UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Federal Center, Denver 25, Colorado

Technical Letter
Dribble-19
April 25, 1962

Mr. James E. Reeves, Manager
Nevada Operations Office
U. S. Atomic Energy Commission
P. O. Box 1676
Las Vegas, Nevada

Dear Mr. Reeves:

Transmitted herewith are two copies of

Dribble-19

GEOLOGY OF CORE HOLE WP-4
TATUM DOME, LAMAR COUNTY
MISSISSIPPI

By

D. H. Eargle

April 25, 1962

USGS-474-282

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Sincerely yours,

W. S. Twenhofel

W. S. Twenhofel
Program Supervisor
Special Projects Branch

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GEOLOGY OF CORE HOLE WP-4
TATUM DOME, LAMAR COUNTY
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By

D. H. Eargle

INTRODUCTION

Core hole WP-4 was drilled on the crest of Tatum salt dome, Lamar County, Mississippi, as the second exploratory and pilot hole in the operations of Project Dribble of the Atomic Energy Commission's Vela Uniform Program. The hole is about 1,600 feet southeast of core hole WP-1 (fig. 1) the geology of which was reported on in Technical Letter Dribble-15. Core hole WP-4 is in the northeastern corner of sec. 14, T. 2 N., R. 16 W., and has the Holmes and Narver coordinates 9,217 N., 9,272 E; it is 783 feet south and 728 feet west of the common point of secs. 11, 12, 13, and 14, T. 2 N., R. 16 W., which has the Holmes and Narver coordinates 10,000 N., 10,000 E. The ground level at the site is 243.82 feet above sea level, and the datum for logging and for the core depths is the rotary drive bushing, 250.82 feet (elevations rounded out for plotting to 244 feet

FIGURE 1.—LOCATION MAP FOR AEC HOLES ON AND NEAR TATUM
DOME, LAMAR COUNTY, MISSISSIPPI

for ground level, and 251 feet for the rotary bushing). The hole was spudded in on February 9, 1961, and was completed on May 17, 1961. It was drilled, as was core hole WP-1, by Texas Water Wells, Inc., of Houston, Tex.

Coring began at 30 feet below the surface and was carried on continuously to 1,539 feet, or about 56 feet below the top of the salt. From that point to 2,307 feet the hole was drilled; from 2,307 to 2,707 feet it was cored; from 2,707 feet to its total depth, 3,507 feet (driller's measurement), the hole was drilled. Hole diameters are 15 inches to 207 feet, where 183½ feet of 10-3/4-inch surface casing was set; 10 inches to 1,508 feet, where 1,433 feet of 7-inch steel casing was set and below which 75 feet of aluminum casing was set; and 6½ inches to 3,507 feet (not cased).

Cuttings were recovered from the drilled intervals; all cores are of NX size, 2½ inches in diameter. The cores were placed in boxes, each containing approximately 15 feet of core, at the well site. After they were brought to the Commission's warehouse in Hattiesburg, Miss., the cores were photographed in color by Holmes and Narver, Inc., studied megascopically and microscopically by Survey geologists, and, after samples were chosen for further laboratory study and testing, were stored in the warehouse. Salt cores were put in polyethylene bags. Methods of studying these cores were the same as those of WP-1, described briefly on page 2 of Technical Letter Dribble-15. The log by E. L. Herbst, of Holmes and Narver, Inc.,

showing all operations performed in the hole, the condition of the hole after it was drilled, casing sizes and depths, and other information on the hole, was used as a reference.

The cores, particularly those of the sediments overlying the cap, were studied megascopically and under the binocular microscope by C. A. Armstrong, Thad Shows, and the writer. J. Schlocker and the writer studied the caprock and salt megascopically. Representative samples of the various lithologic types were chosen for Mr. Schlocker's detailed study of their texture, structure, petrography, and mineralogy in the Menlo Park, California, laboratory of the U. S. Geological Survey. Other samples were chosen for tests of the physical properties of the caprock and salt, to be done by the Survey's laboratory in Denver, Colo., the Corps of Engineers' Waterways Experiment Station, the Bureau of Reclamation's Denver laboratory, the Bureau of Mines' Bartlesville, Okla., laboratory, the Lawrence Radiation Laboratory, and the University of Texas' Petroleum Engineering Laboratory.

GEOLOGY

The geology of core hole WP-4 was determined by examination of cores and cuttings, and was inferred from study of geophysical logs. Figure 2 (see pocket) shows (1) the trace of the electrical log from the surface to the depth of 1,342 feet, (2) the sonic log from 209 feet to the total depth, 3,512 feet, (3) the gamma-ray and neutron logs from 202 to 2,730 feet, (4) the caliper log from 206 to 1,520 feet, and (5) a

generalized lithologic log from the surface to total depth, determined by examination of cores and samples, from interpretation of geophysical logs, and from Hycalog.

Appendix 1 contains a detailed description of the rocks from the megascopic study of the cores and logs; Appendix 2 is the record of the coring, showing the intervals cored on each core-run, the core recovered, and the percent of recovery; Appendix 3 is a list of faults and fractures observed in the anhydrite caprock, the only section of the core with a few exceptions, where the cores preserve definite evidence of faulting and fracturing; and Appendix 4 is a list of the in-hole surveys made and logs produced. Descriptions of some lithologic types and the boundaries of the lithologic zones of some of the sedimentary beds overlying the dome and of the limestone caprock may not be accurate because of the poor core recovery of this material or because, in some cases, the cores were jumbled and out of place in the core boxes when received at the warehouse or were inadequately labeled. The descriptions of the lost-core intervals are mostly by Hycalog, whose geologists examined the cuttings during drilling, as well as the cores, in a mobile laboratory stationed beside the rig. Boundaries of some of the lost-core intervals are from Hycalog and are interpreted from the geophysical logs. The average core recovery from the various lithologic zones encountered are shown in table 1.

Table 1.--Core recovery by lithologic zone, core hole WP-4

Lithologic Zone	Feet cored	Core recovered (feet)	Core recovery (percent)
Sediments overlying the caprock.....	889	271.25	30.5
Limestone caprock.....	82	19.25	23.5
Gypsum caprock.....	2	0	0
Anhydrite caprock.....	461	426.25	92.5
Salt.....	449	355.10	79.0

Stratigraphy

The several sedimentary formations overlying the caprock in core hole WP-4, lithologic zones of the caprock, and the salt were encountered at the depths given in table 2.

Table 2.--Formations and lithologic zones in core hole WP-4

Formation or Zone	Depth below surface, feet		Depth, sea level datum, feet	
	From	To	From	To
Pascagoula and Hattiesburg Clays, undifferentiated...	0	751	+251	-500
Catahoula Sandstone..	751	930	-500	-679
Caprock: limestone...	930	1,016	-679	-765
gypsum.....	1,016	1,018	-765	-767
anhydrite.....	1,018	1,483	-767	-1,232
Salt.....	1,483	3,507 (total depth).	-1,232	-3,256

In addition to these formations, the depths of the principal aquifers (table 3) have been determined, but the exact definitions of the extent of the aquifers are in doubt. Because of their lenticular nature, knowledge of whether they are interconnected is also in doubt. They are, however zones of water-

bearing sands that are presumed to be continuous.

