A FACIES STUDY IN THE GULF COAST
TERTIARY OF TEXAS

Thesis for the Degree of M. S.
MICHIGAN STATE COLLEGE
Karl A. Riggs, Jr.
1952

This is to certify that the

thesis entitled

"A FACIES STUDY IN THE GULF COAST TERTIARY OF TEXAS"

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Wm. A. Kelly
Major professor

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A FACIES STUDY IN THE GULF COAST TERTIARY

OF TEXAS

By

KARL A. RIGGS, JR.

A THESIS

Submitted to the School of Graduate Studies of Michigan
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1952

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The writer wishes to thank Dr. William A. Kelly for directing this study, for his comments and suggestions, and for providing samples for the study.

Many others were very helpful. Among these was Dr. Stanard G. Bergquist, who helped locate maps and made many helpful suggestions and comments. Dr. Bennett T. Sandefur very willingly helped locate laboratory materials and equipment. Dr. Lawrence M. Sommers aided the writer in locating county maps of Texas. Dr. Andrew D. Perejda courteously set up the pantograph for the writer. Mrs. Jane E. Smith gave several helpful hints which aided in making species determinations. Joseph B. Long gave instructions on the use of the LeRoy drafting equipment. Likewise, Neil S. Mallory made numerous comments and suggestions concerning laboratory technique which aided the writer considerably. The Texas Railroad Commission was very cooperative in providing base maps and detailed well locations. The writer would like to take this opportunity to thank all of the individuals mentioned above for their kind assistance.

The writer is extremely grateful to Miss Patricia A. Hartrick, who spent many hours washing and bottling samples, alphabetizing the faunal lists, proofreading the manuscript, and typing the initial drafts. A humble thank you is insufficient for the time she contributed, but it is the only recognition that can be presented at this time.

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PURPOSE AND INTRODUCTION

The purpose of this study is to interpret the subsurface facies changes of the Tertiary sediments in south-central Starr and Hidalgo Counties, Texas (see Map 1). In addition it is desired to determine the depositional environment of the subsurface formation by the utilization of paleontologic and lithologic data.

Many excellent papers have been written which cover the area to a certain extent. The surface geology has been interpreted by such men as E. T. Dumble (1903),[1] A. C. Trowbridge (1932),[2] E. H. Sellards, W. S. Adkins, and F. B. Plummer (1932),[3]

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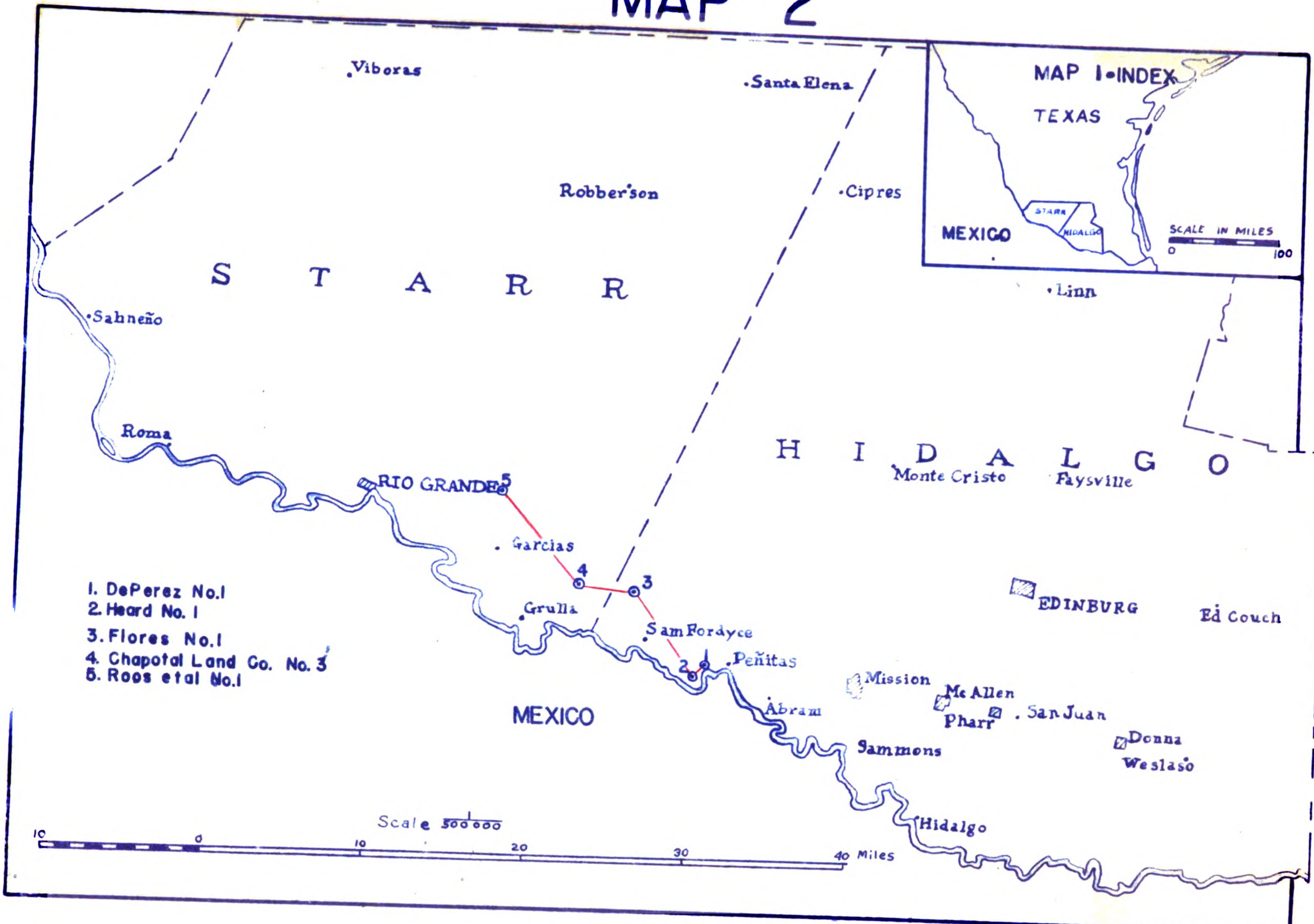
[1] E. T. Dumble (1903), Geology of Southwestern Texas, Trans. Amer. Inst. of Mining Engineers, Vol. 33.

