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# SCREENING OF THREE PROPOSED DOE GEOPRESSURED-GEOTHERMAL AQUIFER NATURAL GAS PROJECT AREAS FOR POTENTIAL CONFLICTING COMMERCIAL PRODUCTION: FRESHWATER BAYOU, LAKE THERIOT, AND KAPLAN, LOUISIANA

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February 1982

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This work was performed under
U.S. Department of Energy
Contract #DE-AC08-81NV10194

## DISCLAIMER

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# I. INTRODUCTION

This report is essentially a continuation of the work that was reported previously by Rogers (1981) which analyzed three fields in Louisiana that were possible DOE geopressured geothermal prospects. The purpose of this report is to screen three additional proposed sites defined by the Louisiana State University resource assessment group for possible conflict with existing gas production. This screening is based on the requirements of the DOE program that (1) only gas laden brine aquifers be considered and (2) that the proposed aquifers must not be connected to known producing gas reservoirs.

The three fields screened in this study were selected because of their current interest to the DOE.

The analysis done here used the public records available at the Louisiana Department of Conservation offices in Baton Rouge, Louisiana and structural and stratigraphic interpretations made by the L.S.U. Resource assessment group. It was judged that these records and interpretations would be adequate for the preliminary screening covered in this report. A more comprehensive evaluation, which includes information from the operators in the areas, will be required prior to the serious consideration of one of the prospect areas.

The search of the Department of Conservation files included a search of the well log files, production files, well files, pressure files and hearing files. Each file had to be searched differently since the log files are cataloged by township and

range; the well files are cataloged by API number; the pressure and production files are cataloged by field; and the hearing files are by docket number. Matching information from the different files is somewhat tedious because of difficulties in cross references and occasionally missing information. Because of the complexity in using the Department of Conservation files it is probable that wells were missed in the search. The complete well list be considered in any subsequent comprehensive evaluation.

## II. FRESHWATER BAYOU FIELD

A search of the well log files was made at the Louisiana Department of Conservation office for logs of wells in the Freshwater Bayou area that were drilled into the geopressured region. Based on mud weights listed on the well logs the top of geopressure occurs at about 12,000 feet in this area. The logs found are listed in Table 1. Figure 1 is a map of the field with the well locations shown. Of the 13 available logs in Table 1 only five of them were for wells which had production. The other eight were plugged and abandoned without production.

The producing intervals for the wells listed in Table 1 are all normal pressured and at depths just on top of the geopressured horizons. The search of the production and pressure files located two other wells which indicated production from the geopressured zones. Well logs were not available however. These wells were as follows:

TABLE I

Wells Logs Available for Fresh Water Bayou Field
Geopressured Production Analysis

| Operator | Well | Location | Depth | Production Intervals |
|---|---|---|---|---|
| Union Oil | La Furs C-12 | 33-T16S-R2E | 17,900 | 12,114-124<br>11,475-551<br>11,434-444 |
| Union Oil | La Furs C-11 | 4-T17S-R2E | 13,370 | 11,773-83<br>11,745-83 |
| Union Oil | La Furs 9-C | 34-T16S-R2E | 14,000 | 11,544-58<br>11,507-515 |
| Union Oil | La Furs 5-C | 33-T16S-R2E | 11,600 | 11,545-560<br>11,529-535<br>11,302-326 |
| Owen | La Furs J-1 | 32-T16S-R2E | 12,222 | 11,848-54 |
| Owen | La Furs "G" | 29-T16S-2E | 15,165 | - |
| Tidewater | E.A.McIlhenny B-1 | 36-T16S-R2E | 15,400 | - |
| Union Oil | La Furs J-2 | 32-T16S-R2E | 15,250 | - |
| Union Texas | La Furs #1 | 3-T17S-R2E | 15,907 | - |
| Owen | La Furs J-2 | 5-T17S-R2E | 13,516 | - |
| Union Oil | P.M.Simons C-1 | 2-T17S-R2E | 18,373 | - |
| Sinclair Oil | E.A.McIlhenny #1 | 10-17S-2E | 17,405 | - |
| Diversa | Humble Oil #1 | 7-17S-2E | 13,726 | - |

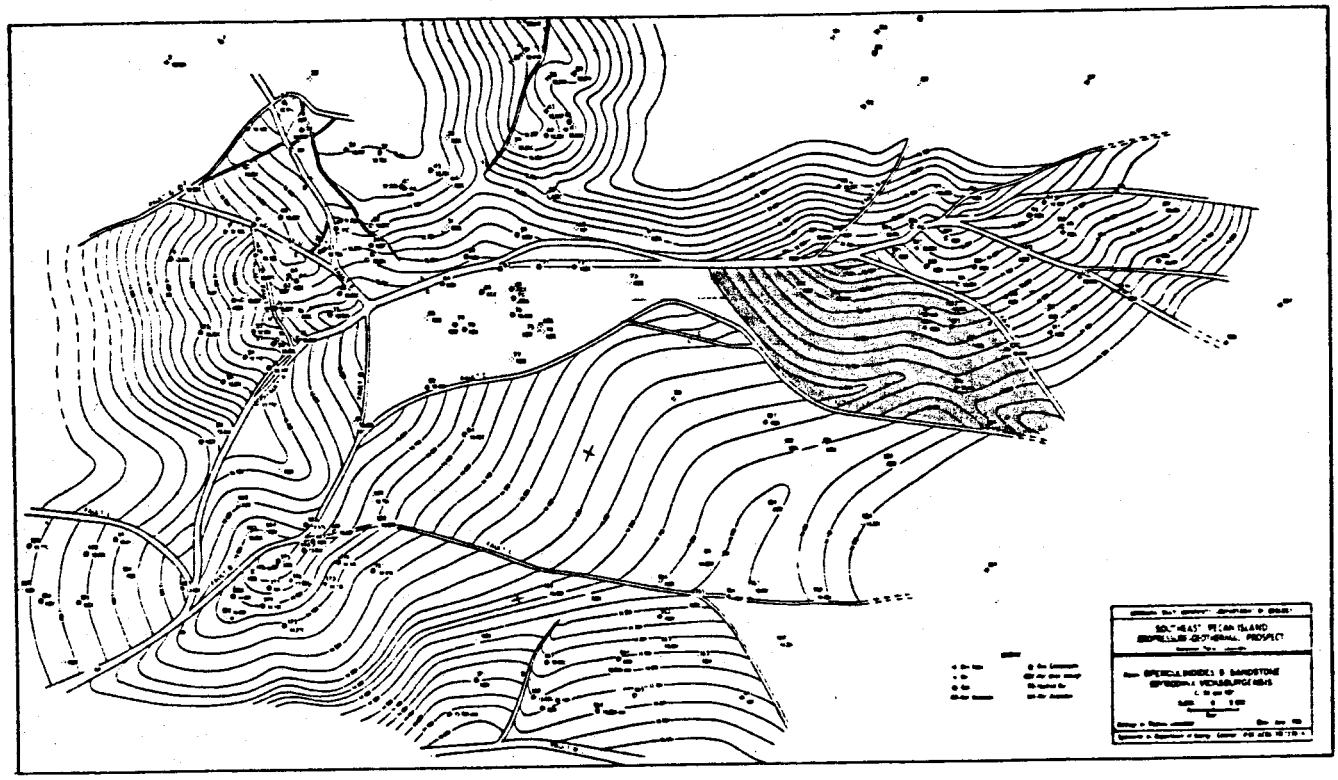


FIGURE 1. Structural contour map on Operculinoides 9 Sandstone. South Freshwater Bayou prospect is centered in the north half of T17S-R2E. (From Cavanagh, 1981)

| Operator | API #1 | Production Interval |
|---|---|---|
| Signal Oil | 146,080 | 15,300 |
| Stone Oil | 148,544 | 14,300 |

There was pressure or production data on some 15-20 additional wells in the field, but in the short time available at the Department of Conservation offices there was not time to cross check all the wells so as to segregate the deep production from the shallow production.

