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GENERAL SURVEY OF THE OIL AND GAS PROSPECTS OF TRANS-PECOS TEXAS

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INTRODUCTION

Trans-Pecos Texas west of the Delaware Basin includes parts of the Diablo Plateau, the Salt Basin, the Hueco Bolson and the Chihuahua Trough, all of which can be considered prospective for oil and gas accumulations. Possibilities are limited locally by proximity to outcrops of pre-Permian Paleozoic rocks, there being no reasonable expectation of finding oil and gas trapped or preserved close to these older outcrops. Outlined on Figure 1 are areas in the vicinity of Precambrian to Devonian outcrops which, from west to east, are the Franklin Mountains, the western part of the Hueco Mountains, the isolated outcrops of Precambrian rocks at Pump Station Hills, and the Van Horn uplift. Also shown on Figure 1 are intruded areas, poor prospects because of the likelihood that traps or accumulations have been physically destroyed by intrusions or chemically metamorphosed by heat and igneous emanations.

DIABLO PLATEAU

Permian conglomerates or shelf limestones lie with great unconformity on uptilted, truncated blocks of older Paleozoic and Precambrian rocks throughout the Diablo Plateau (Albritton and Smith, 1965; King, 1948). Under analogous structural and stratigraphic conditions, oil and gas are trapped on the Central Basin Platform. Areas with the best possibilities for truncation traps in the Devonian, Silurian and Ordovician reservoir rocks are those where 1) an adequate thickness of Pennsylvanian shale is preserved to serve as source and seal, and 2) the basal Permian is micritic, fine or impermeable rather than coarse-grained or porous. The Trans-Pecos region has a geologic history of tectonic activity and faulting, affording repeated opportunities for fracturing and exposure of traps, so that chances for finding oil and gas accumulations preserved and protected may be best where Permian and Pennsylvanian shales and fine-grained limestones are thick and widespread. By comparison, traps in Permian and older rocks on the Central Basin Platform have not been disturbed by Laramide and younger Tertiary tectonic movements, and reservoirs have been protected from exposure and from the influx of meteoric waters by a cover of Permian evaporites not present on the Diablo Plateau.

Reef-type Permian carbonates, which are exposed in spectacular abundance around the margins of the Diablo Plateau, are evidence of the predominance of a shelf environment during most of Permian time, rather than of a sinking sea floor with basinal deposition and long, continuous burial. Oil and gas traps are more likely to exist where shelf and basin conditions are in ideal proportion, and it may be possible to localize the more favorable areas for exploration in the Diablo Plateau area on this basis.

SALT BASIN

The Salt Basin, which has been variously termed a graben, a small-scale rift, and the easternmost of all the basins of the North American Basin and Range province, owes its present physiographic form to Tertiary block faulting. Tertiary fault zones diagonally cross older northwest-striking structural features such as the Babb, Victorio, and Bone Spring flexures.

Permian facies and depositional trends, which were influenced somewhat by these early structures, can be projected from the outcrop across the younger fault zones and into the down-faulted basin in some areas. Permian rocks exposed on the bordering uplifts exhibit striking stratigraphic changes from shelf and reef carbonate deposits on the west to clastic deposits on the east, where the sandstones of the Delaware Mountain Group (Bell Canyon, Cherry Canyon, and Brushy Canyon Formations) form the scarps and cuestas of the Delaware Mountains (see Williamson, this guidebook). Wedge-outs of these sandstones and permeability changes within them have trapped oil in the Delaware Basin, and oil may have been trapped in the Salt Basin in a similar manner. The sandstones are associated with black bituminous limestones and black shales that were deposited in a marine environment favorable to the generation and preservation of hydrocarbons from abundant organic source material. Discontinuous sandstone lenses and wedges of Wolfcampian or Leonardian age may be considered prospective, but they present problems that are common to exploration for stratigraphic traps in any area of sparse subsurface control. Less prospective are uptilted fault blocks and high shelf areas where deposits are thin or have been exposed to the atmosphere and to the influx of meteoric waters. Notably absent in the Salt Basin are the Permian evaporites, which cover the greater part of the area east of the Delaware Mountains, where Delaware Mountain Group sandstones are productive.