[2] A. C. Trowbridge (1932), Tertiary and Quaternary Geology of the Lower Rio Grande Region, U. S. Dept. of Interior, Geological Survey, Bulletin 837.

[3] E. H. Sellards, W. S. Adkins, and F. B. Plummer (1932), The Geology of Texas, The University of Texas, Bulletin 3232, Vol. 1.

MAP 2



Viboras
Santa Elena
Robber'son
Cipres
S T A R R
Sahneño
Roma
RIO GRANDE
Garcias
Grulla
Sam Fordyce
Peñitas
MEXICO
H I D A L G O
Monte Cristo
Faysville
Linn
EDINBURG
Ed Couch
Mission
McAllen
Pharr
San Juan
Donna
Weslaso
Abram
Sammons
Hidalgo
MAP 1 • INDEX
TEXAS
MEXICO
STARR
HIDALGO
SCALE IN MILES
0
100
1. DePerez No.1
2. Heard No. 1
3. Flores No.1
4. Chapotal Land Co. No. 3
5. Roos etal No.1
Scale 1/500000
10
0
10
20
30
40 Miles

W. G. Kane and G. B. Gierhard (1935),[1] A. W. Weeks (1937),[2] and J. M. Patterson (1942).[3] Other men, such as W. G. Meyer (1939)[4] and E. D. Guzman (1949),[5] have described the subsurface geology of the area. Many others have also written on the Gulf Coast Province, but they have concentrated their efforts in other localities.

Some of these workers have made detailed lithologic and paleontologic studies of the outcrop. Others have interpreted the general lithology and geologic structures from

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[1] W. G. Kane and G. B. Gierhart (1935), Areal Geology of Eocene in Northeastern Mexico, American Association of Petroleum Geologists, Bulletin, Vol. 19, No. 9.

[2] A. W. Weeks (1937), Miocene, Pliocene, and Pleistocene Formations in the Rio Grande Region, Starr and Hidalgo Counties, Texas, American Association of Petroleum Geologists, Bulletin, Vol. 21, No. 4.

[3] J. M. Patterson (1942), Stratigraphy of Eocene Between Laredo and Rio Grande City, Texas, American Association of Petroleum Geologists, Bulletin, Vol. 26, No. 2.

[4] W. G. Meyer (1939), Stratigraphy and Historical Geology of Gulf Coastal Plain in the Vicinity of Harris County, Texas, American Association of Petroleum Geologists, Bulletin, Vol. 23, No. 2.

[5] E. D. Guzman (1949), New Petroleum Development by Petroleos Mexicanos, in Northeastern Mexico, American Association of Petroleum Geologists, Bulletin, Vol. 33, No. 8.

subsurface geophysical data. These subsurface studies have been limited to the vicinity of the present coast of the Gulf of Mexico.

It is desired to supplement the existing literature by concentrating on the facies changes and their significance. Furthermore, wells have been chosen which will disclose the stratigraphy between the outcrop area to the west and the subsurface stratigraphy of the coastal region to the east.

A great amount of uncertainty exists relating to the stratigraphic nomenclature and the age of the formations in the area. No attempt is made to solve this problem, for the inconsistencies can only be resolved by extensive studies on a regional basis. The development of the stratigraphic nomenclature is shown in graphic form in Figure 1. For the most part, Meyer's[1] classification has been used. The only changes are the substitution of Anahuac for Middle marine Oligocene, and Vicksburg for the Lower marine Oligocene. Both of these names have become acceptable in recent years.[2]

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[1] W. G. Meyer, op. cit.

[2] E. D. Guzman, op. cit.