For the deep wells where logs were available the the major sand sections were noted and tabulated in Table II. From limited evaluation of the logs the sandstones at the geopressured depths appear to be essentially all wet. On the spontaneous potential - induction electric or electric logs there is only an occasional high resistivity spike that would indicate a possible gas bearing layer.

For the two wells that are apparently producing from the geopressured zone additional information possibly including a copy of the well log will be required to correlate the production with the sand sections noted in Table II. The production in these two wells lasted for about two years, in the years 1975-1978, and the final pressure was still high. Based on the structural interpretations, Figure 1, the reservoir was probably a limited accumulation against a fault block and had an active water drive. The Owen-La.Furs No. 1 dry hole located in Section 29, about 3 miles west of the Stone and Signal wells,

TABLE II
Fresh Water Bayou
Deeper Sands Indicated on Available Well Logs

| Operator/Well | Major Sand Intervals | Comments |
|---|---|---|
| Union La Furs C-12<br>API 133365 | 12,100-13,300<br>14,060-14,440<br>15,700-15,970 | Alternating ss/sh sequence<br>Massive sand with shale streaks<br>Massive sand of lower qualitv |
| Tidewater/McIlhenny B-1<br>API 73745 | 12,100-13,640<br>14,670-14,800<br>14,800-14,980<br>15,110-15,240<br>15,360 - ? | Alternating ss/sh sequences<br>Massive sand with shale streaks<br>Sand streaks in shale<br>Sand with shale streaks<br>Massive sand |
| Union/La Furs J-2<br>API 84876 | 13,190-13,420<br>13,960-14,110<br>14,440-14,780<br>14,990-15,250+ | Poor quality sand with shale<br>Poor quality sand with shale<br>Alternating ss/sh sequences<br>Massive sand with thick shale streaks |
| Union/La Furs #1<br>API 142442 | 12,100-13,350<br>13,840-14,060<br>14,540-14,610<br>15,060-15,500<br>15,660-15,880 | Alternating ss/sh sequences<br>Sand stringers in shale<br>Poor quality of sand<br>Massive sand with shale stringers<br>Massive sand with shale stringers |
| Union/Simmons C-1<br>API 120860 | 12,440-13,450<br>14,090-14,150<br>15,450-15,570<br>15,730-15,910<br>17,000-17,500<br>17,700-18,050 | Alternating ss/sh sequences<br>Dirty sand<br>Massive sand w/large shale stringers<br>Massive poor quality sand<br>Massive very poor quality sand<br>Massive poor quality sand |
| Sinclair/McIlhenny #1<br>API 74698 | 12,100-13,440<br>15,070-15,520<br>15,680-15,830<br>16,660-16,950 | Alternating ss/sh sequence<br>Massive sand w/large shale stringer<br>Sand with many shale streaks<br>Shale with poor quality sand streaks |

showed no gas accumulation development thus precluding a model of wells watering out at the edge of an extensive reservoir.

Geopressured sandstone aquifers have been identified below 13,000 feet which could be candidates for the DOE program. Cavanagh and Pilger (1981) recognized three stratigraphic intervals with appreciable sand development in the geothermal geopressured zone. A structural map and two cross sections from the Cavanagh and Pilger (1981) paper are presented as Figures 1, 2 and 3. The target fault block is colored yellow on Figure 1.

There may be stringers of free gas scattered through the region, as suggested by the small spikes on the SP-electric logs, which could lead to the possible production of gas from the design geopressured-geothermal wells in excess of the amount that can be dissolved in the water. This, of course, is speculation.

A more detailed study which would include discussions with the operators in the area would be needed prior to a design well project. The more comprehensive study confirming the lack of interference between geothermal and conventional production should include all of the available information plus a prognosis from the operators about near term anticipated activities in the area.

## III. KAPLAN FIELD

The Kaplan Field is a relatively compact field with several wells producing gas from the geopressured region. The well logs

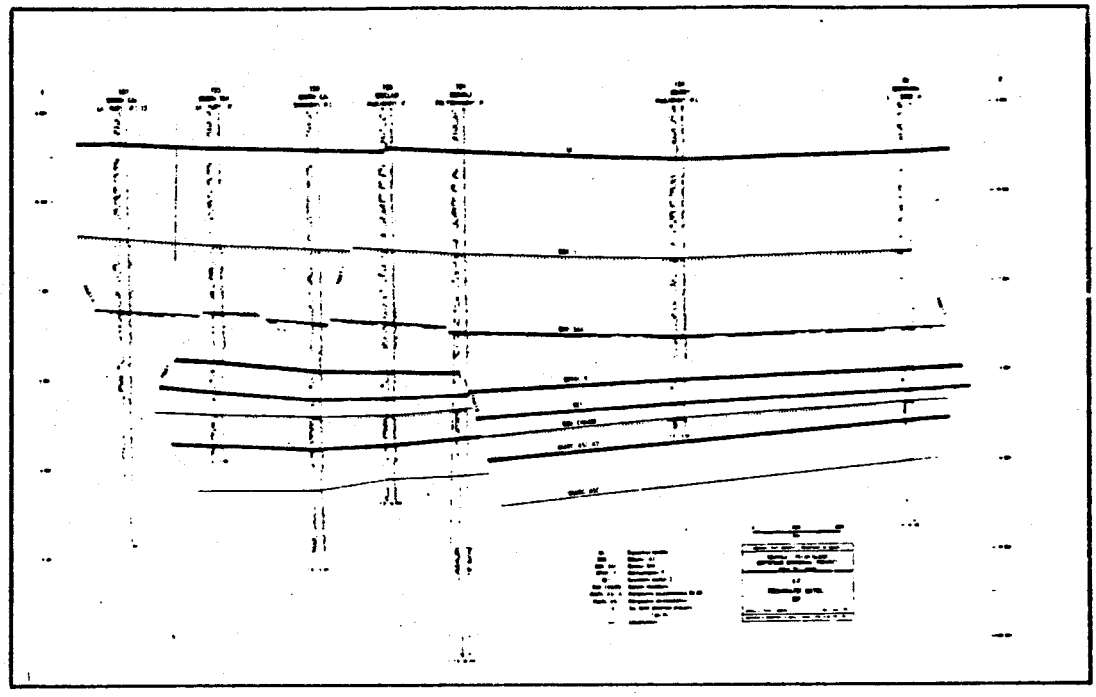


FIGURE 2. Section Across South Freshwater Bayou Prospect. Sandstone Below Robulus Chambersi Horizon From Prospective Reservoir. (From Cavanagh, 1981).