Table 3.--Aquifers in core hole WP-4

Aquifer	Formation	Depth (feet)	
		From	To
1	Pascagoula and Hattiesburg.	420	488
2	Pascagoula and Hattiesburg.	542	751
3	Catahoula.	854	884
Caprock.	Limestone and gypsum.	930	1,018

The lithologic character of the sediments, the caprock and salt of the central area of Tatum dome have been described in the report on core hole WP-1 (Technical Letter Dribble-15). In most respects the geology of core hole WP-4 is similar to that of core hole WP-1, and the lithology of the various formations is only summarized here. Some conspicuous differences, however, have been found and these will be noted.

The characteristics of the various formations are as follows:

Pascagoula and Hattiesburg Clays.--Clay, silt, and sand; clays and silts are generally grayish green to greenish gray, bluish gray, and light gray to olive gray; the sands are generally light gray, but where admixed with silt or clay are grayish green to olive gray. Reddish-brown silty clay was found in one zone, at the 344- to 346-foot depth. Some of the clays and silts are slightly calcareous and some contain calcareous nodules, mica, pyrite, and carbonaceous matter; some clays are internally and irregularly slickensided, believed to be the result of compaction. None of the clays is undurated or shaly; some

are thin-bedded, interbedded with silt and very fine sand.

The sands are loose and unconsolidated, and cave readily into the hole when unsupported by thick or heavy drilling mud. Most of the sands are fine to very fine, but some beds are medium to coarse grained near the base. Gravel was recorded in the sands in 3 zones, at depths of 385 to 394 feet, 448 to 488 feet, and 542 to 604 feet. The basal sand of the Pascagoula-Hattiesburg from 714 to 751 feet is medium to coarse grained. The sands are chiefly subangular to subrounded quartz, with only minor percentages of heavy minerals. The gravel is chiefly chert, up to about a half an inch in diameter, and many pebbles are polished. They range from white through yellow and gray to black. Only one of the beds was found to be calcareous, with slight induration, from the 309- to 319-foot depth. One zone, from 628 to 642 feet, is brownish gray and contains considerable carbonaceous matter.

Catahoula Sandstone.--Clay, silt, sand, and lignite, 179 feet thick. Clays and silts are dark brown (carbonaceous) to grayish green, grayish brown, olive, and medium gray. Sands are gray to dark brown, depending on the amount of carbonaceous matter. Lignite is black to dark brown; it checks and cracks vertically and horizontally upon drying, and is light in weight.

The Catahoula Sandstone of core hole WP-4 differs greatly from that of WP-1. The core from hole WP-4 lacks the basal 31 feet of fossiliferous sandy silt, coarse sand, and limestone

conglomerate that was logged (only 6 feet of core recovered) from 892 to 923 feet in core hole WP-1; some of this may have been present, however, in the 13-foot section of WP-4 above the limestone caprock, from 916 to 929 feet, from which no core was recovered. In addition, the thick lignitic and highly carbonaceous section in hole WP-4 from 784 to 916 feet was not found in the cores from hole WP-1, nor was it logged by Hycalog. It is not believed to have been present, for so thick and conspicuous a section could hardly have been overlooked in the cuttings from lost-core intervals in hole WP-1. The conspicuous differences between the sections immediately above the caprock in the two holes are most probably due to faulting that was followed by erosion before the overlying Pascagoula-Hattiesburg Clay was deposited.

Caprock, limestone.--The limestone caprock, although its boundaries are not exactly defined, is about 86 feet thick and extends from 930 to 1,016 feet. The upper part of the caprock is gray, fine to medium crystalline calcium carbonate, cut by white calcite veins. The veins are fractures that have been healed by secondary deposition of calcium carbonate. Some vugs and channels have been leached and are lined with secondarily precipitated crystals of calcium carbonate. Some vugs are stained with petroleum residue, and the core has a fetid odor when crushed or broken. About 60 feet below the top of the caprock the calcite has

earthy white gypsum in a matrix of calcite, and some strontium minerals, celestite and strontianite. Many of the vugs are lined with euhedral crystals of strontium minerals.

The lower 20 feet of the limestone consists of brecciated black calcitic limestone with the fragments cemented with strontium minerals and containing vugs lined with these minerals. Some of the limestone consists of granular, poorly cemented or loose calcite crystals containing doubly terminated quartz crystals.

Core recovery from the limestone was so poor (23.5 percent of the section cored) that definite boundaries and details cannot be determined, but it is believed that the limestone section is replete with water-filled caverns and channels. During drilling circulation was lost at the 970-foot depth, and the caliper log shows a wide zone from about 960 to 964 feet. The limestone caprock grades downward into the gypsum section below.

Caprock, gypsum.--The zone of chiefly gypsiferous rock is only about 2 feet thick, from 1,016 to 1,018 feet. No core was recovered from this zone, but the lithology is believed to be gradational from limestone with gypsum at the top to gypsiferous anhydrite below. A small cavity exists in this interval, and a sharp deflection outward of about a foot is recorded on the caliper log. In addition, some drilling mud, but not complete circulation, was lost at about this interval.

The bottom of the zone is taken as the point of deflection outward on the sonic log, below which the high velocities of the anhydrite caprock are recorded. Also, the cores beginning 3 feet below this horizon are chiefly anhydrite with gypsum veins.

Caprock, anhydrite.--The anhydrite caprock is about 465 feet thick, extending from about 1,018 to 1,483 feet. The upper part of the section has been highly fractured, and gypsum veins ramify the cores. These gradually diminish in size and frequency to about 1,050 feet, below which few, if any, gypsiferous zones were found. Most of the gypsum has developed as zones bordering slickensided fractures, and in some instances the slickensides are lined with a thin zone of gypsum schist. The anhydrite is medium gray, hard, firm, finely crystalline, and rings when struck with a hammer. The gypsum surrounding the slickensides in the anhydrite is somewhat lighter in color, medium gray to medium light gray, is finely crystalline, massive and compact, but is easily determined by its softer nature (can be scratched with the fingernail, and the core has been more deeply etched during drilling). The gypsum zones have developed in many instances since the anhydrite was fractured, but later movement along the fracture produced alignment of gypsum crystals to make the gypsum schist.

The anhydrite consists chiefly of interlocking randomly oriented crystals of anhydrite, with some disseminated fine crystals of calcite and a few crystals of sulfur. Some of the anhydrite shows thin, lenticular banding of alternating dark and lighter gray layers. The lighter bands in some instances contain abundant calcite crystals. The bands, an inch or more thick, generally have sharp basal contacts and resemble channels cut into the darker anhydrite. Some bands are bent and seem to be disturbed by postdepositional movement.

