THE STRATIGRAPHY OF THE PERMIAN AND TRIASSIC FORMATIONS IN GUADALUPE COUNTY, NEW MEXICO

APPROVED:

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Dean of the Graduate School
August 13, 1932.

THE STRATIGRAPHY OF THE PERMIAN AND TRIASSIC FORMATIONS IN GUADALUPE COUNTY, NEW MEXICO

THESIS

Presented to the Faculty of the Graduate School of the University of Texas in Partial Fulfillment of the Requirements

For the Degree of

MASTER OF ARTS

By

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Austin, Texas
August, 1932

PREFACE

In attempting to write on the stratigraphy of Guadalupe County, the author is following the suggestion of Mr. L. T. Barrow of Houston, Texas. The paper as here presented is an enlargement on a paper prepared for the Humble Oil and Refining Company in 1931[1]. The author wishes to take this opportunity to express his appreciation to Mr. T. F. Petty and Mr. Milward Miller for their criticism and help when the author was in the field; to the Humble Oil and Refining Company for permission to use its well logs and other data; to Mr. C. L. Baker for his valuable suggestions; and to Professors F. L. Whitney, E. H. Sellards, and F. B. Plummer for their criticisms and suggestions in reviewing this manuscript.

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[1]Teagle, J.: "Reconnaissance Report on the Geology of Guadalupe County," Roswell Office, 1931.

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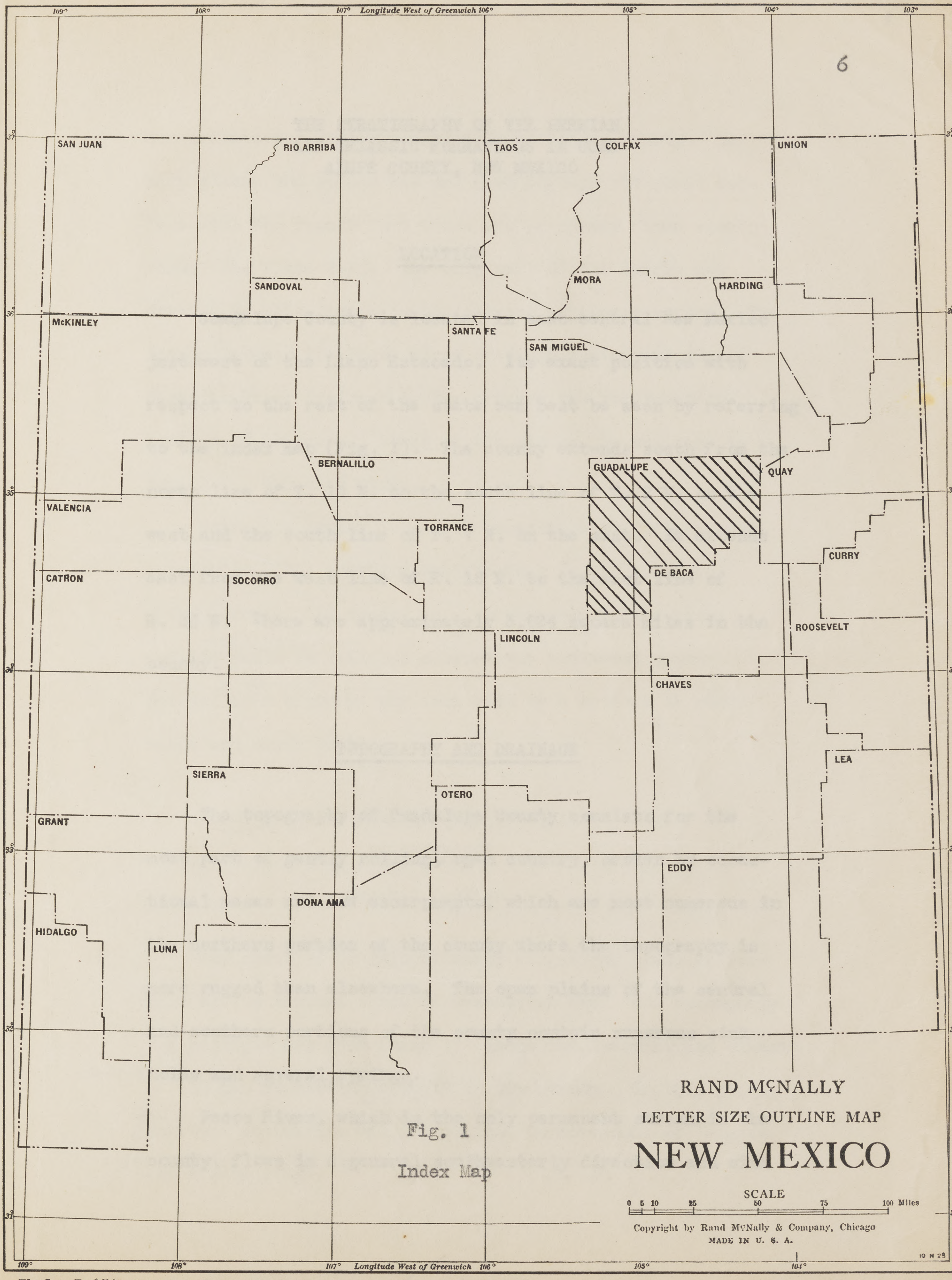