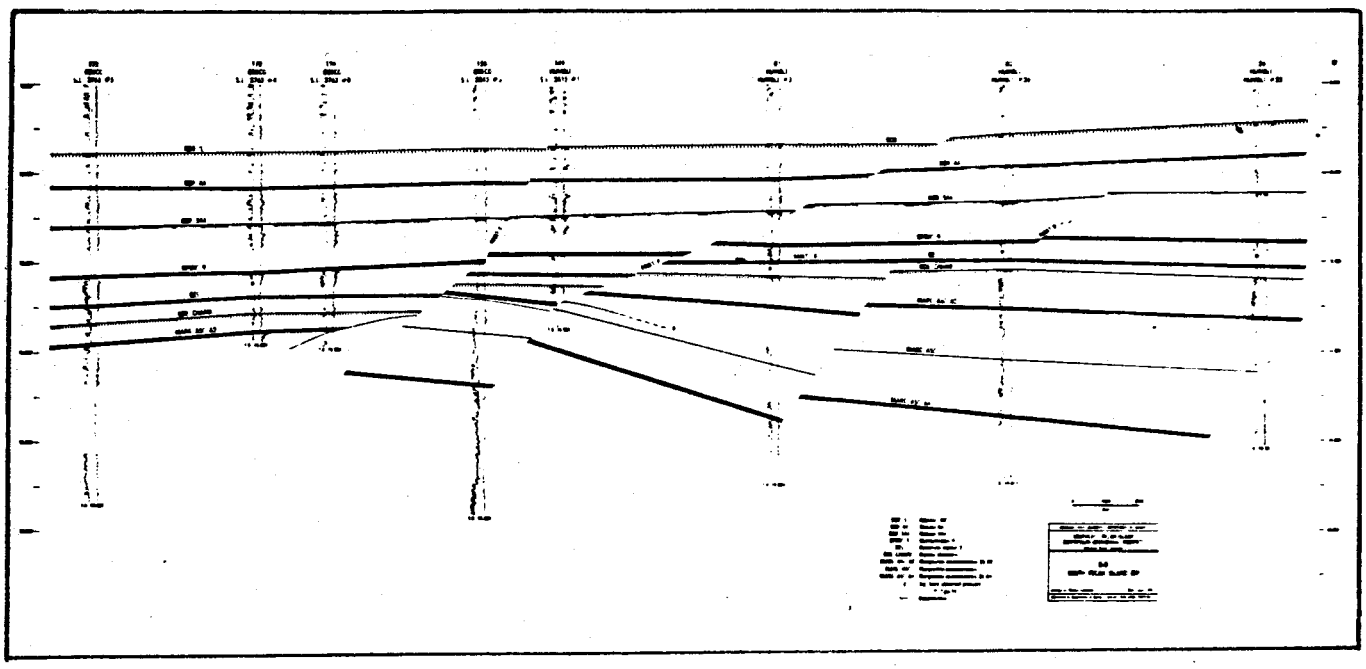


FIGURE 3. Strike Section Across Southeast Pecan Island Prospect. (From Cavanagh, 1981).

found in the Department of Conservation search on this field are listed in Table III. Note that the deep geopressured producing wells are all Superior Oil Company wells. Other companies in the area are producing from the shallower horizons above 12,000 feet that are at normal pressures.

The Kaplan prospect area (Sections 13,14,15,22,23,24, T12S, R1E) is unusual in that it has a number of wells drilled through at least part of the proposed geopressured-geothermal aquifer, Figure 4. Bassiouni's (1978) cross sections, Figures 5 and 6, do not show similar sand development in any of the adjacent wells. This indicates a low probability of highly significant sustained production from any of the target zones because of the probably limited reservoir continuity.

The well logs show a massive shale section from the top of geopressure down to about 17,000 feet with only one major sand, which is 50 feet thick, at a depth of about 14,500 feet. Shale occurs from 14,500 feet to 17,000 feet. The Camerina sands appear at this depth, then mostly shale down to around 19,500 feet where the Miogypsinoides sands are found. There are occasional thin sand stringers scattered through the shale, but these are unsuitable for geopressured geothermal consideration. The three major sand bearing intervals just mentioned show different degrees of development in the well logs. The well logs show that although the sandstone formations appear to be mostly water saturated, gas occurs in all of the three major sand formations. Also, all three zones have been completed for commercial production somewhere in the field.

TABLE III

Well Logs Available for Kaplan Field
Geopressured Production Analysis

| Operator | Well | Location | Depth | Production Interval |
|---|---|---|---|---|
| Superior Oil | A.Trahan #1 | 26-12S-1E | 19,802 | 14,625- 51 |
| Superior Oil | W.Dartey #1 | 14-12S-1E | 20,510 | 18,379-448 |
| Superior Oil | E.Dartey #1 | 14-12S-1E | 20,814 | 19,434- 92 |
| Superior Oil | B.Broussard#2 | 23-12S-1E | 19,500 | 12,835- 43 |
| Superior Oil | B.Broussard#1 | 22-12S-1E | 19,000 | 16,950-17,106 |
| Superior Oil | W.Greene #1 | 23-12S-1E | 17,230 | 16,788-970 |
| Superior Oil | A.Romaine #1 | 24-12S-1E | 18,822 | - |
| Superior Oil | L.Hebert #1 | 15-12S-1E | 18,700 | - |
| Superior Oil | A.Trahan #2 | 22-12S-1E | 19,000 | - |
| Pel Tex Oil | L.Romaine #1 | 25-12S-1E | 20,422 | - |
| Midwest Oil | E.Faulk #1A | 26-12S-1E | 17,653 | - |
| Gulf Oil | A.Trahan #1A | 23-12S-1E | 13,263 | - |
| No. Central Oil | L.Trahan #1A | 13-12S-1E | 13,440 | 11,404- 12 |
| No. Central Oil | A.Romaine #1 | 13-12S-1E | 11,512 | 11,376-396 |
| No. Central Oil | I.Irrigation#1 | 18-12S-2E | 11,543 | 11,363-383 |