The anhydrite section of the core of hole WP-4 contains about twice as many fracture zones as core from hole WP-1. More than 80 fractures were listed (see Appendix 3), but this does not include the individual fractures in a zone of multiple fracturing from 1,382 to 1,424 feet from which only about 9 feet of core were recovered.

The bottom few inches of the anhydrite section consists of sugary crystals, and the rock is less undurated than the section above. The bottom contact with the salt is sharp, and no crystals of salt were found in the basal anhydrite.

Salt stock.--The salt stock consists of gray to very light gray, anhydrite-bearing halite to transparent, very coarse crystalline, almost pure halite. The salt is banded with nearly vertical alternating thin bands of anhydrite-bearing halite and almost pure halite. The bands of anhydrite-bearing halite are from a fraction of an inch to several inches wide, are cloudy to fairly dark, depending on the percentage

of anhydrite, and their boundaries are fuzzy. Some are discontinuous, gradually wedging out within a foot of core, and some thin bands are broken by areas of purer halite, and the anhydrite crystals may be bunched in clusters or knots. Generally the anhydrite crystals are discrete, surrounded by halite. The halite in these bands is more finely crystalline than that of the more pure bands and the halite crystals are generally about 3 to 8 mm in diameter. The bands generally dip from 80° to vertical, and rarely as low as 45° .

Halite crystals of the more pure layers are generally from 10 to 30 mm in diameter are somewhat elongate, with their long axes distinctly oriented at an angle to the banding. The axis of orientation of the crystals dips from about 40° to about 65° . Some of the crystals in the halite-rich bands contain occasional discrete crystals of anhydrite and locally, dolomite.

A few sections of the core are pale yellow. Generally there was an efflorescence of yellow or gray from the salt a few days after drilling. It has not been determined whether the yellow color is due to finely disseminated sulfur crystals or whether it results from contained light fractions of petroleum.

ANALYSIS OF GEOPHYSICAL LOGS

The electrical log of the section overlying the caprock shows generally low self-potential and high resistivity. Because the aquifers carry fresh water, both self-potential and

resistivity curves through them are deflected to the right (positive).

In the caprock section, the self-potential is low and relatively featureless in both the limestone and gypsum, and in approximately the upper 90 feet of the anhydrite. In the section of the anhydrite caprock below 90 feet from the top the self-potential arcs outward (or left) toward the negative side of the log. The limestone and gypsum sections of the caprock show moderately high resistivity, but the anhydrite shows very high resistivity. The electrical log ends in the anhydrite section at the 1,342-foot depth, approximately 140 feet above the top of the salt.

The gamma-ray log shows that the clays are more radioactive than the sands in the section overlying the caprock, but the neutron log shows slightly higher activity in the sands than in the clays. In the caprock gamma-ray activity is low and featureless, whereas the neutron activity is considerably higher in that section than in the overlying sediments. The neutron activity is generally low and variable in the limestone and gypsum caprock, but is higher in the anhydrite and highest in the salt. The lower 150 feet of the anhydrite caprock shows lower neutron activity than the upper 300 feet.

The sonic log of the section overlying the caprock shows somewhat higher velocities in the clayey sections than in the sandy ones. The limestone section of the caprock shows generally

high, very irregular velocities; the gypsum has low velocity, and the anhydrite, very high velocity. The salt section has only slightly lower velocity than the anhydrite section. The anhydrite and salt sections are generally featureless and monotonous.

Table 4 shows the average velocity for the various zones in the well.

Table 4.--Velocity zones in hole WP-4

Depth (feet)	Average interval transit time (microseconds/foot)	Approximate feet/second
209-352	165	6,060
352-410	152	6,580
410-662	170	5,880
662-854	160	6,250
854-928	155	6,450
928-944	125	8,000
944-962	140	7,140
962-1,002	90	11,110
1,002-1,018	120	8,330
1,018-1,482	53	18,870
1,482-3,512	67	14,930

The caliper log shows the width of the hole at various depths (table 5).

Table 5.--Hole size, core hole WP-4, after drilling

Interval, depth	Width, inches, average
209-274	Widens from 10½ to 20.
274-296	19-20
296-440	>20
440-453	19-20
453-484	>20
484-554	13-20
554-606	>20
606-706	14-20
706-732	>20
732-874	14
874-912	Widens to 20.
912-920	>20
920-976	Narrows to 11.
976-1,510	10

The temperature log run on April 30, 1961, shows that in a hole full of salt gel with a resistivity of .035 at 90°F the temperature at the surface is about 94°F and decreases to about 90° at about 170 feet. From 170 to 185 feet the temperature increases sharply to 96°F; from 180 to 380 feet, it increases gradually to 98°; from 380 to 390 feet, it increases to 100° F; from 390 to 2,305 feet, it increases gradually to 111½°F; and from 2,305 to 2,507 feet, it gradually increases to 117° F. No temperature survey of the hole was made after it was completed.

The directional survey run by Sperry-Sun Well Surveying Company shows that the hole describes a little more than a half of a spiral revolution. The upper part of the hole deviates northeasterly, reaching a point about 14 feet northeast

of the starting point at a depth of about 1,600 feet. Thence it deviates south-southeasterly to a point about 15 feet south-east of the starting point at a depth of 2,512 feet. From that point it deviates southwesterly, reaching a point about 46 feet south-southwest of the starting point at 3,507 feet, the bottom of the hole. The in-run measurement shows a horizontal displacement of the bottom of the hole to be 46.05 feet south, 08°48' west of the top. The out-run measurement shows a horizontal displacement of the bottom of the hole to be 47.21 feet south, 16°45' west of the top. The angles of inclination of the hole are shown in the Sperry-Sun data as being 1 degree or less to about 1,660 feet below the surface, and from 1-1/4 to about 2-1/4 degrees to total depth, with the exception of the interval between 2,572 feet and 2,814 feet, where deviations of 2-3/4 to 3-1/4 degrees were measured.

Appendix 1 contains descriptions of a number of cores of the salt, but the salt was not logged continuously. These descriptions are typical of the remainder of the core.

APPENDIX 1

Lithologic Log

Core hole WP-4

Tatum Dome, Lamar County, Mississippi

Location: Sec. 14, T. 2 N., R. 16 W., 783 feet S., 728 feet W.
of NE corner of section (Holmes and Narver coordinates
9,217 N., 9,272 E.).

Elevation: Ground level, 244 feet above sea level.

Depth datum: Rotary drive bushing, 251 feet above sea level.

Total depth: 3,507 feet.

Lithology from core descriptions and Hycalog, and interpreted
from sonic, radioactivity, caliper, and electrical logs.

Cores examined by C. A. Armstrong, Thad Shows, J. Schlocker,
and D. H. Eargle.

Descriptions summarized and coordinated by D. H. Eargle.