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[1] W. G. Meyer, *op. cit.*

[2] E. D. Guzman, *op. cit.*

FIGURE ONE

CLASSIFICATION OF MIDDLE TERTIARY FORMATIONS

	A.C. TROWBRIDGE 1932	A.C. ELLISOR 1933	A. DEUSSEN AND K.D. OWEN 1939	W. G. MEYER 1939	E.J. GUZMAN 1949	K.A. RIGGS 1952
OLIGOCENE	**VICKSBURG ?** FRIO CLAY	FRIO VICKSBURG	**UPPER** CATAHOULA (surface) MARINE OLIGO. WEDGE (subsurface) **LOWER** FRIO (surface) VICKSBURG (subsurface)	**GUEYDAN** CATAHOULA (Oligocene ?) SUBSURFACE STRATA FRIO SUBSURFACE STRATA	MIOCENE FLEMING **GUEYDAN** unconformity ANAHUAC FRIO VICKSBURG	**GUEYDAN** CATAHOULA ANAHUAC FRIO VICKSBURG
EOCENE	**JACKSON** FAYETTE	**JACKSON** WHITSETT McELROY CADDELL	**JACKSON** WHITSETT (or Fayette) McELROY CADDELL	**JACKSON** WHITSETT McELROY CADDELL	JACKSON	**JACKSON** WHITSETT McELROY CADDELL

The environmental classification used is based upon the depth of water, and is the same as that used by Lowman.[1] In case the reader is unfamiliar with these terms, the neritic zone is defined as the zone extending from lowest tide to 100 fathoms, the bathyal zone ranges from 100 fathoms to 1,000 fathoms, and the abyssal zone includes all environments which exceed 1,000 fathoms in depth of water. The inner neritic zone is the subdivision of the neritic zone which occurs nearest to the shore line.

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[1] S. W. Lowman (1949), Sedimentary Facies in Gulf Coast, American Association of Petroleum Geologists, Bulletin, Vol. 33, No. 12, pp. 1954-55.

METHODS AND MATERIALS

The well samples used in this study are the property of the Department of Geology and Geography at Michigan State College. They were originally given to the department by Dr. J. A. Young, of the Sun Oil Company, Philadelphia, Pennsylvania.

The wells used and their locations, as shown on Map 2, are as follows:

Roos *et al.* No. 1	elevation: 242 feet; Porcion 91 and 92, Share 1-A Center of 160 acre tract, Starr County.
Chapotal Land Company No. 3	elevation: 198.5 feet; Porcion 99, 700 feet south of State Highway number 4, 330 feet west of east line of lease, Starr County.
R. Flores No. 1	elevation: 206.6 feet; Porcion 39, Tract 250, 800 feet north and 330 feet west of southeast corner of tract, Hidalgo County.
J. W. Heard No. 1	elevation: 134 feet; Los Ejidos de Reynosa A. Viego Survey, 467 feet east of west line, 261 feet from north and south lines Hidalgo County.
D. S. DePerez *et al.* No. 1	elevation: 217 feet; Los Ejidos Grant Block 225, 660 feet from north line.

Although most of the samples are rotary cuttings, a few core samples also were used. The interval of sampling varies considerably. The Roos well has rotary samples with vertical intervals varying from 8 to 24 feet. The core samples from the same well vary from 1 to 9 feet. Rotary samples were taken from the Chapotal well at intervals of approximately 10 feet. In the Flores well, rotary samples were taken every 15 feet, but the cores vary from 2 to 9 feet. Core and rotary samples from the Heard well were taken from 1 to 4 and 30 to 49 feet, respectively. Rotary samples in the DePerez well range from 30 to 32 feet, but the cores vary from 4 to 10 feet.

When possible, the lithologic sequence was derived from the cores, but in their absence, the lithology was interpreted from the rotary samples according to the method described by LeRoy and Crain.[1]

After detailed examination of samples was started, it was found that portions of the section were either sparsely

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[1] L. W. LeRoy and H. M. Crain (1949), Subsurface Geologic Methods, Colorado School of Mines, Golden, Colorado, pp. 299-302.

represented, or altogether absent in the Frio and Catahoula formations. Furthermore, many of the samples present have sampling intervals exceeding 10 feet. Since R. M. Whiteside[1] claims that detailed stratigraphy can not be derived from rotary samples with intervals exceeding 10 feet and since geophysical data was unobtainable, the original plan of attack on facies problems had to be modified. For this reason no detailed correlation is attempted in the Catahoula and upper Frio formations; however, the general nature of these formations has been described. Compared to the work of others, a detailed correlation has been made in the Lower Frio, Vicksburg, and upper Jackson formations on Figures 2 and 3; however, even these should be considered general trends. The writer is convinced that the facies changes are more complex, but the available material prevents the accurate determination of the details.

Figure 4 shows the position of the samples upon which this paper is based.

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[1] R. M. Whiteside (1932), Geologic Interpretation from Rotary Cuttings, American Association of Petroleum Geologists, Bulletin, Vol. 16, No. 7, p. 671.

