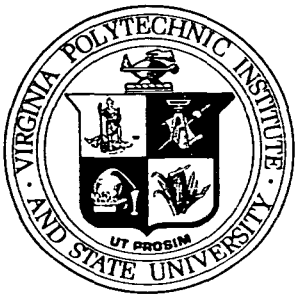
VPI&SU-78ET-27001-7

EVALUATION AND TARGETING OF GEOTHERMAL ENERGY RESOURCES IN THE SOUTHEASTERN UNITED STATES

Progress Report

John K. Costain, Lynn Glover, III, and A. Krishna Sinha
Principal Investigators



Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061

July 1, 1979 — September 30, 1979

PREPARED FOR THE U.S. DEPARTMENT OF ENERGY
UNDER CONTRACT NO. DE - AC05 - 78ET27001

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(Formerly ET-78-C-05-5648)

Coastal Plain Stratigraphy at DGT-1, Crisfield, Maryland

Michael Svetlichny and Joseph J. Lambiase

The first deep geothermal test hole (DGT-1) drilled in the Atlantic Coastal Plain province was completed June 14, 1979. Drill cuttings were sampled every 3m, and ten 10-meter core attempts were made at selected intervals in the Coastal Plain sediments. Core intervals and recoveries are listed in Table A-1; the cores have not yet been analyzed. Preliminary lithologic descriptions of drill cuttings have been completed (Table A-2).

Tentative geologic formation boundaries have been defined using drill cuttings , a natural gamma ray log, and an electric log consisting of a self-potential curve and three resistivity curves (Figure A-1). The descriptions of the cuttings and a gamma log from the nearby Janes Island well (Som-Dc3) (Hansen, 1967) facilitated choosing formation boundaries in the first 461 m of DGT-1. For the remainder of the hole, determination of formation contacts was made by comparing lithologic and geophysical data with established criteria for the coastal plain of Maryland. The formation contacts, depths, and thicknesses are described below, and are summarized in Table A-3.

Overlying the basement rock at a depth of 1362 m is a 75 m thick, well-indurated unit. From drill cuttings, this unit appears to be a lithologically heterogeneous composite of buff, blue-gray, brown, and red shale clasts, and gradually downward increasing amounts of subrounded to subangular sand-sized gray-green metavolcanic fragments. This unit is interpreted to be the westward extension of the "lower acoustical zone" of Jurassic and/or Triassic age, which is believed to occupy deep, graben-like structures beneath the Atlantic Continental Shelf (Schlee and others, 1976). The top of this unit is marked by major breaks in the gamma and electric logs (Figure A-1), and an abrupt change in lithology from shale to the medium-to-coarse grained sand that is typical of the overlying Patuxent Formation. Seismic profiles from VIBROSEIS Line Dor-1, located east of Church Creek (Hansen, 1978) and VPI Line 6, along Route 413 in the vicinity of Hopewell, show conspicuous reflectors at the top of this unit, which is referred to as horizon "Z". (Hansen, 1978). Earlier reports assumed that the lower acoustical unit pinched out offshore, but a seismic line from the Maryland - Virginia portion of the Delmarva Peninsula indicates an up-dip wedge of the lower acoustical unit beneath the Outer Coastal Plain of Maryland (Schlee and others, 1976).

Figure A-1.

CRISFIELD MUNICIPAL AIRPORT CRISFIELD, MD.

WELL NO. DGT-1

ELEV. (m.): K.B. 3.5
D.F. 2.9
G.S. 1.1 (approx.)

LOG MEASURED FROM D.F.