Fig. 1

Index Map

THE STRATIGRAPHY OF THE PERMIAN AND TRIASSIC FORMATIONS IN GUADALUPE COUNTY, NEW MEXICO

LOCATION

Guadalupe County is located in east-central New Mexico just west of the Llano Estacado. Its exact position with respect to the rest of the state can best be seen by referring to the index map (Fig. 1). The county extends south from the north line of T. 11 N. to the south line of T. 2 N. on the west and the south line of T. 7 N. on the east. It extends east from the west line of R. 16 E. to the east line of R. 26 E. There are approximately 3,024 square miles in the county.

TOPOGRAPHY AND DRAINAGE

The topography of Guadalupe County consists for the most part of gently rolling, open country, broken by occasional mesas and low escarpments, which are most numerous in the northern portion of the county where the topography is more rugged than elsewhere. The open plains of the central and southern portions of the county contain numerous sink holes and several springs.

Pecos River, which is the only permanent stream in the county, flows in a general southeasterly direction and with its tributaries drains practically the whole county. In many places the stream has cut down through the plain surface with the result that there are prominent river escarpments (See Plate 2-A). The only part of the county not drained by this stream is the extreme northeast corner. The divide between the Pecos River drainage system and the Canadian River drainage system crosses the northeastern portion of the area. North of the divide the drainage is toward Canadian River.

Guadalupe County is easily accessible by railroad and automobile. The Southern Pacific-Rock Island Railroad system crosses the county in a northeasterly direction; and the Santa Fe Railroad crossed the southwest corner. Several main highways are connected by a network of minor roads and ranch trails.

STRATIGRAPHY

General Section

The rocks of Guadalupe County range from those of Permain age up through those of Cretaceous age. The accompanying geologic map (See Plate 1) shows the location and extent of all the formations exposed in the county. In this paper, however, discussion will be limited to the rocks of Permian and Triassic age.

Above the rocks of the Triassic system were several outcrops of rocks of Jurassic and Cretaceous age. These were very local in extent, and will not be described here. Plate 5-B is an illustration of the contact between the Triassic and these younger rocks.

Tertiary sands, gravels, and caliche are also present in several places in Guadalupe County. The more important of these areas have been mapped (See Plate 1), but cannot be discussed in detail here.

There is very little evidence of igneous activity in Guadalupe County. Only two outcrops of igneous rock were observed. One, the larger, was in the form of a porphyry dike approximately three miles long and lying just west of Cuervo Hill in T. 10 N. and T. 11 N., R. 23 E. The other is a small porphyry knob in the northeast corner of the Perea Grant in T. 10 N., R. 23 E.

The area has a slight regional dip of less than one degree to the east. Consequently, surface outcrops show older rocks on the west, with younger rocks outcropping to the east. Rich has given the following very good generalized section[1]:

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[1]Rich, J. L.: "The Stratigraphy of Eastern New Mexico--A Correction," American Journal Science, 5 ser., vol. 2, p. 295, 1921.

A Generalized Section for Guadalupe and Adjacent Counties

	Thickness
Triassic--	
Red and purple shales and sandstones	1500' ±
Coarse, grey sandstone conglomeratic at base (Santa Rosa sandstone)	50'-100'
Triassic or Permian--	
Brick red sandstone and red shale becoming more shales toward the base . . .	150'-200'
Permian--	
Red, brown, and variegated shales and sandstones with much gypsum, anhydrite, and salt (Pecos Valley red beds of Baker and probably the Castile gypsum of other writers). This formation occurs in the form of a wedge, thinning to the northwest and thickening notably toward the southeast	0 -1000' ±
Blue-grey limestone with some gypsum (San Andreas limestone)	0(?)-300'+
Sandstone, coarse, grey, massive (Glorieta sandstone)	300-500'
Salmon pink sandstones and shales with gypsum (Yeso formation)	700' ±
Permian (or Pennsylvanian, Böse[2])	
Dark red sandstones and shales (Abo formation)	800' ±

The thickness of the formations vary from place to place and thicken toward the north. A good idea of the thickness is furnished by the two subsurface cross sections included in this report.

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[2] "Generally thought to be Permian, but regarded by Böse as Pennsylvanian at least in the lower part." See Böse, Emil: "On Ammonoids from the Abo Sandstone of New Mexico and the Age of the Beds Which Contain Them," American Journal Science, 4 ser., Vol. 49, pp. 51-60, 1920.

Permian

Only the upper formations of the Permian system outcrop in Guadalupe County, although the lower part of the series is exposed to the north and west. The Manzano group, as defined by Lee[3] and named from the Manzano Mountains which lie southeast of Albuquerque, New Mexico, includes all the Permian occurring in this part of New Mexico. Lee, when he named the group, placed it in the Pennsylvanian system[4], but this correlation was later corrected by Lee himself[5] and also by Darton and other writers.

