INFORMATION CIRCULAR 41

CHATTAHOOCHEE ANTICLINE, APALACHICOLA EMBAYMENT, GULF TROUGH AND RELATED STRUCTURAL FEATURES, SOUTHWESTERN GEORGIA, FACT OR FICTION

by

S. H. Patterson and S. M. Herrick

THE GEOLOGICAL SURVEY OF GEORGIA
DEPARTMENT OF MINES, MINING AND GEOLOGY

Jesse H. Auvil, Jr.
State Geologist and Director

ATLANTA

1971

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ILLUSTRATIONS

CHATTAHOOCHEE ANTICLINE, APALACHICOLA EMBAYMENT, GULF TROUGH AND RELATED STRUCTURAL FEATURES, SOUTHWESTERN GEORGIA--FACT OR FICTION

by

S. H. Patterson [1] and S. M. Herrick [2]

Abstract

Many different locations have been proposed for the Chattahoochee Anticline without convincing supporting evidence. The original interpretation and a redefinition of this anticline in 1965 are now known to be incorrect. Probably the small Gordon Anticline does exist in the southern part of the area that many geologists thought was occupied by the Chattahoochee Anticline. The influence of the small Gordon Anticline on the regional dip, plus the shift in the strike of Coastal Plain formations along the Chattahoochee River from a northeast direction in Georgia to a westerly direction in Alabama, may have been the cause of the many different interpretations of the structure of this region.

The Gulf Trough is a large elongate sedimentary basin extending northeast from the Apalachicola Embayment. Several authors have expressed the opinion that this trough is a graben, and others have called it a syncline. Some geologists have thought that the Ochlockonee Fault of Sever forms the southeast side of the trough. Reassessment of the geologic data upon which this fault was proposed led to the conclusion that the fault is no more than hypothetical and that the formal name should be considered invalid. The evidence now available is insufficient to prove the origin of the Gulf Trough. It may be a sediment-filled Tertiary strait or marine valley instead of a syncline or graben, and its configuration probably has been modified extensively by the solution of carbonate rocks.

[1] U. S. Geological Survey, Beltsville, Md.

[2] U. S. Geological Survey, Atlanta, Ga.

Introduction

Most of the structural features in the Georgia Coastal Plain that have been proposed were compiled by Cramer (1969). His compilation is helpful to geologists working in south Georgia, because it presents in one article most of the numerous ideas which have evolved through the years, and which need to be considered in understanding the geologic structure of the region. Cramer's intent was to compile the various ideas about the structural features in the region, but he made no attempt to evaluate any of them.

One of the principal objectives of this paper is to evaluate some of the proposals regarding structural features in southwestern Georgia, and to point out that some of the hypothetical structural features in the Coastal Plain rocks are either incorrectly delineated or are misrepresented in published reports. We see a real possibility that poorly substantiated features, through repeated use by geologists, may become generally accepted by the profession. When and if this happens, some of the questionable and even invalid structural features will be used in other geologic interpretations, and, as a consequence, errors will be compounded so that a reasonable understanding of the structure of the Coastal Plain will be made more difficult, if not impossible.

The lack of agreement among geologists concerning the extent of Tertiary formations and structural features in southwestern Georgia becomes obvious to anyone making even a cursory review of the literature. Much of the disagreement is caused by factors that make geologic observations difficult. Most surficial rocks are thoroughly weathered, and large areas are blanketed by residuum. The best exposures for study are in scattered roadcuts, strip mines, quarries, sinkholes, and stream beds. Many of the rocks are characterized by both vertical and lateral gradations of one rock type into another; therefore, key horizons on which to base structural interpretations and formational boundaries commonly are difficult to recognize. Regional dips of Cenozoic rocks are very gentle in the direction of the Atlantic Ocean and the Gulf of Mexico, and any reversal in the regional dip is difficult if not impossible to observe in surficial rocks. Because of the sparsity of outcrops, much of the knowledge of Coastal Plain rocks must be obtained by the study of well cuttings and other methods of investigating subsurface strata. The lack of adequate subsurface data in critical areas is one of the major roadblocks to the understanding of the structure of southwestern Georgia. Still another difficulty in interpreting the structural features of the region results from the extensive solution of carbonate rocks. Beds displaced downward due to solution of underlying rocks make it difficult to correlate rock units and can easily be misinterpreted as having been displaced by tectonic forces. Because of all these unfavorable factors, the general lack of agreement among geologists concerning the areal and structural geology of the region is not surprising.