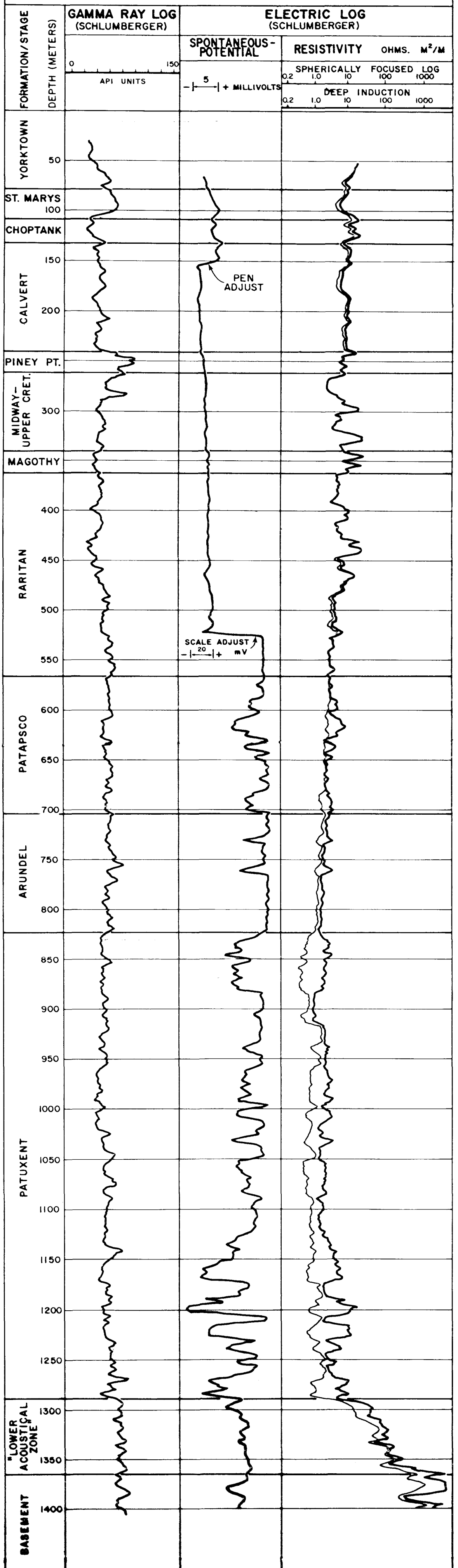

TABLE A-1. Coring intervals and recoveries, DGT-1.

Depths are recorded in meters from the ground surface.

Attempt	Interval Cored	Interval(s) Recovered	Recovery in Meters
1	332.0 - 341.1	335.7 - 341.1	5.5
2	341.1 - 347.2	345.4 - 345.6, 346.3 - 346.9	0.8
3	347.2 - 356.3		0.0
4	793.4 - 802.6	796.4 - 802.6	6.2
5	802.6 - 811.7	804.4 - 811.7	7.3
6	811.7 - 820.9	811.9 - 814.3, 815.1 - 820.9	8.3
7	946.7 - 955.9	946.7 - 950.1, 951.3 - 955.9	7.9
8	1250.9 - 1260.1	1253.2 - 1260.1	6.9
9	1260.1 - 1269.2	1260.1 - 1264.0, 1265.0 - 1268.8	7.8
10	1269.2 - 1278.4	1276.5 - 1277.5	0.9

TABLE A-2. Lithologic descriptions of drill cuttings

All depths are referenced to the ground surface, 1.1 m above mean sea level.

Formation		Lithology
Miocene Series Yorktown Formation		
43.3 -	52.5	Fine sandy silt, white
52.5 -	58.6	Gray silt
58.6 -	64.7	Silty granule sized gravel. Minor shells
64.7 -	67.7	Slightly granular fine sandy silt. Minor shells
67.7 -	76.2	Fine sandy gray silt
Miocene Series St. Marys Formation		
76.2 -	79.3	Gray silt. Minor shells
79.3 -	85.4	Dark gray clay and silt. Minor shells
85.4 -	88.4	Light gray clay and silt. Minor shells
88.4 -	91.5	Gray clay and silt, slightly micaceous. Minor shells
91.5 -	106.7	Gray clay and silt, no mica. Minor shells
Miocene Series Choptank Formation		
106.7 -	115.9	Very fine gray sandy silt. Abundant shells
115.9 -	122.0	Very fine to fine sandy silt, micaceous. Abundant shells from 115.9 - 118.9
122.0 -	128.1	Very fine sandy silt, light gray. Abundant shells
128.1 -	131.7	Light gray clay and silt, minor amounts of fine sand. Abundant shells
Miocene Series Calvert Formation		
131.7 -	152.4	Light gray clay and silt, minor fine sand. Abundant shells from 131.7 - 134.2. Minor shells from 137.2 - 140.2 and 143.3 - 152.4. No shells from 140.2 - 143.3
152.4 -	158.5	Clayey, silty shell bed
158.5 -	164.6	Gray clay. Shells
164.6 -	170.7	Dark gray clay
170.7 -	176.8	Light gray clay and silt
176.8 -	182.9	Dark organic clay. Minor shells from