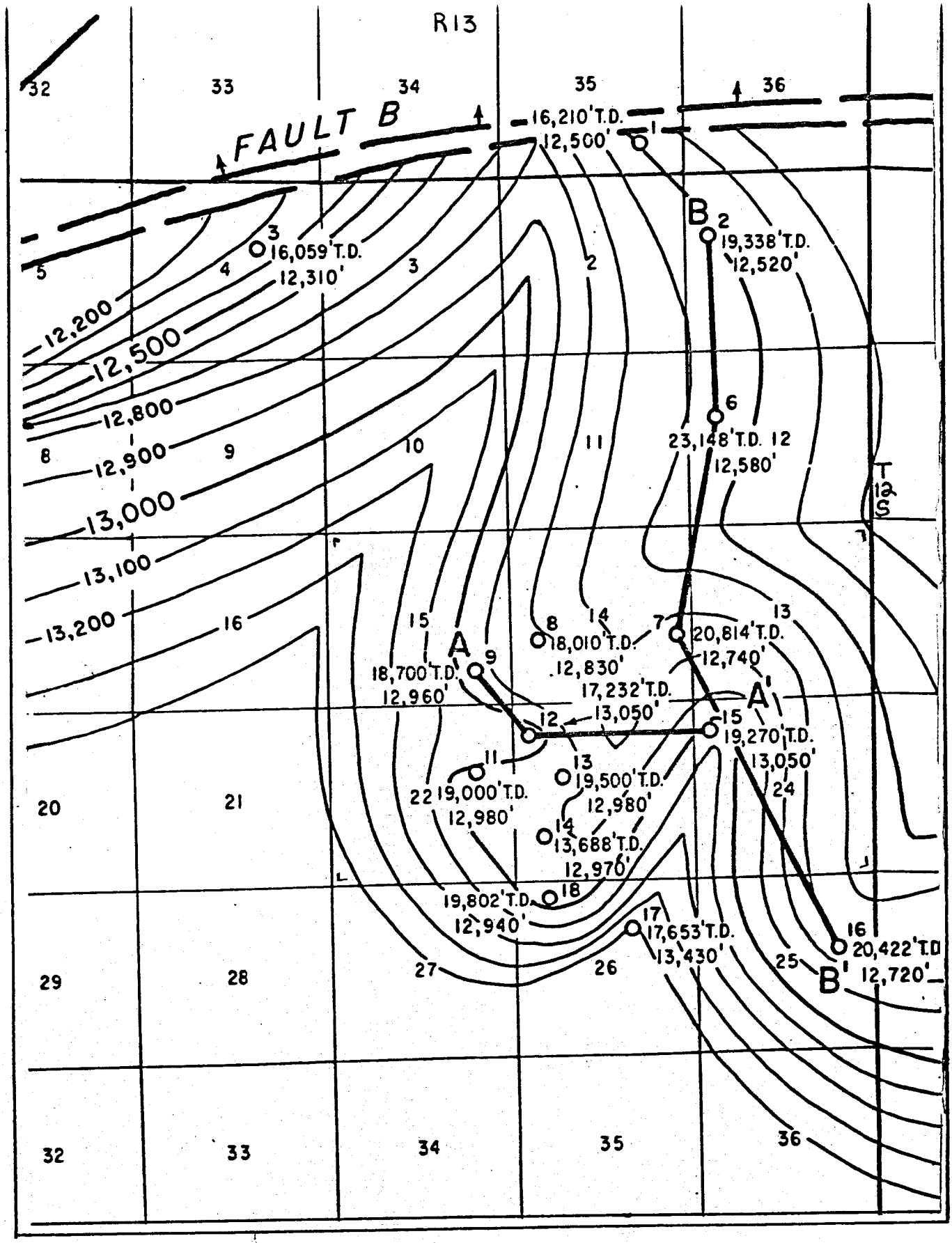



FIGURE 4. Kaplan Prospect Structure Map with Cross Section Shown in Bassiouni (1978). Geothermal Prospect Area is Colored Yellow.

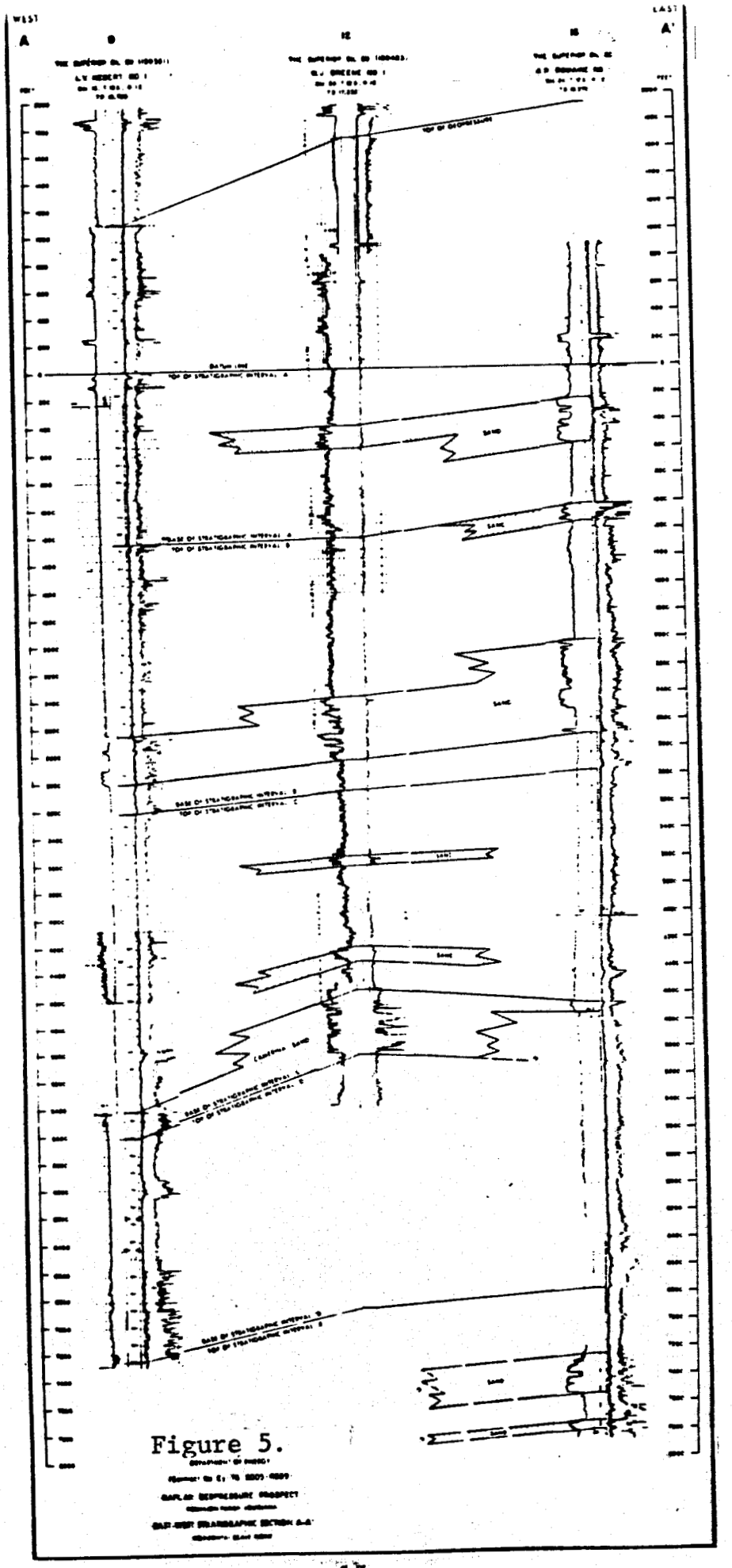



Figure 5.