Much of the disagreement about the structural geology of southwestern Georgia centers about the location and extent of the Chattahoochee Anticline, Apalachicola Embayment, Gulf Trough, and features associated with them. The conflicting interpretations are well illustrated when the anticlines, synclines, and embayments that have been proposed are plotted on one map (Fig. 1) and the faults on another (Fig. 2). Major differences in the interpretations of the areal geology related to these features also are revealed in a comparison of the maps by Veatch and Stephenson (1911), Cooke (1943), and MacNeil (1947). The maps by these geologists are reproduced here (Figs. 3, 4, and 5) in simplified form in order to illustrate the uncertainties of the extent of Tertiary formations in this region. Cooke's mapping is shown as it was reduced and included as a part of the Geologic Map of the United States (U. S. Geol. Survey, 1932).

Acknowledgments

The authors benefited materially from discussions with several geologists during the preparation of this article. H. R. Cramer of Emory University aided in locating several references containing information on structural features of the region and discussed related problems with the authors. S. M. Pickering, Jr., of the Georgia Department of Mines, Mining and Geology, permitted the citation of unpublished geologic information on an area he is investigating in Georgia. R. O. Vernon, C. W. Hendry, Jr., and H. S. Puri of the Florida Bureau of Geology, and B. F. Buie, W. F. Tanner, and L. D. Toulmin of Florida State University discussed problems related to the geologic structure of the region. R. C. Vorhis, H. F. LeGrand, and V. T. Stringfield of the U. S. Geological Survey read the manuscript and made constructive criticisms.