		179.9 - 182.9
182.9 -	192.1	Light gray clay and silt. Minor shells from 182.9 - 186.0
192.1 -	195.1	Dark gray clay
195.1 -	198.2	Clay and silt
198.2 -	207.3	Brown and green clay
207.3 -	213.4	Gray clay and silt. Minor shells from 207.3 - 210.4
213.4 -	216.4	Dark gray clay
216.4 -	226.2	Gray clay and silt. Minor shells from 223.2 - 226.2
226.2 -	229.2	Clay
229.2 -	232.3	Very fine sandy clay and silt, light gray
232.3 -	235.3	Fine sandy clay
235.3 -	238.4	Very fine sandy clay
Eocene Series		
Piney Point Formation		
238.4 -	253.6	Very fine sandy clay and silt, glauconitic. Minor shells from 238.4 - 241.4
253.6 -	256.7	Fine-medium sand and clay, glauconitic
256.7 -	259.7	Gray silty fine-medium sand, glauconitic
Rocks of Midway Age and/or Upper Cretaceous (undivided)		
259.7 -	262.8	Gray glauconitic clay
262.8 -	265.8	Gray fine sandy silt and clay, glauconitic
265.8 -	280.0	Gray glauconitic clay
280.0 -	284.1	Gray glauconitic clay with medium sand
284.1 -	290.2	Same as 278.0 - 284.1, but with abundant mica
290.2 -	293.3	Clayey fine-medium sand, glauconitic, micaceous
293.3 -	299.4	Clayey, silty fine-medium sand, glauconitic, slightly micaceous
299.4 -	302.4	Sample missing
302.4 -	305.4	Silty fine-medium quartz sand, glauconitic, micaceous
305.4 -	308.5	Same as 302.4 - 305.4, but slightly micaceous. Minor shells
308.5 -	311.5	Sample missing
311.5 -	314.6	Silty fine-medium quartz sand, slightly glauconitic. Minor shells
314.6 -	317.6	Light gray fine sandy silt and clay
317.6 -	320.7	Light gray fine sandy micaceous silt, slightly glauconitic
320.7 -	323.7	Sample missing
323.7 -	329.8	Light gray fine-medium quartz sand, micaceous, slightly glauconitic
329.8 -	332.9	Silty fine-medium quartz sand,

		micaceous, slightly glauconitic
332.9 -	335.9	Silty, clayey fine sand. Minor shells
335.9 -	338.9	Same as 332.9 - 335.9, but with plant remains

Upper Cretaceous Series
Magothy Formation

338.9 -	342.0	Sample missing
342.0 -	345.1	Slightly silty fine-medium sand, minor glauconite
345.1 -	348.1	Fine-medium quartz sand
348.1 -	351.2	Silty fine-medium quartz sand, micaceous, slightly glauconitic
351.2 -	354.2	Fine-medium quartz sand, minor glauconite and lignite
354.2 -	357.3	Fine to coarse quartz sand, clay aggregates
357.3 -	360.3	Fine to medium sand, some clay aggregates

Upper Cretaceous Series
Raritan Formation

360.3 -	363.4	Silty fine-medium sand, lignitic. Minor shells
363.4 -	366.4	Same as 360.3 - 363.4, but no lignite or shells
366.4 -	369.5	Reddish gray silty fine-medium sand with clay aggregates
369.5 -	372.5	Reddish silty fine-medium sand, slightly micaceous
372.5 -	375.6	Brown silty very fine-fine sand, lignite, mica and plant remains
375.6 -	378.6	Light brown fine sandy silt with lignite and mica. Minor shells.
378.6 -	381.6	Light brown silt and fine sand, even amounts of each. Slightly micaceous
381.6 -	384.7	Light brown fine sandy silt with clay aggregates
384.7 -	387.7	Reddish brown and gray silty fine-medium sand, lignitic, minor mica and plant remains
387.7 -	393.8	Reddish brown fine sandy silt
393.8 -	399.9	Silty fine sand, lignitic, slightly micaceous
399.9 -	403.0	Silty fine-medium sand, no lignite or mica
403.0 -	406.0	Reddish silty fine-medium sand, abundant lignite and plant remains
406.0 -	412.1	Light brown sandy silt. Lignite from 406.0 - 409.1
412.1 -	415.2	Light brown sand and silt