Darton, in his "Red Beds" bulletin, has included at least the upper two-thirds of the Manzano group in a formation which he has named the Chupadera formation from outcrops on a mesa of the same name[6], but the subdivisions remain unchanged. The Manzano group has been divided into the Abo sandstone, named from Abo Canyon, at the base; the Yeso formation, named from Mesa del Yeso; and the San Andreas limestone, named from San Andreas Mountains, at the top. The Chupadera formation includes the Yeso and San Andreas of the Manzano group, as well as an unnamed series of red shales

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[3]Lee, W. T.: "The Manzano Group of the Rio Grande Valley, New Mexico," U. S. Geological Survey Bull. 389, p. 10, 1909.

[4]Ibid, p. 16 and following.

[5]Lee, W. T.: "Notes on the Manzano Group, New Mexico," American Journal Science, 4th Ser., Vol. 49, p. 325, 1920.

[6]Darton, N. H.: "Red Beds and Associated Formations in New Mexico," U. S. Geological Survey Bull. 794, pp. 21-26. Also U. S. Geological Survey Bull. 726, p. 181.

and gypsum lying above the San Andres limestone and constituting the uppermost Permian in this region.

Abo Sandstone

The Abo sandstone, although not outcropping in Guadalupe County, underlies the area and is identified in deep wells. It has a thickness of approximately 1000 feet in this area and is separated from the underlying Magdalena formation of Pennsylvanian age by a major unconformity easily discernible wherever the contact can be seen. The formation consists of dark red, massive, coarse-grained sandstone with irregular lentils of red shale. The sand is fairly well rounded and well cemented. Silica predominated in the composition of the sand. The lower part of the formation contains fragments of granite and some limestone breccia. A section including in its base the upper part of the Abo sandstone (Plate 3-A) was measured in Gloriete Mesa commencing at the station house on the Santa Fe Railroad at Rowe, New Mexico. No fossils were found in the formation at this point, although the lower part of the formation is known to be somewhat fossiliferous. G. H. Girty has identified the following fossils in the formation, all of Permian age:

Myalina permiana

Aviculipecten cf. A. whitei

Composita subtilita

Spirorbis sp.

Bellerophon ? sp.

Goniospira ? sp.

Fossil plants from this formation have been classed as Permian by David White, and bones coming from the same series have been classed as Permian by Williston and Case.[7]

The section is as follows[8] :

Section 1

<u>Section up Glorieta Mesa at Rowe, New Mexico</u>

	Thickness
Triassic--	
23. Brown sandstone, locally conglomerate	28' 3"
22. Purple shale	17' 0"
21. Brown, massive sandstone	5' 8"
20. Pinkish-grey to lavender, thin bedded limestone	85' 0"
19. Red shale	73' 8"
18. Soft, red sandstone	11' 4"
Permian--	
San Andrés limestone--	
17. Covered	11' 4"
16. Nodular, grey limestone	11' 4"
15. Thin-bedded, red shale and gypsum	15' 6"
14. Grey to yellow, flaggy limestone	22' 8"
Yeso formation--	
Glorieta sandstone member--	
13. White, massive, coarse-grained, sugary sandstone	113' 4"
12. White to yellow, sugary sandstone and shale	60' 8"
11. Black to dark grey limestone, much iron stained	25' 0"
10. Grey to yellow sandy clay	28' 3"
10.	

[7] Williston, S. W., and Case, E. C.: "The Permo-Carboniferous of Northern New Mexico," Journal of Geology, Vol. 20, pp. 1-12, 1912.

[8] For a section taken very near to Rowe, but including all of the Abo sandstone and part of the Magdalena formation, see Lee, W. T.: "The Manzano Group of the Rio Grande Valley, New Mexico," U. S. Geological Survey Bull. 389, p. 34, 1909.

Near the top of the Yeso formation is the Glorieta sandstone member, named from its outcrop on Glorieta Mesa. This is the oldest unit outcropping in Guadalupe County. It outcrops in small patches along the western edge of the county and also just east of Esterito Butte in T. 11 N., R. 18 E., in a pronounced dome of that name. The formation, however, has a wide lateral extent, as shown in subsurface well sections. The rock consists of coarse, grey, tan and white ~~limestone~~ Sandstone, weathering to yellowish-brown or white. The sand grains are loosely cemented and well rounded. In composition quartz greatly predominates. The thickness of the formation varies. On Glorieta Mesa a thickness of 175 feet was measured, but in Guadalupe County the thickness of the sand varies from 200 to 600 feet. The greatest thickness of Glorieta observed in the county was 585 feet in the section of the New Mexico Producing and Refining Company's McMullen No. 1 in Sec. 24, T. 5 N., R. 16 E. The Glorieta sand, because of its distinctive characteristics, is a good marker over a large area of New Mexico, and is not easily mistaken for other formations. Yet some geologists[9] have not distinguished it from the Santa Rosa and have unfortunately caused some confusion. Rich,[10] in a paper published in 1920, shows the true relationships of

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[9]Baker, C. L.: "Contributions to the Stratigraphy of Eastern New Mexico," American Journal Science, 4th Ser., Vol. 49, pp. 112-120, 1920.

