University of Texas Bulletin

No. 2539: October 15, 1925

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By

H. P. BYBEE AND R. T. SHORT

BUREAU OF ECONOMIC GEOLOGY

J. A. Udden, Director **E. H. Sellards, Associate Director**

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The benefits of education and of useful knowledge, generally diffused through a community, are essential to the preservation of a free government.

Sam Houston

Cultivated mind is the guardian genius of democracy. . . . It is the only dictator that freemen acknowledge and the only security that freemen desire.

Mirabeau B. Lamar

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THE LYTTON SPRINGS OIL FIELD

By

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LOCATION

The Lytton Springs oil field is located about two miles due south of Lytton Springs, Caldwell County, Texas. The general location is shown on Figure 1. It is twenty-eight miles south of Austin. Dale, four miles from the field on the Missouri, Kansas and Texas Railroad, is the nearest shipping point.

Caldwell County is a portion of the Gulf Coastal Plain and has a gently undulating surface. Within a radius of three miles of the field the relief will not exceed one hundred feet. The area is drained by the tributaries of Walnut Creek, which empties into the Colorado River. The field is situated upon a small oval hill.

HISTORY

The surface structure of the Lytton Springs oil field was recognized and mapped by Mr. John Blanchard for the Gulf Production Company. The discovery well was drilled by Lefevre and Storey on a 60-acre block out of the northwest corner of the Mrs. M. L. Brewer tract in the Jonathan Burleson Survey. The first well which was started January 24, had a strong show of oil February 27, and was completed on March 13, 1925. While the field was well developed within four months, the absence of either a surface or subsurface supply of water greatly retarded its development. The first wells were drilled with water pumped from open pits in the Wilcox sands at Lytton Springs and delivered to the field through three-inch pipe lines. Later, water lines were laid to Plum Creek.

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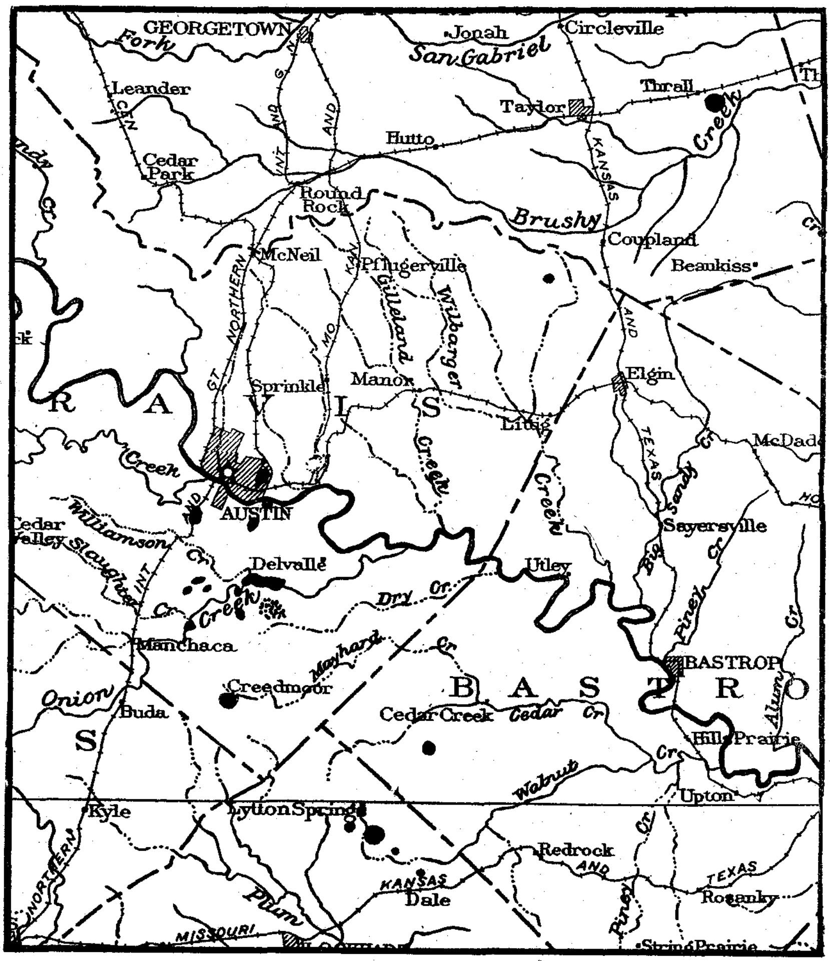

Figure 1. Map showing the known locations in Travis, Williamson, Bastrop, and Caldwell Counties of altered igneous rock similar to that found to be producing oil at Lytton Springs and Thrall.

The Lytton Springs oil field is like the Thrall oil field in many respects and in so far as known is the second area in which the pay formation is an altered igneous rock. In this report the two fields will be compared and some of the data given in the report on the Thrall oil field will be reproduced, as that publication is no longer available.[1]

ACKNOWLEDGMENTS

The Bureau of Economic Geology has received full co-operation from all parties concerned in the development of the Lytton Springs oil field, in securing samples of borings, well logs and data on production. Special acknowledgments are due to Mr. J. M. Dawson of the Gulf Production Company and Mr. L. T. Barrow of the Humble Oil and Refining Company for making available data used in this report. Acknowledgment is also due to Morgan Davis, Robert Cuyler, Eugene Murchison, William Weed and Robert Briggs for collecting and assembling the data necessary for the construction of the Peg Model as well as its actual building. See Plates 5 and 6A. Acknowledgment is made also for co-operation from the Oil and Gas Division of the State Railroad Commission.

GEOLOGY

Stratigraphy

The formations that outcrop in the vicinity of the Lytton Springs oil field are those of the lower part of the Tertiary System represented by the Midway and Wilcox formations. In addition the formations of the Upper Cretaceous and the upper formations of the Comanchean System were explored by the drill in the general development of the field. The following table indicates the approximate succession, thickness and depth of the various formations penetrated by the drill.

A more complete description of these formations may be found in "The Geology of the Coastal Plain of Texas West of the Brazos" by Alexander Deussen.[2]

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[1]The Thrall Oil Field by J. A. Udden and H. P. Bybee, Bulletin University of Texas, 1916: No. 66.

[2]U. S. Geol. Survey Prof. Paper 126, pp. 20-46, 1924.

System	Series	Formation and Thickness	Description
TERTIARY	Eocene	Midway 250′+	Clay and concretionary limestone of marine origin. Green sands. Fossils: Enclimatoceras vaughani.
UPPER CRETACEOUS	Gulf	Navarro 550′	Light bluish to dark clay and marls; thin sandstone layers and limestone concretions. Fossils: Exogyra costata, Sphenodiscus lenticularis.
		Taylor Marl 575′	Blue, calcareous clay and marls. Fossils: Exogyra ponderosa.
		Igneous Rock 0—640+	Dark green, soft material frequently with brecciated or fragmental structure.
		Austin Chalk 350′	Soft, white, chalk-like limestone interbedded with thin beds of blue marl. Fossils: Gryphaea aucella, Exogyra laeviuscula, Exogyra ponderosa, Ostrea diluviana.
		Eagle Ford 10—30′	Dark laminated petroliferous shale; light yellow fissil shale. Thin beds of arenaceous limestone, pyrite nodules. Fossils: Inoceramus, Fish teeth.
LOWER CRETACEOUS (Comanchean)	Washita	Buda 60′	Hard yellow limestone. Thin to heavy bedded.
		Del Rio 60—100′	Yellowish to green clay, carrying selenite. Fossils: Exogyra arietina.
		Georgetown 60—80′	Nodular gray limestone, interbedded with marl and shale.
	Fredericksburg;	Edwards 500′ ?	White hard limestone with a few nodular dark flint beds.

THIN ROCK BEDS IN UPPER 600 FEET OF THE BORINGS

Thin rock was noted from one to five times in each of forty-nine well logs that were studied from this field. These hard rock beds averaged less than two feet in thickness and could not be correlated. However, when reduced to a common datum plane they appeared to fall into groups at depths below the surface of 240, 300, 350, 415, 500 and 600 feet respectively. Since it was impossible to correlate any of these beds, no check on structure could be obtained. These rock beds evidently represent the rock ledges so frequently noted in the upper and middle portions of the Navarro formation.

STRUCTURE

The regional dip of the strata in northern Caldwell County is to the southeast. It is very difficult to give an estimate of the amount of regional dip since the area is broken by numerous faults.[1]

FAULTS

There are two faults closely associated with the area under consideration. The fault nearest the field may be seen in the public road near the northwest corner of the T. H. Brown farm in the Dorothy Benton Survey, and again near the northwest corner of the J. C. Prewitt farm in the Jonathan Burleson Survey. The fault may also be observed in a tank and in the creek very near the southeast side of the E. Beaty 322-acre farm. It is doubtful if the throw of this fault exceeds one hundred and twenty-five feet. The exposure of the fault in the E. Beaty farm is the last place that it cold be definitely noted in its northeast extension, towards the field.

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[1]A statement issued by the Bureau of Economic Geology in June, 1925, places the regional dip as from 125 to 150 feet per mile.

The available data does not suggest the presence of a fault with a throw of more than a few feet, if any, in the developed part of the field. The northeast extension of this fault may be noted in Plate 1. The other fault may be noted by referring to the upper left corner of Plate 1, where it may be seen on the Fred E. Perry 101-acre farm. It is located about half way between well No. 60 and the northwest corner of the above named farm. This fault has a trend of north 42 degrees east.

Surface Structural Features

The surface expression of the Lytton Springs structure is that of a slightly elongated dome, the long axis of which trends north 30 degrees east. The dome-like structure is indicated by the broad curved bend made by the contact between the Midway and Wilcox formations. The position of this contact may be noted on Plate 1.

THE IGNEOUS ROCK

The igneous rock, which has yielded most of the oil in this field, appears to lie in a flat dome-shaped body having its highest point near well 173, where it reaches an elevation of 615 feet below sea level. From this point to well 159, some 1500 feet to the east, the upper surface of the igneous rock appears to dip 191 feet. The slope in the other directions is less pronounced.

The form and position of the upper surface of the igneous rock is shown on Plate 1 by contours having an interval of fifty feet and indicating the distance of the altered igneous rock below sea level. Plates 5 and 6A show a peg model of the field and bring out quite clearly the dome-like upper surface of the igneous rock. The cross-sections shown on Plate 2 also brings out less noticeably this same dome-like feature. Plate 4 shows contours drawn on the upper surface of the igneous rock in the Thrall oil field. A comparison of Plate 1 with Plate 4 shows that the two masses of volcanic rock are quite similar in form. In locating the contours shown on Plate 1 it was necessary to ignore the records given for some locations such as wells Nos. 103-135-136-213-95. However, very few were found that did not conform with the surrounding wells.

Size of Producing Area

At the present time it seems that the proven area extends about one and seven-tenths miles in a north-south direction and one and one-fourth miles in an east-west direction. The total productive area probably will not exceed 1360 acres. The Thrall oil field had a productive area of no more than 470 acres or slightly in excess of one-third the area of the newer field.

Considerable areas of igneous rock were reached by the drill at Thrall which did not produce oil in commercial quantities and it is quite probable that a noticeable percentage of the 1360 acres of apparently productive area may be non-productive as shown by the well 153 where at least 137 feet of igneous rock was penetrated by the drill, with only a show of oil. The drill encountered at least 182 feet of altered igneous rock in well 159 most of which was harder and contained more calcite than was usually found. This well also had a slight show of oil near the top of serpentine.[1] At least twenty-five wells were reported as dry, in which serpentine was reported to have been encountered by the drill.

Stratigraphic Position of the Serpentine

The upper surface of the altered igneous rock mass appears to be near the base of the Taylor Marl, while the lower portion of the igneous rock appears to displace various amounts of chalk, or to lie upon the upper surface of the chalk.

[1]In this report the terms serpentine and altered igneous rock are synonymous. The pay formation is known as serpentine and is an altered or metamorphosed igneous rock.

In well 159, the writer took a sample from a depth of 1502 feet which was Taylor Marl, showing that at this point the igneous rock did not rest directly on the Austin Chalk. However, it appears that the base of the Taylor Marl and great quantities of Austin Chalk have been displaced by the altered igneous rock in some places.

Lower Surface of Igneous Rock

It seems certain that the base of the igneous body is in close contact with the Austin Chalk in many instances. The logs of the following wells show the igneous rock as being in direct contact with the Austin Chalk.

Well 37. Serpentine 1157-1694, chalk 1694-1708.
Well 40. Serpentine 1199-1616, chalk 1616-1701.
Well 58. Serpentine 1460-1500, chalk 1500-1771.
Well 59. Serpentine 1470-1514, chalk 1514——
Well 74. Chalk 1576-1626, Broken chalk and serpentine 1626-1680, chalk 1680-1700.

Relation between Austin Chalk and the Altered Igneous Rock

The writers hesitate to make any definite statement concerning the relation between the Austin Chalk and the altered igneous rock, but will simply record the available data. While data is available on thirty-four scattered wells where the drill penetrated the chalk the records are so conflicting as to make it impossible to draw any generalizations. Even where the wells encountering the chalk are close together the records are very dissimilar.

It is possible that a similar relationship exists between the igneous rock and the Austin Chalk in this area as is known to exist in other localities where they may be seen at the surface. After observing in the field the very irregular masses of igneous rock, apparently completely surrounded by Austin Chalk, and the more or less isolated bodies of chalk, highly silicified, hardened and apparently detached from the main formation, as described in the Geologic Atlas of the United States, folio 76, one is prepared to better understand the very marked irregularities shown in the records of the Lytton Springs field. In thirty-four wells where the drill is reported to have penetrated the top of the chalk, the shallowest chalk reported is 767 feet below sea level in well 106, while the deepest is 1375 feet below sea level in well 30. The average depth below sea level at which chalk was first noted in these wells is 1058 feet.