415.2 - 418.2	Silty fine-medium sand, micaceous, lignitic
418.2 - 421.3	Silty fine-medium sand, clay aggregates, lignitic, slightly micaceous
421.3 - 427.4	Silty fine-medium sand. Shells from 421.3 - 424.3
427.4 - 430.4	Fine-medium sand, some coarse grains, minor clay chips
430.4 - 433.5	Fine-coarse sand, clay aggregates, lignite
433.3 - 436.5	Fine to coarse sand with lignite
436.5 - 439.6	Mostly lignite with fine-medium sand
439.6 - 442.6	Silty fine to medium sand with lignite
442.6 - 445.7	Medium sand with lignite
445.7 - 448.7	Medium sand, minor lignite and mica
448.7 - 451.8	Silty fine-medium sand, mica, lignite. Minor shells
451.8 - 457.8	Silty fine-medium sand, mica, lignite. Minor shells.
457.8 - 460.9	Silty fine-coarse sand with granules. Minor shells
460.9 - 463.9	Silty medium sand, slightly micaceous
463.9 - 467.0	Silty fine-coarse sand
467.0 - 473.1	Silty fine-medium sand, lignite
473.1 - 476.1	Sample missing
476.1 - 479.2	Silty fine-medium sand, some granules, minor lignite
479.2 - 485.3	Same as 476.1 - 479.2, but no granules or lignite
485.3 - 488.3	Silty fine-medium sand and lignite. Minor shells.
488.3 - 494.4	Fine-coarse sand, lignite from 491.4 - 494.4. Minor shells
494.4 - 497.5	Silty fine-coarse sand with shale. Shells
497.5 - 503.6	Silty fine-medium sand, micaceous
503.6 - 506.6	Fine-medium sand. Minor shells
506.6 - 509.7	Silty fine-medium sand
509.7 - 515.8	Fine-coarse sand with red and yellowish shale. Shells (granules in 512.7 - 515.8)
515.8 - 540.1	Samples contaminated by cement from float shoe
540.1 - 543.2	Fine-medium sand
543.2 - 546.2	Fine-medium sand with mica
546.2 - 558.4	Shale with silty fine s2cnd, micaceous. Fine-medium sand from 549.3 - 552.3, 555.4 - 558.4
558.4 - 561.5	Varicolored shale, silty fine sand, some coarse grains, micaceous
561.5 - 564.5	Red and gray shale with silty fine sand, some coarse grains, micaceous

Lower Cretaceous Series
Patapsco Formation

564.5	570.6	Same as 561.5 - 564.5 but no coarse grains
570.6	573.7	Shale with silty fine sand and lignite
573.7	579.8	Varicolored shale with silt
579.8	601.1	Varicolored shale with silt, mica, and minor lignite
601.1	604.2	Very fine-fine silty sand, abundant lignite and mica
604.2	613.3	Medium-coarse quartz sand
613.3	616.3	Mostly coarse sand, some silty fine sand, minor shale
616.3	619.4	Silty medium-coarse sand with lignite
619.4	622.4	Silty medium-coarse sand, red and gray shale
622.4	631.6	Samples missing
631.6	677.3	Shale with some fine sand and silt. Micaceous from 634.6 - 637.7, 649.9 - 652.9; lignitic from 643.8 - 646.8, 665.1 - 668.2
677.3	692.5	Fine-medium sand with varicolored shale. Minor shale from 683.4 - 686.4
692.5	695.6	Fine-coarse sand, minor shale
695.6	701.6	Medium-coarse sand, minor shale

Lower Cretaceous Series
Arundel Formation

701.6	704.7	Fine-medium sand and shale
704.7	713.9	Shale with fine to medium sand
713.9	716.9	Fine sandy shale and silt
716.9	726.1	Shale with fine-medium sand
726.1	729.1	Shale with fine sand
729.1	732.2	Fine-medium sand, lignite, minor shale
732.2	735.2	Fine-medium sand with more shale than 729.1 - 732.2
735.2	756.6	Shale with some fine-medium sand. Few coarse grains from 744.4 - 747.4
756.6	759.6	Fine-coarse sand with some shale
759.6	765.7	Silty fine-coarse sand with shale. Minor shale from 759.6 - 762.6
765.7	771.8	Shale with silty fine-medium sand
771.8	811.4	Shale, some silty fine sand. Sample missing from 793.1 - 796.2. Minor shells from 802.3 - 811.4
811.4	820.5	Shale, fine-medium sand. Minor shells