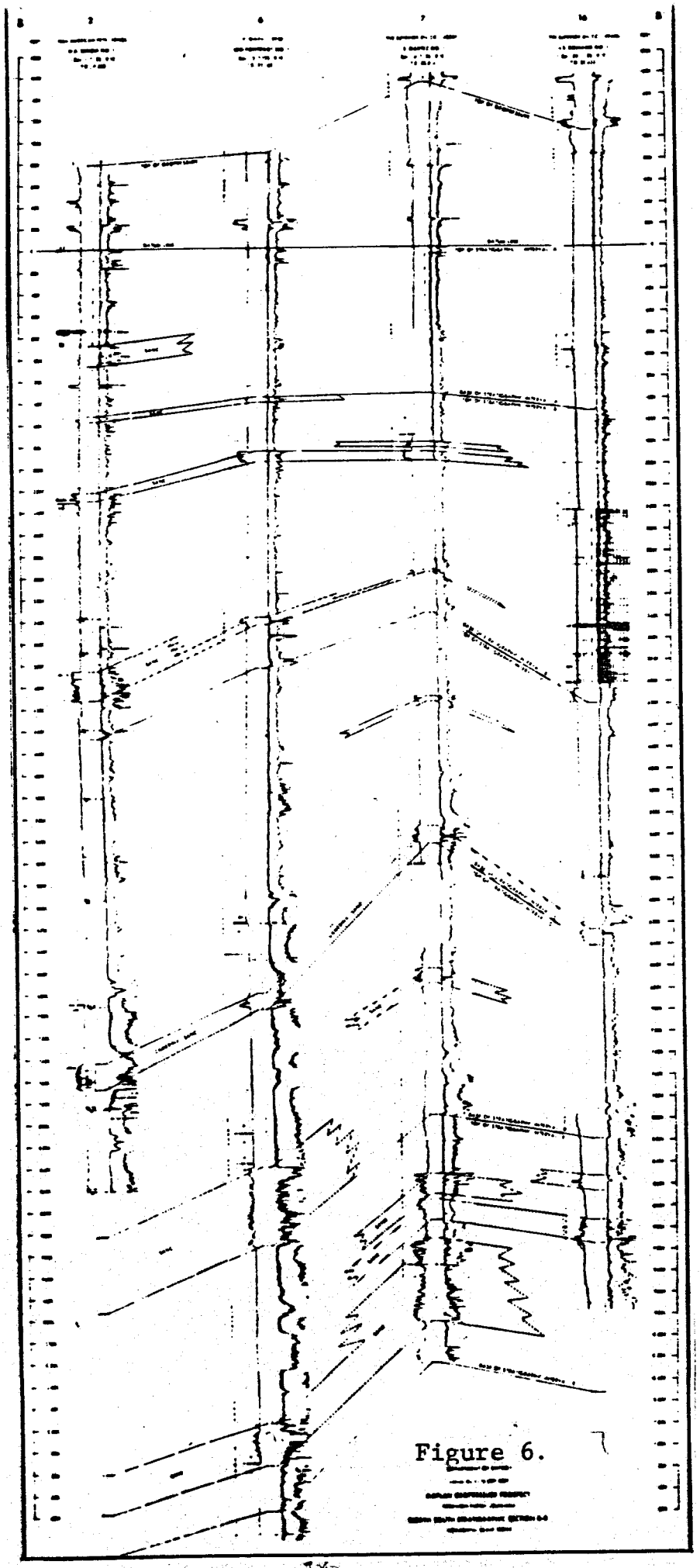


Figure 6.

The tentative conclusions from this study of the Kaplan Field are (1) that the major sands in the geopressured region contain free gas and are all being developed by the Superior Oil Company and (2) that a general lack of reservoir continuity is indicated.

Before considering a DOE geopressured aquifer project in this field it would be advisable to contact Superior Oil and the other operators in the area to identify their feelings about the possible adverse effect of geopressured-geothermal brine production on the productive sands that might be remaining in the area and to attempt to evaluate reservoir limits, perhaps through some cooperative testing in one or more of the Superior wells.

On the basis of this study the Kaplan Field does not appear to be a good prospect for a DOE geopressured aquifer project.

## IV. LAKE THERIOT FIELD

For the Lake Theriot Field it was necessary to search the Louisiana Department of Conservation files for the three adjacent fields as well as the Lake Theriot Field. The adjacent fields are the South Lake Hatch, South Sunrise and East Lake Decade.

In this preliminary search some 22 well logs were found for wells that were drilled into the geopressured region below 13,000 feet. These wells are listed in Table IV. A map with the fields and the well locations is shown in Figure 7

TABLE IV

Well Logs Available for Lake Theriot
Geopressured Production Analysis

| Operator | Well | Location | Depth | Production Interval |
|---|---|---|---|---|
| LAKE THERIOT FIELD | | | | |
| Forest Oil | L L & E #1 | 28-18S-16E | 12,507 | - |
| Exchange Oil | Marmande #1 | 3-19S-16E | 17,900 | - |
| LAKE HATCH FIELD | | | | |
| L L & E | L L & E #3 | 8-18S-16E | 13,400 | 10,098-103 |
| L L & E | L L & E #5 | 8-18S-16E | 13,262 | 11,641- 61 |
| L L & E | L L & E #8 | 15-18S-16E | 13,217 | 12,076-105 |
| Magnolia Petr | L L & E #1 | 20-18S-16E | 16,080 | - |
| Shell | School Board#1 | 16-18S-16E | 17,923 | - |
| Graham Oil | Pelto Oil #1 | 15-18S-16E | 11,665 | - |
| Union Oil | L L & E #B-36 | 17-18S-16E | 15,207 | - |
| Superior Oil | L L & E K#1 | 21-18S-16E | 17,486 | - |
| SOUTH SUNRISE FIELD | | | | |
| McMoran Exp | G.Brien Sr #2 | 32-18S-17E | 18,100 | 13,447- 53 |
| McMoran Exp | C.Duplantis#2 | 34-18S-17E | 15,800 | 11,722- 30 |
| Superior Oil | R. Milling #1 | 31-18S-17E | 17,070 | 13,352-404<br>16,684-694 |
| Superior Oil | R. Milling #2 | 31-18S-17E | 17,064 | 13,991-14,054<br>14,494-503<br>15,213-222 |
| Exchange Oil | M.Marmande #1 | 31-18S-17E | 14,300 | 12,721- 26 |
| Superior Oil | W. Guidry #1 | 31-18S-17E | 15,071 | - |
| Superior Oil | R. Milling #3 | 31-18S-17E | 18,130 | - |
| EAST LAKE DECADE | | | | |
| LaTerre Pet. | LaTerre #1 | 15-19S-16E | 16,020 | 10,256-306<br>11,255- 86<br>11,346- 54 |
| LaTerre Pet. | LaTerre #3 | 15-19S-16E | 15,250 | 6,778- 86 |
| Exchange Oil | School Board#1 | 16-19S-16E | 15,909 | 11,236- 38 |
| Exchange Oil | School Board#2 | 16-19S-16E | 15,995 | 10,274- 82<br>15,436- 40 |
| LaTerre Pet. | LaTerre #2 | 15-19S-16E | 15,388 | - |

(Bassiouni, 1978). Note in Figure 7 that South Lake Hatch Field is to the north of Lake Theriot: South Sunrise Field is east of Lake Theriot and the East Lake Decade Field is south of Lake Theriot.

