Mr. James Reeves  
Assistant Manager for Test Operations  
Albuquerque Operations Office  
U. S. Atomic Energy Commission  
P. O. Box 5400  
Albuquerque, New Mexico

Dear Mr. Reeves:

Transmitted are three copies of:

TECHNICAL LETTER: Dribble-14  
LOG OF EXPLORATORY HOLE 6,  
TATUM DOME, LAMAR COUNTY,  
MISSISSIPPI

By  
C. A. Armstrong, R. V. Chafin, H. B. Harris,  
R. E. Taylor, and John Stanford

December 6, 1961  
USGS-474-277

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Sincerely yours,

W. S. Twenhofel  
W. S. Twenhofel  
Program Supervisor  
Special Projects Branch

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LOG OF EXPLORATORY HOLE 6, TATUM DOME, LAMAR COUNTY, MISSISSIPPI

By

C. A. Armstrong, R. V. Chafin, H. B. Harris, R. E. Taylor, and John Stanford

Exploratory Hole 6, the fourth of the series of exploratory holes drilled on Tatum salt dome, was completed in August 1961. The drill site is at Atomic Energy Commission coordinates, 10,960 N. and 8,820 E. It is 960 feet north and 1,180 feet west of the southeast corner of Sec. 11, T. 2 N., R. 16 W., Lamar County, Mississippi. This location overlies the northern part of the dome (fig. 1).

The primary purpose of Exploratory Hole 6, as well as the other exploratory holes, is to aid in determining the configuration of the salt dome. It also was used to determine the depth, altitude, and thickness of the various lithologic units and to correlate the water-bearing strata with aquifers contiguous to the dome.

Exploratory Hole 6, was drilled with rotary equipment to a depth of 2,999 feet by C. and H. Drilling Company. A series of wire line logs was run consisting of a Widco single-point electric log from the surface to 385 feet, and Lane Wells logs as follows: Induction-electric logs from 365 to 994 feet and 999 to 1,407 feet, focused logs from 998 to 1,596 feet and 1,596 to 2,250 feet, acoustilog from 998 to 2,250 feet, gamma-ray log from the surface to 2,238 feet,
Figure 1. Map showing location of Exploratory Test Hole 6, Tatum Salt Dome, Lamar County, Mississippi.
neutron log from the surface to 2,250 feet, caliper logs from 998 to 1,604 feet and 998 to 2,250 feet. A Sperry-Sun directional survey was made from the surface to 2,600 feet.

Three general rock types, classified by modes of origin, were encountered in the test hole. The uppermost rocks are of sedimentary origin and were deposited in the sea or in estuaries. The middle group of rocks, the dome cap rock, is the insoluble residue and alteration products of the residue left from solution by groundwater of the upper part of the original salt stock. The lower rock type is salt which comprises the salt stock. The salt originally was deposited in widespread beds as a chemical precipitate in a large saline basin. After deposition and subsequent burial the weight of overlying sediments caused the salt to flow upward as a plastic mass, carrying with it some of the interbedded anhydrite and associated minerals, to form Tatum salt dome.

The lithologic units of sedimentary rocks encountered from the surface downward in E-6 are the Pascagoula and Hattiesburg clays undifferentiated and the Catahoula sandstone, of Miocene age. The Pascagoula and Hattiesburg clays are composed principally of greenish-to light-gray, silty, calcareous clays, which dry to a yellowish-gray color, and fine to very coarse, pebbly sand. At the surface the clays are weathered brown and may include a few feet of recent colluvium. The Catahoula sandstone contains in the upper part greenish-to light-gray, silty clay and fine to very coarse sands, which are similar to those of the Pascagoula and Hattiesburg clays. In the lower
part the Catahoula sandstone is predominantly light gray, calcareous sand and sandstone, sandy limestone containing fossiliferous zones, and some greenish-gray clays. The fossiliferous sandy limestone probably represents the Heterostegina zone. This lower calcareous part is sometimes referred to as the false cap rock because the drilling and some of the geophysical characteristics are similar to those found in the true cap rock.

The cap rock, which underlies the Catahoula sandstone, consists of two dominant lithologic units. The upper unit is composed principally of light gray to brown, crystalline limestone with some sand, apparently in thin lenses. The limestone has been subjected to solution by circulating ground water, which has resulted in moderately permeable to cavernous conditions in some places. Near the base of the unit, for example, circulation was lost while drilling at 1,020 feet.

The lower lithologic unit is composed of white to gray, crystalline anhydrite. The anhydrite for the most part is hard and dense, but from 1,430 feet to the salt contact at 1,480 feet the drilling time indicates the hardness of the anhydrite is variable. Cavernous conditions are indicated, as where circulation was lost at 1,440 feet and afterwards never completely regained; only one sample was recovered below 1,440 feet. The two dominant lithologic units of the cap rock are believed to be separated by a cavernous zone several feet thick containing considerable gypsum. However, circulation was lost just above this zone, no samples were recovered, and the presence of gypsum is not positively known.
The salt stock which underlies the cap rock is assumed to be composed principally of white to gray, translucent halite with minor quantities of anhydrite. No salt samples were recovered and this assumption is based on samples and cores from other holes in the salt stock. Some of the insoluble residue from the solution of the salt was recovered from a depth of about 2,900 feet. This sample is composed principally of loose anhydrite crystals with some quartz grains.