Lower Cretaceous Series
Patuxent Formation

820.5 - 829.7	Shale, fine sand. Minor shells
829.7 - 832.8	Shale, fine-medium sand
832.8 - 838.8	Fine-coarse sand with shale. Equal amounts of each from 832.8 - 835.8, more sand than shale from 835.8 - 838.8
838.8 - 841.9	Fine-coarse sand, granules, minor shale
841.9 - 844.9	Fine-coarse sand, few granules, shale
844.9 - 848.0	Mostly coarse sand, some shale. Minor shells
848.0 - 851.0	Coarse-granular sand, some shale
851.0 - 860.2	Medium-coarse sand, minor shale
860.2 - 866.3	Fine-medium sand, minor shale. Minor shale from 863.2 - 866.3
866.3 - 875.4	Fine-coarse sand, minor shale
875.4 - 878.5	Clean fine-coarse sand. Minor shells
878.5 - 881.5	Clean fine-coarse sand, charcoal
881.5 - 884.6	Fine-coarse sand, minor shale
884.6 - 887.6	Shale with fine-medium sand. Minor shells
887.6 - 893.7	Shale with silty fine-medium sand
893.7 - 902.9	Shale with minor silty fine sand. Minor shells from 893.7 - 899.8
902.9 - 939.4	Shale with silty fine sand. Slightly micaceous from 902.9 - 909.0. Minor charcoal from 936.4 - 939.4
939.4 - 942.5	Fine-medium sand, minor shale, lignite
942.5 - 945.5	Fine-medium sand, some coarse grains, shale
945.5 - 957.7	Shale with some silty fine-medium sand
957.7 - 960.8	Shale with fine-coarse sand
960.8 - 973.0	Medium-coarse sand, minor shale
973.0 - 976.0	Medium-coarse sand with more shale than 960.8 - 973.0. Slightly calcareous
976.0 - 979.1	Medium-coarse sand, minor shale
979.1 - 985.2	Fine-coarse sand and shale. Minor shells
985.2 - 988.2	Medium-granular sand, minor shale. Minor shells
988.2 - 991.2	Fine-coarse sand, minor shale
991.2 - 994.3	Fine-medium sand, shale, slightly calcareous
994.3 - 1000.4	Shale with silty fine sand
1000.4 - 1003.4	Silty fine-medium sand, shale
1003.4 - 1012.6	Fine-coarse sand, minor shale
1012.6 - 1015.6	Mostly coarse sand with some fine-medium grains, minor shale
1015.6 - 1018.7	Clean fine-coarse sand
1018.7 - 1027.8	Medium-coarse sand, minor shale
1027.8 - 1033.9	Clean medium-coarse sand
1033.9 - 1037.0	Medium-coarse sand, minor shale
1037.0 - 1040.0	Fine-coarse sand with shale
1040.0 - 1043.1	Shale with silty fine-medium sand

