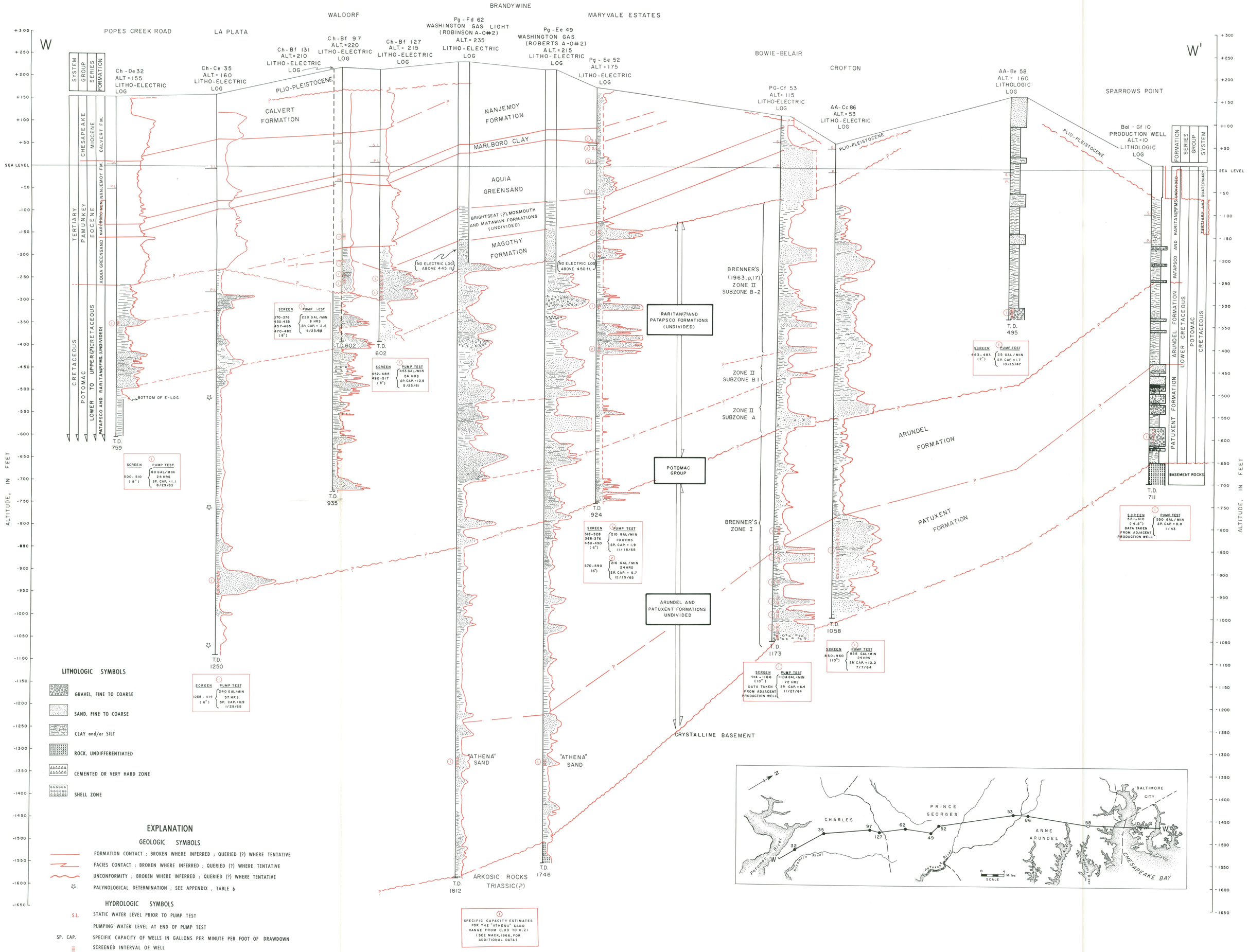

Plate 14. Stratigraphic cross section W-W' extending from Sparrows Point to Popes Creek Road