[10]Rich, J. L.: "The Stratigraphy of Eastern New Mexico--A Correction," American Journal Science, 5th Ser., Vol. 2, p. 296, 1921.

	Thickness
Abo sandstone--	
9. Dark red, massive sandstone	272' 0"
8. Red shale and sandstone	28' 3"
7. White, massive, but loose-grained sandstone	10' 0"
6. Light red, thin-bedded sandstone	28' 3"
5. White sandstone	11' 4"
4. Covered	11' 4"
3. Pink sandstone	34' 0"
2. Pinkish-grey, loosely cemented, massive sandstone with some shale partings	102' 0"
1. Covered, probably red shales and sandstones	147' 4"
Total thickness	1143' 6"

Yeso Formation

The Yeso formation lies conformably upon the Abo sandstone. In thickness it varies from two or three hundred feet up to about two thousand feet. The formation has a very great lateral extent, but no single bed could be traced very far. In surface outcrops north of Guadalupe County the formation is composed of shales, gypsum, and earthy limestone (See Section No. 1 above). Southward, the formation thickens and the gypsum and salt series becomes more predominant. The sandstones and shales vary in color from salmon pink to grey and yellowish-brown. The sand grains are angular and loosely consolidated. The limestones are dark brown to black, contain a large amount of clay, and occur in thin beds. The formation contains considerable white, bedded gypsum.

the two formations. He states:

> "The Santa Rosa sandstone is a very definite unit exposed at Santa Rosa and Puerto de Luna and along the canyon of the Pecos for many miles both above and below those places. From Santa Rosa it may be traced up the valley of the Pecos as a continuous, unbroken, escarpment to the Esteritos Dome east of Anton Chico, where it forms the rim rock surrounding the dome. In the center of the dome, about 200 feet below the base of the Santa Rosa sandstone, the San Andreas limestone, 10 to 25 feet thick, is exposed. Beneath the San Andres on the dome is the Glorieta sandstone in its proper relation and full thickness. The well drilled for oil near the top of the dome started on the top of the Glorieta and penetrated 490 feet of it before entering the salmon colored sandstones of the Yeso below. On another dome 5 or 6 miles west of the village of Anton Chico, there are complete exposures of the series from the Glorieta to the Santa Rosa in such relations that there can be no question as to the relative positions of the various formations. Between the latter place and Gloriete Mesa there is a disturbed belt in which there has been some faulting. It is in this belt that Baker appears to have lost his bearings. East of this he apparently followed the Santa Rosa sandstone, thinking it was the Glorieta."

Baker[11], in defense of his statements, states that the rocks he named Glorieta sandstone were in reality the equivalent of the present Santa Rose sandstone and that he called the present Glorieta sandstone a saccharoidal sandstone. In describing the base of the San Andreas

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[11]Baker, C. L.: Personal communication.

limestone he[12] writes:

> " * * * Its base is often marked by a bed of saccharoidal cream colored sandstone, fully 200 feet thick."

San Andreas Limestone

Above the Glorieta sandstone lies the San Andres limestone. This formation has an average thickness of 400 feet throughout the county. Lithologically, it consists of hard, white to dark grey, and buff crystalline limestone with some gypsum and shale interbedded in it. The limestone is quite cavernous. Fossils are numerous at some localitions and include forms of Bellerophon, Productus, Spirifer, Crinoid stems, corals, and echinoid spines. Outcrops of the formation are numerous in the area, chiefly in the southern part, but there is nowhere an exposure showing the total thickness of the formation.

Red Beds

Above the San Andreas limestone is a series of red beds and gypsum which comprises the uppermost Permian in this region. The beds have no definite name, but

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[12]Baker, C. L.: "Contributions to the Stratigraphy of Eastern New Mexico," American Journal Science, 4th Ser., Vol. 49, p. 112, 1920.

are considered part of the Pecos Valley red beds of Baker[13], the Seven Rivers gypsum of Darton[14], and the Castile gypsum of other writers. The beds are lenticular and range in thickness from 0 to 1000 feet. The average in Guadalupe County is approximately 100 feet. The beds have wide lateral extent and form slightly rolling plains with numerous sink holes where the gypsum has been dissolved. The beds thicken to the south of Guadalupe County, cover large areas of the state, and extend down into Texas. Lithologically, they consist of thin beds of red shale, clay, and bedded gypsum.

TRIASSIC

Santa Rosa Sandstone

The Santa Rosa limestone lies above this series of Red Beds, and is separated from it by an erosional unconformity. This formation constitutes the lowermost Triassic exposed in this region. The rocks are undoubtedly a continental stream deposit.

The formation has a thickness of from 100 to 150 feet at its type locality at Santa Rosa. It has a large areal extent through the northern half of Guadalupe County and forms the river escarpment along the Pecos River and also the prominent scarp on both sides of Pintada Canyon to

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[13] Ibid, p. 112.

[14] Darton, N. H.: "Red Beds and their Associated Formations in New Mexico," U. S. Geological Survey Bull. 794, 1928.

the west of the River. Plate 3-B shown an outcrop of the formation west of Pastura and Plate 2-B shows a break in the scarp along the Pecos River.