1043.1 - 1049.2	Shale and silt, minor fine sand
1049.2 - 1052.2	Fine-coarse sand with shale
1052.2 - 1055.3	Shale with silt, minor fine sand
1055.3 - 1058.3	Silty fine-medium sand, minor shale
1058.3 - 1061.4	Fine-coarse sand, minor shale
1061.4 - 1070.5	Medium-coarse sand, minor shale
1070.5 - 1073.5	Medium-granular sand, minor shale
1073.5 - 1076.6	Clean medium-coarse sand
1076.6 - 1082.7	Fine-coarse sand and shale, even amounts of each
1082.7 - 1091.8	Shale with some fine-medium sand
1091.8 - 1094.9	Fine-coarse sand, minor shale
1094.9 - 1101.0	Mostly coarse sand, minor shale and fine-medium sand
1101.0 - 1104.0	Shale, silty fine sand
1104.0 - 1113.2	Shale with silty fine-coarse sand
1113.2 - 1119.3	Shale with fine-medium sand, even amounts of each
1119.3 - 1125.4	Fine-coarse sand, minor shale
1125.4 - 1128.4	Silty fine-coarse sand with shale
1128.4 - 1158.9	Fine-coarse sand, minor shale
1158.9 - 1168.0	Clean fine-coarse sand
1168.0 - 1177.2	Fine-coarse sand with minor shale
1177.2 - 1183.3	Shale with fine-coarse sand
1183.3 - 1192.4	Shale with minor silty sand. Minor shells from 1189.4 - 1192.4
1192.4 - 1201.6	Shale and fine-medium sand. Minor shells from 1192.4 - 1195.5
1201.6 - 1213.8	Fine-coarse sand, shale
1213.8 - 1216.8	Shale, minor fine sand
1216.8 - 1219.8	Fine-medium sand, minor shale
1219.8 - 1225.9	Medium-coarse sand, minor shale
1225.9 - 1229.0	Same as 1219.8 - 1225.9, but more shale
1229.0 - 1232.0	Medium-coarse sand, minor shale
1232.0 - 1250.3	Slightly sandy silt with shale. Slightly micaceous from 1235.1 - 1238.1
1250.3 - 1277.8	No samples - cores drilled
1277.8 - 1280.8	Fine sandy silt with shale and some gravel
1280.8 - 1283.9	Medium-coarse sand with minor shale
1283.9 - 1286.9	Coarse sand with some granules
Pre-Cretaceous "lower acoustical zone"	
1286.9 - 1290.0	Even mixture of sand, silt, and shale
1290.0 - 1311.3	Slightly sandy silt with abundant shale
1311.3 - 1314.3	Shale and silt
1314.3 - 1338.7	Silty shale, minor fine sand. Plant remains from 1326.5 - 1329.6
1338.7 - 1341.8	Shale, with more fine sand than 1314.3 - 1338.7
1341.8 - 1362.2	Silty shale, minor fine sand. Minor lignite from 1347.9 - 1350.9,

1338.7 - 1341.8	Shale, with more fine sand than 1314.3 - 1338.7
1341.8 - 1362.2	Silty shale, minor fine sand. Minor lignite from 1347.9 - 1350.9, 1360.1 - 1362.2
1362.2 - 1693.0 (T.D.)	Metavolcanic basement rock

TABLE A-3. Geologic Formation Boundaries, DGT-1

Formation/Stage	Depth (m)	Thickness(m)
Yorktown	? - 76.2	?
St. Marys	76.2 - 106.7	30.5
Choptank	106.7 - 131.7	25.0
Calvert	131.7 - 238.4	106.7
Piney Point	238.4 - 259.7	21.3
Midway - Upper Cretaceous (undivided)	259.7 - 338.9	79.2
Magothy	338.9 - 360.3	21.4
Raritan	360.3 - 564.5?	204.2?
Patapsco	564.5? - 701.6	137.1?
Arundel	701.6 - 820.5	118.9
Patuxent	820.5 - 1286.9	466.4
"lower acoustical zone"	1286.9 - 1362.2	75.3

The Patuxent Formation, 466 m thick and extending from a depth of 821 m to 1287 m, unconformably overlies the lower acoustical unit and consists primarily of thick sand layers interbedded with thin layers of variegated shale. The quartzose and feldspathic sands range from fine to coarse, and are commonly gravelly in the basal 18 m. Clean but poorly sorted sands form thin beds within the larger sand bodies, and the majority of the sands contain some shale. Shell fragments, lignite, and mica occur in minor amounts throughout the formation. The upper contact at 821 m can be distinguished in the drill cuttings, and by prominent breaks in the gamma and electric logs (Figure A-1). The characteristic change from the Patuxent to the overlying Patapsco-Arundel group is indicated by the presence of thicker layers of shale. Gamma ray activity is generally higher above 821 m where the Arundel shale unconformably overlies the Patuxent (Figure A-1).