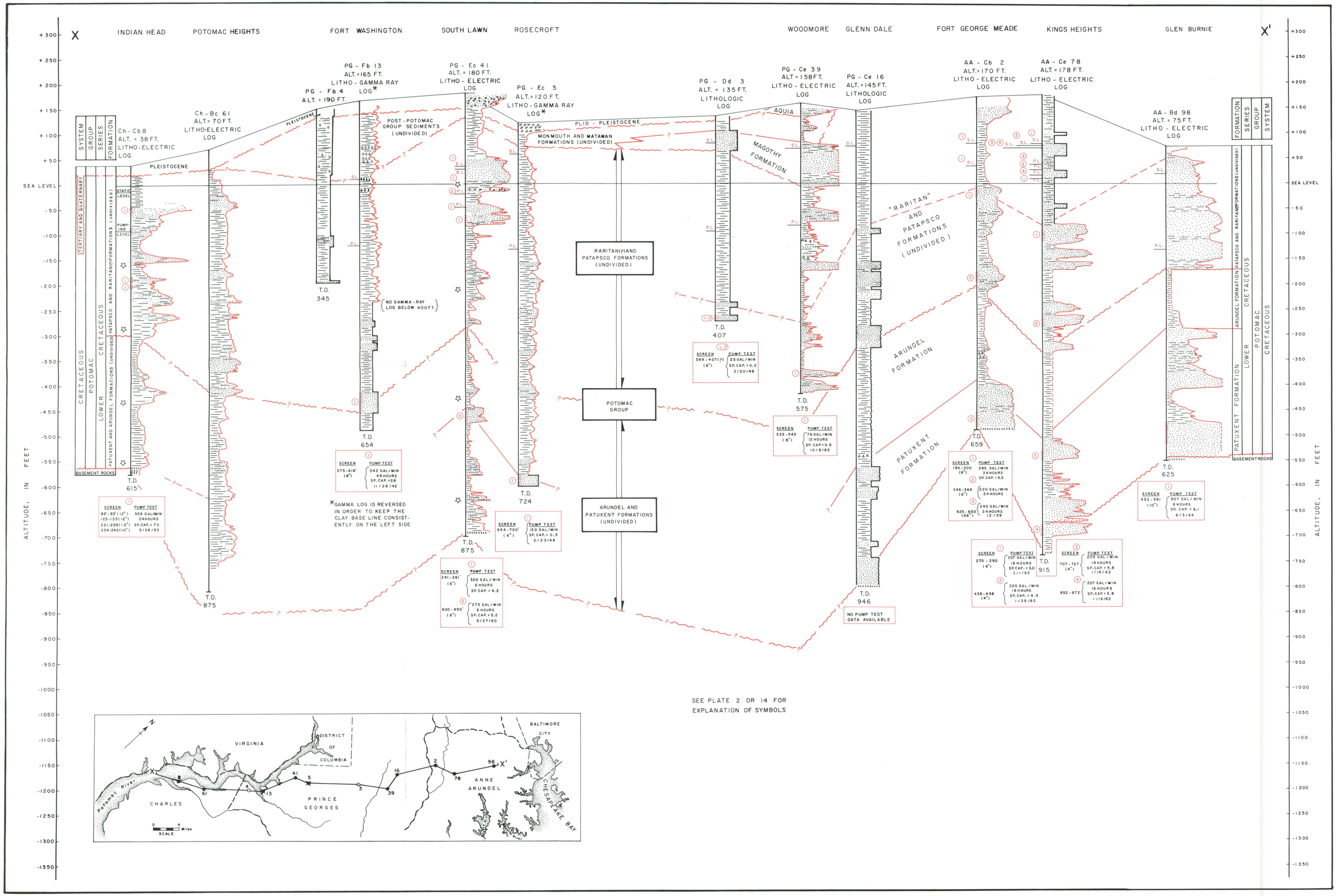

Plate 15. Stratigraphic cross section X-X′ extending from south of Glen Burnie to Indian Head