Lithologically, the formation is composed of grey, brown, and dark red sandstone containing a large amount of quartz, mica, and ferrous compounds. The rock is well cemented, hard, and massive. Near its base it is conglomeratic and coarser than at the top. No fossils of any importance have been identified from the formation, although it contains a large amount of fossilized wood and some vertebrate bones. Baker[15] correlates the formation with the Shinarump conglomerate of western New Mexico and Wyoming. Darton, on the other hand, places this formation in the Dockum beds.[16]

Sections, including the top of the Permian and the base of the Triassic, were measured in several places. They are given below.

Section 2

<u>Stratigraphic section in Pintada Canyon, 1 mile east of San Ignacio, starting at last gypsum outcrop which marks the top of the Permian. (See Plate 4-A.)</u>

	Thickness
Triassic--	
8. Pinkish-grey sandstone	26' 6"

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[15]Baker, C. L.: "Contributions to the Stratigraphy of Eastern New Mexico," American Journal Science, 4th Ser., Vol. 49, pp. 117-119, 1920.

[16]Darton, N. H.: "Red Beds and their Associated Formations in New Mexico," U. S. Geological Survey Bull. 794, p. 32, 1928.

	Thickness
7. Brown sandstone conglomerate	14' 7"
6. Interbedded red and grey sandstone and shale	41' 9"
5. Dark red clay	12' 0"
4. Thin-bedded, purple sandstone	22' 8"
Permian--	
3. Light grey shale	17' 0"
2. Soft, light red sandstone	21' 0"
1. Gypsum	11' 6"
Total thickness	167' 0"

Section 3

One mile N. 70° W. from Los Colonias.

	Thickness
Triassic--	
12. Brown sandstone, partly conglomeratic	14' 2"
11. Pink to grey sandstone	11' 4"
10. Brown sandstone conglomerate	11' 4"
9. Grey sandstone and shale, partly covered	52' 5"
8. Grey, sandy shale	8' 6"
7. Purple shale	12' 0"
6. Dark red, massive sandstone	32' 6"
Permian--	
5. Red and grey sandstone	11' 4"
4. Red shale	11' 4"
3. Red shale with thin beds of gypsum	17' 0"
2. Soft, red sandstone with thin beds of gypsum (1"-3") interbedded with grey sandstone and red shale	39' 8"
1. Covered, red sandy soil to river	50' 0"
Total thickness	271' 7"

Section 4.

Stratigraphic section half a mile N. 55° W. from the mouth of Puerto Creek and starting from the road 3.2 miles southeast of Puerto de Luna.

Triassic--	Thickness
15. Pinkish-grey nodular sandstone	28' 4"
14. Brown sandstone conglomerate . .	17' 0"
13. Brown to tan sandstone conglomeratic at the base	22' 8"
12. Purple clay	5' 0"
11. Thin-bedded, purple sandstone . .	56' 8"
10. Massive, red sandstone	?
9. Massive, white sandstone	5' 8"
8. Grey shale	5' 8"
7. Same as No. 10	17' 0"
6. Same as No. 8	3' 0"
Permian--	
5. Soft, light red sandstone	17' 0"
4. Grey shale and gypsum, mostly covered	5' 8"
3. Interbedded gypsum and red clay	17' 0"
2. Gypsum with some clay	22' 8"
1. Same as No. 4	22' 8"
Total thickness	246' 0"

Upper Triassic

Above the Santa Rosa sandstone is a series of red shales, sandstones, and mudstones which are a part of the Dockum beds of upper Triassic age. In Guadalupe County this series is six or eight hundred feet thick and covers a large area in the eastern part of the county. The rocks are for the most part soft and of a brilliant red color and have only an occasional hard bed of sandstone. Plates

4-B, 5-A, and 6 illustrate this series of rocks. No single bed can be traced successfully for any distance. The formation produces characteristic bad lands topography. The rocks are all of continental origin and seem to have been deposited by streams in the form of an alluvial fan. No recognizable fossils were found, except fossilized wood, which was quite common.

STRUCTURAL AND ECONOMIC CONSIDERATIONS

The regional east dip of the strata in Guadalupe County is interrupted by several reversals. Some of these give rise to quite large and well-developed abnormal structures, whereas others are merely minor flexures. The location and size of the abnormal structures are shown on the map accompanying this report.

The rocks of Guadalupe County have very little to offer economically. Numerous wells have been drilled from time to time in the county in a vain search for oil, and the cross sections included in this report (Figs. 2 and 3) have been made from the logs of some of these wells. Up to the present time no oil has been found in the area.

Near Arabella, on the Southern Pacific Railroad, is the only mine that has produced an appreciable amount of copper, silver, and some gold. It is shut down at the present time.

Eight miles north of Santa Rosa and just east of Pecos River is a large area where the sandstone is saturated with an oily asphalt. This area is owned and the rock is being worked by the New Mexico Construction Company. The rock is crushed and used for road building purposes.

Guadalupe County is valuable chiefly as range land for sheep and cattle. There are several large ranches in the area, and sheep and cattle raising form the principal industry.