STRATIGRAPHY

Catahoula Formation

The top of this formation is not determinable because the highest sample in the Flores well occurs at a depth of 1,000 feet. Since the Catahoula outcrops approximately 6 miles from the Flores well,[1] and since the regional dip is not known to exceed 75 feet[2] per mile in the area, it is believed that the highest samples are well below the top of the Catahoula.

In the Heard and DePerez wells the bottom of the Catahoula is placed at the top of the fossiliferous Anahuac formation.[3] The bottom of the Catahoula in the Flores well is placed at the top of a gray-green shale[4] which occurs at 1,685 feet below the surface. A lithologic contact between the Catahoula and

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[1] A. W. Weeks, *op. cit.*, p. 491.

[2] E. H. Sellards, W. S. Adkins, and F. B. Plummer, *op. cit.*, p. 534.

[3] W. G. Meyer, *op. cit.*, p. 177.

[4] E. H. Sellards, W. S. Adkins, and F. B. Plummer, *op. cit.*, p. 715.

Frio could not be determined in the Roos and Chapotal wells because some of the samples were missing.

Bentonitic and calcareous shales and clays are predominant in the Catahoula, but lenses of sandy shales and fine sandstones are rather common. The beds of clays, shales, and sandy shales are colored various shades of red, pink, gray, and buff. Beds of mottled red and gray, and mottled red and green clays and shales are also common. The sandstones are generally gray or white, and shards of volcanic glass can be noticed occasionally. In the Chapotal well, a few lenses or thin beds of lignite occur.

Charophyta and Ostracoda are very common in all the wells, but the only Foraminifera found were:

Globigerina species A	- 2 specimens
Globigerinella species A	- 3 specimens
Gumbelina species A	- 1 specimen

The two specimens of Globigerina and one of the 3 specimens of Globigerinella occur 1,000 feet below the surface in the Flores well. The other two Globigerinellas occur at scattered points in the Heard well. These Foraminifera are planktonic and cannot be used to interpret the environment.

Judging from lithology and the presence of Charophyta and Ostracoda, the Catahoula is predominantly deltaic. According to Twenhofel[1] the sediments of the lower Mississippi River area are composed of 94 per cent clays, silts, and very fine sands. Judging from the rotary cuttings, the Catahoula has approximately the same textural composition. Furthermore, the Charophyta are characteristic of fresh or brackish water[2] although the Ostracoda are related to fresh, brackish, or marine environments.[3] Ostracoda also occur in continental sediments near the shore area as the result of wind transportation.[4] The Foraminifera may indicate thin beds of marine shale, but it should not be overlooked that the few present could have been introduced by storm waves.[5] At any rate, the marine shales, if present, could not be identified from the rotary samples. The lignite lenses found in the

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[1] W. H. Twenhofel (1950), Principles of Sedimentation, New York, p. 109.

[2] LeRoy and Crain, *op. cit.*, p. 72.

[3] *Ibid.*, p. 66.

[4] W. A. Kelley, personal communication.

[5] W. H. Twenhofel, *op. cit.*, p. 105.

Chapotal well may have been formed on the delta or in fresh water swamps located in the flood plain.

Although predominantly deltaic, the Catahoula may have many lenses of aeolian deposits, swamp deposits, lake deposits and inland fluviatile deposits.

The samples available represent only a part of the Catahoula; consequently, definite conclusions cannot be reached.

Anahuac Formation

Apparently the Anahuac formation pinches out in this area, for only traces of it occur in the Heard and DePerez wells. In the Heard well it is represented by a bed of gray sandstone approximately 20 feet thick. This sandstone is largely composed of gray and white quartz plus minor amounts of accessory minerals, such as glauconite and magnetite. No chemical tests were used to identify these minerals. They were merely determined on the basis of color, hardness, and form.

In the DePerez well the Anahuac is represented by approximately 30 feet of gray sandy shale which is quite calcareous.

The bed of gray sandstone has been correlated with the gray sandy shale because they are definitely distinguishable as marine in origin; whereas, both the overlying Catahoula and the underlying Frio are predominately, if not completely, continental. Furthermore, two species of Elphidium occur which are characteristic of the Anahuac. The Foraminifera found in these two wells are:

Elphidium discoidale multiloculum Cushman and Ellisor
Elphidium sagrum (d'Orbigny)
Nonion species A (1 specimen)
Quinqueloculina species A (1 broken specimen)
Globigerina species A

Ostracoda and Charophyta are also abundant in these two wells.

According to Lowman,[1] this foraminiferal fauna is characteristic of the inner neritic zone (see page 6). Although Ostracoda and Charophyta also occur in the inner neritic zone, the writer is not convinced that they should be used as environment indicators in this case for they may not be indigenous to these beds. Inasmuch as both occur in the overlying Catahoula, they may be the result of caving when the hole was drilled.

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[1] S. L. Lowman, op. cit., p. 1956.

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[1] S. L. Lowman, op. cit., p. 1956.

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[1] S. L. Lowman, *op. cit.*, p. 1956.

Since the Heterostegina zone extends farthest west,[1] the inner-neritic Anahuac of this area can probably be correlated with the Heterostegina zone in the downdip sections.