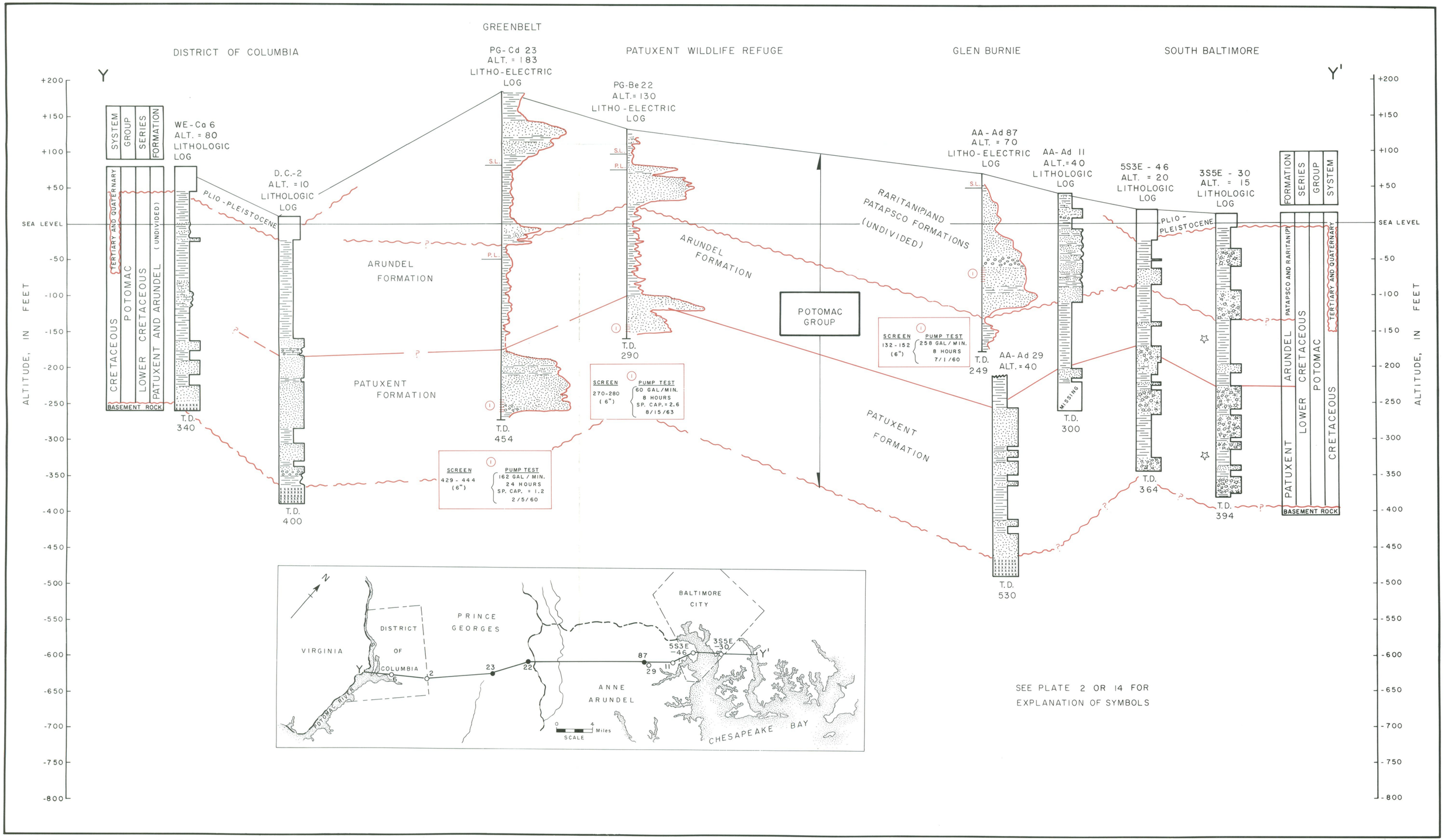

Plate 16. Stratigraphic cross section Y-Y′ extending from Baltimore to Washington, D.C.