It is impossible to contour the upper surface of the chalk with the data available. This uneven upper surface probably is due to serpentine occupying the place of the chalk locally, and to error in recognizing and logging the chalk.

Logging of Chalk within the Altered Igneous Rock

Several records indicate that the drill passed from igneous rock into chalk and back again into igneous rock. The above statement is based upon cores taken in the various wells and not upon cuttings taken from the pit.

The following data is presented to show the alternation of chalk with igneous rock.

(Well No. 74) Top of serpentine 1344, serpentine 1344-1576, chalk 1576-1628, broken chalk and serpentine 1626-1680, chalk 1680-1700.

(Well No. 93) At 1375 cuttings looked like chalk, 1434 cored chalk, 1485-1520 dry serpentine, 1524 cored banded chalk, 1680 cored serpentine.

(Well No. 51) Top of serpentine 1480, Top of chalk 1560, chalk 1560-1568, serpentine 1568-1648, chalk 1648-1652. Dry.

Serpentine Logged as Gumbo

There was a general tendency to log several beds of gumbo between the upper and lower limits of the igneous rock. It seems that these numerous beds of gumbo are in reality soft layers of serpentine or chloritic rock. When wet the chloritic rock sticks to the sides of the rotary drilling bit causing it and the drill stem to spin very much as if drilling in true gumbo. In support of the above idea the senior author removed a ball of this soft green substance from the bit while drilling on well 159. This soft material drilled like gumbo and would have been logged as such had not the drill stem been removed and the materials examined. Hence, it is thought that gumbo should not be logged between beds of serpentine in all cases. In the Well Data the writers have given what they consider the total thickness of altered igneous rock in the column designated "Remarks."

Chemical Composition of the Igneous Rock

The chemical composition of the igneous rock at Lytton Springs is presented in the following table in column No. 1. This analyses was very kindly prepared for this report by Mr. J. E. Stullken under the direction of Professor E. P. Schoch. Under No. 2 the average of eight analyses of altered igneous rock from the Thrall oil field is presented for comparison with the analysis of the Lytton Springs rock. No. 3 shows the average of the analyses of three samples of altered igneous rock from Onion Creek north of Pilot Knob. The last analysis is included to show the general resemblance of the chemical composition of the altered igneous rock in Onion Creek to that found at Thrall and Lytton Springs.

	No. 1	No. 2	No. 3
Silica	34.90	30.93	26.41
Ferrous Oxide	6.56	....	10.84
Ferric Oxide	7.90	13.84	3.76
Phosphoric Anhydride P_2O_5	.19	....	.38
Alumnia	8.00	15.80	10.61
Lime	3.02	9.25	13.83
Magnesium Oxide	13.57	8.92	7.63
Sodium Oxide	12.05	.46	.33
Potassium Oxide	.32	.45	.24
Ignition Loss	12.42	14.81	20.25

No. 1. Sample taken from Gulf Production Company, Beatty No. 1, Lytton Springs Oil Field. Serial No. 203.
No. 2. Average of eight samples taken from the Thrall Oil Field.
No. 3. Average of three samples of altered igneous rock taken from Onion Creek north of Pilot Knob, Travis County.

MICRO-PETOGRAPHIC CHARACTERS

Samples of the altered igneous rock were submitted to Dr. J. T. Lonsdale of the Bureau of Economic Geology and to Dr. T. L. Bailey, formerly with the Bureau of Economic Geology, for micro-petrographic study. Dr. M. A. Hanna, geologist for the Gulf Production Company, has also kindly allowed the results of his observations to be included. The results of their observations will be given below, followed by similar statements on the Thrall oil field, by Dr. W. Harold Tomlinson, Mr. E. S. Larsen, of the United States Geological Survey, and Professor C. L. Baker formerly with the Bureau of Economic Geology.

THE IGNEOUS ROCK OF THE LYTTON SPRINGS OIL FIELD

By John T. Lonsdale

This report is based upon a study of specimens obtained from wells in the Lytton Springs oil field. The samples were from different depths and while a complete vertical section of the igneous body, reported from the area, was not available the samples were of wide enough distribution to show the nature of the rock encountered in the wells.

Two types of igneous material were found. One consists of soft, dark green, essentially massive material which is undoubtedly an altered igneous rock. The second type is a conglomerate or agglomerate composed of rounded to angular fragments of the material composing the massive type. The cementing material of this conglomerate is largely calcite but in some cases chloritic material is present in the cement. It is not impossible that the massive material may be from agglomerate fragments larger in diameter than the core barrel.

The massive material and hence also the fragments of the conglomerate are composed, largely, of serpentine and chlorite.

Although the rock as found now contains none of the primary minerals, its original igneous nature is established beyond doubt by the presence of pseudomorphs of chlorite and serpentine after the original constituents. A study of the crystal outlines of the pseudomorphs shows that the original minerals of the rock included olivine, augite, plagioclase feldspar and possibly nephelite scattered through a very fine textured or glassy ground mass. The rock is thus seen to have been, in its unaltered form, of a porphyritic basaltic type very similar to the limburgite found at Pilot Knob[1] in Travis County. In its altered condition it resembles closely the igneous rock of the Thrall oil field as described by Udden and Bybee.[2]

No evidence is present in the case of specimens of the massive material to show its mode of occurrence. It may well have been either intrusive or extrusive. If intrusive, erosion in Cretaceous times must have occurred to furnish the materials of the agglomerate or tuff associated with it. The fragmental or conglomeratic material, is believed to constitute a tuff or volcanic agglomerate since it is composed of definite fragments of the massive material cemented together. It shows very close resemblance to the material, found on the flanks of Pilot Knob and along Onion Creek in Travis County, which is undoubtedly either tuff or volcanic agglomerate.

By T. L. Bailey

The rock consists of a dark grayish to bluish-green, massive-looking, impure, fragmental serpentine rock containing minor amounts of crystalline calcite and pyrite, and considerable chloritic material. A fair amount of finely fibrous zeolitic or bentonitic material is also present, appearing in section as a brownish cloudy substance.

In thin section the rock is seen to be composed of a number of irregular angular to subrounded fragments of an altered porphyritic and amygdaloidal basic igneous rock. These are included in a matrix of finely fibrous to nearly amorphous serpentine. Between the larger fragments small angular fragments (mostly less than ⅛ mm. in length) of a transparent amorphous material which appears to be glass or altered glass and much serpentine occur. This texture shows the rock to have been originally a volcanic agglomerate.

[1]Kemp, J. F., Notes on a nepheline basalt from Pilot Knob, Texas. American Geologist, Vol. VI, pp. 292-294, 1890.

[2]Udden, J. A. and Bybee, H. P., The Thrall Oil Field, Bureau of Economic Geology and Technology, University of Texas, Bulletin 66, pp. 31-39, 1916.

The phenocrysts in the various rock fragments are merely pseudomorphs after primary minerals with the exception of a few incompletely altered or weathered palgioclase feldspar laths. From their crystal form and type of alteration the larger phenocrysts were apparently mostly olivine. Smaller lath-shaped crystals or pseudomorphs of a plagioclase. feldspar which is impossible to determine specifically, but probably labradorite or a still more calcic feldspar, are fairly numerous and have been replaced by serpentine in many cases. A fair number of pseudomorphs of prismatic crystals, which appear to have a hexagonal cross-section and which may have been nepheline, are also present, but this determination is by no means certain.

The original more or less well-rounded vesicular cavities in the larger igneous rock fragment have been filled with serpentine, some chlorite and considerable calcite. The calcite may have been produced by the alteration of the lime feldspar by percolating meteoric waters containing carbon dioxide or may have been brought in from overlying limestone or marl beds.

It is possible that the agglomeratic texture was produced by expansion on hydration of a basic lava flow or shallow intrusive but this seems unlikely on account of the numerous small, sharply angular, altered glass (?) fragments and the fact that some of the larger rock fragments have quite dissimilar texture. One fragment was noted in which no olivine pseudomorphs could be recognized and in which were stout feldspar phenocrysts surrounded by a felt-like mass of small feldspar laths and small prismatic crystals or grains of an altered ferromagnesian mineral, possibly augite.

The rock could be properly called a serpentinized and chloritized olivine basalt agglomerate (or possibly nepheline basalt agglomerate).

It is possible that the hydration of this rock has been accompanied by a slight doming, but independent folding is a more likely explanation of the oil accumulation.

By Marcus A. Hanna

A core from the Lefevre and Storey No. 1 Brewer, located in the Jonathan Burleson Survey on the Mrs. M. L. Brewer 155-acre tract, near Lytton Springs, Caldwell County, Texas, has lately come to my attention; which because of its character seems to warrant comment and a description. The core is from a depth of 1252 feet. The sea level elevation of the well is 515 feet.

The core megascopically is a soft, dark dull gray, homogeneous rock with a chloritic or serpentine feel. On closer examination it is finely brecciated, with the rounded fragments only a few millimeters in diameter. The matrix surrounding the fragments is slightly lighter in color than the fragments. However, the difference is perceptable only on close examination.. A few cleavage faces of calcite and small grains of pyrite are present on freshly broken surfaces. Many small drusy or miarolitic cavities are irregularly scattered throughout the rock. They are dark velvety green in color, considerable darker than the remainder of the rock.

A number of thin sections were made from the core. The following notes were made from these. The texture of the original material, as partly preserved in the rounded fragments, was that of a fine-grained porphyry. The phenocrysts have a maximum diameter of about two and one-half millimeters. The larger crystals range in shape from euhedral to anhedral. Besides the larger phenocrysts there are a host of smaller ones more or less lath-shaped. Judging from a few fragments of unaltered olivine and from the mesh structure of the altered material in many of the others, the greater part if not all of the larger phenocrysts were originally olivine. The host of smaller lath-shaped crystals were probably augite, but the original material of these has been completely altered. The ground mass in which the phenocrysts were originally imbedded has been completely changed. Scattered through the ground-mass are numerous spherulites, usually only a fraction of a millimeter in diameter, although some are larger. The shape and arrangement of these suggest vesicular cavities later filled with serpentine. In certain instances they are not completely filled.

The ground-mass surrounding the phenocrysts is composed of slightly pleochroic green or brownish-green chlorite, through which iron minerals, chiefly magnetite, are finely disseminated. The original texture of the ground-mass has completely disappeared through alteration. Almost all of the material of the phenocrysts has also disappeared. Except for a few fragments of olivine no material appears to be primary, with the possible exception of magnetite. The pseudomorphs are of several types of material. They are in many cases bordered by clear, rather deep green, pleochroic chloritic material. Certain of the fillings are completely of chlorite, while in others both chlorite and fibrous serpentine are present. Many of the larger crystals contain typical mesh structure. Some are filled with fibrous serpentine, with the fibers normal to the original crystal borders. Where such fillings are not complete the fiber terminations give a very fine miarolitic structure to the cavities. In several instances the central portion of the phenocrysts is filled with calcite, around which is chlorite or serpentine. In two cases the pseudomorphs were partly of pyrite. Irregularly scattered through the phenocrysts and in a few instances in the ground-mass are areas of iddingsite or bowlingite.

The zones surrounding the rounded fragments are filled with fibrous serpentine. The fibers are normal to the surfaces of the fragments. These zones are not always completely filled with serpentine, leaving open cavities in such cases. A few cavities have been filled with calcite. The cavities are narrow, often as much as several millimeters in length. Notwithstanding the scattered cavities in the phenocrysts and interstitial material, the maximum porosity noted is only about ten per cent.

Originally the rock was approximately an olivine basalt. It has been almost completely altered to chlorite and serpentine. The brecciation and rounding of the fragments was caused by the increase in bulk through alteration. The specific gravity of the core is 2.2.

A study of the material from the Gulf Production Company No 1 C. H. Beaty, an off-set to the Lefevre and Storey No. 1 Brewer, gives further data concerning the Lytton Springs field. The lower part of the upper Taylor is the lowest horizon recognized in the cuttings immediately above the altered rock. If the cuttings represent material from the bottom of the hole rather than material fallen down from above, the igneous material is located about the center of the Taylor formation. The uppermost limit of the material at this point is 1186 feet. This gives a known thickness of 60-66 feet. A core taken at 1192 feet is composed wholly of altered material.

Although the material from the Brewer well is very much like the material from the Beatty well, there are certain differences. The phenocrysts in the rock from the Beatty well are smaller. Also there are many more of the spherulites of serpentine, which were probably originally vesicular cavities. Serpentine and calcite form distinct veins of a millimeter or more in width. Veins of the latter are more abundant in the upper-most cuttings. Pyrite is also more abundant in the material from the Beatty well. The porosity is approximately the same in both. None of the fragments of this material found in the cuttings from 1186-1192 are rounded.