Description	Thickness (feet)	Depth (feet)
Pascagoula and Hattiesburg clays, undifferentiated.		
Soil, red, clayey, silty-----	16	0-16
Sand, clear, medium-grained, uncon- solidated-----	14	16-20
Clay, silty, grayish-green-----	21	20-41
Sand, clear, unconsolidated-----	5	41-46
Clay, silty, grayish-green and a few bluish-green streaks; calcar- eous streaks-----	11	46-57
Silt, clayey, light grayish-green and a few bluish-green streaks---	8	57-65
Clay, silty, grayish-green-----	13	65-78
Sand, clear, fine-grained, uncon- solidated-----	1	78-79

Lithologic log of core hole WP-4--Continued.

Description	Thickness (feet)	Depth (feet)
Silt, clayey, and silty clay, grayish-green to bluish-green, with calcareous streaks and some calcareous nodules, and mica--	35	79-114
Sand, clear, fine-grained; medium- grained toward base-----	28	114-142
Clay, silty, grayish-green, with some pyrite; some streaks of grayish-green or greenish-gray clayey silt with mica, and some very fine-grained sandy zones-----	42	142-184
Sand, clear, fine- to medium-grained; medium- to coarse-grained toward base-----	44	184-228
Clay, silty, and clayey silt, grayish-green to greenish-gray; clay is slickensided on fractures; contains some calcareous nodules and mica; interbedded with medium- to coarse-grained sand-----	18	228-246
Clay, silty, grayish-green, mica-----	10	246-256
Sand, clear, medium-grained, uncon- solidated; and sand, grayish-green, tight, very fine-grained and glau- conitic; contains layers of grayish- green silty clay and greenish-gray clayey silt with mica and calcareous nodules-----	19	256-275
Silt, clayey, bluish-gray, minor amounts of mica and pyrite-----	34	275-309
Sand, olive-gray, very fine-grained, with very finely disseminated pyrite and some calcareous cement; some grayish-green and grayish-blue silty clay interbedded-----	10	309-319
Clay, silty, greenish and bluish-gray, micaceous and slightly calcareous--	25	319-344
Clay, silty, reddish-brown-----	2	344-346
Clay, silty, greenish-gray, mottled with olive-gray from 350 to 355 feet; contains calcareous nodules--	39	346-385

Lithologic log of core hole WP-4--Continued.

Description	Thickness (feet)	Depth (feet)
Sand, gravelly (quartz and chert)--	9	385-394
Clay, silty, grayish-green, calcareous nodules and some pyrite--	22	394-416
Sand, unconsolidated, recorded by Hycalog-----	8	416-424
Silt, clay, and silty clay, greenish-gray, micaceous; poorly bedded-----	2	424-426
Sand. Hycalog records green, fine, silty shale, with a trace of red shale from 426 to 444 feet, but electrical log indicates possibly a permeable sand-----	18	426-444
Sand, grayish-green, very fine-grained with yellow chert gravel; grades down into medium- to coarse-grained sand; unconsolidated-----	44	444-488
Clay, silty, dark greenish-gray, thin bedded at 10 to 20° angle; finely disseminated pyrite and mica; slightly carbonaceous toward bottom-----	15	488-503
Sand, slightly clayey, grayish-green, fine-grained, calcareous cement; and clay, sandy, silty, containing pyrite and mica, some carbonaceous matter; some is bedded at 15 to 20° angle. From 516 to 542 feet, beds paper thin to 4 inches thick-----	39	503-542
Sand, gravelly, clear, fine- to coarse-grained, rounded and polished quartz gravel; contains thin beds of greenish-gray silty and sandy clay containing mica and finely disseminated pyrite---	62	542-604
Silt, sandy and clayey, light-gray to greenish-gray-----	15	604-619
Sand, olive-gray, very fine-grained, with some silt beds----	9	619-628

Lithologic log of core hole WP-4--Continued.

Description	Thickness (feet)	Depth (feet)
Sand, gray to brownish-gray, carbonaceous, micaceous; silty sand, very fine-grained, and sandy silt; a half-inch lignitized plant stem at about 630 feet-----	14	628-642
Sand, silty, grayish-green-----	32	642-674
Clay, grayish-green, silty-----	6	674-680
Sand, medium- to coarse-grained, unconsolidated-----	28	680-708
Clay, silty, light grayish-green; trace of pyrite-----	6	708-714
Sand, clear, medium- to coarse-grained, unconsolidated-----	37	714-751
Catahoula Sandstone		
Clay, silty, dark brown to grayish-green, carbonaceous, and pyritic. Slickensided, approximately 45°--	15	751-766
Sand, unconsolidated; some silty clay, dark brown, carbonaceous---	14	766-780
Silt, clayey, grayish-brown, carbonaceous-----	4	780-784
Lignite, black, friable-----	6	784-790
Silt, clayey, grayish-brown, carbonaceous-----	4	790-794
Lignite, black, with a few beds of silty and clayey lignite and very fine sand. Pyrite nodule a half to three-fourths of an inch in diameter-----	10	794-804
Silt, clayey, medium gray, laminated at 30° angle-----	2	804-806
Lignite, black, slightly silty----	3	806-809
Sand, silty, medium-gray, carbonaceous, fine- to coarse-grained, subrounded-----	0.5	809-809.5
Lignite, silty-----	2.5	809.5-812

Lithologic log of core hole WP-4--Continued.

Description	Thickness (feet)	Depth (feet)
Silt, medium-gray, carbonaceous, firm-----	3.5	812-815.5
Lignite, silty-----	2	815.5-817.5
Silt, medium-gray, carbonaceous, firm; a few streaks of lignite near bottom-----	4.5	817.5-822
Sand, medium-gray, fine- to medium- grained, containing silty lenses--	10	822-832
Lignite, black, containing medium- gray carbonaceous silt streaks----	7	832-839
Clay, olive, faulted as base against clayey lignite at 60° angle-----	1	839-840
Silt, lignitic, medium-gray-----	12	840-852
Clay, olive, slickensided internally-	2	852-854
Sand, medium-grained, unconsoli- dated-----	30	854-884
Lignite, brownish-black, light weight, checks and cracks (gener- ally in planes with 45 to 60° angle) into irregular granules. One smooth slickenside showing grooved directional movement at 65° angle (7 feet of core, all lignite, recovered from 885 to 916 feet). Hycalog records light- gray sandy clay from 884 to 394 feet, lignite from 894 to 900 feet, and unconsolidated medium- to coarse-grained sand from 900 to 904 feet, clear, medium- to coarse-grained quartz sand, un- consolidated, and silty gray clay from 904 to 930 feet-----	46	884-930
Caprock Limestone		
Limestone, calcite, gray, fine- to medium-grained, crystalline, cut by white calcite veins. Slight trace of vug development; frac- tures healed by secondary calcite-	5	930-935

Lithologic log of core hole WP-4--Continued.