HUECO BOLSON

Similar problems to those of the Salt Basin exist in the Hueco Bolson: absence of Permian evaporites; repeated and youthful periods of faulting and deformation permitting escape of oil and gas from older traps; scalping of pre-Permian structures; and the relative scarcity of marine organic muds which could have served as source materials and seals. A hindrance to exploration is the thickness of bolson fill which obscures any clues to deeper structure and which must be drilled to depths of 1,500 m or more before any marine rocks or potential oil or gas objectives are reached. The Hueco Bolson, a southward extension of the Tularosa Basin of New Mexico to the north (Greenwood and others, 1977), is flanked by mountain ranges on the east and west where Precambrian and Paleozoic rocks are exposed. Here too, the most prospective areas for exploration are those where thick Permian and Pennsylvanian shales have been preserved overlying the reservoir rocks, which are exhibited at the surface in the adjacent upthrown mountain blocks.

CHIHUAHUA TROUGH

A condition common to the Diablo Plateau, the Salt Basin and the Hueco Bolson is the absence of a thickness of Mesozoic rocks sufficient to contain prospective traps or to form adequate seals

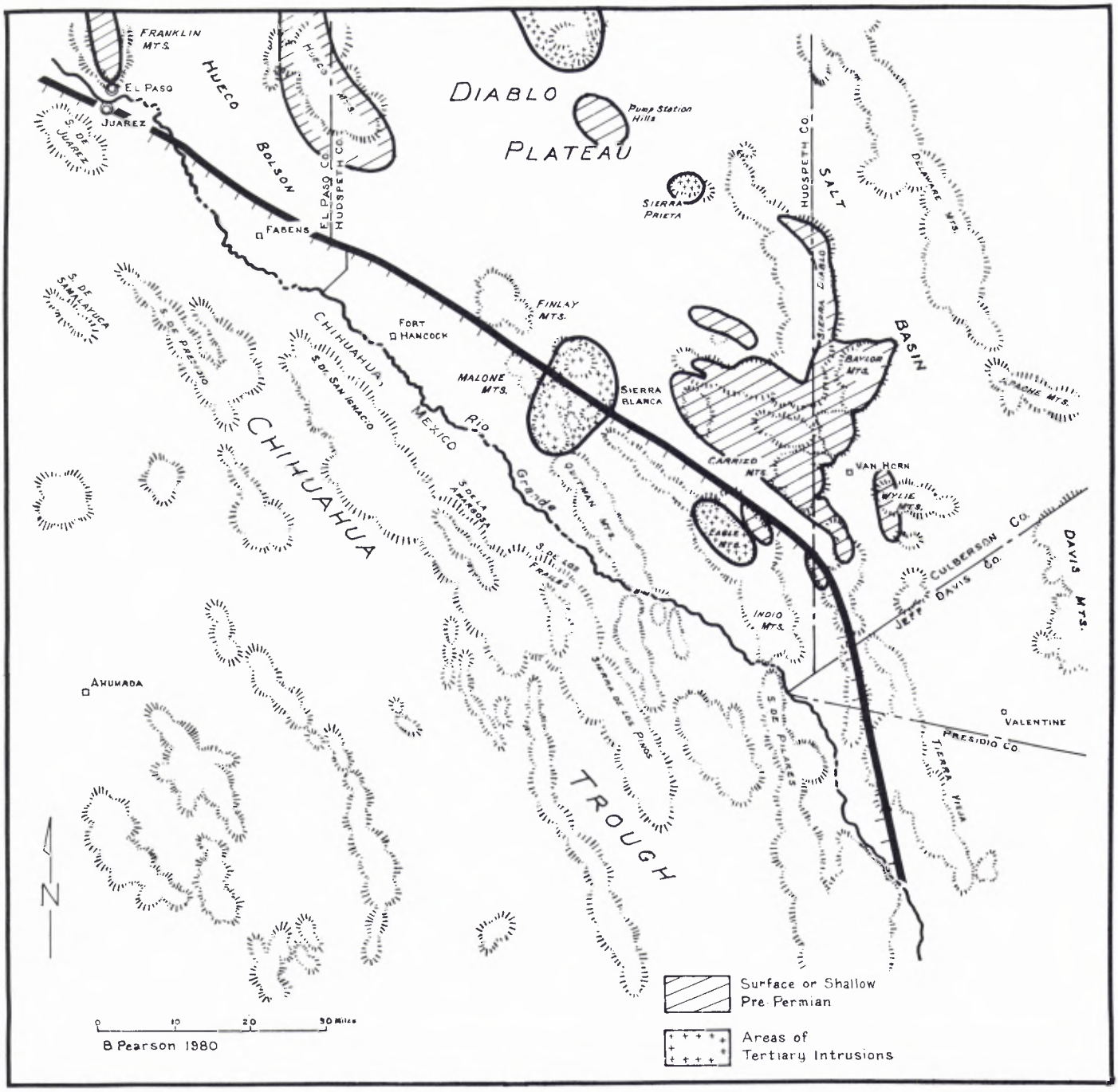

Figure 1. Physiography, areas of surface or shallow subsurface pre-Permian rocks, and areas of Tertiary intrusive rocks in Trans-Pecos Texas and Chihuahua.