Frio Formation

When the Anahuac formation is present, the lower limit of the Anahuac fauna is used as the contact between the Frio and Anahuac formations.[2] Because the samples are missing, its top is not determinable in the Roos well. The contact between the Frio and the overlying Catahoula has already been explained in the section on the Catahoula.

The contact of the Frio and Vicksburg formations is the top of the Sam Fordyce sandstone of the upper Vicksburg[3] (see Figure 2).

In the Roos well, the base of the Frio is placed above the gray sandy shale of the Vicksburg for several reasons.

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[1] A. C. Ellisor (1944), Anahuac Formation, *American Association of Petroleum Geologists, Bulletin*, Vol. 28, No. 9, p. 1363.

[2] E. J. Guzman, *op. cit.*, p. 1359.

[3] *Ibid.*, p. 1358.

Overlying the gray sandy shale are brown shales of the continental type. Furthermore, one specimen of Eponides vicksburgensis occurs in the gray sandy shale (see Figure 2). Since this species is unknown in the Jackson Eocene, but reported from both Oligocene formations in the coastal region,[1] this bed of sandy shale belongs to either the Frio or Vicksburg. Finally, since the gray sandy shale above the Sam Fordyce sandstone in the Chapotal well (see Figure 2) has no Foraminifera, and since the sandy shale below this sandstone has Eponides vicksburgensis as well as other Foraminifera, this sandy shale is placed in the Vicksburg.

The position of the boundaries and the lithologic associations should be clarified in Figures 2 and 4.

The principal rock types of the Frio are gray, red, red-brown, and brown calcareous shales and clays, green sandy shales, and gray sandy shales. In general, these shales and clays are less bentonitic than the Catahoula. Gray, greenish-white, buff, and brown sandstones and siltstones also are common.

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[1] A. C. Ellisor (1932), Jackson Group of Formations in Texas With Notes on Frio and Vicksburg, American Association of Petroleum Geologists, Bulletin, Vol. 17, No. 11, pp. 1322, 1326.

Quartz predominates in the sandstones and siltstones, but minor amounts of glauconite and other accessory minerals which were not identified are present. Calcium carbonate is the predominant cementing material in the sandstones. The various colors of the sandstone beds are due to impurities in the cement.

Also occurring in the section are thin beds of marl, thin beds of lignite which are commonly somewhat pyritized, small amounts of shell breccia, thin beds of green and greenish-gray volcanic ash, small amounts of white bentonite, and a little white tuff.

Ostracoda and Charophyta are very abundant, but Foraminifera are rare. In the Roos well, abraded and broken Foraminifera which were interpreted as representing a reworked fauna occasionally occur. This reworked fauna is composed of:

Guttulina species A
Quinqueloculina species B
Textularia species A
Elphidium species A

In the other wells, the following Foraminifera occur:

Ammobaculites species A
Cibicides americana (Cushman)
Elphidium poeyanum (d'Orbigny)
Nonion species B
Quinqueloculina species C

As stated earlier, the lithology of the Frio consists of thinly bedded multicolored shales with interbedded lenses of sandstone, plus other lithologic types. According to Meyer,[1] lenticular sand beds are characteristic of the nonmarine facies in the Gulf Coast formations. Furthermore, the lithologic sequence in the Chapotal well is comparable to deposits found on the lateral or landward margins of a delta as described by Twenhofel[2] (see Figure 3). Likewise the predominance of clays and silts in the Frio is comparable to conditions existing in the lower Mississippi River area.[3]

The paleontologic data also indicate nonmarine conditions as the dominant environment. Although a few beds in the Chapotal well have very prolific shore line faunas composed mainly of *Elphidium poeyanum*,[4] most of the strata are barren of Foraminifera. Only 5 specimens of Foraminifera occur in the Flores and Heard wells, whereas only reworked Foraminifera occur in

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[1] W. G. Meyer, *op. cit.*, p. 153.

[2] A. C. Twenhofel, *op. cit.*, pp. 103-11.

[3] *Ibid.*, p. 109.

[4] S. W. Lowman, *op. cit.*, p. 1956.

the Roos well. Although the Foraminifera in the Heard and Flores wells may indicate a few thin beds of marine shales, it should be recalled that Foraminifera may be carried inland by strong winds, storm waves, or animals.[1] Since the Ostracoda occur in all environments and may even be carried inland by winds,[2] they can not be used, but the presence of abundant Charophyta favor a fresh or brackish water origin for the Frio.

On the basis of the evidence presented above, the Frio is interpreted as a deltaic deposit which probably has a few flood plain and marine beds associated with it.

Vicksburg Formation

The Vicksburg formation may be unconformable below the Frio. The elimination of the sandstone beds between the Roos and Chapotal wells is interpreted as an unconformity on Figure 2, but this may be a facies change which resulted when the sea withdrew at the close of Vicksburg time. The exact

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[1] A. C. Twenhofel, op. cit., p. 105.

[2] W. A. Kelly, personal communication.

character of the contact cannot be determined with the data available.