Description	Thickness (feet)	Depth (feet)
Limestone, calcite, medium dark-gray, same as depth 930-935. Finely granular-----	3	935-938
No core recovered. Hycalog shows dense vuggy, granular, tan limestone with tan, gray and white calcite veins-----	23	948-971
Limestone, medium-gray, same as depth 948-971, vuggy, cut locally by moderate yellowish-brown calcite veins. Vugs lined with calcite and stained with petroleum. Fetid odor when crushed or broken-----	14	971-985
Limestone; 2 feet recovered, half of which is fragmentary, earthy, white, soft gypsum, in a matrix of fine-grained, massive strontianite and celestite. Bottom half of core consists of fragments about 3 inches long, chiefly of pale pink veins, and thin (1 to 3 mm) nearly horizontal streaks of black calcite. Vugs in strontianite or celestite chiefly, 1 cm wide, lined with celestite or strontianite-----	11	985-996
Calcite, black, containing abundant veins of pale pink strontianite or celestite. The calcite is brecciated, with breccia cemented by strontianite- or celestite-vein materials. Veins a half an inch wide separated by 3 to 5 inches of black calcite with a few small veins. Vug development striking, more confined to strontianite-celestite veins. Some vugs are full width of core, with black calcite projecting from interior of vug. Vugs lined with celestite euhedral crystals. Thin zone of calcarenite containing many doubly terminated citrine quartz crystals near bottom of core-	20	996-1,016

Lithologic log of core hole WP-4--Continued

Description	Thickness (feet)	Depth (feet)
Caprock, Gypsum		
Gypsum, and calcite intermixed, white to light-gray, firm and dense, vuggy; contains calcite veins. Boundaries of zone determined chiefly on geophysical logs--	2	1,016-1,018

Caprock, Anhydrite

Anhydrite, medium-gray, finely crystalline, with many gypsum veins. Gypsum is medium-gray to medium light-gray, finely crystalline, finely banded with faint undulating bands, firm and hard. Slight vug development along slickensides. Veins at 1- to 2-inch intervals, about a quarter to a third of an inch wide, and most show a thin zone of slickensiding in the center of each vein (gypsum development is post-slickensiding). Zones of anhydrite at about 1,024 feet, slightly lighter gray than gypsum. At 1,026 to 1,028 feet anhydrite is spotted, medium gray and medium light gray; bottom 6 inches in gypsum. Section at 1,028 to 1,029 feet is mostly gypsum separated by nearly horizontal thin bands of anhydrite a quarter to a half an inch thick. At 1,029.5 to 1,029.7 feet and 1,031.5 to 1,032 feet are thick bands of gypsum with sharp wavy boundaries. At 1,032 to 1,032.5 feet are slickensides, upper

Lithologic log of core hole WP-4--Continued.

Description	Thickness (feet)	Depth (feet)
<p>one at 40°, lower one at 45° angle, in center of half-inch zones of gypsum. At 1,033.5 feet one slickenside at 50°, one at 1,034.2 feet at 20°, with high calcite content. Dark spots a quarter to a half an inch wide at 1,035.5 feet-----</p>	18	1,018-1,036
<p>Anhydrite, medium-gray, finely crystalline (crystals average about 1 mm in diameter), tough dense, rings when struck; crystals in random orientation, inter- locked. Faint banding, with lensing bands of slightly lighter gray with medium gray. Banding is irregular and is disturbed by post depositional movement or penecontemporaneous disturbance; bands are definitely bent and in places replaced with massive anhydrite. Some small calcite crystals disseminated through anhydrite and some lighter anhydrite bands have concen- tration of calcite. Lower in core, disseminated traces of sulfur, especially concentrated along fracture planes. Upper part of anhydrite section, down to about 1,050 feet, contains bands of gypsum, most of them along slickensided fracture zones, as in section from 1,028 to 1,036 feet, but de- crease in frequency downward. Fractures are listed and briefly described in Appendix 3.</p>		

Lithologic log of core hole WP-4--Continued.

Description	Thickness (feet)	Depth (feet)
<p>At 1,038 to 1,038.5 feet are slightly darker bands of anhydrite with 50° dip. In places, as at 1,088.5 feet, strong odor of hydrogen sulfide when broken. In section from 1,088.9 to 1,089.5 feet is sharp horizontal contact of dark anhydrite above, with light banded anhydrite below.</p>		
<p>In core from 1,127 to 1,148 feet, Hycalog records free sulfur on fracture planes and trace of sulfur disseminated through cores; also at 1,160 feet, at about 1,290 and 1,320 feet. At 1,276.5 feet, disseminated sulfur in core. From 1,280 to 1,282 feet has faint banding at a 30° angle.</p>		
<p>At 1,287.5 feet is an irregular, white, tabular zone, nearly horizontal, containing abundant calcite. At 1,290 feet are 3 irregular calcite-rich bands a half an inch to about 3 inches thick, grading into medium-gray anhydrite along edges. From 1,397 to 1,424 feet, the core was badly broken by fracturing, and most of the core was lost. At 1,424 feet the anhydrite is light gray and has sugary texture, although indurated. From 1,469 to 1,483 feet the anhydrite is light gray, but contains a few zones of medium light gray, and, at the bottom, a few inches of sugary anhydrite. Boundary with salt below is sharp-----</p>	447	1,036-1,483

Lithologic log of core hole WP-4--Continued.

Description	Thickness (feet)	Depth (feet)
Salt Stock		
Salt, light-gray to very light-gray; top 2 inches is light gray, containing more disseminated anhydrite than salt below. Band dips at 40°; anhydrite crystals in this band are roughly aligned along foliation of band. Band of halite-rich salt below the anhydrite-rich band consists of coarsely crystalline halite, with crystals from 1 to 5 mm wide, 25 mm long, with long axis nearly horizontal, making the core appear to be foliated horizontally. Contains fine-grained clear anhydrite crystals disseminated throughout; anhydrite crystals are 1/2 mm diameter, 1-1/2 mm long-----	0.8	1,483-1,483.8
Salt, very light-gray, and relatively pure (very few anhydrite crystals seen). Halite crystals 10 X 20 mm in more or less parallel arrangement, long axes averaging 30° from horizontal-----	0.8	1,483.8-1,484.6
Salt, clear, scattered anhydrite crystals, no bands of anhydrite. Crystal orientation same as above--	1.7	1,484.6-1,486.3
Large crystals of halite 5 to 10 X 30 mm, dipping at 35 to 45°. Anhydrite scarce. At 1,486.4 feet is a tight, bifurcating break. In reflected light salt above break is lighter than that below. In transmitted light salt is more milky above the break-----	1.9	1,486.3-1,488.2
Salt, slightly darker gray than above. Salt crystal orientation is about 30°. Anhydrite-rich, faint band made up of disseminated crystals. Band is 1 cm wide, dips 80°; does not go through core-----	0.8	1,490.6-1,491.4

Lithologic log of core hole WP-4--Continued.