PLATE I.

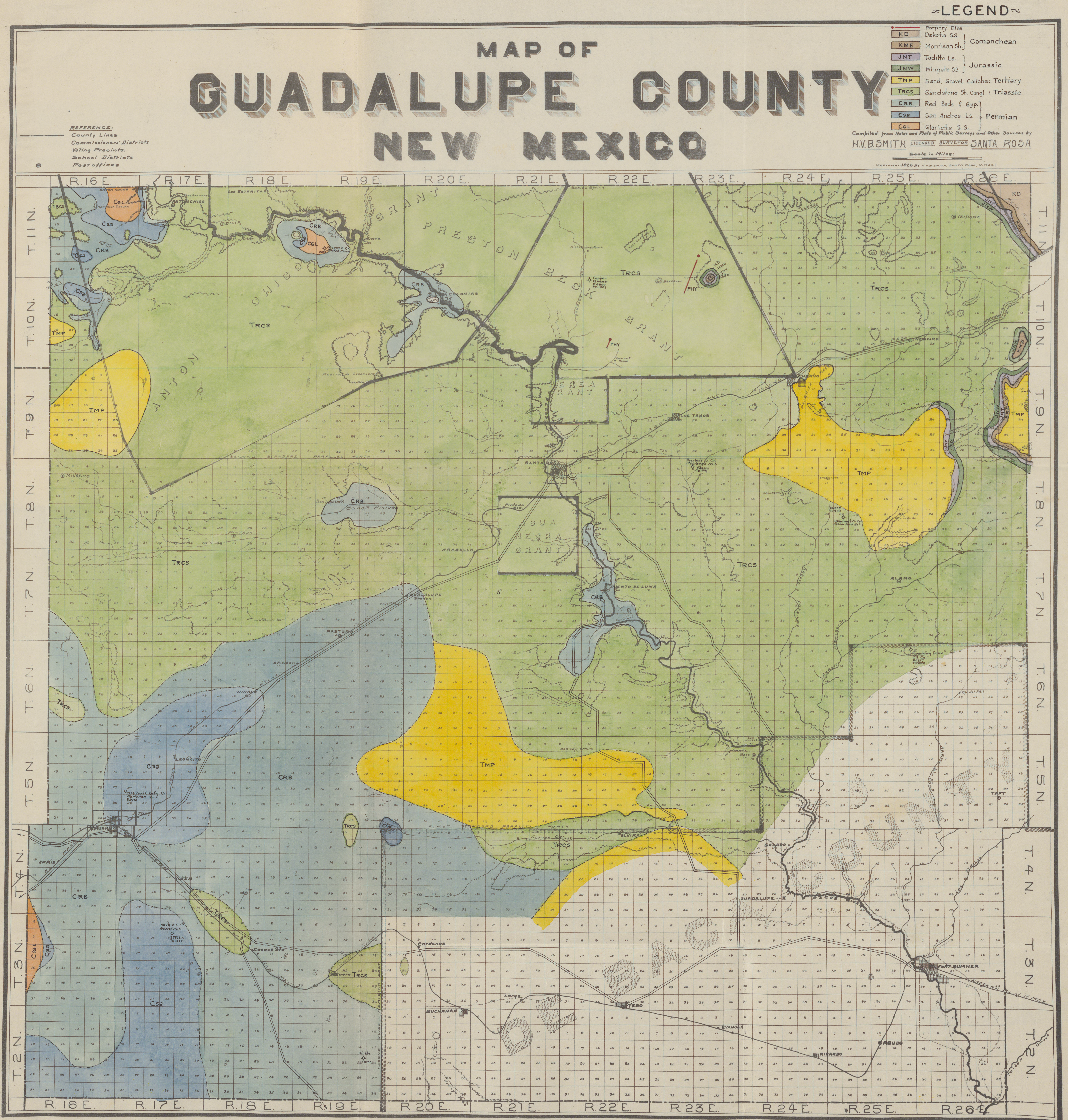
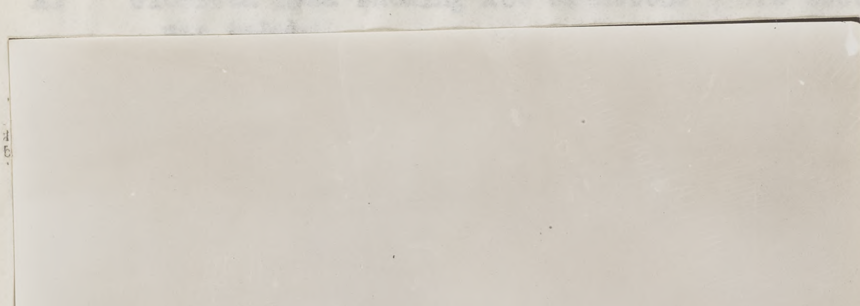