As already explained in the section on the Frio, the Sam Fordyce sandstone is the uppermost member of the Vicksburg formation. This sandstone is composed of greenish-gray, medium-textured, angular grains of white and gray quartz, calcite, amphibole, and glauconite, plus a small percentage of accessory minerals. As in the other formations, these mineral identifications are based on physical properties.

The highest occurrence of the Jackson fauna is used for the contact between the Jackson and the overlying Vicksburg. Although no lithologic break is apparent, the abrupt change from Jackson fauna to Vicksburg fauna and the elimination of several significant sand beds is convincing evidence for the presence of one or more unconformities or diastems. This interpretation is shown on Figure 3.

The Vicksburg is composed of marine shales, sandy-shales, and sandstones. The calcareous shales and sandy-shales are mainly gray, brown-gray, and green-gray, but a few beds of mottled red and gray shales occur, as well. The sandstones are gray and green-gray course-to-fine sandstones having essentially the same mineralogic composition as the Sam Fordyce sandstone.

Figure 3 shows the general trend of the facies changes throughout Vicksburg time. One fact which is not emphasized on Figure 3, but which should be considered, is the occurrence of several sandy lenses in the upper Vicksburg shales of the DePerez well.

These sandy shales are essentially different from both the shales and sandy shales found in the Flores well. For the most part they are gray shales; however, they have a few coarse quartz grains. Because the samples occur at intervals of 30 to 32 feet in this section of the well, it is rather difficult to estimate the thickness of the beds. However, judging from the proportion of the sandy shale present, the writer doubts if they attain a thickness exceeding 3 feet, and are certainly less than 5 feet in thickness. Since they are so far from the shore line, as implied in the Flores well, and since they lack fossils, they probably represent reworked offshore bars.

A few specimens of Charophyta occur in the Flores sample in the 4,350-to-4,380-feet interval. Since these do not occur in any of the other Vicksburg samples below the top of the Sam

Fordyce sandstone, the writer is convinced that they are indigenous to the original sample. Furthermore, since they are considered characteristic of brackish or fresh water, they may indicate local continental conditions. Since continental conditions imply that beds will be eroded if exposed, the writer has used the presence of Charophyta as partial evidence for the unconformities at the base of the Vicksburg.

Foraminifera and Ostracoda are relatively rare, compared to the faunas reported as existing in the Vicksburg near the coast. Although eighteen different species are listed, only one or two specimens of many occur in the samples examined.

Cibicides americana (Cushman)
Cyclammina sp. A
Elphidium poeyanum (d'Orbigny)
Eponides vicksburgensis Cushman and Ellisor
Globigerina bulloides d'Orbigny
Globigerinella sp. A
Gumbelina sp. A
Gumbelitria sp. A
Guttulina problema (d'Orbigny)
Haplophragmoides sp. A
Nonion advenum Cushman
Quinqueloculina sp. D
Robulus limbatus (Bornemann)
Robulus vicksburgensis (Cushman)
Rotalia sp. A
Spiroplectammina mississippiensis (Cushman)
Textularia tumidula Cushman
Textularia warreni Cushman and Ellisor

Elphidium, Globigerinella, and Gumbelina are very common in the area, and especially in the sandstone beds. According to Lowman,[1] abundant numbers of Elphidium are characteristic of the inner neritic zone. The large number of species with few representatives is also characteristic of the inner neritic zone.[2]

On the basis of the paleontologic data, it is concluded that the Vicksburg sea was rather shallow, and that the continental slope and coastal plain had a rather gentle slope. If one compares the paleontologic data with the results of Lowman,[3] one observes that the Vicksburg sea in this area definitely did not exceed 100 feet in depth. Although a quantitative analysis of the data was not attempted, it is believed that a maximum depth of 40 feet is a good estimate in Starr and Hidalgo Counties.

The lithologic evidence as portrayed on Figure 4 supports the theory of a shallow, gently-sloping sea floor. The

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[1] S. W. Lowman, op. cit., p. 1956.

[2] Ibid., p. 1952, Fig. 12.

[3] Loc. cit.

sandstones, sandy shales, and shales indicate a rather rapid shifting of the shore line over relatively short periods of time. Furthermore, the presence of the coarse quartz grains in some of the shale beds in the DePerez well, as already explained (page 24) are most easily accounted for as offshore bars formed along a shallow-water, gently sloping continental shelf. Although the evidence is not conclusive, this seems to be the best interpretation that can be made on the basis of the present data.

Whitsett Formation

Although a complete set of samples occurs in the Whitsett Formation of the Roos well, the other wells have samples only near the top of the member.

The lithology is dominantly brownish-gray and gray sandy shales and shales, but a few beds of gray, coarse-to-fine sandstones also occur. Quartz is the dominant constituent of the sands, but amphibole and glauconite are common. Minor amounts of the accessory minerals also are present. Calcite and silica are the predominant cementing constituents in the sandstones.