Several thin sections of the altered basic igneous rock from the Thrall oil field, Williamson County, Texas, some forty-five miles to the northeast, were examined and compared with the material from the Lytton Springs field. Although there is some variation in the material from the different points in the Thrall field, the character as a whole compares favorably with those of the material from the Lytton Springs field. The original material of the two have been approximately the same. As pointed out by Larsen, 'Altered basic rock would probably be preferable to serpentine, as a name for the rock.'[1]

THE IGNEOUS ROCK OF THE THRALL OIL FIELD

Mr. W. Harold Tomlinson made and examined nineteen thin sections of rock from the Thrall oil field and reported on them. It should be noted that three of these samples were fragments of limestone, believed to have come from near the contact between the Taylor Marl and the igneous rock, submitted to ascertain if they showed any evidence of contact metamorphism. No such evidence is reported. Mr. Tomlinson's report follows:[2]

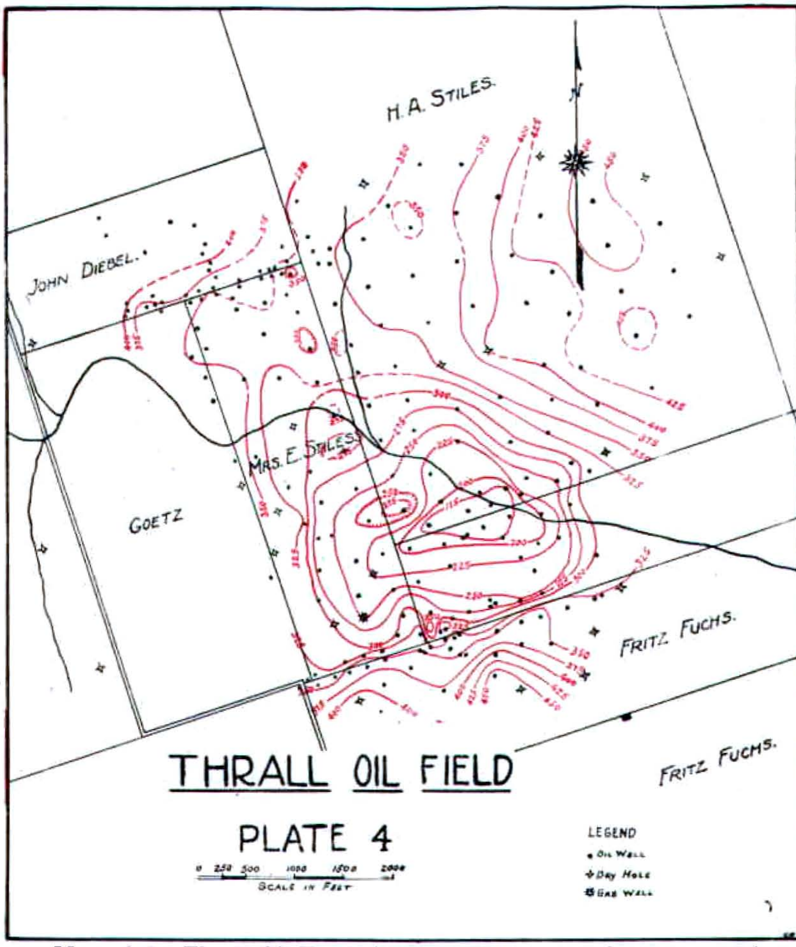
Three of the lot are finely crystalline limestone: Caldwell Oil Company, caprock, 847 feet; First Thrall Oil Company No. 3, dump; and First Thrall Oil Company No. 3, contact below the igneous body. All these show fragments of fossil shells. In addition to shells the First Thrall Oil Company No. 3, below the igneous contact, shows opaque brownish material, probably markings from animal remains. Another sample from the First Thrall Oil Company No. 3, dump, shows small amorphous fragments or grains of limestone cemented together by a zeolite.

The remaining sixteen sections show different phases of an igneous rock in last stages of decomposition. Only a few of the sections give any idea of the original nature of the rock; the rest being breccias. One sample marked Taylor Oil and Gas Company No. 3, depth 745-758 feet, and one marked Taylor Oil and Gas Company No. 3, depth 768-780 feet, give the best idea of the rock. (See plates 5 and 6.) Although all the original minerals are metamorphosed, their crystalline form and texture is sufficiently preserved to enable one to recast the original rock with a fair degree of certainty. The

[1]J. A. Udden and H. P. Bybee, The Thrall Oil Field. Bulletin University of Texas, Number 66, 1916, pp. 39.

[2]This report on the igneous rock from the Thrall Oil Field and also that of E. S. Larsen and C. L. Baker, which follows, is reprinted from the Bulletin on the Thrall Oil Field to which reference has been made.

University of Texas Bulletin No. 2539 **Plate IV**



Map of the Thrall Oil Field showing contours on the upper surface of the altered igneous rock.

sections show outlines of phenocrysts of augite and olivine set in a base of brownish glass containing numerous smaller phenocrysts of plagioclase in the form of small rods and containing clouds of minute specks of magnetite. The rock is therefore a basic basalt approaching limburgite. The sections show many roundish patches of zeolites, which probably indicate that the rock was originally somewhat cellular. Either this or they represent volume changes during abstraction of the alkalies. The altered rock shows patches of fibrous zeolites, calcite and the serpentine variety deweylite, replacing the phenocrysts and an amorphus material replacing the glassy base.

I have recast the original rock on an analysis sheet as nearly as I can approximate it. On the analysis sheets representing the different sections I have set down the minerals in a way to give an idea of their volumetric proportions without marking percentages. To do the latter for these rocks with any degree of accuracy would be nearly impossible. You will find, however, that the mineralogic composition will explain the chemical analysis.

In regard to the breccias, most of them show large angular fragments of the meta-basalt with concave sides, as though broken from a cellular rock. The cementing material is mostly deweylite of a pale green color. In one section, Bowers and Witherspoon No. 1, dump, the cement is a carbonate. In others, and in parts of nearly all zeolites are present in the cement, as well as through the fragments of basalt. One sample, Taylor Oil and Gas Company No. 3, 795 feet, is a somewhat different rock. In this one the fragments are much smaller and more even in size and more closely set.

The metamorphism of this rock seems to have followed two courses. First, carbonation and hydration, which results in the removal of most of the alkalies and some of the combined silica, and is accompanied with some decrease in volume. Secondly, further hydration by which the serpentines and zeolites were formed. This stage of the alteration was accompanied by a large increase in volume. These processes may readily have caused the formation of the breccias.

Several samples of cuttings of the igneous rock from the Thrall oil field were sent to Mr. E. S. Larsen, of the United States Geological Survey, for petrographical identification, and Mr. Larsen reports as follows:

Thin sections of five of the samples have been examined. The original materials have been completely decomposed and the rocks are now chiefly chlorite with more or less carbonate. The greater part of the chlorite is so finely crystalline as to give aggregate polarization, but that occupying the position of the original phenocrysts, as well as spherulitic and less regular areas, is finely fibrous. The details of the original texture are obliterated, but the rock was unquestionable porphyritic and with little doubt had scattered, tabular crystals of plagioclase and probably crystals of augite, perhaps of olivine and other minerals, in a fine-textured or glassy ground-mass. Parts of it appear to have been highly vesicular and some specimens strongly suggest a rather fine-textured tuff. The rock was without much doubt a basaltic rock, although it may not have been strictly a basalt.

The chemical analysis which you have published confirm the determination of the material as now essentially a chlorite. Altered basaltic rock would probably be preferable to serpentine, as a name for the rock.

In interpreting the analyses one must bear in mind that the rock has undergone large changes in its chemical makeup.

Professor Baker's report on the altered igneous rock of the Thrall oil field is as follows:

Every slide of the more than one hundred examined shows extreme and widespread alteration. The only primary minerals left are olivine and magnetite and in these olivine was seen in only a very few instances and then always partially altered to serpentine. The serpentine belongs to the varieties chrysolite and picrolite. Minute, rounded, colorless particles ('insect eggs') found in a few instances are probably titanite. More abundant are slender, often branching, needles of rutile in crystals that were originally olivine. There is also often a little bowlingite or iddingsite.

The most abundant minerals are the secondary serpentine and chlorite. In crystals which were originally olivine, the most abundant primary mineral in the original rock, the process of alteration to serpentine corresponds exactly to the description given by Rosenbuch (Physiography of the Rock-making Minerals, translated by Iddings, pp. 221): 'The most common (alteration) is the alteration of olivine to serpentine; this always starts from the surface and from cracks and leads to a fibration, at the same time with the separation of the iron in the form of ferric oxide, hydrous oxide, and magnetite. The greenish to yellowish-green fibers stand perpendicular to the crystal boundaries and the cracks. This produces a net-like appearance, the strings of serpentine forming the webb of the net, the meshes consisting of olivine as yet unaltered. As the process advances, new cracks form with the increase in volume accompanying the serpentinization, resulting finally in the complete alteration of the olivine. Although the serpentinization of olivine in many cases may be a simple act of weathering, yet in others it is probably due to the action of warm waters.

The calcite occurs mainly in seams and cracks and is also often seen in the interior of crystals originally olivine, where it is now surrounded by serpentine. Calcite is very widespread. The serpentine, light leek-green in color, is very often found in ellipsoidal to spherical aggregates with radiating finely fibrous structure. These are often hollow. Hour-glass structure in skeletal lath-shaped crystals originally of olivine exhibit short needles of titanite oriented parallel to the longer crystal axis. Such structures are not abundant. Slender lath-shaped crystal forms are still apparent in some specimens and were probably originally augite. A very few hexagonal outlines of original nepheline were seen.

Practically all specimens show traces of original crystal boundaries. For this reason the original rock was not a tuff, for no basic tuff would exhibit so many crystals of such large size and so well developed. The rock was originally undoubtedly porphyritic with large and abundant phenocrysts of olivine, less abundant and considerable smaller phenocrysts of augite, an occasional phenocryst of nepheline, and a fine-grained ground mass made up of a large percentage of finely granular magnetite and of other minerals the nature of which cannot now be determined. In composition the rock was a nepheline-basalt very likely limburgite. Its structure and texture was practically identical with that of the intrusive nepheline-basalt (limburgite) of Pilot Knob, Travis County, Texas. The evidence thus indicates that the oil-bearing rock in the Thrall field was originally intrusive, probably in the form of a sill.

THE ORIGIN OF THE ALTERED IGNEOUS ROCK AT LYTTON SPRINGS

It seems to the writers that the origin of the altered igneous rock in this area presents more complicated problems than did the origin of the serpentine at Thrall. At Thrall the altered igneous rock lay entirely within the basal portion of the Taylor Marl. The Austin Chalk did not appear to carry igneous rock. At Thrall also there was a definite lower boundary to the serpentine which sloped gently towards the vent through which the molten rock reached the bottom of the sea and which was approximately two hundred feet above the Austin Chalk.

Igneous rock was encountered in the Lytton Springs area from the middle of the Taylor Marls, intermittently downward to the lower portion of the Austin Chalk.

Serpentine is said to have been found with chalk both above and below it in wells Nos. 50, 74, and 94. Again in well 117 serpentine was not reported either within Taylor

Marl or the Austin Chalk. In many wells serpentine was logged with layers of gumbo intercalated between masses of igneous rock. Banded chalk was reported from a core taken from well 93 at a depth of 998 feet below sea level. This core of Austin Chalk and others that were studied had a higher content of silica, were banded and were harder than the average chalk. These samples were also more crystalline and had a yellowish cast. The above samples resemble chalk found in contact with altered igneous rock in a valley southeast of Travis Heights, Austin, Texas, and probably represent similar conditions.

The wide-spread occurrence of altered igneous rock as shown on Figure 1 indicates rather intensive volcanic activity within that area. The surface outcrops of altered igneous rock occurs at Creedmoor (under the concrete bridge), along Onion Creek (both northeast and north of Pilot Knob), along Rinard's Creek northwest of Pilot Knob, along the International and Great Northern Railroad track at Kouns (three miles south of Colorado River bridge), in valley northeast of St. Edwards College, in valley east of Travis Heights, in East Austin (one-half mile east of cottonseed oil mill where the Webberville road crosses the creek), and at other places.

In wells within this area, altered igneous rock has been found on the dump or ditch of the Mid-West Texas Company's G. H. Smith No. 1 on the Blaylock Survey. It was not, however, noted by the drillers at the time of drilling. Also, fragments of igneous rock were found in cuttings saved from the well. Cuttings from Bednor No. 1 which appeared to be altered igneous rock were submitted to the Bureau of Economic Geology by E. H. Givens and associates. This well is located on the Ella Hill Survey, seven miles southeast of Lytton Springs. A similar sample was seen from the Chamberlain No. 1, drilled by the Plateau Oil Company, two miles northeast of Dale, Texas. The material appeared to be serpentine but would not hold together well enough to make a thin section. The driller's log of the Carlson No. 1, on the W. M. Smith Survey

Travis County, four and one-half miles southwest of Coupland showed "green rock-serpentine" 190-191 feet.

The localities mentioned above probably represent several different unrelated volcanic eruptions, which may have occurred near the same time or during a considerable period of time. These areas may be more generally connected than we now think but it is our opinion that they represent separate and more or less distinct activities.

The authors venture to suggest that the serpentine-like igneous rock at Lytton Springs represents a submarine volcano of considerable magnitude, which poured its lava out upon the bottom of the lower Taylor Marl Sea. Also, that intrusive sheets were forced out into the only slightly indurated beds of the Austin Chalk.

ORIGIN OF THE IGNEOUS BODY AT THRALL

The following paragraphs on the "Origin of the Igneous Rock" are also taken from the bulletin on the Thrall oil field and are reprinted here to give a basis for the better comparison of these two fields:

Whether the igneous body at Thrall is an intrusive or extrusive contemporaneous with the deposition of the lower part of the Taylor Marl, is a question on which it would be desirable to have more evidence. The authors of this paper are both of the opinion that this igneous body is an extrusive and most probably represents an irregular cone left by some small submarine eruption, on the bottom of the Cretaceous sea.

It may well be admitted that the evidence supporting this view is not conclusive, but it seems to us quite strong. The direct evidence is the fact that one specimen of chloritic rock showed a texture like that of volcanic tuff. It was a fragment of green rock in which the chlorite showed markings like the boundaries of angular fragments of sizes ranging mostly between one-sixteenth and one-half mm. in diameter.