MAP OF
GUADALUPE COUNTY
NEW MEXICO
LEGEND
Porphry Dike
KD Dakota S.S.
KME Morrison Sh.
Comanchean
JNT Todilto Ls.
JNW Wingate S.S.
Jurassic
TMP Sand, Gravel, Caliche: Tertiary
TRCS Sandstone Sh. Congl : Triassic
CRB Red Beds & Gyp.
Csa San Andres Ls.
CGL Glorietta S.S.
Permian
Compiled from Notes and Plats of Public Surveys and Other Sources by
H.V.B.SMITH LICENSED SURVEYOR SANTA ROSA
Scale in Miles:
(COPYRIGHT-1926 BY H.V.B.SMITH, SANTA ROSA, N.MEX.)
REFERENCE:
County Lines
Commissioners' Districts
Voting Precints.
School Districts
Postoffices
R.16 E.
R.17 E.
R.18 E.
R.19 E.
R.20 E.
R.21 E.
R.22 E.
R.23 E.
R.24 E.
R.25 E.
R.26 E.
T.11 N.
T.10 N.
T.9 N.
T.8 N.
T.7 N.
T.6 N.
T.5 N.
T.4 N.
T.3 N.
T.2 N.
ANTON CHICO
PRESTON BECK GRANT
ANTON CHICO GRANT
AGUA NEGRA GRANT
SANTA ROSA
LOS TANOS
PUERTO DE LUNA
PASTURA
ISIDORE
NEWKIRK
CUERVO
DUORAN
VAUGHN
ELVIRA
CARDENAS
BUCHANAN
YESO
EVANOLA
RICARDO
FORT SUMNER
GUADALUPE
DE BACA COUNTY
TRCS
TMP
CRB
Csa
CGL
PHY
KD
JNT
JNW

PLATE II.

A.   Pecos Valley--Southeast of Puerto de Luna.



B.   Break in Triassic scarp where El Puerto Creek
joins ~~the~~ Pecos River.

PLATE III.

A. Glorieta Mesa showing Abo sandstone where section was taken.

B. Scarp of Santa Rosa sandstone west of Pastura.

PLATE IV.

A. Permian-Triassic contact in Pentada Canyon.
P = Permian Tr = Triassic

B. Esterito Butte showing Triassic sandstone and red beds.

PLATE V.

A. Cuervo Hill
Tr = Triassic J = Jurassic

B. View of Jurassic in eastern part of county.
M = Morrison formation W = Wingate sandstone
Tr = Triassic

PLATE VI.

Upper Triassic red beds looking south from Cuervo.