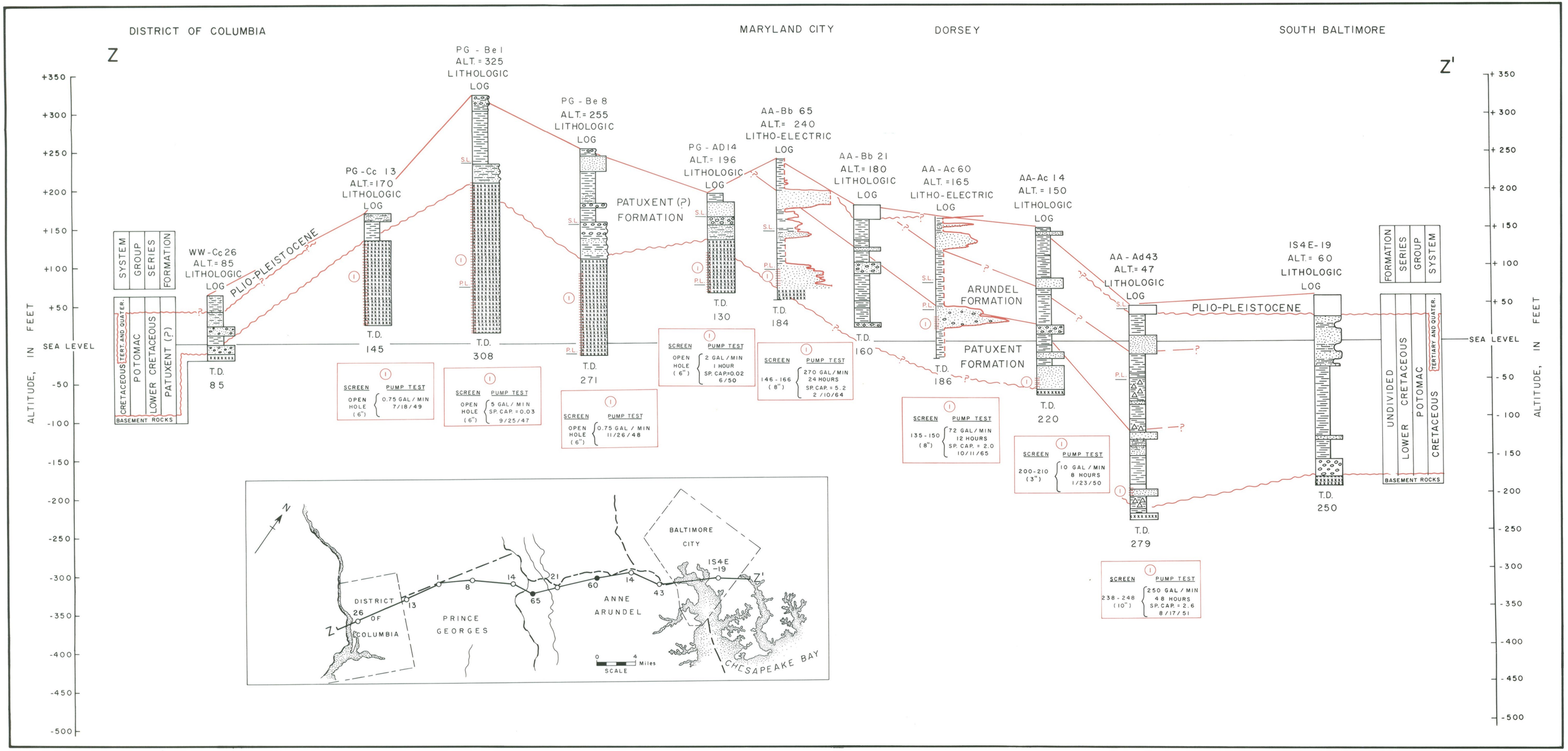

Plate 17. Stratigraphic cross section Z-Z′ extending from Baltimore to Washington, D.C.