Further, Mr. Tomilson reconstructs the metamorphic rock as having been originally a basaltic lava, in part glass, and he speaks of a sample taken from the depth of 745 to 758 feet and another from 768 to 780 feet below the surface in the Taylor Oil and Gas Company well No. 3, as giving the best idea of the original rock. He says of this that the original texture is sufficiently preserved to enable one to recast the original rock with a fair degree of certainty. These sections show outlines of phenocrysts of augite set in a base of brownish glass, and the sections show many roundish patches of zeolites which probably indicate that the rock was originally somewhat cellular. He also says of the breccias that most of them show large angular fragments of the meta-basalt with concave sides, as though broken from a cellular rock. Mr. Larsen likewise says that 'the rock was unquestionably porphyritic . . . and with little doubt had scattered . . . crystals . . . in a fine-textured or glassy ground-mass. Parts of it appear to have been highly vesicular and some specimens strongly suggest a rather fine-textured tuff.' Other direct but indecisive evidence is the presence in quite many of the samples of microscopic bodies resembling spheruliths, as if the rock were originally in part glassy. Glassy intrusives are, however, known to exist. Professor C. L. Baker suggests that such structures may be the result of metamorphism, as if due to a kind of concretionary growth. The absence of all evidence of contact metamorphism from all the materials examined is negative evidence, also of some significance, for careful search has been made in a large number of samples without discovering the smallest fragment of any rock that can be regarded as having been subject to metamorphism by heat. The presence of much calcite in the zones of contact both below and above the igneous rock is, on the other hand, evidence of the existence of permeable material in the places where an intrusive would naturally have baked and hardened the inclosing beds.

The present authors regard two other features as strongly favoring the hypothesis of contemporaneous volcanic activity. These are the form of the igneous body and the nature of the cap rock. A glance at the map showing the contours of the upper surface of the igneous body is sufficient to suggest resemblance to a flat cone, such as might be produced by some small submarine volcanic eruption and by subsequent leveling by marine currents, which would naturally disintegrate and scatter the extended materials. The central part of the cone is some 250 feet higher than its outer border, if referred to a horizontal base. An intrusive might very well have a form like this, but it is hardly probable that an intrusive would be found to thin out peripherally as gradually in nearly all directions as this body seems to do. Laccolites intruded into clay formation have the habit of terminating abruptly on nearly all sides, evidently for the reason that clay formations do not as readily open along cleavage lines as do more indurated stratified rocks, such as limestones and sandstones. A number of intrusives in the Upper Cretaceous marls in the western part of this State, show heaped up forms terminating in nearly vertical lateral slopes. The igneous body of the Thrall field has, edgewise, a cuspidate form. Its highest part is truncated. Beyond the border of this high area there is first a rapid slope of the upper surface and then a more and more gradual slope to what appears to be an indeterminate thin outer margin.

The material immediately overlying the igneous rock is known as the 'cap rock' and differs markedly from the typical phase of the Taylor Marl in which the igneous body is contained. This is particularly true on the northeast half of the dome. In this part of the field the cap rock consists of a porous shell breccia more or less filled with clear calcite. In many wells this rock has furnished the greater part of the oil production. But in nearly all of the wells on the southwest half of the dome, from which samples of the cap rock have been examined, it is found to consist of much finer material, either like the typical Taylor Marl or finer than this, and calcareous so as to resemble limestone. This differentiation in the nature of the sediments immediately overlying the igneous body can readily be accounted for as a result of sorting by deep currents in the sea, in the presence of a local obstruction on the bottom of the basin. Not only might such an obstruction intensify the current on the fronting side against which it impinged and produce slack conditions on the lee side; but it would also naturally greatly favor the development of a flourishing fauna on the fronting side, to the detriment of the inhabitants on the lee side. At any rate, if the igneous body is supposed to have been an intrusive it is difficult to account for the presence of an unusual phase of brecciated organic sediment in an otherwise very uniformly developed marl formation, and to explain why this unusual rock occurs only on one slope of the intruded body.

THE ORIGIN OF THE OIL

Very little can be said on this subject, however, it is the opinion of the writers that the marls and the shales of the Upper Cretaceous have supplied the organic materials from which the oil at Lytton Springs was derived. The basal one hundred feet or more of the Taylor Marl is known to have a rather high carbon content. These lower marls will almost invariably yield oil by distillation. Hence it seems reasonable to assume that the oil from the basal Taylor Marls may have migrated into the very porous altered igneous rock, probably by capillary movement. It is also believed that the oil did not migrate any considerable distance but was derived from the adjacent marls. The above statement is based upon two facts, first that there is no general ground water in the Taylor Marls and probably never could have been sufficient circulation to gather oil from any extended area. Second, that the Cretaceous formations underlying the Taylor Marls are not known to have a high organic content, while the pre-Cretaceous formations that have been explored by the drill in the Luling oil field are certainly devoid of any considerable carbon content. This would preclude any considerable possibility of a deep-seated origin of the oil at Lytton Springs.

By referring to the Well Data it may be noted that there are at least two wells in the field, which the records show get production below the Taylor Marl. In well 93 it is apparent that production came from somewhere near the base of the Austin Chalk or the Eagle Ford. In well 117 the records would indicate that production was secured from the Eagle Ford Shales. While it would be impossible to prove that oil found in the Austin Chalk and Eagle Ford Shales was derived from the Taylor Marls, it seems to the authors that such is probably the case. The only evidence that might help to decide this question of the origin of the oil in these two wells would be an analysis of the oil from wells 93 and 117 compared with analysis of oil from several wells of lesser depth. The Eagle Ford Shales have been explored many times but the oil from the above wells is the first commercial production, that has been secured.

INITIAL PRODUCTION

A study of the initial production of one hundred and ninety-six wells, for which records were available, in the Lytton Springs oil field is condensed in the following table:

Initial Production in Barrels	Percentage
1-8	1.00
8-40	17.34
41-200	46.95
201-1000	18.00
1001-5000	12.00
Dry holes	14.71

The grouping and location of the above wells with respect to the upper surface of the altered igneous rock is indicated by Plate 3.

GROSS PRODUCTION

The writers did not have sufficient time to complete a study of the field showing production by leases. The gross production by months is as follows:

March	2,950 bbls. of 42 gallons
April	81,714 bbls. of 42 gallons
May	224,733 bbls. of 42 gallons
June	316,382 bbls. of 42 gallons
July	336,690 bbls. of 42 gallons
August	337,801 bbls. of 42 gallons
September	341,481 bbls. of 42 gallons
October	326,050 bbls. of 42 gallons

Total of 2,052,801 barrels produced to November 1, 1925

By the end of July some one hundred and ninety-six wells had been completed either as dry holes or producers. By dividing the number of completions into the gross production up to August 1 gives an average gross production of 5125 barrels for each well completed. This appears to show that the field in a general way has paid for its development during the first five months. Of course, this does not take into consideration the cash involved in the purchase price of some of the leases, neither would it be true for the small leases, where the percentage of dry holes was large compared to the producing wells.

During the month of July, 1925, there was one lease with seventeen producing wells that averaged approximately one hundred and twenty-five barrels per well per day. The next highest average was ninety-four barrels per well per day, with twelve producing wells. Some of the leases ranged as low as twenty-five barrels per well per day, while the average for sixteen of the larger leases was sixty-seven barrels per well per day.

The peak of production appears to have been reached during the month of September, 1925, when the average daily production was slightly less than 12,000 barrels. The average daily production for October, 1925, dropped to 10,517 barrels, still permitting Lytton Springs to be classed as a major oil field.

Lytton Springs produced 1,007,469 barrels of oil during the first five months while Thrall yielded 1,130,221 barrels during the first year of its history.

DRILLING TIME

The average time required to drill and complete a well appears to be between eleven and twelve days. These figures are based upon the drilling records of seventy-eight wells obtained from the Oil and Gas Division of the Railroad Commission. Not considering the discovery well, none required more than twenty-eight days for drilling while at least one well was drilled to a depth of 1820 feet, completed and turned into the flow tank in fifty-six hours. The ease of drilling through the clays and shales, the absence of water troubles and the readiness with which the pay rock may be identified are responsible for low average drilling time.,

PROSPECTING FOR OIL IN SIMILAR IGNEOUS BODIES

The chances of finding other pools similar to that at Thrall and Lytton Springs must be considered quite limited. The fact that the Lytton Springs oil field was discovered ten years after Thrall bears out the above statements. It is evident that submarine volcanoes do not occur regularly and in great numbers, that volcanic rock does

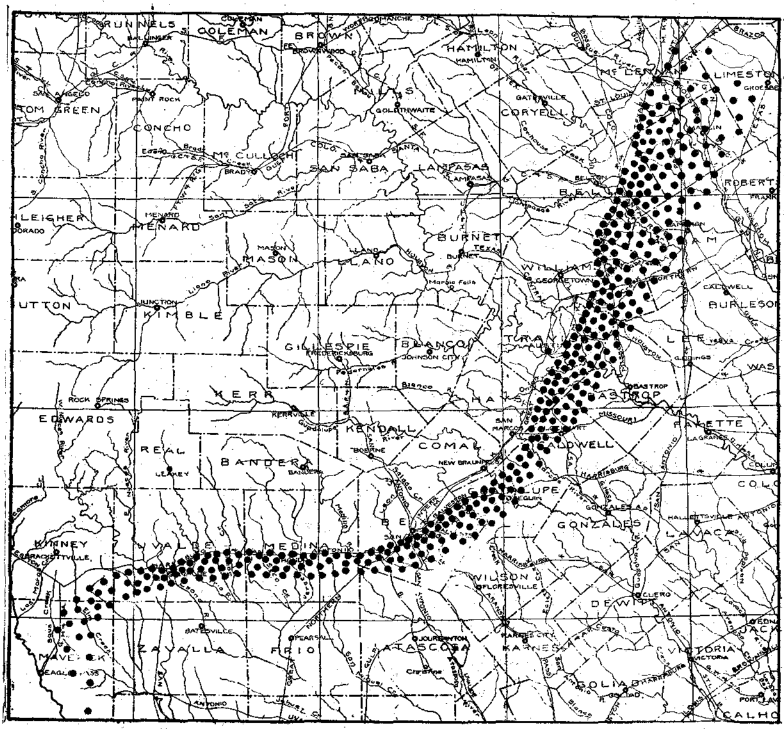


Figure 2. Map approximately locating a belt following the down throw of the Balcones escarpment, where the Taylor Marl and overlying Cretaceous and Tertiary deposits are from 0 to 2500 feet in depth and where igneous bodies like those at Thrall and Lytton Springs are believed to be most likely to occur in situations analogous to those at Thrall and Lytton Springs.

not always metamorphose in such a manner as to be sufficiently porous to absorb oil and that volcanic rock may not come in contact with that portion of the Taylor Marl which has a high organic content. Again, the clays and marls of the Navarro and Taylor formations have very few beds that resist erosion more effectively than the main body of the marl itself, rendering the finding of surface structure quite difficult. There are many areas of altered igneous rock known either from surface outcrops or from well cuttings and cores. Figure 1 shows the distribution of these localities. Figure 2 indicates the belt where altered igneous rock might be associated with the lower portion of the Taylor Marl at the depth of 2500 feet or less.

The Lytton Springs oil field was indicated by a noticeable topographic high as well as by determinable structural

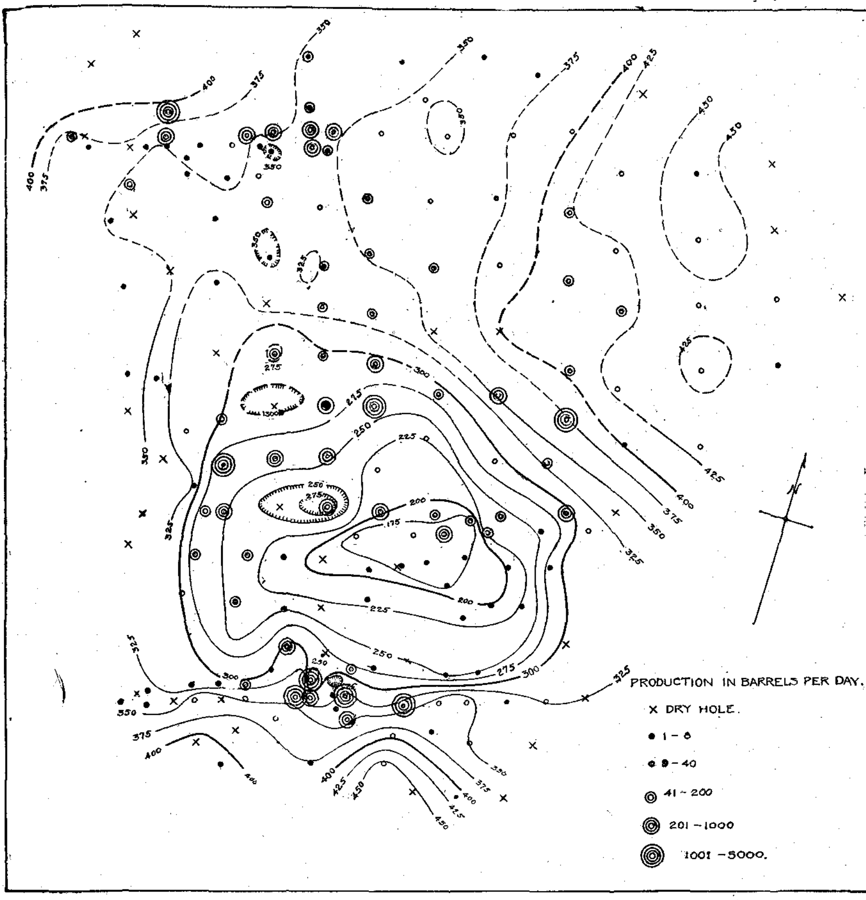


Figure 3. Map showing the distribution of wells giving amounts of production in the Thrall Oil Field. Contour lines show elevation of upper surface of oil-bearing rock in feet below sea level. Compare with Plate 3 in folder.

features such as the broad bend in the contact between the Midway and Wilcox formations. The Thrall field is located upon a slight topographic high but presents no surface or subsurface evidence of a structure in the beds of Taylor Marl or Navarro formations. With one of the known fields of this type presenting no surface structure and the other one presenting somewhat prominent structural features, it is quite evident that prospecting for oil and gas within the area shown on Figure 1 and 2 would be quite uncertain and hazardous. However, within the above mentioned area drilling costs are rather low, due to the ease of drilling and to the absence of serious water problems. Since it is difficult to recognize surface structure it would probably be worth while to test this area out in a systematic manner with a core drill, for there undoubtedly must be more productive areas similar to Thrall and Lytton Springs.