According to E. D. Guzman,[1] field workers do not agree on the marker horizon for the top of the Whitsett. Some prefer to use the top of the Marginulina cocoaenensis zone, while others prefer to use the top of the Anomalina jacksonensis zone. No Marginulina cocoaenensis occurs in these well samples and therefore it cannot be used. The absence of Marginulina is probably due to ecologic conditions. Since Marginulina is most common in water which is 145 to 300 feet deep,[2] and since the upper part of the Jackson in this area is a shallow-water deposit (Figure 2), Marginulina cocoaenensis is probably very rare, if it occurs at all. On the other hand, using the upper limit of the Anomalina jacksonensis zone to determine the contact is unsatisfactory for it occurs at a variable depth below the top of the formation.[3] The Jackson fauna differs greatly from the Vicksburg fauna in these wells. Furthermore, the Jackson fauna is quite abundant even in the regressive sandstones at the top of the formation; consequently, it offers a

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[1] E. D. Guzman, op. cit., p. 1356.

[2] S. W. Lowman, op. cit., p. 1961.

[3] E. D. Guzman, op. cit., p. 1356.

vivid contrast to the comparatively sparse fauna of the Vicksburg. For these reasons, the top of the Jackson fauna is used to mark the top of the formation. For comparison, the top of the Anomalina jacksonensis has been plotted on Figure 2.

The bottom of the Massilina pratti zone marks the lower limit of the Whitsett Formation.[1]

As already mentioned, and as demonstrated in the following list of Foraminifera, the Jackson has a large number of both species and individuals.

Ammobaculites agglutinans (d'Orbigny)
Anomalina bilateralis Cushman
Anomalina jacksonensis (Cushman and Applin)
Bolivina gracilis Cushman and Applin
Bolivina jacksonensis Cushman and Applin
Bolivina jacksonensis Cushman and Applin var. striatella Cushman and Applin
Bulimina jacksonensis Cushman
Cibicides cooperensis Cushman
Cibicides sp. A
Dentalina sp. A
Elphidium eocenicum Cushman and Ellisor
Eponides pygmaea (Hantken)
Globigerina bulloides d'Orbigny
Globigerinella species A
Globulina gibba d'Orbigny
Gumbelina sp. A
Gyroidina sp. A
Hantkenina alabamensis

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[1] W. G. Meyer, op. cit., p. 163.

Marginulina sp. A
Massilina pratti Cushman and Ellisor
Nonion inexcavatum (Cushman and Applin)
Nonion scaphum (Fichtel and Moll)
Nonionella hantkeni (Cushman and Applin)
Planularia sp. A
Pleurostomella jacksonensis Cushman and Applin
Polymorphina sp. A
Pseudopolymorphina dumblei (Cushman and Applin)
Robulus limbosus (Reuss)
Robulus propinquus (Hantken)
Saracenaria italica (Defrance)
Siphonina carltoni Cushman and Ellisor
Spiroplectammina alabamensis (Cushman)
Textularia hockleyensis Cushman and Applin
Textularia sp. B
Uvigerina alata Cushman and Applin
Uvigerina cocoaensis Cushman
Uvigerina dumblei Cushman and Applin
Uvigerina gardnerae Cushman
Virgulina dibollensis Cushman and Applin

The sandstones have a less abundant fauna which is dominated by Elphidium; however, no essential difference exists between the faunas of the sandy shales and the shales.

The Buliminidae and Lagenidae are the most abundant families both in species and numbers. Comparing this faunal assemblage with that analyzed in present-day seas leads to the conclusion that the Jackson sea in this area is representative of the neritic zone.[1] The predominance of the Buliminidae and

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[1] Ibid., pp. 1954-55.

Lagenidae indicate that the ocean was relatively deep during most of upper Jackson time.

Although the lack of complete samples hinders definite conclusions concerning the nature of the Whitsett sea in this area, a few general statements can be logically interpreted. The rapid facies changes in the lower Whitsett samples of the Roos well (Figure 2) indicate that the shifting shore line was located in central Starr County at this time. Furthermore, the long succession of sandy shales and shales in the 3,300-to-3,800-feet interval indicate a major advance of the Jackson sea during middle Whitsett time. The sandy shales in the middle of this interval probably should be interpreted as a significant retreat during the over-all advance. The sandy shales and sandstone persisting at the top of the Whitsett indicate a major regression of the sea at the close of the Eocene. Such a major withdrawal must have resulted in an unconformity, as shown on Figure 2.

CONCLUSIONS

During most of the Upper Eocene the neritic zone of the sea occupied this area, but at the close of the Eocene the sea withdrew, permitting the development of a major unconformity. In Lower Oligocene time the sea gradually advanced as far west as central Starr County. Apparently the coastal plain and continental shelf had a very low gradient at this time, for offshore bars were developed. Many diastems are inferred to exist in the Vicksburg, and the strand line seems to have fluctuated on either side of the Starr-Hidalgo border during most of Vicksburg time.