CHATTAHOOCHEE ANTICLINE

Previous Interpretations

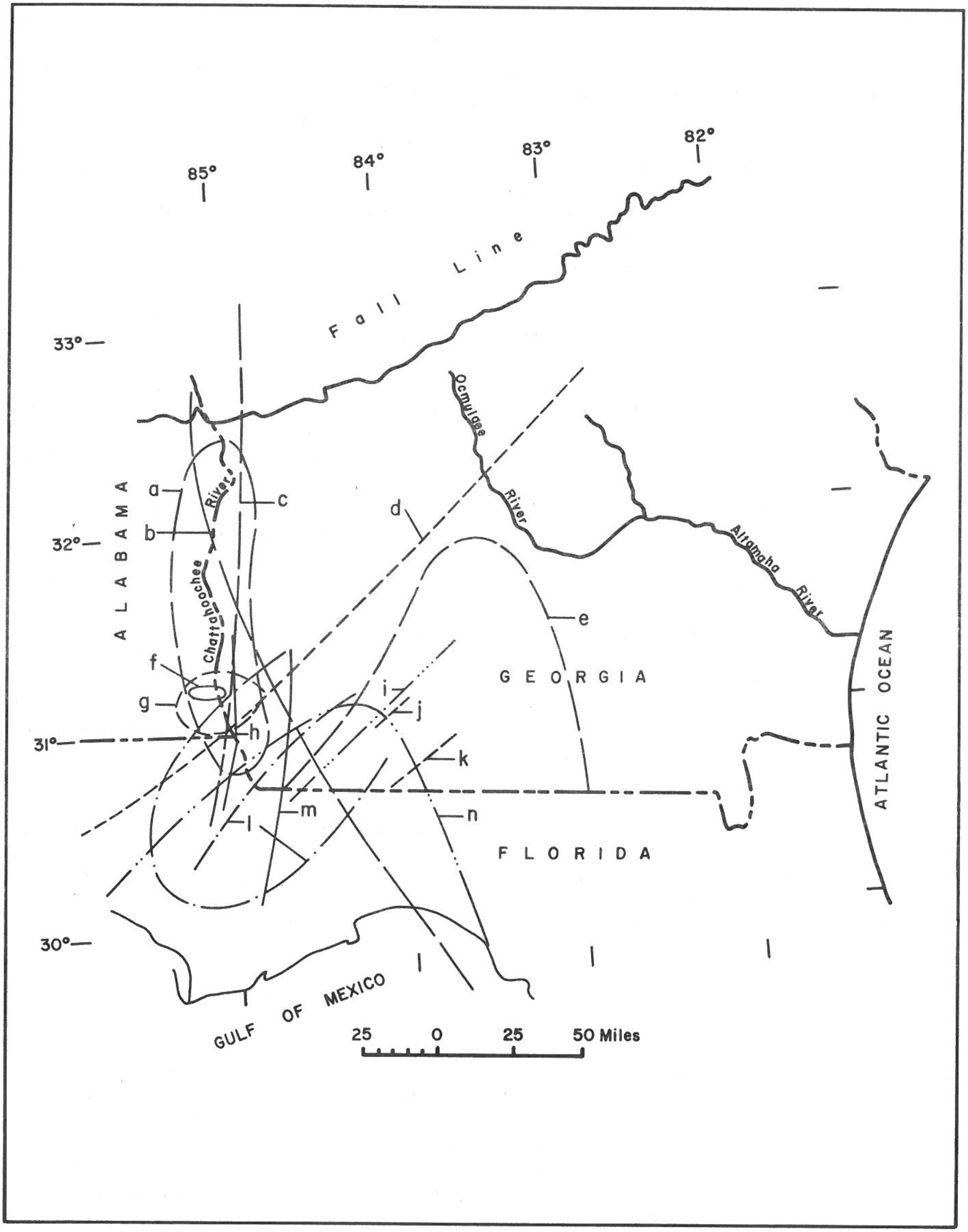
The existence of the Chattahoochee Anticline was first postulated by Veatch (*in* Veatch and Stephenson, 1911, p. 62, 63), who showed it as extending for approximately 100 miles in a northerly direction and straddling the Chattahoochee River for which it was named (Fig. 1). Stephenson (1926, Pl. 1) illustrated an axis of an anticline overlapping Veatch's broad uplift and extending in a southeasterly direction into the Gulf of Mexico more or less parallel to the coast of peninsular Florida. Stephenson did not name this anticline, but its relation to the Chattahoochee Anticline is clear because of its extent and the fact that he was co-author with Veatch (Veatch and Stephenson, 1911) of the bulletin in which the original postulation was made. Later, Stephenson (1928a, Fig. 1; 1928b, Fig. 12) apparently changed his mind about the location of the Chattahoochee Anticline, because he illustrated its axis as extending northward along the river (Fig. 1) from northern Florida to beyond the overlap of Coastal Plain strata on older crystalling rocks in Georgia. Leet (1940, Fig. 1) illustrated the axis of the Chattahoochee Anticline in approximately the same position that Stephenson had plotted it in 1928, but did not extend it as far north as the crystalline rocks. Toulmin (1955, Fig. 2) apparently agreed with Leet on the location of this anticline because he illustrated its axis as in approximately the same position. Stringfield (1964, Fig. 1; 1966, Fig. 22) and Stringfield and LeGrand (1966, Fig. 2) show the axis of the Chattahoochee Anticline in the same position Toulmin placed it. Murray (1961, p. 103, Fig. 3.10) uses the name "Chattahoochee Arch" but did not plot it on his map of major structural features in the region. Puri and Vernon (1964, Fig. 2), in outlining the general geology of Florida, show the Chattahoochee Anticline as a large elliptical dome having an arcuate northeast-trending axis. They locate the anticline south and east of the area in which most earlier reports show it; however, they were illustrating the major structural features of Florida in an artistic drawing and had not attempted to locate the anticline accurately (R. O. Vernon, oral commun., Dec., 1969). Sever (1965, p. 42, Fig. 5) attempted a redefinition of the Chattahoochee Anticline and showed it trending northeast and extending more than 225 miles (Figs. 1 and 4). His redefinition was based on Cooke's mapping as reduced and included as part of the Geologic Map of the United States (U. S. Geol. Survey, 1932).