WELL DATA

Log of Wells

Humble Oil and Refining Company on the Mrs. M. L. Brewer Farm

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
1	1	505	100	Shale 0-804; sand and lime 804-1010; shale and boulders 1010-1206; serpentine 1206-1637. T. D.	
2	2	522	50	Shale 0-1130; hard shale and shell 1130-1217; serpentine 1217-1414. T. D.	
3	3	528	75	Clay and shale 0-1229; serpentine 1229-1522. T. D.	
4	4	512	100	Clay, shale, boulders and gumbo 0-1200; shale and lime 1200-1235; serpentine 1235-1651. T. D.	
5	5	513	200	Surface clay 0-210; shale and gumbo 210-1295, serpentine 1295-1571. T. D.	
6	6	522	100	Shale and boulders 0-1178; hard chalky shale 1178-1246; chalk 1246-1261; hard chalky shale 1261-1312, gummy shale 1312-1345; pay sand 1345-1359; broken lime and shell 1359-1425; serpentine 1425-1532; sandy shale 1532-1550. T. D.	

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
7	7	528	75	Clay, shale and gumbo 0-1329; serpentine 1329-1469. T. D.	Drilling time 7 days.
8	8	523	350	Clay, shale and gumbo 0-1232; serpentine 1232-1467. T. D.	
9	9	524	100	Surface soil clay and shale 0-254; lime rock 254-256. shale 256-377; shale, gumbo and boulders 377-1215; lime rock 1215-1217; sand 1217-1225; serpentine 1225-1388. T. D.	
10	10	530	75	Clay, shale and boulders 0-1217 serpentine 1237-1451. T. D.	Drilling time 15 days
11	11	523	50	Serpentine 1220-1453.	
12	12	517	150	Surface soil shale and boulders 0-1214; serpentine 1214-1440. T. D.	
13	13	513	640	Surface clay, shale and boulders 0-400; rock 400-402; shale and gumbo 402-1190; serpentine 1190-1487; gumbo 1487-1493; sticky shale 1493-1495; serpentine 1495-1519. T. D.	Drilling time 13 days.
14	14	519	100	Serpentine 1223-1480.	
15	15	510	100	Surface clay, shale, boulders and shell 0-1220; serpentine 1220-1300; gumbo 1300-1328; serpentine 1328-1338; gumbo 1338-1363; serpentine 1363-1574. T. D.	Drilling time 11 days.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
16	16	528	100	Serpentine 1275-1545. T. D.	
17	17	524	200	Serpentine 1331-1542. T. D.	
18	18	530	200	Serpentine 1360-1616. T. D.	
19	19	525	50	Serpentine 1338-1575. T. D.	
20	20	520	40	Serpentine 1226-1702. T. D.	
21	21	529	60	Serpentine 1268-1607. T. D.	
22	22	521	160	Serpentine 1245-1643. T. D.	
23	23	514	75	Serpentine 1262-1669. T. D.	
24	24	527	240	Serpentine 1295-1695. T. D.	
	Sun Oil Company on the A. H. Gomillion Farm				
25	1	509	350	Clay and shale 0-220; lime shell 220-221; shale 221-310; lime shell 310-311; shale 311-420; shale 420-421; shale 421-480; lime shell 480-481; shale and boulders 481-550; lime shell 550-552; shale gumbo and boulders 552-1070; sand shale and boulders 1070-1080; shale 1080-1185; pay sand 1185-1245. T. D.	Drilling time 10 days. Show of oil at 1080.
26	2	527	2000	Surface clay, shale and boulders 0-225; rock 225-227; shale and boulders 227-345; rock 345-347; shale 347-1190; oil sand 1190-1276.	Drilling time 8 days.
27	3	530	500	Surface shale and boulders 0-1109; chalky shale 1109-1129; gummy shale 1129-1140; chalky shale 1140-1156; gummy shale and gumbo 1156-1171; broken cap rock 1171-1181; oil sand serpentine 1181-1451. T. D.	Drilling time 6 days.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
28	4	512	250	Shale and boulders 0-1077; broken chalk and shale 1077-1250; pay 1250-1279; sticky and sandy shale 1279-1555. T. D.	Drilling time 6 days.
29	5	534	1000	Clay, shale and boulders 0-800; black shale 800-850; gumbo, shale and boulders 850-1180; broken formation, lime and rock 1180-1216; lime shale and boulders 1216-1268; cap rock 1268-1270; oil sand serpentine 1270-1420; rock 1420-1421, oil sand soft serpentine 1421-1489. T. D.	Drilling time 9 days.
30	6	512	660	Clay, shale and boulders 0-745; shale and lime 745-819; sticky shale 819-1021; chalky shale 1021-1164; gumbo and shale 1164-1174; gumbo and shale 1174-1500. T. D.	Drilling time 21 days. Serpentine 1174-1500.
31	7	501	1500	Serpentine and pay 1168-1578. T. D.	
32	8	514	500	Serpentine 1270-1489. T. D.	
33	9	502	75	Serpentine and pay 1156-1567. T. D.	
34	10	517	100	Serpentine 1289-1748. T. D.	
35	11	510	150	Serpentine 1278-1592. T. D.	
36	12	532	100	Serpentine 1236-1596. T. D.	

Serial number	Lease number	*Elevation*	Initial production	Log of wells	Remarks
37	13	499	50	Surface sand, gravel and shale 0-156; sand 156-176; shale and boulders 176-406; rock 406-406′6″; gumbo and shale 406′6″-1182; serpentine and pay 1182-1384; shale 1384-1495; chalk 1495-1500; gumbo and shale 1500-1694; chalk 1694-1708. T. D.	Drilling time 6 days. Chalk 1694-1708.
38	14	502	200	Surface sand, shale and boulders 0-1080; hard limey shell 1080-1140; shale and gumbo pay 1166-1468, gumbo 1468-1481.	Serpentine 1161-1481.
39	15	509	100	Clay, shale and gumbo 0-348; rock 348-349; shale and gumbo 349-991; gumbo and lime 991-1016; shale and lime 1016-1124; shale and gumbo 1124-1192; lime 1192-1195; serpentine 1195-1239; gumbo 1239-1243; serpentine 1243-1300; gumbo 1300-1309; serpentine 1309-1368; gumbo and shale 1368-1426. T. D.	Drilling time 16 days. Serpentine 1195-1400.
40	16	504	75	Surface shale, gumbo and boulders 0-1007; sticky shale and chalk boulders 1007-1175; shale and gumbo pay 1175-1666; chalk 1666-1703. T. D.	Drilling time 12 days. Serpentine 1199-1666.
41	17	518	100	Surface shale, gravel and rock 0-341; shale rock 341-346; shale and boulders 346-1310; serpentine 1310-1658. T. D.	Drilling time 11 days.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
42	18	520	150	Clay, shale and gumbo 0-875; chalky shale 875-1020; sticky shale 1020-1100, hard shale and streaks of chalk 1100-1240; serpentine 1240-1387; gumbo 1387-1401; serpentine 1401-1420. T. D.	Drilling time 11 days.
43	19	522	100	Shale 0-188; rock and lime 188-201; blue shale 201-261; shale 261-356; rock 356-360; shale 360-1175; chalky shale 1175-1242; shale and gumbo 1242-1315; cap rock 1315-1318; serpentine 1318-1538. T. D.	Drilling time 14 days.
44	20	534	200	Clay, shale and gumbo 0-978, rock 978-980; gumbo, shale and lime 980-1100; broken lime 1100-1145; hard shale 1145-1200; lime-broken 1200-1222; serpentine 1222-1432. T. D.	Drilling time 10 days. Show of gas 1100-1145.
45	21	522	200	Clay, shale and boulders 0-320; shale and lime 320-365; shale and boulders 365-1010; gumbo, lime and shale 1010-1200; chalky lime 1200-1254; pay 1254-1421; gumbo 1421-1423; serpentine 1423-1423′6″. T. D.	Drilling time 8 days. Serpentine 1254-1423.
46	22	512	40	Gravel, clay, shale and gumbo 0-690; rock 690-692; shale and boulders 692-980; chalky shale 980-1091; gumbo and shale 1091-1145; broken lime 1145-1165 tough gumbo	Drilling time 7 days. Serpentine 1190-1325.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
				1165-1180; broken lime 1180-1186; cap rock 1186-1190; serpentine 1190-1241; gumbo 1241-1247; serpentine 1247-1325; gumbo 1325-1326 T. D.	
47	23	510	100	Gravel, shale, boulders 0-990; hard shale with streaks of chalk 990-1045; gumbo 1045-1066; chalky shale 1066-1160; shale 1160-1175; rock 1175-1177; serpentine 1177-1393. T. D.	Drilling time 8 days.
48	24	519	25	Serpentine pay 1294-1495. T. D.	
49	25	514	50	Serpentine 1196-1432. T. D.	
49A	26	500	50	Serpentine 1195-1388. T. D.	
49B	27				

Humble Oil and Refining Company on the H. A. Brewer "A" Farm

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
50	1	511	400	Serpentine 1335-1628. T. D.	
51	2	538	Dry	Surface clay, shale and boulders 0-1010; gumbo and brown sand 1010-1110; shale and boulders 1110-1366; shale and broken chalk 1366-1400; sticky shale 1400-1470; lime shells and shale (serpentine) 1470-1480; serpentine 1480-1498; serpentine shale and chalk 1498-1560; chalk 1560-1568; mostly serpentine and a little chalk 1568-1608; chalk (cored) 1648-1652. T. D.	No production

Serial number	Lease number	Elevation	Initial production	Location — Log of wells	Remarks
52	3				
53	4	513	100	Serpentine 1335-1557. T. D.	
54	5	521	300	Serpentine 1335-1605. T. D.	
55	6	528	75	Serpentine 1355-1590; chalk 1590-1593. T. D.	
56	7	513	25	Serpentine 1326-1525. T. D.	
The Grayburg Oil Company on the C. H. Beaty Farm					
57	1	546	Dry	Top of serpentine 1500; top of chalk 1510; Buda limestone at 1840. T. D.	
Olmstead and Dietert on the E. Beaty Farm					
58	1	507	Dry	Serpentine 1460-1500; chalk 1500-1771. T. D.	
Evans Oil Company on the H. A. Brewer Farm					
59	1	535	Dry	Serpentine 1470-1514; chalk 1514-? T. D.	
Armstrong, Lefevre and Story on the Fred Perry Farm					
60	1	?	Dry	Surface 0-40; shale and shell 40-140; sandy shale 140-190; sandy lime 190-193; shale and gumbo 193-750; shells 750-752; shale and gumbo 752-1125; gumbo and shells 1125-1175; shells 1175-1177, gumbo and shale 1177-1405; Austin chalk cored 1405-1737; Eagle Ford shale 1737-1748; Buda lime 1748-1763;	

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
				Del Rio shale and pyrites 1763-1885; Georgetown broken lime 1885-1926; porous lime, no oil, gas or water show 1926-1977. T. D.	

Humble Oil and Refining Company on the H. A. Brewer Farm

61	1	?		Location.	