over older reservoir rocks. In the Chihuahua Trough the Mesozoic section increases in thickness from about 700 m in the Diablo Plateau area to over 6,500 m in the State of Chihuahua. The Jurassic, completely absent over all of western Texas except for the outcrops around the Malone Mountains, is around 1,500 m thick in the vicinity of Placer de Guadalupe in Chihuahua. The updip thinning and wedging-out of great thicknesses of Mesozoic rocks from the center of the Chihuahua Trough toward the Diablo Platform and the changes from basinal to shelf to continental and evaporitic facies afford many chances for the formation of stratigraphic traps in Jurassic and Cretaceous rocks.

Cretaceous rocks have exhibited oil seeps and shallow oil shows in Mexico and in the Big Bend region of Texas. The relatively narrow, deep Chihuahua Trough has the classic criteria for a potential oil province: a thick wedge of marine sediments containing source beds, reservoir rocks and seals, shows of oil on the outcrops and anticlinal structures. The Trough also presents an unusual number of exploratory problems. There is a scarcity of wells for subsurface control. The international boundary, the Rio Grande, restricts exploration by geologists from either country, and very few American geologists have visited, much less studied, the outcrops south of the border.

The greatest difficulty is the intensity and complexity of structural deformation (Gries and Haenggi, 1971). Outcrops show overturned folds, evaporite diapirs, thrust faults with miles of lateral displacement, all transected by Basin-and-Range-type normal