The relative position of the stratigraphic Interval B contoured in Figure 7 is displayed on the two cross sections, Figures 8 and 9, and the sand quality is displayed in the isopach map, Figure 10 (Bassiouni, 1978).

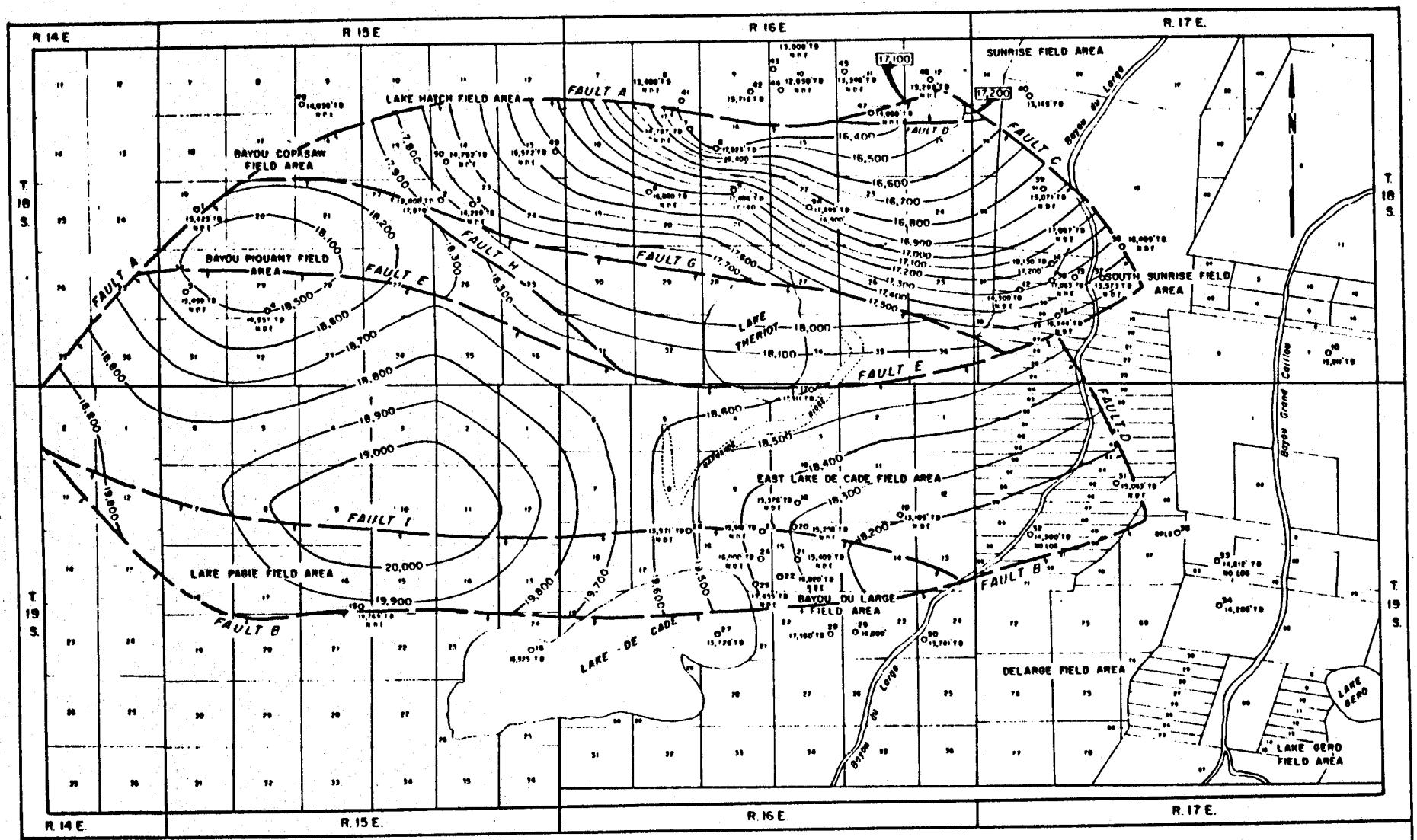
According to the geological structure shown in Figure 5 the South Sunrise Field occurs on a structural high within the main Lake Theriot prospect fault block. This nearby West Lake Theriot prospect is colored yellow in Figure 7.

The East Lake Theriot prospect (colored orange in Figure 7) appears to be in a fault block that contains the East Lake Decade Field.

Lake Theriot prospects appear to be in large fault blocks that forms the generally structural low areas. Because the structural lows are a poor place to drill for hydrocarbons there are not many wells in the area, hence the detailed stratigraphy of the prospects are not well definded.

The two wells in the West Lake Theriot area showed substantial sands, but no commercial gas or oil.

There is very little production from the geopressured horizons in this area according to the information available for this study. Only three wells in the South Sunrise Field and one well in the East Lake Decade Field had production from the geopressured strata below 13,000 feet. If the South Sunrise

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LAKE THERIOT GEOPRESSURE ENERGY PROSPECT

TERREBONNE PARISH, LOUISIANA

# Figure 7.

STRUCTURE MAP

BASE STRATIGRAPHIC INTERVAL "B"

CONTOUR INTERVAL 100'

EXPLANATION

| | |
|---|---|
| O[29] | Well Location & Identification Number |
| 15,748'TD | Total Depth |
| 10,300' | Datum Point |
| 350' | Total Sand Value |
| 270+ | Actual Sand Value (Entire Interval Not Penetrated) |
| ? | Estimated Point |
| NDF | Not Deep Enough |
| NL | No Log |
| BH/SL | Bottom Hole / Surface Location |
| F/O | Faulted Out |