In the Arundel (702 m - 821 m) the sediments consist chiefly of dark colored clay, shale and sandy shale. However in two distinct intervals, from 729 m - 735 m and from 757 m - 766 m, the Arundel is primarily fine to coarse sand with minor shale. From 565 m to 702 m there are alternating beds of sand and varicolored shale typical of the Patapsco Formation. Although it is usually difficult to separate these units, the lithostratigraphic change, coupled with major breaks in the gamma and electric logs at 702 m, suggest that the Patapsco-Arundel contact occurs at this depth (Figure A-1). Similarly, the upper contact of the Patapsco is not easily recognized in the section. Fine sands and varicolored shales, particularly gray and red shales are reported from the upper portion of the Patapsco, and in the basal part of the overlying Raritan Formation in Maryland (Rasmussen and Slaughter, 1955). However, the Raritan Formation usually contains more abundant mica than the Patapsco. In DGT-1, there is a marked increase in mica content above 565 m. On this basis, a tentative Patapsco - Raritan boundary has been assigned at 565 m.

The Raritan is fine to medium sands intercalated with variegated shale and clay. Lignite and mica are common to abundant, and plant fragments are occasionally seen in the upper portion. The upper contact with the Magothy Formation is marked by a decrease in gamma ray activity and a break in the electric log at approximately 360 m (Figure A-1).

The top and bottom of the Magothy are defined by the vertical extent of fine-to-medium white and buff quartz sand with minor stringers of carbonaceous clay and lignite. This unit is clearly defined by prominent breaks in the gamma and electric logs at 339 m and 360 m (Figure A-1). A similar pattern for the Magothy is seen in logs from the Janes Island well at a shallower depth (Hansen, 1967).

Above the Magothy, and extending from 260 m to 339 m are rocks of Midway age and the Upper Cretaceous (undivided) section; these are inseparable by lithology alone. This interval consists of alternating thin beds of fine to medium quartz sand and gray clay. Glauconite becomes a common constituent for the first time in the Atlantic Coastal Plain section; the sediments reflect a change from a marginal

marine to a marine depositional environment. In the upper portion, between 260 m and 290 m, the cuttings are mainly glauconitic clay. This lithology is consistent with the gamma and resistivity trends (Figure A-1). The equivalent section from the Janes Island well (244 m - 325 m) is lithologically very similar to DGT-1; there is glauconitic clay in the upper 37 m (Hansen, 1967).

The boundaries of the overlying Piney Point Formation are easily distinguished from logs and cuttings. This unit is typically highly glauconitic, clayey, fine-to-medium quartz sand. Gamma logs from DGT-1 and Janes Island show a high, although variable, rate of activity between 241 m and 262 m (Figure A-1). This is unusual for sand bodies but it may be explained by the high concentration of glauconite. The contact of the Piney Point with the overlying Calvert Formation is defined by a major electrical log break, and by abundant clay and silt above 238 m (Figure A-1). A regional disconformity between the two units represents a period of nondeposition or erosion during the Oligocene Epoch.

The Calvert, 107 m thick and extending from 132 m to 238 m, is predominantly diatomaceous gray clay and silt. In the basal 9 m, the sediments contain a small fraction of fine sand. A clayey shell bed exists from 152 to 158 m, and a few other intervals contain minor shell fragments. At approximately 132 m, both the gamma and electric log exhibit breaks that are correlative to the breaks seen in logs from the Janes Island well at 116 m (Figure A-1) (Hansen, 1967). These breaks, plus the appearance of abundant shells above the breaks, mark the Choptank-Calvert contact at approximately 132 m.

The Choptank Formation conformably overlies the Calvert and ranges in depth from 107 m to 132 m. The highly fossiliferous sediments are more sandy than clayey in the upper two thirds of the unit with a gradual downward increase in clay from 125 m to the base.

Overlying the Choptank is the St. Marys Formation (76 - 107 m) which is easily distinguishable by the appearance of gray clay and silt above 107 m. Minor amounts of shell fragments are present in all the samples from this unit. The upper contact with the Yorktown Formation is indicated by a negative "kick" in the gamma log at 76 m, and by a corresponding break in the self-potential and resistivity curves (Figure A-1). Sand content increases above 76 m, becoming coarse and granular from 59 m to 68 m.

The Yorktown - Columbia Group contact cannot be determined for DGT-1 due to difficulty in collecting samples during the first 46 m of drilling. In the Janes Island well, this boundary was picked at 12 m (Hansen, 1967); it is anticipated that the boundary in DGT-1 is within a few meters of that depth.

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