Description	Thickness (feet)	Depth (feet)
Same as depth 1,490.6 to 1,491.4, except not banded. Bottom 8 inches show hori- zontal crystal orientation-	5.6	1,491.4-1,497
Salt, crystals at 30° dip. Two bands anhydrite-rich salt, dipping at 80°, 15 to 20 mm wide; clear to nearly clear salt between, 15 cm thick-----	2.5	1,506.5-1,509
Salt, no core-----	5	1,509-1,514
Clear salt, oriented crystals-	1	1,514-1,515
Clear salt at top. Oriented crystals about 45°; cloudy, banded anhydrite in knots or bunches, as if band divided in direction of crystal axes, 2 inches apart. Anhydrite bands, three-fourths of an inch wide, cut by secondary orientation. Some cores have more anhydrite-rich bands than others-----	24	1,515-1,539
Salt, no core-----	768	1,539-2,307
Band of anhydrite-rich salt, 60° from horizontal. Salt crystals oriented 45°, three-fourths of an inch across. One to two inches between centers of bands---	2	2,307-2,309
No banding but crystal orien- tation distinct at 55 to 60°. Halite crystals are 1-1/4 inches long, 1/2 to 1 inch wide-----	13	2,309-2,322
Anhydrite banding 3 inches apart, 1/2 inch wide. 60° angle. Smaller crystals than above-----	1.5	2,354-2,355.5

Lithologic log of core hole WP-4--Continued.

Description	Thickness (feet)	Depth (feet)
Anhydrite-rich band, 1½ to 2½ inches wide. Clear salt is 3 inches wide, dips about 50°-----	0.7	2,412.7-2,413.4
At 2,430 feet, angle of crystal orientation is 45°. Banding at 45° to 80°. Clear salt 4 inches, bands 1/2- to 3/4-inch wide. From 2,458 to 2,460 bands at 70°, crystal orientation 40°.		
Anhydrite bands are cloudy-	33	2,427-2,460
Very slight banding, anhydrite crystals sparse-----	1.5	2,463.5-2,465
Anhydrite bands conspicuous; knotty; 65° dip. Bands discontinuous, offset by shearing parallel to crystal orientation. Some crystals in clear salt are 1½ inches long. Bands of clear salt, 1½ to 4 inches wide-----	1	2,465-2,466
Salt is yellowish-gray, salt and anhydrite not banded distinctly. Yellow color appears to be inclusions in anhydrite-----	1.5	2,471.5-2,473
Very distinct crystal orientation, 40°. Faint, narrow, anhydrite-rich band about 85°-----	1.5	2,473.5-2,475
Cloudy faint anhydrite band, discontinuous, 60° dip. Large and small salt crystals in clear salt zone. Crystal orientation about same as anhydrite bands----	1.5	2,473-2,474.5

Lithologic log of core hole WP-4--Continued.

Description	Thickness (feet)	Depth (feet)
Salt cores have yellow efflorescence-----	0.8	2,475.2-2,476
Same as above-----	0.3	2,478-2,478.3
Same as above-----	4.5	2,486-2,490.5
Efflorescence is white-----	2.5	2,490.5-2,493
Faint anhydrite--cloudy band, 60° dip, parallel to crystal orientation. Darker part of band is a half an inch wide. Fades out into purer salt with coarse crystals-----	2.5	2,493-2,495.5
Very faint anhydrite banding at 70° dip. Horizontal, feathery, banding probably cleavage. From 2,500 to 2,500.3 feet, salt shows slightly yellowish color-----	1.5	2,500-2,501.5
Cloudy anydrite bands 6 to 8 inches wide, clear salt about same and grade into each other; about 60° dip, banding and crystal orientation-----	2.5	2,512.5-2,515
Core shows anhydrite band 80°, cut by secondary bands at 55° that are parallel to crystal orientation-----	1	2,522.5-2,523.5
Anhydrite banding shows convergence. One band 50°, another 80°-----	1	2,525-2,526
Dip of 60° on dark fuzzy anhydrite bands. Halite crystals 20 X 30 mm in clear salt layers; in anhydrite layers, halite averages 3 X 8 mm. Anydrite bands 15 mm wide, diffuse band is 5 inches thick. Salt crystal boundaries are conspicuous-----	1.5	2,526-2,527.5

Lithologic log of core hole WP-4--Continued.

Description	Thickness (feet)	Depth (feet)
Two 1-inch bands of anhydrite-rich, very dark salt, 1½ inches apart. No transmitted light through one, with cloudy edges; sheared at small angles to bedding. Dip at 60°, shearing 45°. Crystals, ¾ to 1 inch wide, large crystals-----	1.5	2,568.5-2,570
Anhydrite bands 55° dip, 3 inches wide, separated by clearer salt as much as 6 inches wide-----	2.5	2,570-2,572.5
Cloudy bands of anhydrite, dip about 55°-----	2.5	2,610-2,612.5
Cloudy banding of anhydrite at 60°, crystal orientation at 45°-----	2	2,623-2.625
Very little anhydrite banding in coarse crystalline salt. At 2,659 to 2,660 feet one cloudy band, with indistinct edges; crystal axes at 45°-----	14	2,650-2,664
Coarsely crystalline halite banded with anhydrite-rich salt at about 80°, distinct crystal orientation at about 55°. This cross structure of the crystals appears to have obscured the edges of the anhydrite bands, making them fuzzy, indicating slight movement in the recrystallization---	2.5	2,693.5-2,696

Lithologic log of core hole WP-4--Continued.

Description	Thickness (feet)	Depth (feet)
One 3-inch anhydrite-rich band, top contact sharp with anhydrite concentra- tion in upper half an inch at 65° dip. Crys- tal orientation not dis- tinct, but appears to be same-----	1.5	2,705.5-2,707
Drilled, no core, salt-----	800	2,707-3,507 (total depth)

APPENDIX 2

CORE RECORD ON TATUM WP-4 CORE HOLE, PROJECT DRIBBLE

(Drilling, coring begun February 9, 1961, completed May 7, 1961)

Depth datum is rotary table, 251 feet above sea level

Core no.	Interval (depth-feet)	Footage drilled or core cut	Core recovered (feet)	Percent recovery	Remarks
	0-30	30	-	-	Drilled.
1	-40	10	2.0	20	2-1/8 inch core.
2	-50	10	1.0	10	
3	-57	7	3.0	43	
4	-62	5	1.25	25	
5	-67	5	1.25	25	
6	-72	5	1.75	35	
7	-77	5	1.5	35	
8	-85	8	2.0	25	
9	-90	5	0.25	5	
10	-95	5	2.0	40	
11	-100	5	4.0	80	
12	-105	5	4.0	80	
13	-110	5	4.0	80	
14	-113	3	0	0	
15	-118	5	1.0	20	
16	-124	6	0.25	4	

Core record on Tatum WP-4 core hole--Continued.