Pressler (1947, Fig. 1) also was convinced of the existence of an anticline having a northerly trend in the region. However, he plotted the axis to the earlier locations (Fig. 1, m), and named his proposed uplift the Decatur Arch. He gave no explanation for the name, though it presumably was after Decatur County, Georgia. Applin (1951b, p. 407), Richards and Straley (1953, Fig. 1), and Gunter, Vernon, and Calver (1953, p. 42 and 48) all used the name Decatur Arch and apparently accepted Pressler's idea of its location. Hendry and Yon (1958, p. 21) also list the name Decatur Arch in a review of historical structural features in the region, and Hendry and Sproul (1966, p. 95) in another review list the name "Decatur Arch (Chattahoochee Anticline)." Neither Pressler in his original proposal of the Decatur Arch, nor any of the other authors who have used the term, gave any evidence for the existence of this anticline or discussed it in detail.

A comparatively small domal uplift called the Gordon Anticline (Fig. 1, f) has been proposed in the southern part of the area that many geologists have thought was occupied by the large Chattahoochee Anticline. The discovery of the small anticline was announced by Hager (1918, p. 426, Fig. 1). He described it as extending from near Gordon, Alabama, into Georgia, and as having a closure of 40 feet and an area of 10 square miles. Hager did not actually name this anticline in a formal sense, but listed the name "Gordon" under the heading "prospective pools," in his figure. Adams (1929, p. 202) looked for the Gordon Anticline and found ".....some irregularities of dip on the river at the place noted, but no well-defined structure." A somewhat larger inferred, unnamed dome (Fig. 1, g) was illustrated by Applin (1951a, Fig. 2) in the area surrounding the Gordon Anticline. Other reports having a bearing on the Gordon Anticline are Toulmin and LaMoreaux (1963, Fig. 4), and Toulmin, LaMoreaux, and Newton (1963). These authors, though they make no mention of a structural feature, illustrate a reversal of dip in their geologic section along the Chattahoochee River at the location of the Gordon Anticline. This reversal is probably the irregularity of dip noted by Adams.

Discussion

The authors, in attempting to evaluate the validity of the various conflicting ideas on domal uplift along the Chattahoochee River, find that most published reports in which structural features are proposed, fail to spell out supporting evidence in a convincing manner. Many articles simply illustrate the axis of an anticline on a small scale map and mention the feature by formal name in the text. Most of the questionable evidence in support of the Chattahoochee Anticline was outlined by Veatch (*in* Veatch and Stephenson, 1911) in his original proposal, and by Sever (1965) in his redefinition. The results of several investigations, both published and unpublished, are in opposition to the ideas advanced by Veatch and Sever. None of the authors who have used the name "Decatur Arch" cite evidence in support of their interpreta-


85°
84°
83°
82°
33°
32°
31°
30°
Fall Line
Ocmulgee
River
Altamaha
River
Chattahoochee
River
ALABAMA
GEORGIA
FLORIDA
ATLANTIC OCEAN
GULF OF MEXICO
a
b
c
d
e
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g
h
i
j
k
l
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n
25
0
25
50 Miles

tion. Geologic observations related to the small Gordon Anticline are published in several reports on unrelated work.