Gulf Production Company on the F. A. Gomillion Farm of 50 Acres

62	1	521	75	Serpentine 1325-1502; gumbo 1502-1504; serpentine 1504-1680; shale and shell 1680-1750; serpentine 1750-1883; lime and shell 1883-1887; hard shale 1887-1896; lime rock 1896-2016; Edwards lime cored 2020. T. D.	
63	2	527	100	Clay, shale, boulders, gumbo 0-1063; sandy lime 1063-1200; shale and gumbo 1200-1300; serpentine 1300-1327; shale 1327-1445; gumbo 1445-1449; shale 1449-1495. T. D.	Drilling time 14 days. Serpentine 1300-1495.
64	3	518	50	Shale and gumbo 0-1180; hard lime and shale 1180-1214; hard shale 1214-1272; hard lime and shale 1272-1280; shale and gumbo 1280-1337, cap rock 1337-1358; serpentine 1358-1438; chalk 1438-1496; serpentine 1496-1528; gumbo 1528-1544; chalk 1544-1548; serpentine 1548-1580. T. D.	Serpentine 1336-1580.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
65	4	520	50	Surface, clay and boulders 0-125; rock 125-126; shale and boulders 126-210; rock 210-211; shale 211-340, rock 340-342; shale and boulders 342-420; sticky shale, shale and gumbo 420-1335; serpentine 1335-1558; shale 1558-1630, serpentine 1630-1716. T. D.	Drilling time 10 days. Serpentine 1336-1700.
66	5	512	200	Shale, gumbo 0-1180; lime and shale 1180-1260; gumbo and shale 1260-1345; serpentine 1345-1349; gumbo 1349-1360; serpentine 1360-1438; gumbo 1438-1442; serpentine 1442-1557. T. D.	Drilling time 8 days. Serpentine 1345-1557.
67	6	527	1550	Rock 240-242; rock 266-268; serpentine 1340-1355; gumbo 1355-1365; serpentine 1365-1533; gumbo 1533-1543; serpentine 1543-1566. T. D.	Serpentine 1340-1566.
68	7	531	25	Rock 280-281; rock 320-321; rock 450-451; rock 560-562; shale and boulders 562-1323; serpentine 1323-1328; shale and gumbo 1328-1394; serpentine 1394-1419; chalk 1419-1424; serpentine 1424-1602. T. D.	Serpentine 1424-1602.
69	8	528	600	Shale, boulders and sand 0-363; rock 363-367; shale, boulders 367-1165; chalk 1165-1276; sticky shale and gumbo 1276-1302; serpentine 1302-1503; chalk 1503-1512. T. D.	Serpentine 1370-1503.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
70	9	501	50	Clay, shale and gravel 0-350; lime rock 350-352; shale, gumbo and boulders 352-1290; broken lime 1290-1308; gumbo and shale 1308-1408; serpentine 1408-1436; gumbo 1436-1464; serpentine 1464-1474; gumbo 1474-1506; serpentine 1506-1579. T. D.	Drilling time 11 days. Serpentine 1380-1580.
71	10	532	50	Surface shale, boulders 0-150; rock 150-151; shale, gumbo, boulders 151-1404; serpentine 1404-1526; gumbo 1526-1536; serpentine 1536-1575; chalk 1575-1583. T. D.	Drilling time 15 days.
72	11	516	Dry	Surface shale and boulders 0-400; rock 400-403; shale, gumbo and boulders 403-1430; serpentine 1430-1550; sandy chalk and chalk 1550-1662; broken formation 1662-1760; gumbo 1760-1777; T. D. Dry and abandoned.	Drilling time 10 days. Serpentine 1430-1750. Show of oil 1630-1662.
Gulf Production Company on the Mrs. H. E. Palmer Farm					
73	1	534	14	Serpentine 1460-1823. T. D.	
Marland, Cranfill and Reynolds on the Mrs. E. A. Gomillion Farm of 56 Acres.					
74	1	514	2500	Clay, shale, boulders and rock 0-543; rock 543-555; gumbo and hard shale 555-1181; hard shale, gumbo and lime 1181-1222; shale 1222-1238; hard chalky shale 1238-1318; oil shale 1318-1420. T. D.	Drilling time 15 days.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
75	2	511	150	Clay, shale, gumbo and boulders 0-1333; chalk 1333-1335; sticky shale 1335-1360; serpentine 1360-1477; gumbo 1447-1516; serpentine 1516-1637; gumbo and shale 1637-1735; shale 1735-1752; serpentine 1752-1770. T. D. Another record shows chalk 1576-1626; broken chalk and serpentine 1680-1700; Georgetown limestone 2025.	
76	3	511	150	Surface sand and gravel 0-56; rock 56-58; shale 58-311; rock 311-325; gumbo, shale and boulders 325-1321; serpentine 1321-1473; sticky shale and gumbo 1473-1526; serpentine 1526-1665; chalk 1665-1670. T. D.	Drilling time 13 days.
77	4	520	100	Gravel, shale and boulders 0-100; rock 100-102; hard shale 102-220; hard rock 220-223; shale 223-300; rock 300-303; shale 303-381; rock 381-383; shale 383-402; rock 402-405; shale, gumbo and boulders 405-894; sand, light show of oil 894-896; shale and gumbo 896-1153; rock 1153-1155; shale 1155-1184; shale and shell 1184-1232; shale and gumbo 1232-1340; serpentine 1340-1480; gumbo 1480-1485; serpentine 1485-1520; gumbo 1520-1524; serpentine 1524-1570; chalk	Drilling time 15 days.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
				1570-1691; serpentine 1691-1826; broken chalk 1826-1853; sandy lime 1853-1900; hard lime 1900-1903; sandy lime 1903-1930; shale 1930-1980; lime (cored) 1980-1985; lime 1985-1990; hard lime 1990-1996; lime 1996-2026. T. D.	
78	5	515	800	Surface clay, sand, shale, gumbo and boulders 0-450; sand, rock 450-452; shale and boulders 452-1173; broken chalk 1173-1218; shale and broken chalk 1218-1250; gumbo 1250-1333; oil sand 1333-1742. T. D.	Drilling time 8 days. Serpentine 1329-1742.
79	6	510	200	Surface shale 0-345; rock 345-347; shale 347-475; rock 475-476; shale and boulders 476-540; rock 540-541; shale 541-1384; serpentine 1384-1645. T. D.	Drilling time 6 days.
80	7	513	200	Surface clay, shale and gravel 0-275; rock 275-280; shale 280-294; rock 294-297; shale 297-490; rock 490-491; shale and gumbo 491-1142; rock 1142-1146; shale 1146-1320; serpentine 1320-1392; gumbo 1392-1403; serpentine 1403-1540; chalk 1540-1620. T. D.	Drilling time 5 days. Serpentine 1320-1620.
81	8	511	250	Serpentine 1320-1678. T. D.	
82	9	530	250	Clay, shale and boulders 0-1240; chalk and shale 1240-1340; chalk 1340-1343; serpentine 1343-1405; gumbo	Drilling time 9 days.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
				1405-1425; serpentine 1425-1440; gumbo 1440-1465; serpentine 1465-1480; gypsum 1480-1495; serpentine 1495-1509; gumbo 1509-1520; serpentine 1520-1650; chalk 1650-1655. T. D.	
83	10	518	300	Clay, shale, gumbo and boulders 0-1120; broken chalk 1120-1255; shale and gumbo 1255-1333, oil sand 1333-1447; serpentine 1447-1650. T. D.	Drilling time 5 days. Serpentine 1333-1650.
84	11	509	300	Serpentine 1305-1500. T. D.	
85	12			Not drilling.	
86	13	519	70	Serpentine 1555-1746. T. D.	
87	14	524	25	Serpentine 1400-1686. T. D.	
88	15			Location.	
89	16			Location.	
90	17			Location.	

Kampman Oil Company on the Mrs. F. E. Palmer Farm

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
91	1	519	Dry	Serpentine 1554-1832. T. D.	

Grayburg Oil Company on the Mrs. E. A. Gomillion Farm

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
92	1	526	500	Cuttings looked like chalk 1375; cored chalk at 1434; dry serpentine at 1485-1520; cored banded chalk at 1584; cored serpentine at 1680; hit hard rock at 1739; came out of hole to take core the oil followed the bit to the top.	
93	2	532	25	Serpentine 1400-1710. Chalk.	

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
94	3	538	200	Serpentine 1406-1630.	
95	4	538	50	Serpentine 1462-1636.	
96	5	529	25	Serpentine 1360-1631.	
97	6	534	Dry	Serpentine 1487-1504. Cored Edwards limestone at 2122, 2140, and 2158.	
98	7	520	Dry	Chalk and chalk-shale 1092-1409; serpentine 1409-1485; serpentine 1600-1723; chalk 1723-1778 (core).	
99	8	524	Dry	Serpentine 1416-1425; 1460-1495; 1545-1570; 1585-1640; 1670-1682; chalky shale 1682-1715. T. D.	
100	9	531	10	Serpentine 1396-1730. T. D.	
101	10			Location.	
102	11			Location.	
Mills-Bennett now Witherspoon on the M. L. Brewer Farm					
103	1	528	100	Serpentine 1303-1437. T. D.	
104	2	529	Dry	Serpentine 1208-1333. T. D.	
105	3	524	500	Serpentine 1276-1900. T. D.	
106	4	533	30	Shale, gumbo and boulders 0-1300; chalk 1300-1325; shale 1325-1350; serpentine 1350-1530. T. D.	Drilling time 11 days.
107	5	517	225	Clay, shale and boulders 0-320; rock 320-321; shale and gumbo 321-1316; serpentine and shale 1316-1509. T. D.	Drilling time 11 days.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
108	6	534	150	Serpentine 1577-1709.	
109	7	532	Dry	Serpentine 1380-1530.	
110	8	526	325	Clay, sand rock, shale and boulders 0-343; rock 343-344; shale 344-365; rock 365-367; shale 367-400; rock 400-402; shale 402-510; rock 510-515; shale and gumbo 515-1397; serpentire 1397-tine 1397-1651; chalk 1651 -1657. T. D.	Drilling time 7 days.
111	9	528	150	Surface clay, shale and boulders 0-1141; serpentine 1441-1447; sticky shale 1447-1475; serpentine 1475-1615; chalk 1615-1619. T. D.	Drilling time 9 days.
112	10			Location.	
112A	11			Location.	
Calzado Oil Company on the M. Eppright Farm					
113	1	541	Dry	Chalk 1640-1899; Eagle Ford 1899-1956; shale 1956-1976.	No Serpentine reported.
114	2	532	150	Pay sand 1540-1720. Oil show 1546-1771.	Probably Serpentine.
Johnson Brothers Oil Company on the M. Eppright Farm					
115	1	553	Dry		
Walsh-Marland Oil Company on the M. Eppright Farm					
116	1	563		Serpentine 1554-1650; chalk at 1650; top of Georgetown 2016. T. D. 2030.	

New Domain Oil Company

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
117	1	517	200	Clay, shale, gumbo and boulders 0-1370; lime 1370-1372; gumbo 1372-1460; hard chalky shale 1460-1512; hard lime shell 1512-1548; gumbo 1548-1585; hard lime shell 1585-1618; gumbo 1618-1635; lime 1635-1687; hard chalky lime 1687-1700; chalky lime 1700-1792; hard lime 1792-1826; shale 1826-1832; hard shale 1832-1849. T. D.	Set casing at 1700 feet. Oil at 1832-1834. Drilling time 20 days.
118	2	522	30	Clay, shale and boulders 0-481; hard rock 481-484; shale and gumbo 484-780; limey shale 780-897; gypy gumbo 897-1002; hard limey shale 1002-1101; gummy shale and hard limey shale 1101-1321; gumbo 1321-1345; broken shell 1345-1363: serpentine close 1363-1376; serpentine sandy 1376-1415; serpentine close 1415-1425; gumbo 1425-1435; serpentine and gumbo 1435-1521. T. D.	Set casing at 1363 feet. Serpentine 1360-1520. Drilling time 16 days.
119	3	520		Location.	

Marland Oil Company on the F. A. Gomillion Farm

120	1	522	Dry	Serpentine ? 1397-1806, chalk 1806.	

Marland and Lucy on the H. E. Palmer Farm

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
121	1	532	200	Serpentine 1313-1460.	
122	2	534	Dry	Serpentine 1349-1514.	
123	3	520		Location.	
124	4	525	150	Serpentine 1315-1485.	
125	5	515	Dry	Serpentine 1316-1540.	
126				126 to 134 locations only.	

Quaker Oil Company on the H. E. Palmer Farm

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
135	1	522	75	Surface clay, shale and boulders 0-170; rock 170-175; shale, gumbo and boulders 175-549; rock 549-551; shale, gumbo and boulders 551-1140; broken lime, shale 1140-1168; slate and shale 1168-1180; blue gumbo 1180-1208; gumbo and shale 1208-1257; sand 1257-1400; gumbo 1400-1418. T. D.	Drilling time 20 days. Serpentine 1257-1400.
136	2	518	100	Serpentine 1309-1409. T. D.	
137	3	522	75	Surface clay, rock and gravel 0-136; broken lime 136-210; shale and boulders 210-227; rock 227-229; shale sticky 229-278; rock 278-280; shale and gumbo 280-420; rock 420-423; shale and boulders 423-478, lime rock 478-483; sticky shale 483-570; lime rock 570-576; shale and gumbo 576-900; broken lime 900-920; gumbo and	Drilling time 11 days. Set casing at 1276 feet.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
				shale 920-1020; broken lime 1020-1040; sticky shale 1040-1140; lime rock 1040-1150; broken lime 1150-1175; shale 1175-1276; shell rock 1276-1277; serpentine 1277-1353; gumbo 1353-1355. T. D.	
138	4	522	50	Serpentine 1276-1456. T. D.	
138A	5	525	75	Surface soil and yellow clay 0-160; shale and broken lime 160-247; shale and boulders 247-385; sand rock 385-390; lime and sand rock 390-400; gummy shale 400-510; lime rock 510-512; gumbo and shale 512-745; broken lime and shale 745-820; gypsum and gumbo 820-900; gypsum and lime 900-1100; broken lime 1100-1230; shale and shell rock 1230-1280; serpentine sand 1280-1358; gypsum and gumbo 1358-1440. T. D.	Drilling time 12 days. Set casing at 1250 feet. Serpentine 1282-1440.
138B	6	514	50	Clay, shale, gumbo 0-336; rock lime 336-338; gypsum shale 338-368; broken lime 368-400; lime rock 400-402; sticky shale 402-440; lime rock 440-442; shale 442-520; sandy lime rock 520-522; shale and gumbo 522-690; broken lime 690-728; shale and gumbo 728-845; lime rock 845-846; shale, gumbo and boulders 846-1020; limey shale 1020-1200; gumbo 1200-1230; shale, lime and	Drilling time 18 days. Set casing at 1273 feet.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
				shell 1230-1276; serpentine 1276-1450; gumbo 1450-1500; serpentine 1500-1703; gypy gumbo 1703-1718. T. D.	
				Gulf Production Company on the M. L. Brewer 56 Acre Farm	
139	1	511	Dry	Serpentine 1230-1820?	
140	2	522	300	Serpentine 1190-1512.	
141	3	518	350	Top of serpentine 1210-1344. T. D.	
142	4	502	200	Serpentine 1190-1481. T. D.	
143	5	504	Dry	Serpentine 1196-1407. T. D.	
144	6			Location.	
145	7	516	800	Clay, shale and boulders 0-280; rock 280-281; shale and boulders, gumbo 281-1250; pay shale 1250-1320; gumbo 1320-1326; pay shale 1326-1400. T. D.	Drilling time 4 days. Serpentine 1250-1400. Set casing at 1238 feet.
146	8	525	100	Serpentine 1246-1430.	
147	9	524	?	Serpentine 1282-1715.	
148	10	517	?	Serpentine 1276-?	
149	11	515		Serpentine 1355.	
				Quaker Oil Company on the L. A. Cardwell Farm	
150	1	522	100	Serpentine 1307-1507.	
151	2	516	400	Serpentine 1285-	
152	3	509	25	Serpentine 1276-1600.	