SCALE - MILES

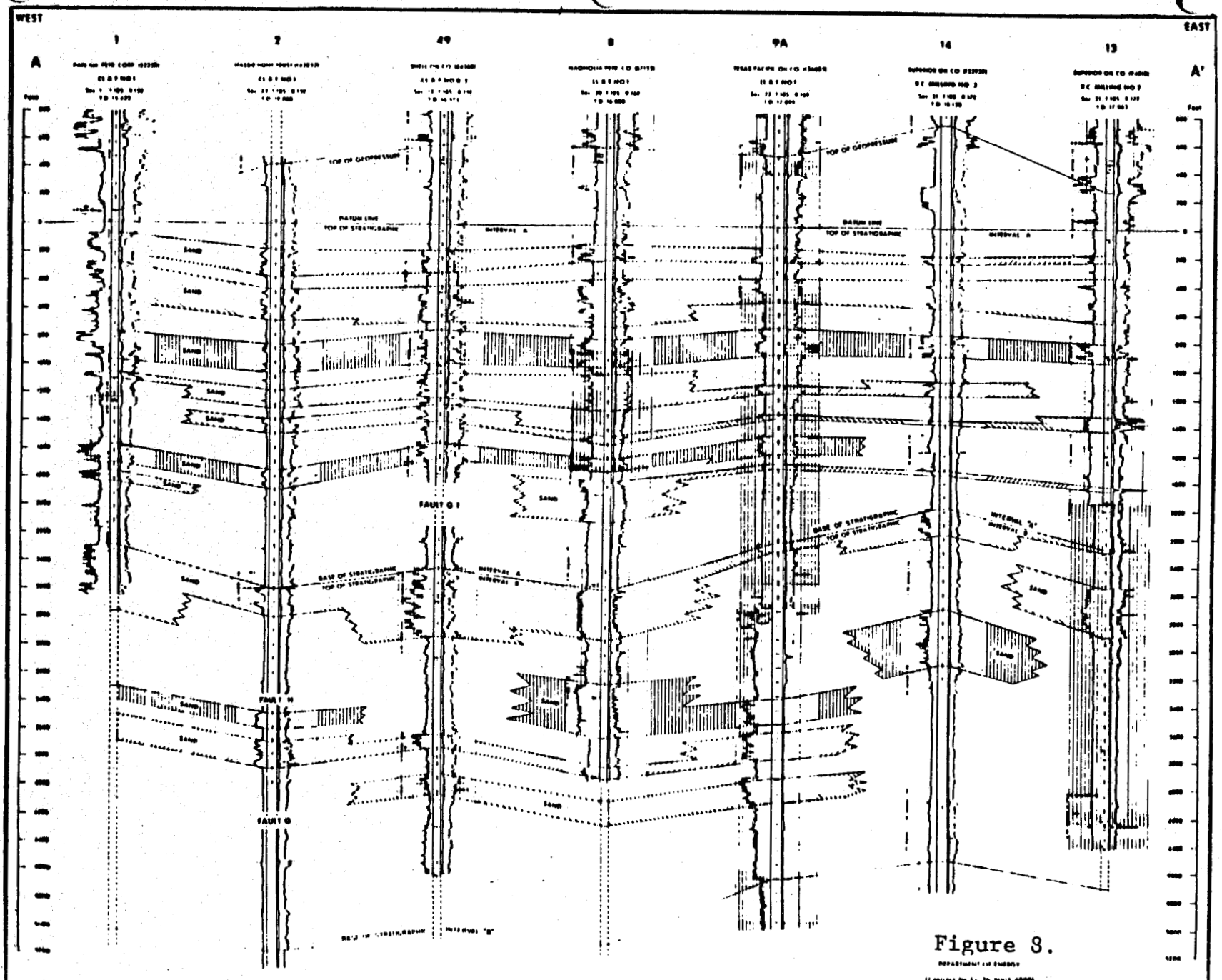



Figure 8.

DEPARTMENT OF ENERGY

LAKE THERIOT GEOPRESSURE PROSPECT

EAST WEST STRATIGRAPHIC SECTION A A'

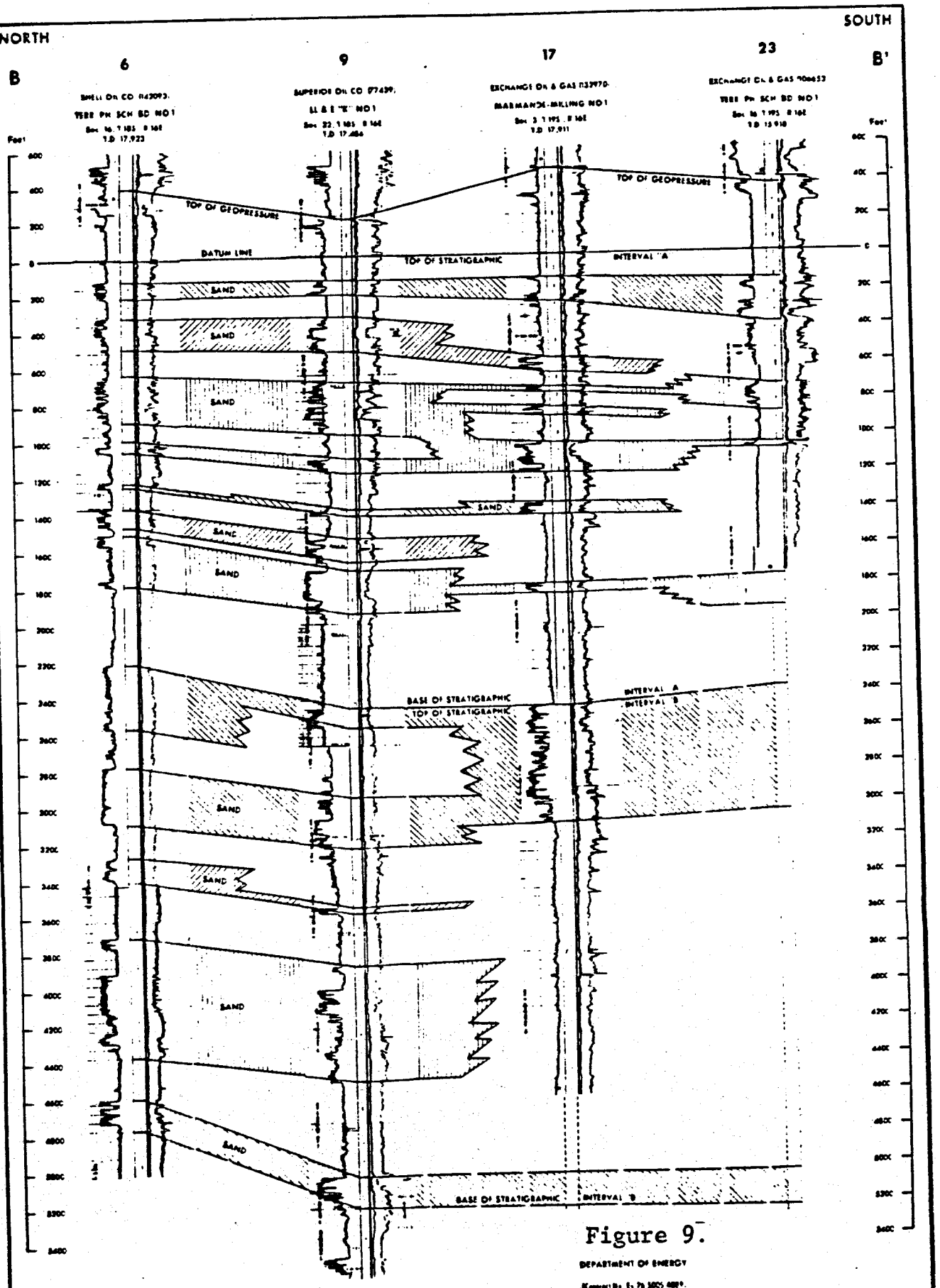



Figure 9.