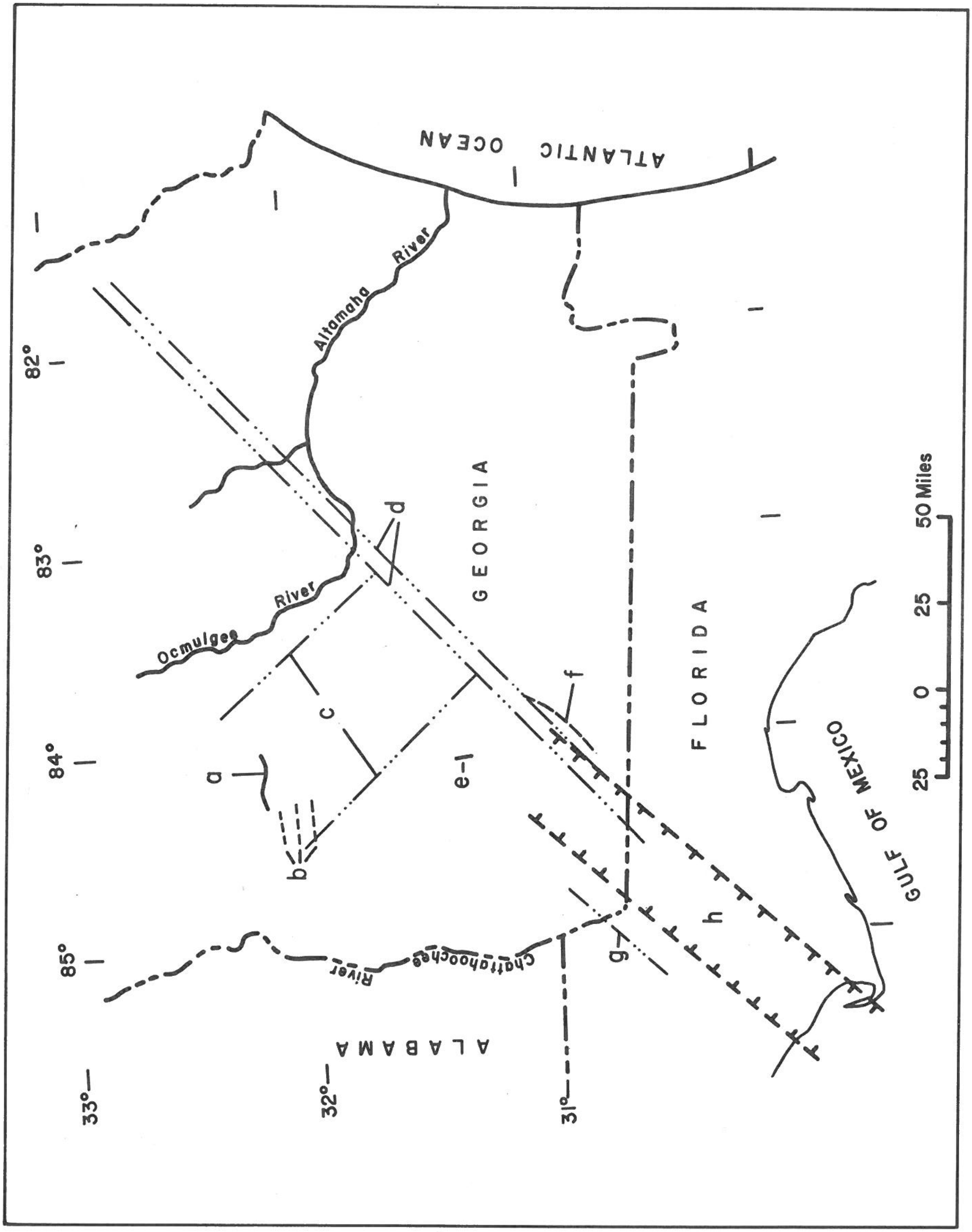
Veatch (*in* Veatch and Stephenson, 1911, p. 62-65, Fig. 5) proposed the Chattahoochee Anticline mainly on the basis of the north-south alignment of the Chattahoochee River along the axial part of the elongate uplift, as he visualized it (Fig. 1, a), and the entrenchment of that river. His ideas regarding this anticline are suspect for the following reasons: 1) the course of the Chattahoochee River is nowhere diverted as it should be, if it were influenced by an uplift, and the proposed axial position of this river is an unlikely one; 2) the entrenchment of the river is not sound evidence for an anticline along it, because similar entrenchment has been noted further west in Alabama where it is attributed to regional uplift in Pliocene time (Adams, 1929, p. 202).