Core no.	Interval (depth-feet)	Footage drilled or core cut	Core recovered (feet)	Percent recovery	Remarks
17	124-130	6	0	0	
18	-135	5	0	0	
19	-142	7	0	0	
20	-147	5	0	0	
21	-152	5	1.0	20	
22	-157	5	0	0	
23	-162	5	0.25	5	
24	-170	8	5.0	63	
25	-176	6	2.75	46	
26	-181	5	2.25	45	
27	-187	6	3	50	
28	-192	5	0	0	
29	-198	6	0	0	
30	-207	9	0.25	3	
	207-214	7	-	-	Drilled.
31	-219	5	0	0	
32	-224	5	0	0	
33	-229	5	0	0	
34	-234	5	1	20	

Core record on Tatum WP-4 core hole--Continued.

Core no.	Interval (depth-feet)	Footage drilled or core cut	Core recovered (feet)	Percent recovery	Remarks
35	234-244	10	3.25	33	
36	-249	5	2.5	50	
37	-254	5	2.25	45	
38	-259	5	2.5	50	
39	-265	6	1.75	29	
40	-274	9	3.25	36	
41	-279	5	2.5	50	
42	-284	5	1.75	35	
43	-289	5	4.25	85	
44	-294	5	3.5	70	
45	-304	10	4	40	
46	-309	5	5	100	
47	-314	5	1.75	35	
48	-319	5	3.75	75	
49	-324	5	3.5	50	
50	-329	5	5	100	
51	-335	6	5.5	92	
52	-340	5	5	100	
53	-345	5	5	100	

Core record on Tatum WP-4 core hole--Continued.

Core no.	Interval (depth-feet)	Footage drilled or core cut	Core recovered (feet)	Percent recovery	Remarks
54	345-350	5	1.75	35	
55	-355	5	3	60	
56	-365	10	1.75	18	
Depth correction: 365 = 370					
57	370-375	5	3.5	70	
58	-380	5	4.5	90	
59	-392	12	5.25	44	
Depth correction: 392 = 394					
60	394-409	15	11	73	
61	-425	17	4.75	28	
62	-445	20	0	0	
63	-465	20	0	0	
64	-485	20	1.5	8	
65	-505	20	14	70	
Depth correction: 505 = 510					
66	510-515	5	0	0	
67	-520	5	4.5	90	
68	-530	10	8.5	85	
69	-540	10	1.5	15	
70	-550	10	0	0	

Core record on Tatum WP-4 core hole--Continued.

Core no.	Interval (depth-feet)	Footage drilled or core cut	Core recovered (feet)	Percent recovery	Remarks
71	550-560	10	0	0	
72	-571	11	0	0	
73	-581	10	0.75	8	
74	-596	15	0	0	
75	-601	5	0.5	10	
76	-611	10	7	70	
77	-621	10	6.5	65	
78	-628	7	0	0	
79	-638	10	9	90	
80	-647	9	2.75	31	
81	-656	9	0	0	
82	-671	15	0	0	
83	-686	15	0	0	
84	-701	15	0	0	
85	-716	15	0	0	
86	-731	15	0	0	
87	-746	15	0	0	
88	-761	15	7.5	50	
89	-778	17	1.5	8	
90	-793	15	13	87	

Core record on Tatum WP-4 core hole--Continued.

Core no.	Interval (depth-feet)	Footage drilled or core cut	Core recovered (feet)	Percent recovery	Remarks
91	793-808	15	14.5	97	
92	-822	14	12.5	89	
93	-839	17	6.5	38	
94	-854	15	5.5	37	
95	-869	15	0	0	
96	-885	16	0	0	
97	-901	16	7.5	47	
98	-916	15	0	0	
99	-929	13	0	0	
100	-945	16	1	6	Top of limestone cap-rock 930 feet.
101	-948	3	0.25	8	
Depth correction: 948 = 951					
102	951-970	19	2.5	13	Lost circulation at 970 feet.
Depth correction: 970 = 971					
103	971-985	14	3	21	
104	-996	11	2	18	

Core record on Tatum WP-4 core hole--Continued.

Core no.	Interval (depth-feet)	Footage drilled or core cut	Core recovered (feet)	Percent recovery	Remarks
105	996-1,021	25	10.5	42	Top of gypsum caprock, 1,016 feet. Top of anhydrite caprock 1,018 feet.
106	-1,027	6	6	100	
107	-1,036.5	9.5	9.5	100	
108	-1,051.5	15.0	15.0	100	
109	-1,056	4.5	4.5	100	
110	-1,071	15.0	15.0	100	
111	-1,072	1.0	1.0	100	
112	-1,087	15.0	15.0	100	
113	-1,107	20	20.0	100	
114	-1,127	20	20	100	
115	-1,148	21	21	100	
116	-1,168	20	20	100	
117	-1,187	19	19	100	
118	-1,207	20	20	100	
119	-1,227	20	20	100	
120	-1,247	20	20	100	

Core record on Tatum WP-4 core hole--Continued.

Core no.	Interval (depth-feet)	Footage drilled or core cut	Core recovered (feet)	Percent recovery	Remarks
121	1,246-1,267	20	20	100	
122	-1,279	12	12	100	
123	-1,294	15	15	100	
124	-1,310	16	16	100	
125	-1,330	20	20	100	
126	-1,341	11	11	100	
Depth correction: 1,341 = 1,343					
127	1,343-1,363	20	20	100	
	-1,367	4	-	-	Drilled.
128	-1,382	15	15	100	
129	-1,397	15	9	60	
130	-1,411	14	0	0	Core barrel jammed by core fragments.
131	-1,414	3	0	0	
132	-1,418	4	0.25	6	
133	-1,421	3	0	0	
134	-1,424	3	3	100	
135	-1,439	15	15	100	
136	-1,454	15	15	100	

Core record on Tatum WP-4 core hole--Continued.

Core no.	Interval (depth-feet)	Footage drilled or core cut	Core recovered (feet)	Percent recovery	Remarks
137	1,454-1,469	15	15	100	
138	-1,484.5	14.5	14.5	100	Top of salt 1,483 feet.
139	-1,497	12.5	12.5	100	
140	1,497-1,508	11	11	100	
	Depth correction:	1,508 = 1,509			
	1,509-1,514	5	-	-	Drilled.
141	-1,539	25	23.5	94	Bridge developed at 1,538 feet (4-15-61), 10 days after drilled on 4-5-61. Was not bridging over on 5-2-61. Drilled.
	1,539-2,307	768-foot interval.			
142	-2,537	50	45	90	
143	-2,407	50	9.0	18	
144	-2,457	50	6.4	13	
145	-2,491	34	34	100	
146	-2,535	44	41.2	94	Temperature 117°.
147	-2,585	50	50	100	
148	-2,635	50	50	100	
149	-2,685	50	50	100	
150	-2,707	22	22	100	
	2,707-3,507 (Schlumberger, total depth 3,512).	800	-	-	Drilled.