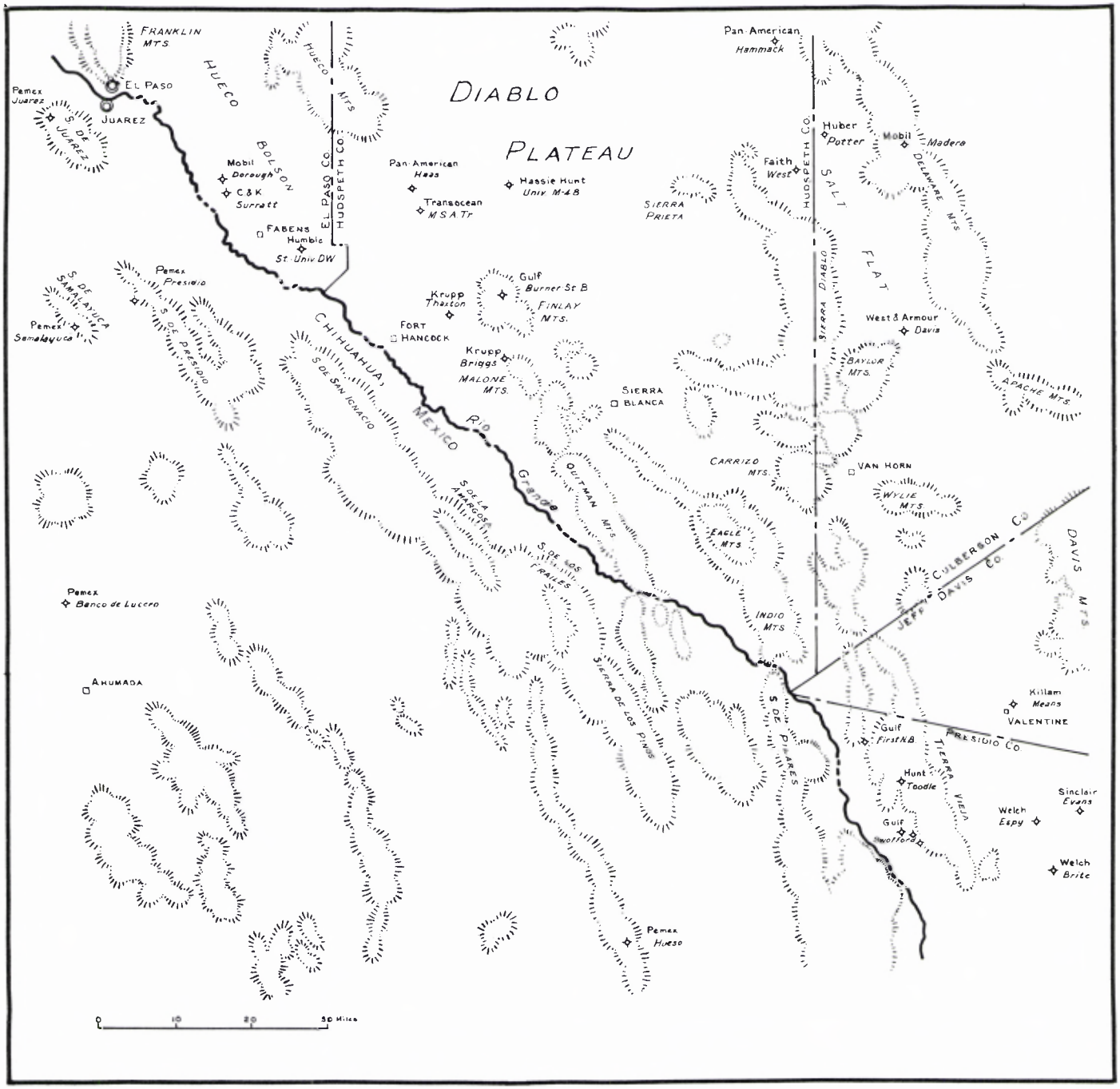

Figure 2. Significant oil and gas wells in the Trans-Pecos area (see Appendix for details).

faults. Jurassic evaporites have formed decollement planes along which rocks have been squeezed, contorted, displaced and sometimes detached in overthrust sheets, so that structures at the surface or at shallow depth are often unrelated to structures beneath. The presence of evaporites may be a favorable circumstance, however, in that they may have healed over the faulted and truncated reservoirs that underlie them. Oil and gas have been found trapped in complexly faulted and folded rocks of the Middle East, and lately in the overthrust belt of the western United States, and this success may encourage application of new and sophisticated geophysical techniques to the Chihuahua Trough. Perhaps the best prospecting in the Trans-Pecos area is in this overthrust area, with two principal objectives: 1) the intensely deformed Mesozoic and Jurassic reservoirs and 2) Paleozoic reservoirs in less severely disturbed structures beneath the soles of the Mesozoic thrust sheets. Initially, the best places to explore may be the higher inclined slopes off the Diablo Platform, away from areas of concentrated intrusive activity or areas where hot waters may be indicative of destructively high temperatures.

SUMMARY

The Trans-Pecos area has many of the characteristics of an oil province: source material, reservoir rocks and structures of the same type that produce in other parts of the Permian Basin and the western United States. It is, however, a deformed, broken, faulted, intruded, fresh-water-flushed region, which has been subjected to

Laramide and late Tertiary structural movements that did not disturb the older structures of the Delaware Basin and the Central Basin Platform. Other things being generally favorable, the most important deficiency over much of the area may be in seals—the lack of thick, plastic, flowing clays, marls, or evaporites to heal over the faults, fractures and truncated edges of the rigid, brittle sandstone and limestone reservoir rocks that are exhibited in the high ridges and mountains of the uplifts. Unfortunately, the area where the evaporites are present in abundance is also an area of intense and repeated structural deformation, and the greatest part of it is south of the Rio Grande.