Sever's (1965) redefinition of the Chattahoochee Anticline was based mainly on mapping by Cooke, as it was reduced and included as part of the Geologic Map of the United States (U. S. Geol. Survey, 1932). This map shows an irregular lenticular core virtually surrounded by Oligocene rock, seemingly indicative of an anticline located as Sever has illustrated it (Fig. 1, d; Fig. 4) in his redefinition. However, several lines of evidence and reasoning support the conclusion that the enclosure of older rocks by younger ones is due to topography and not to domal uplift, with the possible exception of the immediate vicinity of the small Gordon Anticline. Therefore, Sever's redefinition of the Chattahoochee Anticline is no more correct than Veatch's original proposal. To begin with, no evidence of an anticline along the Chattahoochee River has been revealed by the two other major attempts to map the Coastal Plain rocks of Georgia (Figs. 3 and 5). The differences between these maps and Cooke's (Fig. 4) illustrate clearly that the extent of Tertiary formations is not well enough known to ascertain the existence of the anticline, as Sever redefined it. Secondly, Cooke himself is quoted by Munyan (1938, p. 796-797) as believing that his core of Eocene rocks surrounded by Oligocene results from topography, a conclusion also reached by Prettyman and Cave (1923, p. 110). This is possible because the older rock is mainly in the valley of the Flint River, and the younger ones are on the uplands. The third point is that several geologists have looked for and failed to find evidence for the reversal of regional dip necessary for an anticline to occur, either as originally proposed by Veatch or as redefined by Sever. Further reasons for questioning both the original proposal and redefinition, and for concluding that the core of older rock surrounded by younger rock on Cooke's map is due to topography, are outlined as follows:

Probably the first geologist who looked for the Chattahoochee Anticline and disagreed with Veatch's idea was Adams (1929, p. 202), who concluded that ".....no one has adduced geologic facts that support the suggestion made by Veatch." Geologic sections by Applin and Applin (1947) of Upper Cretacous rocks of the region show only the gentle regional dip, and no reversal as would be required by the Chattahoochee Anticline. The work by Toulmin and LaMoreaux (1963, p. 385, Fig. 4) and Toulmin, LaMoreaux, and Newton

Figure 1. Approximate areas or axes of anticlines, synclines, and embayments proposed in southwestern Georgia.

a. Chattahoochee Anticline of Veatch (*in* Veatch and Stephenson, 1911, Fig. 5).
b. Anticline of Stephenson (1926, Pl. 1).
c. Chattahoochee Anticline of Stephenson (1928a, Fig. 1; 1928b, Fig. 12).
d. Chattahoochee Anticline of Sever (1965, Fig. 5).
e. Withlacoochee Anticline of Veatch (*in* Veatch and Stephenson, 1911, Fig. 5)
f. Gordon Anticline (Hager, 1918, Fig. 1; Sever, 1965, Fig. 2).
g. Interred dome (Applin, 1951a, Fig. 2)
h. Chattahoochee Anticline of Leet (1940, Fig. 1) and Toulmin (1955, Fig. 2)
i. Approximate axis of Gulf Trough (Fig. 6 of this report)
j. Meigs Basin of Sever (1966a, Fig. 1; 1966b, Fig. 2)
k. Barwick Arch of Sever (1966a, Fig. 1; 1966b, Fig. 2)
l. Chattahoochee Anticline of Puri and Vernon (1964, Fig. 2)
m. Decatur Arch of Pressler (1947, Fig. 1)
n. Southwest Georgia Basin of Murray (1957, Fig. 2) and LeGrand (1961, Fig. 3); Apalachicola (southwest Georgia) Embayment of Murray (1961, p. 103); Apalachicola Basin of Stringfield (1966, Fig. 22)


ATLANTIC OCEAN
GEORGIA
FLORIDA
ALABAMA
GULF OF MEXICO
Altamaha River
Ocmulgee River
Chattahoochee River
82°
83°
84°
85°
33°
32°
31°
a
b
c
d
e-1
f
g
h
25
0
25
50 Miles

(1963), on the stratigraphy of Coastal Plain rocks along the Chattahoochee River, demonstrates that regional dip is to the south at the approximate rate of 13 feet per mile. Though they do not mention structural features, their findings show no reversal of the regional dip, as would be required by Veatch's anticline. Their figure, however, does show a minor reversal in the vicinity of Hager's "prospective pool." The absence of any deviation or reversal of the regional dip east of the Chattahoochee River, where it would be required if either Veatch's anticline or Sever's redefinition of it were correct, is reported by Herrick and LeGrand (1964, p. 27) and has been recognized by other geologists. R. C. Vorhis (written commun., July, 1969) has found continuity of regional dip in a southeasterly direction in Sumter, Dooly, Pulaski, Lee, and Crisp Counties, Georgia. Similar uniformity of regional dip has also been found by S. M. Pickering, Jr., of the Georgia Department of Mines, Mining and Geology, in parts of the Perry and Cochran Quadrangles. Pickering (1970, p. 5) states that the Chattahoochee Anticline does not exist in this area. The area investigated by Vorhis (Fig. 4) extends across the projected axis of the Chattahoochee Anticline as redefined by Sever (1965, p. 42, Fig. 5). Pickering's area is on the northwest side of the proposed anticlinal axis, where the dip would have to be in the opposite direction from what he found, if the redefinition were correct.