Davis, et al. on the L. A. Cardwell Farm

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
153	1	492	Dry	Serpentine 1343-1480.	
154	2	498	Dry	Serpentine 1366-1542; chalk 1542-1577.	

C. N. White, Now Witherspoon, on the Mrs. A. H. Cardwell Farm

155	1	528	400	Serpentine 1242-1750.	
156	2	516	200	Serpentine 1054?-1593.	
157	3	529	75	Serpentine 1212-1672.	
158	4	517	150	Serpentine 1172-1836.	
158A	5	521		Location.	
158B	6	514		Location.	
158C	7	500		A producer.	
158D	8	508		Location.	

Danley et al. on the A. H. Cardwell 14 Acre Tract

159	1	514	Dry	Serpentine 1320-1502; serpentine was hard and tight, show of oil in the upper part of the serpentine.	

Humble Oil and Refining Company on the Mrs. A. H. Cardwell 36 Acre Tract

160	1	514	240	Serpentine 1260-1772.	
161	2			Location.	
162	3			Location.	
162A	4			Location.	

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
162B	5			Location.	
162C	6			Location.	
Gulf Production Company on the Mrs. A. H. Cardwell Farm					
163	1	511	Dry	Serpentine 1460-1720.	
163A				163A to 163I are locations.	
Gulf Production Company on the Mrs. M. L. Brewer 95-Acre Tract					
164	1	449	100	Sand shale, gumbo and boulders 0-219; sand and rock 219-223; sticky shale 223-242; sand rock 242-246; gumbo 246-260; sand rock 260-283; gumbo 283-320; gumbo and shale 320-1116; rock 1116-1118; shale and gumbo 1118-1165; serpentine 1165-1214; gumbo and shale 1214-1403; rock 1403-1404; shale 1404-1414; rock 1414-1416; shale 1416-1438. T. D.	Serpentine 1225-1257. Show of oil 1165, 1226, 1301, 1359, and 1374.
165	2	506	Dry	Surface clay, shale and boulders 0-236; rock 236-237; shale, gumbo and boulders 237-1169; rock 1169-1175; serpentine 1175-1431; rock and gumbo 1431-1443; serpentine 1443-1464; rock and gumbo 1464-1495; serpentine 1495-1764; hard shale 1764-1819. T. D.	Serpentine 1175-1764.
166	3	449	800	Clay, shale and gumbo 0-1130; serpentine and shale 1130-1164; pay serpentine 1164-1175; serpentine 1175-1300. T. D.	Serpentine 1140-1300.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
167	4	502	10	Surface clay, shale and boulders 0-779; shell and shale 779-820; shale, gumbo and boulders 820-1082; broken hard shale 1082-1103; shale 1103-1198; serpentine 1198-1300; shale 1300-1366. T. D.	Serpentine 1210-1366.
168	5	514	75	Surface clay and shale 0-230; lime and shell 230-232, shale gumbo and boulders 232-1190; shell 1190-1191; gumbo 1191-1195; shell 1195-1196; serpentine 1196-1225; gumbo 1225-1228; serpentine 1228-1515; gumbo 1515-1516; serpentine 1516-1546; gumbo 1546-1548; serpentine 1548-1605. T. D.	Drilling time 8 days. Serpentine 1196-1605.
169	6	491	4000	Surface 0-50; shale 50-1123; shell 1123-1131; shale 1131-1280; gumbo 1280-1304; soft shale 1304-1436. T. D.	Drilling time 11 days. Serpentine 1131-1436.
170	7	496	130	Serpentine 1153-1442. T. D.	
171	8	498	30	Surface 0-10; clay shale and boulders, gumbo 10-1050; sandy lime 1050-1075; gumbo 1075-1127; shale 1127-1369. T. D.	Drilling time 9 days. Serpentine 1127-1302.
172	9	501	60	Surface 0-30; shale and boulders 30-788; gummy shale 788-816; hard shale and boulders 816-1160; gummy shale 1160-1198, serpentine 1198-1400. T. D.	Drilling time 13 days. Serpentine 1235-1400.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
173	10	505	40	Sand and clay 0-40; lime and shale 40-177; shale and boulders 177-1060; gumbo 1060-1068; broken sand 1068-1110; broken shale and lime 1110-1120; serpentine 1120-1408; gumbo 1408-1410. T. D.	Drilling time 16 days. Serpentine 1120-1410.
174	11	500	40	Surface 0-75; shale and boulders 75-1060; broken lime 1060-1072; gumbo and shale 1072-1130; serpentine 1130-1450. T. D.	Drilling time 16 days. Serpentine 1130-1450.
175	12	495	40	Surface 0-50; shale and boulders 50-366; rock 366-368; shale and boulders 368-1000; gumbo and gummy shale 1000-1097; serpentine 1097-1480. T. D.	Drilling time 8 days. Serpentine 1133-1480.
176	13	497	1200	Surface 0-75; shale and boulders 75-450; sandy shale 450-473; shale 473-951; broken shale and shell 951-997; broken formation 997-1088; packed sand 1088-1100; sandy shale 1100-1120; serpentine 1120-1131; shale 1131-1133; serpentine 1133-1218. T. D.	Drilling time 9 days. Serpentine 1120-1218.
177	14	528	60	Surface 0-80; shale and boulders 80-475; broken formation 475-1248; serpentine 1248-1290; gumbo 1290-1294; serpentine 1294-1430; gumbo 1430-1435; serpentine 1435-1500; sticky shale 1500-1510; serpentine 1510-1591. T. D.	Drilling time 14 days. Serpentine 1248-1591.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
178	15	521	50	Surface 0-50; shale and boulders 50-600; broken formation 600-1235; gumbo 1235-1240; serpentine 1240-1280; gumbo 1280-1286; serpenpentine 1286-1345; gumbo 1345-1377; serpentine 1377-1400; gumbo 1400-1450; serpentine 1450-1522; gumbo 1522-1528; serpentine 1528-1548; gumbo 1548-1565; serpentine 1565-1592. T. D.	Drilling time 15 days. Serpentine 1240-1592.
179	16	507	100	Surface clay 0-145; shale and boulders 145-1040; shale 1040-1145; serpentine 1145-1600. T. D.	Drilling time 15 days. Serpentine 1145-1600.
180	*17*	*511*	*25*	Surface clay and shale 0-115; rock 115-117; shale 117-200; rock 200-201; shale and boulders 201-330; rock 330-331; shale 331-370; rock 370-372; shale 372-500; rock 500-502; shale and bounlders 502-1145; serpentine 1145-166. T. D.	Drilling time 11 days Serpentine 1145-1600
181	10	507	40	Surface clay 0-60; shale 60-900; sandy shale 900-1000; sandy shale and lime 1000-1060; lime and shale 1060-1108; shale 1108-1147; serpentine 1147-1212; gumbo 121-1220; serpentine 1220-1365; gumbo *1365-1385*; serpentine 1385-1440; gumbo 1440-1450; serpentine 1450-1600. T. D.	Drilling time 9 days. Serpentine 1147-1600.
182	19			Location, abandoned.	

Mid-Kansas Oil Company on the Mrs. M. L. Brewer Farm

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
183	1	506	70	Surface 0-60; soft sand rock 60-62; shale and boulders 62-805; hard shale and boulders 850-930; soft sticky shale 930-1020; hard shale and boulders 1020-1124; medium broken lime 1124-1138; dry serpentine 1138-1182; serpentine pay 1182-1257. T. D.	Drilling time 11 days. Serpentine 1138-1257.
184	2	502	1600	Surface 0-65; soft sand, sticky shale and boulders 65-750; sticky shale 750-864; gummy shale, hard 864-950; shale and boulders 950-1080; broken lime, soft, 1080-1113; hard gumbo 1113-1150; serpentine, green soft, 1150-1285; sticky shale 1285-1289. T. D.	Drilling time 7 days. Show of gas at 864 and 1139. Serpentine 1150-1289.
185	3	513	Dry	Serpentine 1165-1513. T. D.	
186	4	522	140	Surface clay and shale 0-240; hard rock 240-242; shale and boulders 242-1120; gumbo 1120-1124; lime 1124-1139; shale and gumbo 1139-1166; broken lime 1166-1184; serpentine, hard 1184-1195; oil 1195-1266; serpentine, firm 1266-1331. T. D.	Drilling time 8 days. Serpentine 1184-1331.
187	5	522	60	Surface soil and clay 0-30; clay and shale 30-303; rock 303-306; shale 306-390; hard rock 390-392; shale and gumbo 392-1221; serpentine 1221-1347. T. D.	Drilling time 8 days. Serpentine 1221-1347.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
188	6	520	8	Surface 0-75; soft sandy shale 75-100; hard rock 100-101; shale 101-150; hard rock 150-152; soft shale and boulders 152-200; hard rock 200-203; soft shale and boulders 203-400; soft shale, gumbo, sand and boulders 400-1100; boulders 1100-1120; gumbo hard 1120-1125; lime and shale 1125-1161; gumbo and shale 1161-1187; hard lime 1187-1210; hard serpentine 1210-1243; hard gumbo 1243-1255; soft serpentine 1255-1350; hard green marl 1350-1360; hard serpentine 1360-1370. T. D.	Drilling time 8 days. Serpentine 1210-1370.
189	7	503	30	Surface 0-50; soft rock shale and boulders 50-850; limey shale 850-875; soft shale 875-1080; lime 1080-1130; broken lime and shale 1130-1205; serpentine 1205-1394. T. D.	Drilling time 5 days. Serpentine 1205-1394.
190	8	504	145	Surface 0-25; clay, shale gumbo and boulders 25-1105; lime 1105-1113; chalk lime 1113-1120; lime 1120-1128; gumbo 1128-1160; serpentine 1160-1320. T. D.	Drilling time 4 days. Serpentine 1160-1320.
191	9	506	10	Surface 0-75; shale and boulders 75-200; sand rock 200-204; shale 204-210; rock 210-212; shale 212-1035; lime, broken 1035-1156; serpentine 1156-1321. T. D.	Drilling time 9 days. Serpentine 1156-1321.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
192	10	508	15	Surface 0-50; shale 50-1080; broken lime, soft, 1080-1095; gumbo, hard 1095-1105; soft shale 1105-1145; serpentine soft 1145-1156. T. D.	Drilling time 8 days. Serpentine 1145-1156.

Lefevre and Storey, Now Witherspoon, on the Mrs. M. L. Brewer Tract

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
193	1	529	75	Surface soil, clay and gravel 0-45; shale and boulders 45-229; rock 229-301; shale and boulders 301-359; rock 359-362; gumbo 362-383; rock 383-384; shale and boulders 384-459; rock 459-460; shale and gumbo 460-907; hard shale 907-1081; rock 1081-1084; hard shale 1084-1091; rock 1091-1094; hard shale and boulders 1094-1169; broken lime, shale 1196-1183; hard shale 1183-1220; oil showing 1220-1252. T. D.	Serpentine 1252-1409. Discovery well.
194	2	514	35	Sand and clay 0-50; shale and boulders 50-465; shale, gumbo and boulders 465-1156; serpentine 1156-1350. T. D.	Drilling time 28 days. Serpentine 1156-1350.
195	3	525	400	Hard rock 0-124; shale and boulders 124-675; sand and gravel 675-685; shale 685-762; rock 762-768; shale 768-1023; chalky shale 1023-1087; shale 1087-1141; blue rock 1141-1167; serpentine 1167-1362. T. D.	Drilling time 25 days. Serpentine 1167-1362.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
196	4	497	200	Clay and shale 0-110; lime shale 110-111; lime and broken shale 111-248; lime rock 248-251; shale and boulders 251-275; lime shell 275-276; shale, gumbo and boulders 276-1055; gumbo and shale 1055-1169; serpentine 1169-1400. T. D.	Drilling time *26 days.* Serpentine 1169-1400.
197	5	500	1200	Gummy shale and hard rock 0-510; gummy shale and lime 510-720; gummy shale and boulders 720-930; rock and boulders 930-1128; serpentine 1128-1375; shale and gumbo 1375-1397. T. D.	Drilling time 29 days. Serpentine 1128-1375.
198	6	497	70	Gravel, shale and boulders 0-152; hard rock 152-153; shale and boulders 153-161; hard rock 161-162; shale and boulders 162-906; shale and lime 906-1032; hard shale 1032-1131; serpentine 1131-1366. T. D.	Drilling time 10 days. Serpentine 1131-1366.
199	7	515	12	Clay and shale 0-150; lime shell 150-151; shale 151-275; lime rock 275-277; shale 277-1072; sticky shale and broken lime 1072-1130; sticky shale 1130-1160; lime shell 1160-1240; serpentine 1240-1623. T. D.	Drilling time 10 days. Serpentine 1240-1623.
200	8	511	22	Gravel and shale 0-50; shale 50-300; shale, gumbo and boulders 300-804; oil show and boulders 804-914; sticky shale 914-1142; serpentine 1142-1397. T. D.	Drilling time 25 days. Serpentine 1142-1397.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
201	9	494	2000	Surface 0-40; shale, gumbo and boulders 40-350; sand rock 350-355; shale and gumbo 355-760; sand show of oil and gas 760-765; shale, gumbo and boulders 765-1093; sand, rock, oil show 1093-1096; gumbo 1096-1110; serpentine 1110-1412. T. D.	Drilling time 7 days. Serpentine 1110-1412.
202	10	493	40	Surface clay 0-35; shale, boulders, gumbo and sand rock 35-962; shale, gumbo and boulders 962-1093; sand rock, oil show 1093-1095; gumbo 1095-1140; serpentine 1140-1410. T. D.	Drilling time 18 days. Serpentine 1140-1410.
Gulf Production Company on the C. Beaty 449-Acre Tract					
203	1	534	250	Surface 0-95; shale and boulders 95-200; rock 200-202; shale and boulders 202-273; rock 273-275; shale and boulders 275-295; rock 295-297; shale and boulders 297-360; rock 360-365; shale, boulders and gumbo 365-1084; rock 1084-1087; hard shale 1087-1093; rock 1093-1095; hard shale and broken lime 1095 1212; shale 1212-1275. T. D.	Serpentine 1186-1275.
204	2	538	500	Surface 0-115; shale 115-228; rock 228-230; shale 230-985; limey shale 985-1177; shale and broken lime 1177-1208; serpentine 1208-1220;	Serpentine 1208-1392.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
				gumbo 1220-1225; serpentine 1225-1324; gumbo 1324-1336; serpentine 1336-1349; gumbo 1349-1360; serpentine 1360-1362; gumbo 1362-1386; serpentine 1386-1390; gumbo 1390-1392. T. D.	
205	3	542	300	Surface 0-30; shale 30-150; rock 150-151; shale 151-300; rock 300-301; shale 301-320; shale and boulders 320-1226; serpentine 1226-1280; gumbo 1280-1289; serpentine 1289-1297; gumbo 1297-1298; serpentine 1298-1400. T. D.	Drilling time 8 days. Serpentine 1226-1400.
206	4	510		Location.	
207	5	528	25	Surface 0-80; shale and boulders 80-810; gumbo 810-890; packed sand 890-895; gumbo and shale 895-1167; rock 1167-1170; hard gumbo and sticky shale 1170-1250; cap rock 1250-1251; gumbo and sandy shale 1251-1284; serpentine 1284-1386; sticky shale 1386-1460; chalk 1460-1485; shale 1485-1532; serpentine 1532-1545; gumbo and shale 1545-1652; serpentine 1652-1672; chalk and lime 1672-1714; shale 1714-1720; serpentine 1720-1740. T. D.	Drilling time 16 days. Serpentine irregular.
208	6	489	15	Surface clay 0-41; shale, boulders and gumbo 41-1255; serpentine 1255-1440. T. D.	Drilling time 11 days. Serpentine 1255-1440.