Outside the Chihuahua Trough, the most promising areas for exploration are the basins, or grabens, rather than the uplifts, and perhaps especially those parts of the basins which have been continuously negative, receiving rather than shedding detritus. It may be that oil and gas will be discovered in discontinuous lenses or wedges of sandstones or conglomerates, surrounded by shales, rather than in the reef or carbonate shelf reservoirs, which are such prolific and attractive objectives in other parts of the Permian Basin and which crop out so spectacularly in the desert mountains of Trans-Pecos Texas.

REFERENCES

Albritton, C. C. and Smith, J. F., Jr., 1965, Geology of the Sierra Blanca area, Hudspeth County, Texas: U.S. Geological Survey Professional Paper 470, 313 p.

Greenwood, E., Kottlowski, F. E. and Thompson, S. III, 1977, Petroleum potential and stratigraphy of Pedregosa Basin: Comparison with Permian and Orogrande Basins: American Association of Petroleum Geologists Bulletin, v. 61, p. 1448-1469.

Gries, J. C. and Haenggi, W. T., 1971, Structural evolution of the eastern Chihuahua Tectonic Belt, *in* Seewald, K. and Sundeen, D., *editors*, The geologic framework of the Chihuahua Tectonic Belt: West Texas Geological Society Symposium, Publication 71-59, p. 119-137.

King, P. B., 1948, Geology of the southern Guadalupe Mountains, Texas: U.S. Geological Survey Professional Paper 215, 183 p.

APPENDIX
Significant Wells

Chihuahua, Republic of Mexico

Pemex—No. 1 Banco de Lucero
- Alluvium—0-2010 m
- Cuchillo—2010-3563 m
- Las Vigas-Navarrete—3563-4675 m
- Lower Cretaceous-Upper Jurassic—4675-5000 m

Pemex—No. 1 Hueso
- Las Vigas-Navarrete—0-2935 m
- Jurassic—2935-4617 m
- Rhyolite—4617-4918.5 m
- Total Depth—4918.5 m

Pemex—No. 1 Juarez
- Alluvium—0-86 m
- Cuchillo—86-293 m
- Fault—293 m
- Upper Cretaceous (Mojado)—293-557.5 m
- Total Depth—557.5 m

Pemex—No. 1 Presidio
- Spudded in alluvium. Drilled 2135 m of Lower Cretaceous and Jurassic sediments.
- Bottomed in low rank metamorphic rocks.
- Total Depth—2337.5 m

Pemex—No. 1-A Samalayuca
- Drilled phyllites and metaquartzites from surface to total depth.
- Total Depth—1372.5 m

Culberson County, Texas

Davis, West & Armour—No. 1 Davis
- D & A 5-15-60
- Elevation 3700′ D.F.
- Base of fill, top of Permian—1240′
- Bone Spring—3440′
- Detritus (Permian?)—5540-6120′
- Sandstone and limestone—6120-7200′
- No information below 7200′
- Total Depth, 8201′

J. M. Huber—No. 1 Tom Potter
- D & A 5-29-68
- Elevation 3953′ D.F.
- Bone Spring—1872′
- Base Wolfcamp—6210′
- Total Depth—6362′

Mobil Oil Corp.—No. 1 Madera-Broman
- D & A 9-10-79
- Elevation 4958′ K.B.
- Woodford—8048′
- Montoya—9034′
- Ellenburger—9542′
- Total Depth—10,005′

El Paso County, Texas

Humble Oil & Refining Co.—No. 1 State Univ. "DW"
- D & A 4-15-72
- Elevation 3796′ D.F.
- Total Depth—17,708′
- Information not released.