Herrick and LeGrand (1964) have shown that much of the area on Cooke's map, where Eocene rocks are illustrated as surrounded by Oligocene (Fig. 4), is an extensive solution plain drained by the Flint River. This plain has been a major area of ground water recharge, and the movement of water has resulted in a high degree of solution of carbonate rocks. Virtually all the Oligocene rocks have been removed over a large area, leaving Eocene sediments immediately overlain by a blanket of residuum. Oligocene rocks occur in their normal position downdip on the southeast side of the plain and as scattered outliers on the other sides where recharge has been less active or solution has not progressed to the complete removal stage. The result is that the rocks of this region can be mapped as Eocene virtually surrounded by Oligocene (Fig. 4), giving the false indication of an anticline.

The small Gordon Anticline is the only proposed domal uplift along the Chattahoochee River about which published reports agree, and some geologic evidence for its existence has been presented. Though Hager (1918, p. 426, Fig. 1) failed to provide evidence for his Gordon "prospective pool," the inferred dome by Applin (1951a, Fig. 2) enclosing Hager's anticline seems to be more than a coincidence. Applin's dome was based on his findings that the pre-Mesozoic rocks penetrated in three deep oil tests were higher than in the surrounding region. Furthermore, the irregularities in dip noted by Adams (1929, p. 202), and the dip reversal illustrated by Toulmin and LaMoreaux (1963, Fig. 4), and Toulmin, LaMoreaux, and Newton (1963), which is based on stratigraphic sections measured from the river, agree well with Hager's idea of the Gordon Anticline.

APALACHICOLA EMBAYMENT AND GULF TROUGH

Previous Interpretations

The area extending north and northeast of the mouth of the Apalachicola River, as far as the Georgia-Florida boundary, has been thought to be structurally depressed since Johnson (1892) proposed the "Chattahoochee Embayment" of

Figure 2. Proposed faults in southwestern Georgia.

a. Andersonville Fault (Zapp, 1965, p. 9, Pl. 1).
b. Probable fault (Owen, 1963b, Figs. 1, 3, and 6).
c. Probable fault (Callahan, 1964, Fig. 5).
d. Inferred fault (Callahan, 1964, Fig. 5).
e. Probable fault (Owen, 1963a, p. 22, Fig. 2).
f. Ochlockonee Fault of Sever (1966a, Figs. 1-3; 1966b, Figs. 2, 3, and 8).
g. Inferred fault (Callahan, 1964, Fig. 5), in part Cypress Fault (Moore, 1955, p. 26-29, Pl. 1).
h. South Georgia Graben of Tanner (1966, p. 85, Fig. 1); northwest fault of graben is presumably the Bainbridge-Chattahoochee-Blountstown Fault of Tanner (1966, p. 87).