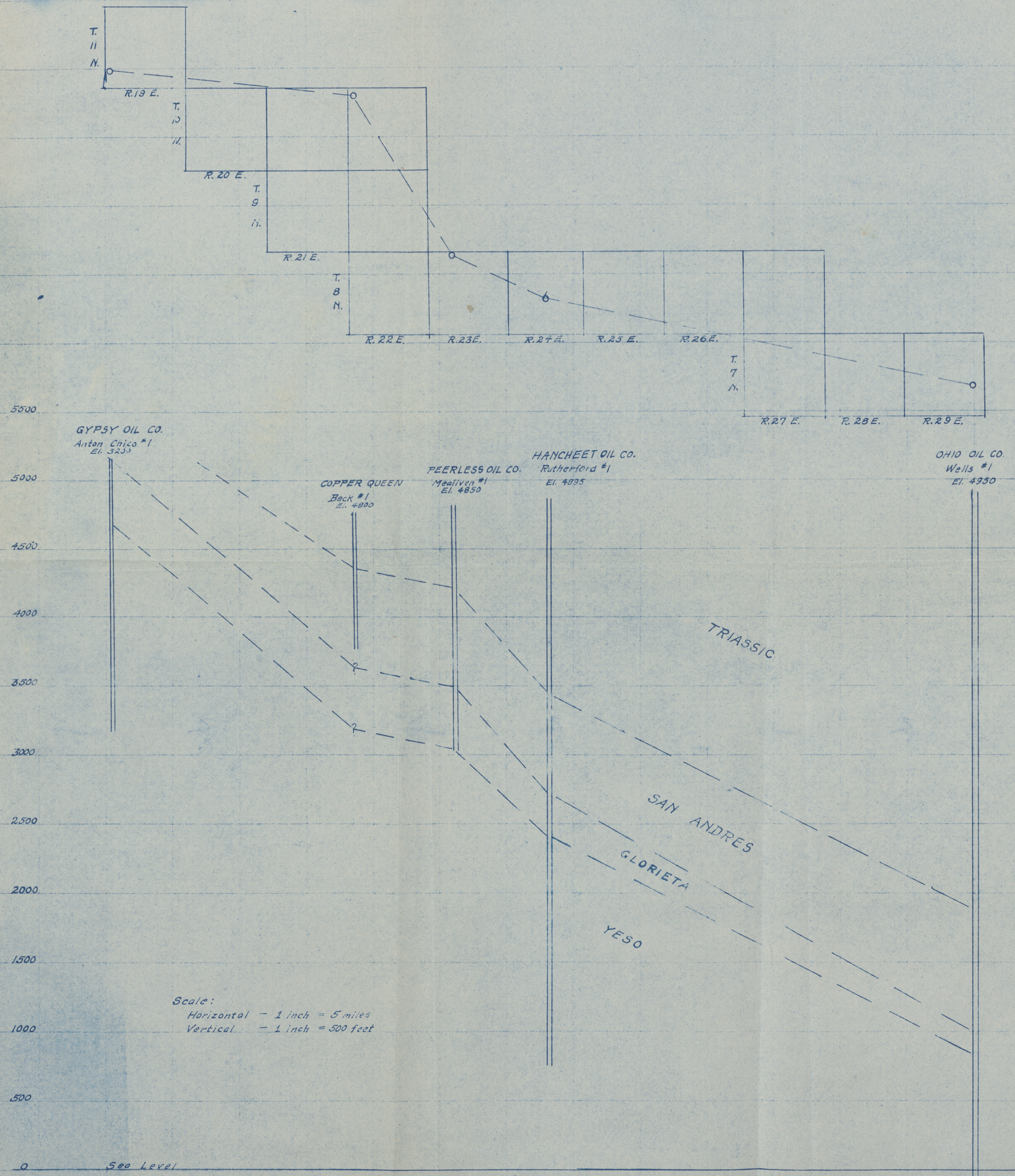


Figure 2
Subsurface cross-section #1

FIG. 3

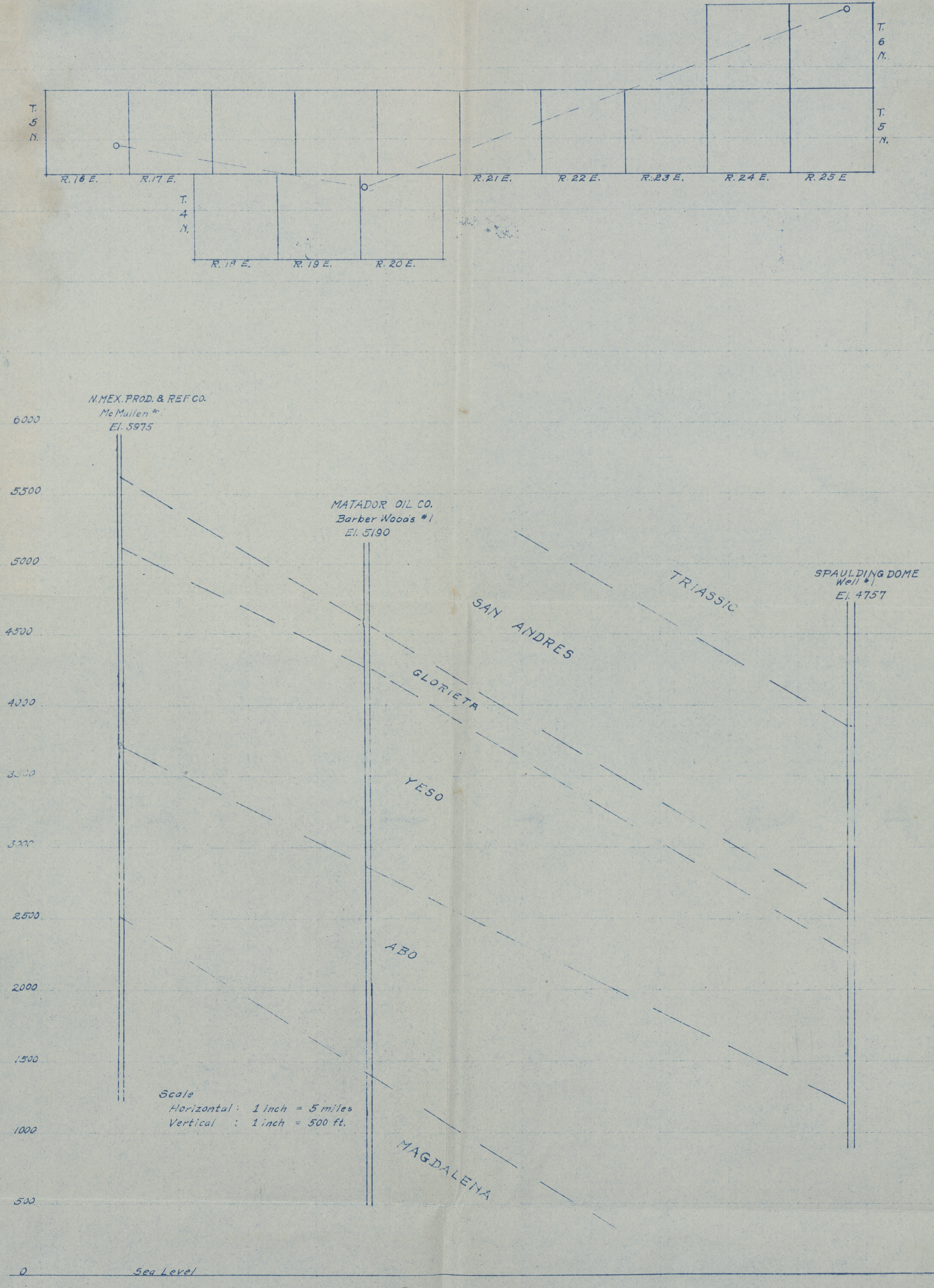


Figure 3
Subsurface Cross-section #2

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