Chambers & Kennedy—No. 1 Surratt
- D & A 7-4-68
- Elevation 3641′ D.F.
- Base of Fill—2500′
- Buda—3670′
- Del Rio—3950′
- Georgetown—4020′
- Cox—5000′
- Reverse Fault—7350′
- Repeated Buda—8200′
- Total Depth (Cretaceous)—9822′

Mobil Oil Corp.—No. 1 T. W. Dorough
- D & A 7-6-70
- Elevation 3645′ D.F.
- Base of Fill—1547′
- Buda—3054′
- Mississippian—4760′
- Fusselman—4880′
- El Paso—6120′
- Bliss—7010′
- Total Depth—7910′

Hudspeth County, Texas

Faith Minerals, Inc.—No. 1 Wesley West
- D & A 4-10-77
- Total Depth—10,743′
- Information not released.

Gulf Oil Corp. No. Burner-State "B"
- D & A 4-16-63
- Elevation 4652′ D.F.
- Pennsylvanian—2620′
- Mississippian—5950′
- Fusselman—6043′
- Granite—9142′
- Total Depth—9224′

Hassie Hunt Trust—No. 1 University "M-49"
- D & A 10-31-69
- Elevation 4910′
- Devonian—5289′
- Fusselman—5405′
- Ellenburger—6869′
- Bliss—7878′
- Total Depth—8250′

Haymon Krupp Oil and Land Co.—No. 1 Briggs
- D & A 1937
- Elevation 4016′
- Permian (Briggs Fm.)—115′
- Fault—790′
- Upper Cretaceous—790′
- Finlay—3440′
- Cox—3700′
- Bluff Mesa and Yucca—4500 to 5973′
- Total Depth—5973′

Haymon Krupp Oil and Land Co.—No. 1 Thaxton
D & A 1936
Elevation 4100′ (approximately)
Upper Creteceous—135′
Fault Zone—1375′
Cretaceous (Washita)—1404′
Finlay—2843′
Cox—3105′
Permian (Leonard?)—6128′
Total Depth—6402′

Pan-American Petroleum Corp.—No. 1 Philip Haas
D & A 6-4-68
Elevation 4503′
Pennsylvanian—2300′
Mississippian—4412′
Devonian—4703′
Ellenburger—6152′
Total Depth—7535′

Pan-American Petroleum Corp.—No. 1 Hammick
D & A 8-7-62
Elevation 3653′ D. F.
Permian—900′
Woodford—5555′
Ellenburger—6950′
Total Depth—7061′

Texaco—No. 1 Hudspeth County core test
D & A 1965
Information not released

Transocean Oil Co.—No. 1 M.S.A. Trustee
D & A 10-29-79
Elevation 5089′ K.B.
Permian—1022′
Woodford—4775′
Fusselman—5025′
Total Depth—5348′

Jeff Davis County, Texas

O. W. Killam—No. 1 Cole A. Means
D & A 8-3-51
Elevation 4463′
Base Tertiary (Top Cretaceous)—6760′
Total Depth (Cretaceous)—8370′

Presidio County, Texas

Gulf Oil Corp.—No. 1 First National Bank of Fort Worth, Trustee
D & A 6-5-65
Total Depth—11,701
Information not released.

Gulf Oil Cor.—No. 1 Swofford
D & A 1-5-64
Total Depth—8815′
Information not released.

N. B. Hunt—No. 1 Toodle
D & A 7-12-53
Elevation 3858′ D. F.
Cretaceous (San Carlos) Surface
Buda—2615′
Trinity—3865′
Permian—5805′
Granite—8005′
Total Depth—8111′

Sinclair—No. 1 Evans
Elevation 4673′ G.L.
Cretaceous—4755′
Permian—5780′
Ordovician—7150′
Ellenburger—7710′
Granite—9160′
Total Depth—9420′

Lewis W. Welch—No. 1 Brite
D & A 2-26-53
Elevation 5058′
Cretaceous—3145′
Permian—4633′
Cambrian ss—6026′
Total Depth—6135′

Lewis W. Welch—No. 1 Joe Espy
D & A 8-2-52
Elevation 4741′ D.F.
Cretaceous—3381′
Permian—5146′
Cambrian—7236′
Granite—7770′
Total Depth—7837′

Weeping lovegrass plant and spikelet, *Eragrostis curvula*.