The different lithologies are shown on figure 2, which also gives the electrical log and indicates the most significant aquifers. Aquifer 1 is correlated with the conglomeratic material found in the samples from the interval between 378 to 471 feet. Aquifer 2 is well developed as shown on figure 2. Only the upper part of Aquifer 3 appears to be present, as the cap rock intercepts and has apparently displaced most of the aquifer. This suggests hydraulic connection between the limestone part of the cap rock and Aquifer 3 on side of the dome. The cavernous zone in the lower part of the anhydrite has not been correlated with any of the known aquifers but connection may be possible with either Aquifer 4 or 5. Depending on conditions of faulting around the dome, it is possible that the cavernous zone could be connected to both aquifers.

Samples were taken from the shale shaker by the drilling crews during the course of drilling. They represent approximately 20-foot intervals and are described in table 1. Because of the condition of the drilling fluid and the drill hole, and the sampling techniques
used, the samples generally are of poor quality and do not contain a representative quantity of loose or very friable material, particularly in the silt to coarse sand sections encountered.

The records of Holmes and Narver, Inc., architects and engineers for the Atomic Energy Commission, show that after drilling to 391 feet, one string of 9 5/8-inch steel casing was set and cemented from the surface to 365 feet. Drilling then proceeded to 1,020 feet where circulation was lost, and the drill pipe became stuck due to caving sands higher in the hole. The drill pipe was freed and stuck several times while regaining circulation. The hole was then reamed and 7 5/8-inch steel casing was set from 320 to 1,000 feet and cemented in place. Several attempts were made before successful circulation was maintained. Drilling then proceeded to 1,440 feet where circulation was again lost and never completely recovered in spite of the use of different kinds of lost-circulation materials. Drilling proceeded blind (with no returns) to a depth of 2,999 feet using fresh water. A cavity was dissolved in the salt which was of such large diameter that the caliper logging instrument could not measure it. One calculation, based on the volume of gravel and cement placed in the hole, indicated that the lower 26 feet of the hole averaged about 3.75 feet in diameter, and probably was larger higher up in the hole.

After completion of drilling, three unsuccessful attempts were made to set a cement plug at about 2,500 feet in the salt stock. Two other plugs were then set; the first from about the anhydrite-salt contact to 1,230 feet, and the second from 25 to 75 feet. A steel cap was placed on the casing to complete the test hole.
<table>
<thead>
<tr>
<th>Lithologic log of Exploratory Hole 6—Continued</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness (feet)</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>Sand, light-gray, medium to very coarse, subangular to rounded, pyritic</td>
</tr>
<tr>
<td>Sand, light-gray, medium to very coarse, subangular to rounded; contains yellowish-gray clay</td>
</tr>
<tr>
<td>Sand, light-gray, fine to coarse, angular to rounded, very clayey, pyritic</td>
</tr>
<tr>
<td>Sand, light-gray, very fine to very coarse, subangular to rounded, pyritic</td>
</tr>
<tr>
<td>Sand, light-gray, fine to coarse, subangular to rounded</td>
</tr>
</tbody>
</table>

Catahoula sandstone
(Top at 796 feet, interpreted from electric log)

| Sand, light-gray, fine to coarse, subangular to rounded, clayey | 20 | 805 |
| Sand, pale greenish-yellow, very fine to coarse, subangular to rounded, very clayey, pyritic | 20 | 825 |
| Sand, light-gray, very fine to coarse, subangular to rounded, pyritic | 40 | 865 |

Cap rock limestone
(Top at 878 feet, interpreted from electric log)

| Limestone, medium light-gray, clayey, soft, fossiliferous | 20 | 885 |
| Sand, light-gray, very fine to coarse, angular to subrounded, very calcareous | 20 | 905 |
| Limestone, light- to medium-gray, finely crystalline; contains very coarse, rounded sand | 60 | 965 |
| Limestone, light-brown to medium dark-gray, finely crystalline | 20 | 985 |
Lithologic log of Exploratory Hole 6---Continued

<table>
<thead>
<tr>
<th>Thickness (feet)</th>
<th>Depth (feet)</th>
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<tr>
<td>20</td>
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<td>15</td>
<td>1,020</td>
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<tr>
<td>160</td>
<td>1,440</td>
</tr>
<tr>
<td>1,559</td>
<td>2,999</td>
</tr>
</tbody>
</table>

Limestone, medium light-gray to white and light-brown, finely crystalline

Limestone, dark-gray to light-brown, finely crystalline, hard

Cap rock anhydrite
(Top at 1,030 feet, interpreted from electric log)

Missing

Anhydrite, light-gray, coarsely crystalline, hard

Anhydrite, gray, coarsely crystalline, hard

Missing (samples consisting of lost circulation materials)

Anhydrite, white, coarsely crystalline, hard

Salt Stock
(Top at 1,480 feet, interpreted from electric log)

Missing

(Residue sample recovered from about 2,900 feet principally white to clear, anhydrite crystals with minor amounts of quartz crystals. Most crystals are approximately 1/2 to 1 mm. in length.)
U. S. Department of the Interior
Geological Survey

Technical Letter
Dribble-14
Section 11, T. 2 S., R. 16 W.
Elevation 239.5 feet above sea level
Datum, rotary table, elevation 2kf.

Lithology from binocular microscopic examination of cuttings, boundaries of lithology zones interpreted from geophysical logs.

- Pascagoula and Hattiesburg Clays undifferentiated
- Sea Level
- Surface casing set at 365'

Vertical Scale, 1 inch = 100 feet.

Figure 2.—Lithologic and electrical logs of Exploratory Test Hole 6, Tatum salt dome, showing most significant aquifers.

Oct 1961