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
209	7	543	25	Surface clay and gravel 0-50; shale and boulders 50-1009; shale and streaks of lime 1009-1202; shale 1202-1262; serpentine showing oil 1262-1273; tough gumbo 1273-1285; serpentine 1285-1378; gumbo 1378-1392; serpentine showing oil 1392-1455; gumbo 1455-1470; serpentine 1470-1483; chalk 1483-1484. T. D.	Drilling time 8 days. Serpentine 1224-1483.
210	8	506	50	Surface soil and shale 0-332; shale and boulders 332-1250; broken formation 1250-1271; serpentine 1271-1276; gumbo 1276-1279; serpentine 1279-1588. T. D.	Drilling time 4 days. Serpentine 1271-1588.
211	9	498	30	Serpentine 1178-1642. Top of chalk 1887. Cored Edwards limestone at 2020 feet. T. D.	
212	10	511	80	Serpentine 1280-1544.	
213	11	527	800	Serpentine 1355-1480.	
214	12			Serpentine 1260-1550. Chalk and shale 1100-1244.	
214A	13	506		Serpentine 1277-1285-1300; 1305-1500.	
214B	14			Top of serpentine 1285-?	
214C	15			Serpentine 1222-1589.	
Magnolia Petroleum Company on the C. Beaty Tract					
215	1	470		Serpentine 1242-1524.	

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
216	2	485	10	Serpentine 1311-1500.	
217	3			Location.	
217A	4			Location.	
217B	5			Location.	
217C	6			Location.	
217D	7			Location.	
				Randolph et al. on the C. Beaty Tract	
218	1	479	?	Serpentine 1235-1401.	
219	2	468	10	Serpentine 1248-1448.	
220	3	492		Serpentine 1240-1500.	
221	4	470		Location.	
				Brownlee and Pope on the C. Beaty Tract	
222	1	496	?	Serpentine 1297-1590.	
223	2	483	200	Serpentine 1270-1594.	
224	3	495	300	Serpentine 1300-1548.	
225	4	489		Serpentine 1295-1550.	
225A	5	?		Top of serpentine 1276.	
225B	6			Serpentine 1310-1592; gumbo 1592-1594.	
225C	7			Location.	
225D	8			Location.	
225E	9			Location.	
225F	10			Location.	

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
				Texas Oil Company on the C. Beatty Tract	
226	1	479	50	Serpentine 1324-1596.	
227	2	472	250	Serpentine 1250-1468.	
228	3	483	400	Serpentine 1290-1402.	
229	4	491		Serpentine 1320-1471.	
230	5	485		Serpentine 1400-1571.	
231	6	483	Dry	Serpentine 1410-1610.	
232	7	481		Serpentine 1402-	
233	8			Location.	
				C. M. Cope on the C. Beaty Farm	
234	1	466	15	Serpentine 1447-1667.	
235	2	473	385	Serpentine 1418-1609.	
236	3	468		Serpentine 1420-1610.	
236A	4	471		Serpentine 1396-1786; chalk 1786-1790.	
				Gulf Production Company on the W. H. Riddle Tract	
237	1		Dry	Serpentine 1544-1635; chalk 1658-1667.	
				Armstrong et al. on the W. H. Riddle Tract	
238	1	473	Dry	Serpentine 1504-1620. Chalk at 1620. Edwards limestone at 2090-2197.	

Serial number	Lease number	Elevation	Initial production	Log of wells	Remarks
	Smith and Marland on the E. T. Lackey Tract				
239	1	482	5	Serpentine 1435-1685.	
240				240 to 245 locations.	
246	8	480	15	Serpentine 1472-1616.	
247				247 to 258 are locations.	
	Marland Oil Company on the Tabor Estate				
259	1				
	Texas Oil Company on the E. T. Lackey Tract				
260	1	Dry		Serpentine 1544-1635; chalk 1658-1667.	
	Schmidt Oil Company on the Mrs. A. H. Cardwell Farm				
261	1				

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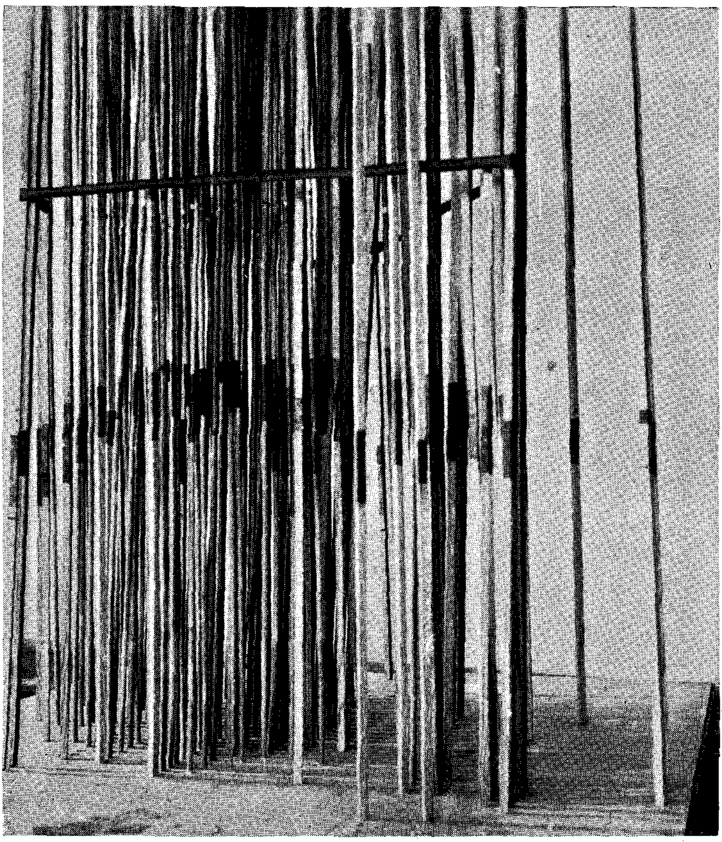


Peg model of the Lytton Springs Oil Field looking northeast. The dark band represents the position of sea level. The dark sections on the pegs represents the altered igneous rock. The highest part of the igneous rock is over six hundred feet below sea level.

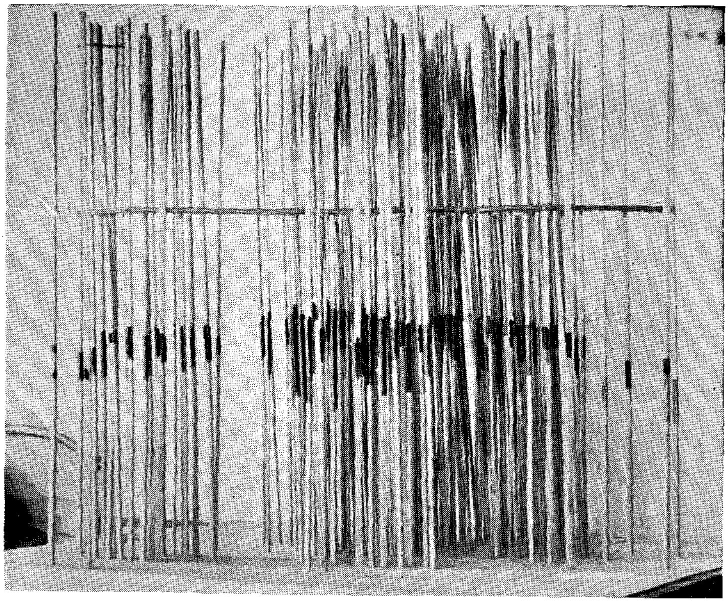


Figure A. Peg model of the Lytton Springs Oil Field looking northwest.

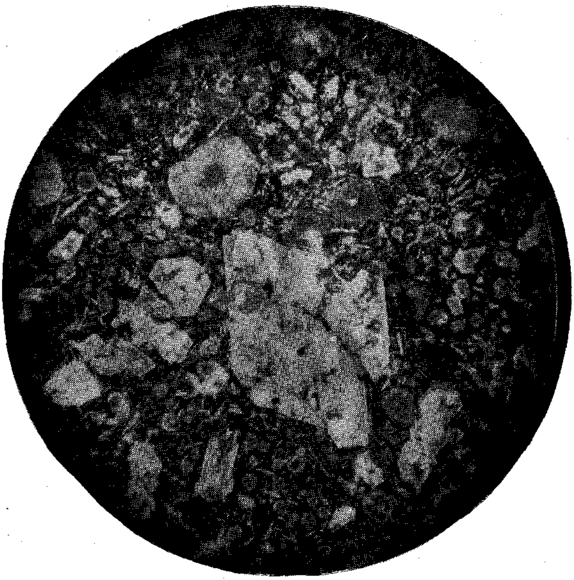
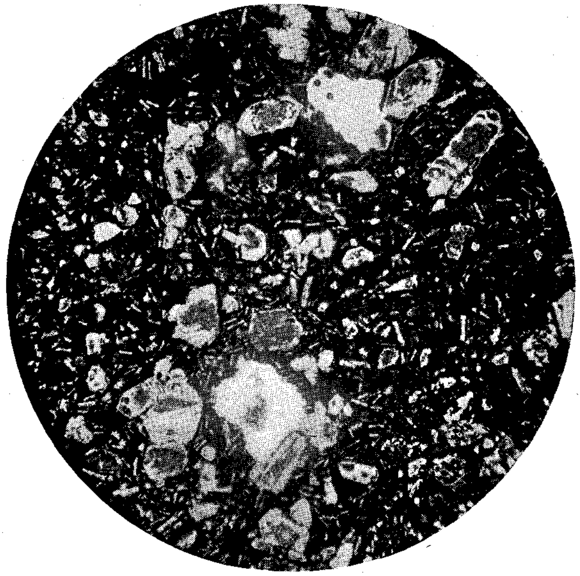
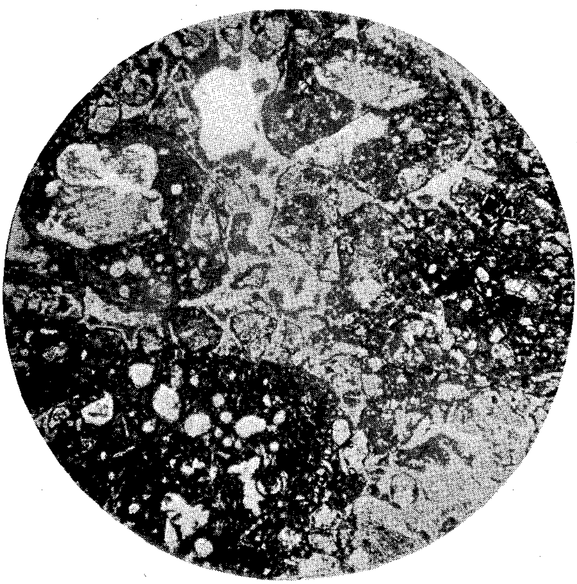


Figure B. Micro-photograph of a thin section of altered igneous rock taken from Well 73, Thrall Oil Field, showing the structure of the original basalt. Plane polarized light. Magnified about forty diameters. Photograph by W. H. Tomlinson. Compare this rock with that shown in Plate VII.





Micro-photographs of a thin section of the altered igneous rock said to have been taken from Well 193 in the Lytton Springs Oil Field. Magnification about thirty diameters. Photograph by R. T. Short.

Photograph of a piece of altered igneous rock taken from Well 140. The core was secured at a depth of 1190 feet below the surface. Six-fifth natural size. Photograph by Christianson Studio.

Photograph of a piece of chlorite rock said to have come from Well 164, Thrall Oil Field, at somewhere from 729 to 917 feet below the surface. The photograph shows the polished surface of the rock. Natural size. Compare this photograph with that of Plate VIII.