APPENDIX 3

TATUM DOME CORE HOLE WP-4, SLICKENSIDES AND FRACTURES IN ANHYDRITE CAPROCK

Depth	Description
1,022	In gypsum rock, about 40° with horizontal, vugs lined with calcite crystals developed along fracture.
1,025.5-1,026	Several slickensides 0 to 20°, mostly curved.
1,032-1,032.3	Double slickenside, bottom one at 55°, top one 35°, with half-inch gypsum vein surrounding each.
1,033	About horizontal, in middle of gypsum vein 2 inches wide.
1,035.2	25°, gypsum vein a half an inch wide.
1,035.5	40°, gypsum vein a half an inch wide.
1,036-1,051	One somewhere in this section in half-inch gypsum vein.
1,050	25°, no gypsum.
1,056	35°.
1,064.5	30°, irregular.
1,066.5	35°.
1,067	45°.
1,069	15°, black gypsum-lined.
1,073	35°, smooth.
1,076	35°, smooth.
1,079	Horizontal, irregular.
1,079.3	Horizontal, warped slightly.
1,079.5	10°, rough, coated with sulfur.
1,081.1	10°, irregular.
1,084.5	Horizontal, slightly irregular.
1,092	15°, slightly irregular.
1,102.5	30°, smooth, slightly irregular.
1,103	30°, fluted.
1,103.3	30°, smooth.
1,104	15°, slightly warped.
1,104.5	Horizontal, somewhat smooth.
1,105.9	Horizontal, semirough.
1,110	Horizontal, grooved.
1,113.5	15°, uneven, rough; fractured, not slickensided.
1,116	25°, smooth.
1,124.5	Rough fracture, not slickensided.
1,125.5	20°, somewhat rough, indicating slight movement.

Tatum Dome core hole WP-4--Continued.

Depth	Description
1,130	Slightly slickensided fractures, rough, indicating slight horizontal movement.
1,132	Horizontal, rough, sulfur-coated.
1,133	30°, slick, warped.
1,135	40°, slick, slightly warped.
1,136.5	35°, slick, slightly warped.
1,143.5	5°, rough, fractured.
1,145	12°, smooth.
1,145.05	20°, very smooth, polished.
1,147.5	45°, smooth, curved, irregular.
1,159	40°, somewhat rough and irregular, dull black, with trace of sulfur.
1,165.3	20°, moderately smooth, little movement.
1,166.7	5°, smooth, slightly irregular.
1,167	30°, smooth, slightly irregular.
1,169	12°, smooth, slightly irregular.
1,173.7	35°, smooth.
1,199.5	18°, rough, dull black-coated fractures.
1,217	12°, smooth, slightly irregular.
1,218	20°, smooth, slightly irregular.
1,219	15°, smooth, slightly irregular.
1,222.5	30°, rough, dull black-coated fractures.
1,231.3	8°, irregular, smoothed slightly, not polished.
1,232	50°, rough, irregular fractures.
1,234.5	10°, rough, irregular fractured rock.
1,240	5°.
1,242	Horizontal, dull black-coated fractures, slightly smoothed, secondary flaky mineral.
1,252.5	Almost horizontal, dull, somewhat polished, slightly irregular.
1,265.5	45°, rough, irregular, black.
1,269.5	20°, platy selenite-coated fracture, somewhat smooth.
1,272.5	Sulfur on fresh fracture.
1,278.5	8°, rough, dull black, very slightly polished.
1,287.5	Irregular, nearly white to gray gypsum bands (fractures ?), grading down into gray anhydrite.
1,289	Sulfur on fresh fracture. Sulfur is between moderate yellow and moderate greenish-yellow. NRC color chart.

Tatum Dome core hole WP-4--Continued.

Depth	Description
1,302	35°, rough, irregular, black, fractured.
1,307	10°, coated with sulfur and selenite, full luster, somewhat smoothed.
1,309.3	Horizontal, polished, slightly irregular.
1,319	Almost horizontal, polished, selenite-coated.
1,321.5	Horizontal, somewhat rough, selenite-coated fracture.
1,328.5	20°, slick, selenite-coated.
1,329.5	25°, rough fracture, coated with layer of sulfur, 1 mm thick, maximum found anywhere in caprock.
1,334.7	40°, irregular, rough fracture, black.
1,338.5	Horizontal, irregular, rough.
1,342	Horizontal with a curved, smoothed fracture.
1,346	10°, smooth, wavy, coated with selenite.
1,350.3	Horizontal, rough fracture.
1,359.5	15°, warped, smooth.
1,370.5	Horizontal, polished and coated with sulfur; faulting is post sulfur.
1,377.5	60°, healed fracture, coated with sulfur.
1,378.5	Horizontal, rough, gypsum coated (not selenite).
1,381.5	Horizontal, selenite coated, smooth, wavy.
1,387	Flat, warped, smooth, dull.
1,391	Glossy, black fracture, rough.
	No core recovery, except a few fragments from 1,397 to 1,424. Fragments of core show anhydrite crystals in a schistose anhydrite matrix.

APPENDIX 4

IN-HOLE SURVEYS AND LOGS PRODUCED

Company or organization	Type of Log	Interval (depths in feet below surface)	Scale of log
Hycalog	Mud log	12-3,507	5" = 100'
USGS (Widco)	Electrical	25-206	5" = 100'
Schlumberger	Electrical	209-1,342	2" - 5" = 100'
Schlumberger	Gamm-ray, neutron	209-1,510	5" = 100'
Schlumberger	Gamma-ray, neutron	1,508-2,710	5" = 100'
Schlumberger	Sonic	209-1,506	5" = 100'
Schlumberger	Sonic	1,506-2,703	5" = 100'
Schlumberger	Sonic	2,703-3,512	5" = 100'
Schlumberger	Caliper	209-1,509	5" = 100'
Schlumberger	Temperature	88-1,510	2" = 100'
Schlumberger	Temperature	7-2,507	2" = 100'
Sperry-Sun	Gyro Deviatonal, Directional	6-3,507	Approx. 60' spacing
USGS	Lithologic	0-3,507	1" = 100'

WP-4

AEC Vela Uniform Core Hole
Tatum Dome, Lamar County, Mississippi

LOCATION: Section 14, Township 2 North, Range 16 West.

COORDINATES: 9217 North, 9272 East (783 feet south, 728 feet west of northeast corner of section).

ELEVATION: Ground level, 244 feet above sea level.

DATUM: Rotary drive bushing, 252 feet above sea level.

LITHOLOGY: D.H. Eargle, C.A. Armstrong, Thad Shows, J. Schlocker, U.S.G.S.; Hycalog; and interpreted from geophysical logs.
Electrical log from 1 foot to 200 feet, Widco, by Billy Wasson, USGS; from 200-1342 feet, by Schlumberger Well Surveys Corp.;
Sonic and Gamma Ray-Neutron logs by Schlumberger.

FIGURE 2.— LOG OF CORE HOLE WP-4, TATUM DOME, LAMAR COUNTY, MISSISSIPPI