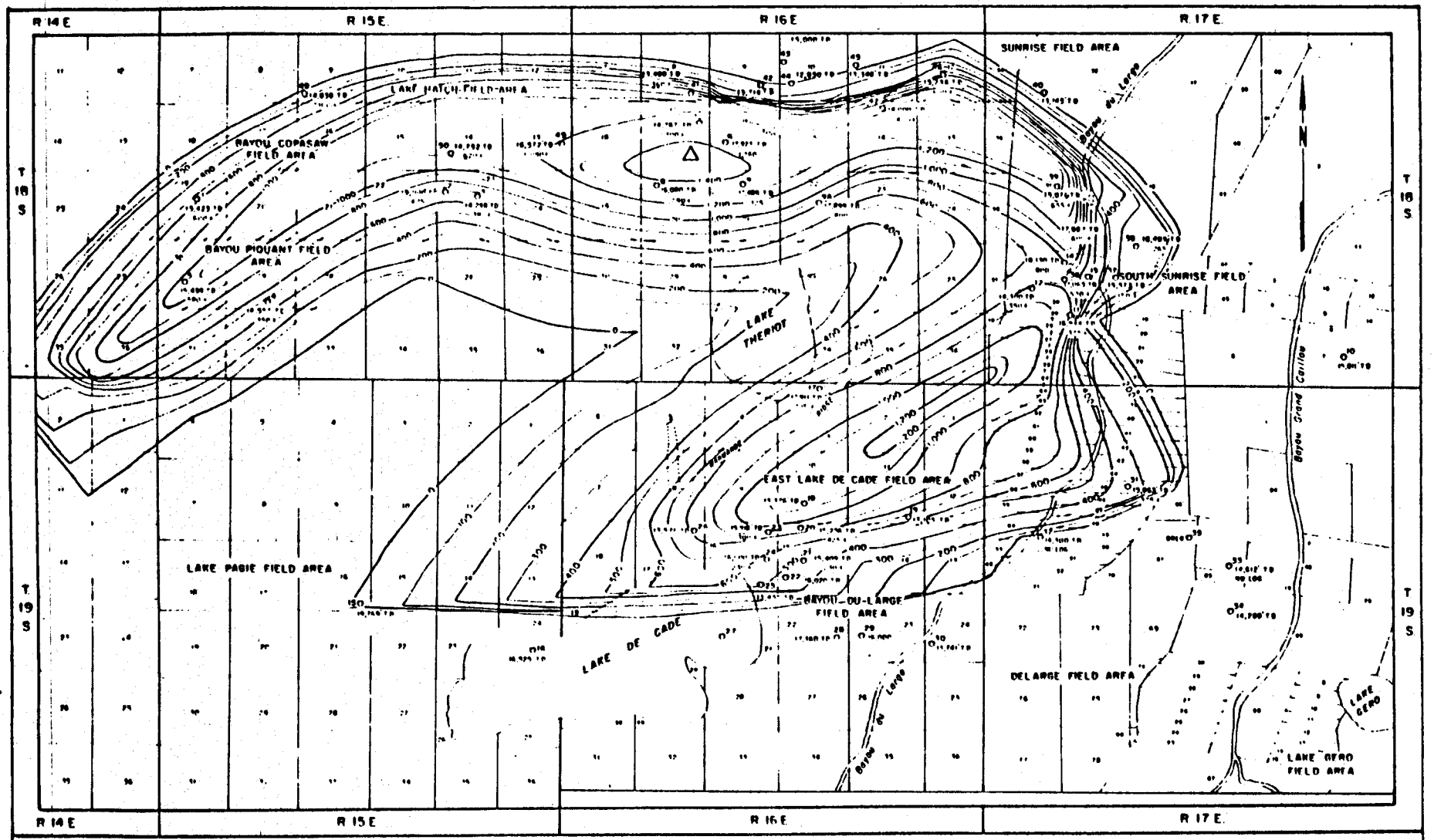
DEPARTMENT OF ENERGY

LAKE THERIOT GEOPRESSURE PROSPECT

TERREBONNE PARISH, LOUISIANA

NORTH-SOUTH STRATIGRAPHIC SECTION B-B'

HORIZONTAL SCALE NONE

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LAKE THERIOT GEOPRESSURE ENERGY PROSPECT

TERREBONNE PARISH, LOUISIANA

# Figure 10.

COMPOSITE NET SAND ISOPACH MAP

STRATIGRAPHIC INTERVALS "A" & "B"

CONTOUR INTERVAL 100'

EXPLANATION

- Well Location & Identification Number
- Total Depth
- Datum Point
- Total Sand Value
- Areal Sand Value (Entire Interval Not Penetrated)
- Estimated Point
- Not Deep Enough
- No Log
- Bottom Hole / Surface Location
- Faulted (ht)
- Proposed Test Site

Field is isolated from the East Lake Theriot prospect by the faulting, then production from the prospect would not interfere in any way with the production from the South Sunrise Field. However, production from geopressured horizons in the East Lake Theriot prospect may interfere with production from the East Lake Decade Field. There is not enough stratigraphic control to verify this, and when the well logs for the School Board wells in the East Lake Decade Field are laid beside the Marmande well near the Lake Theriot prospect the sands do not correlate very well. Also the gas producing sand at 15,440 feet in the School Board #2 well in East Lake Decade does not occur at the corresponding section in the Marmande well two miles to the north.

Additional data will be need to made a definite assessment of the possible connection between the two wells.

Only limited correlation are observed when the well log for the Marmande well in the Lake Theriot Field is compared with the Superior-LL&E K1 well in the South Lake Hatch Field some 3 miles to the north. One good correlation is a massive sand section at a depth of about 15,800-16,400 feet that seems continuous from the South Lake Hatch Field, through the Lake Theriot Field and on towards the East Decade Field. This section appears to be some 400-600 feet thick of mostly brine saturated sandstone with numerous small shale stringers. This same section is seen on the logs for the South Sunrise Field but it is less well developed in that field. This section appears to be an excellent prospect for a DOE geopressured-geothermal aquifer

test from the point of view of not being connected to any reported commercial production. The extention of this section to the west is unknown at this time because of a lack of well control.

It is presumed for this report that operators in the area have geophysical seismic data, or other information, that shows that this broad syncline continues to the west such that this area does not warrant drilling for unconventional gas or oil. Further checking with the operators in the area would be needed to further evaluate the prospect.

## V. CONCLUSION

Based on the available information from the Louisiana Department of Conservation files a different conclusion was made as to each of the three fields screened concerning possible conflicts was gas production from the geopressured regions below 12,000 feet. For the Freshwater Bayou Field little gas production was found from the geopressured region, but two incomplete production records for gas in the 14,300-15,300 feet interval suggested a possible problem. More information should be obtained before seriously considering this area as a design well prospect.

For the Lake Theriot Field no geopressured gas production was found near the area of interest. However, the South Sunrise Field shows some production in the west Lake Theriot fault

block, and the East Lake Decade Field shows production in the East Lake Theriot prospect fault block.

The production is removed from the prospect areas and limited correlations occur. However, the possibility of interference should be carefully evaluated by a more detailed study before proceeding with a design well project in either Lake Theriot areas.

The Kaplan Field seems to have poor aquifer continuity and the geopressured horizons contain gas that is actively being developed by commercial operators. Therefore, a DOE project in this field should be considered as a low-priority project.

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