Another retreat of the sea is recorded at the close of the Vicksburg, which possibly resulted in an unconformity. For the most part, the Frio is a deltaic or continental deposit. Overlying it is the continental Catahoula and the marine Anahuac. The exact westward limit of the Anahuac is not determined, but it probably extends within two miles east of the Starr-Hidalgo Boundary.

The exact nature of the Frio-Catahoula contact cannot be inferred from the data which are available.

This study also discloses the fact that many commercial well samples are inadequate for detailed ecologic studies. S. W. Lowman has made a very excellent quantitative study of the ecologic relations of modern Foraminifera; however, this detailed data cannot be fully applied. Rotary samples are subject to so many sources of pollution that a worker cannot be sure that the Foraminifera are definitely diagnostic of the ecology of any single bed. The Rotary samples are quite satisfactory, however, in determining the dominant environment of a formation.

Although the available samples have had a limiting effect on the results, it is hoped that this study has clarified the subsurface lithologic and ecologic relationships in Starr and Hidalgo Counties.

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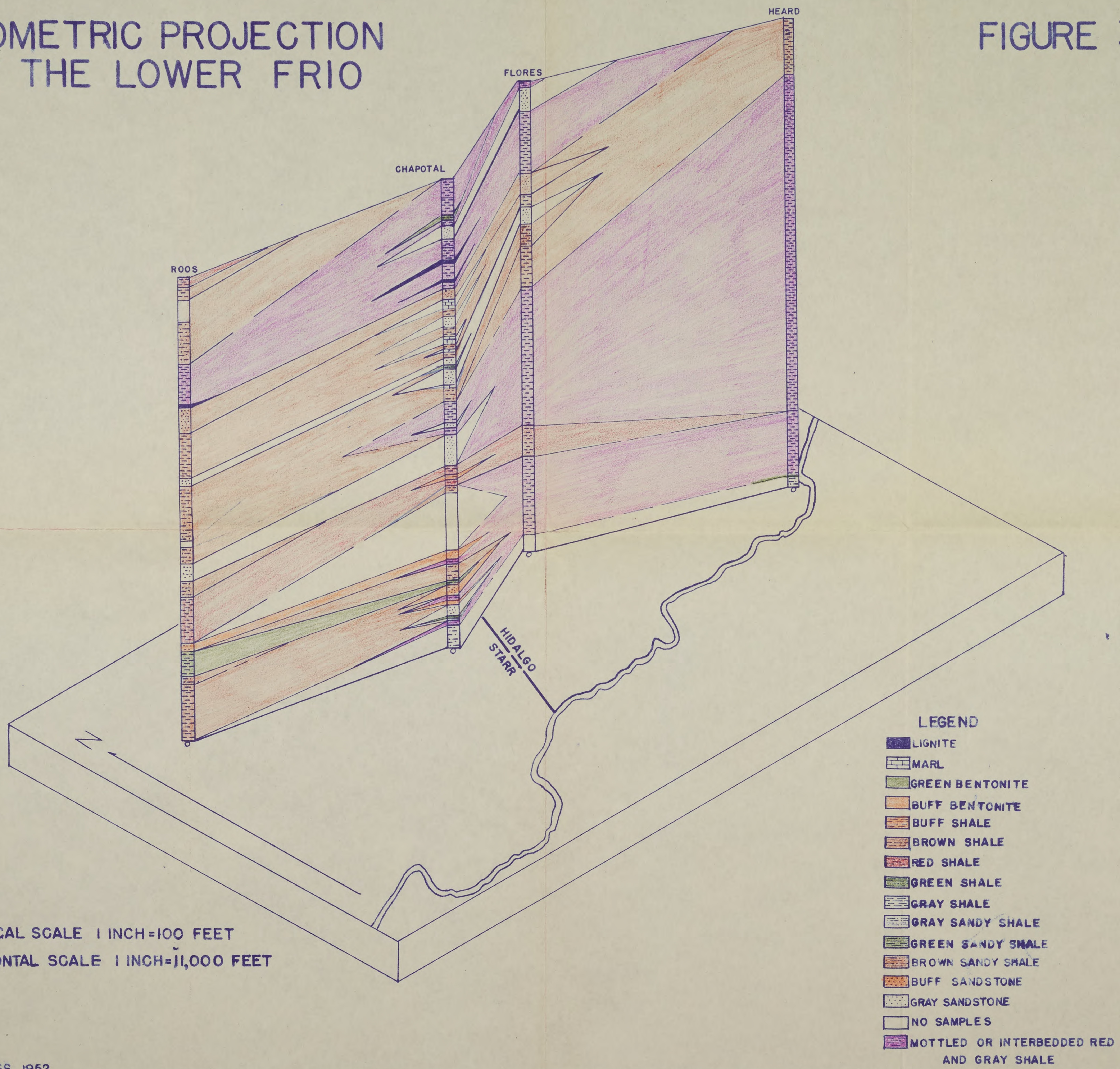
ISOMETRIC PROJECTION OF THE LOWER FRIO

FIGURE 3



VERTICAL SCALE 1 INCH=100 FEET

HORIZONTAL SCALE 1 INCH=~11,000 FEET

K.A. RIGGS, 1952