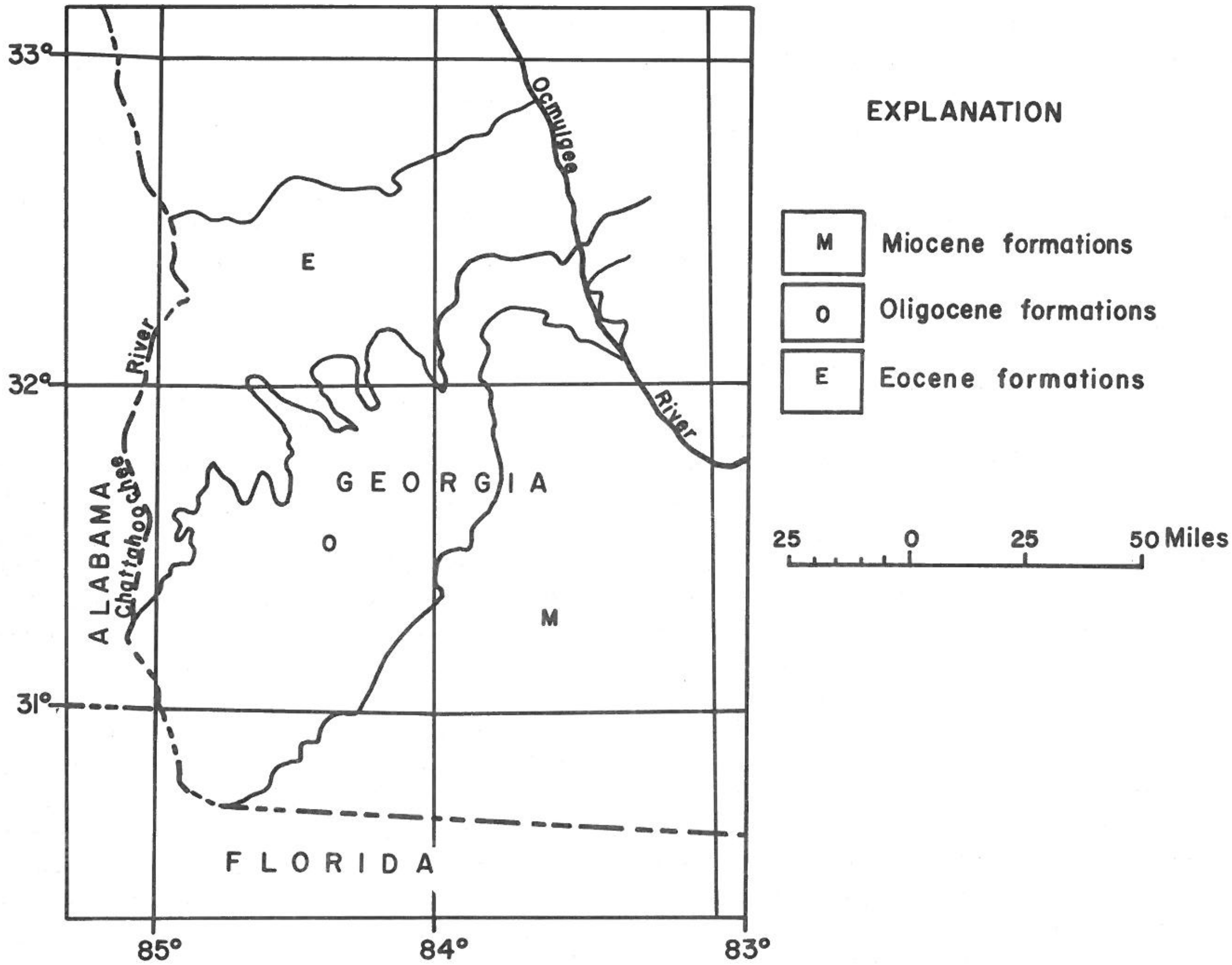


Figure 3. Tertiary formations in southwestern Georgia, generalized from Veatch and Stephenson (1911).

the Gulf of Mexico. This region was described as structurally low by Mossom (1926, p. 208), and a small unnamed syncline extending northeast through the Tallahassee, Florida, area into Georgia was illustrated by Stephenson (1928a, Fig. 12). Leet (1940, p. 875, Fig. 1) illustrated this same feature and described it as a shallow syncline separating the "Chattahoochee and Florida Upwarps." Applin and Applin (1944, p. 1727, Figs. 14 and 15) apparently also recognized a channel or trough in this region and thought it to be a major "structural" feature. They illustrated its axis as approximately in the same position as Stephenson's syncline on a structure contour map of the top of the Middle Eocene, and about 25 miles farther west on a map of the Upper Eocene. Pressler (1947, p. 1853, Fig. 1) described a belt of thick sediments as lying between the Ocala Uplift and the Central Georgia Uplift. He applied the name "Apalachicola Embayment of the Gulf Basin" to this belt, placing the formal name over the general area of the Apalachicola River delta on his map of major structural features.

Murray (1957, Fig. 2) illustrated a triangular area with one side along the Gulf of Mexico in the region of the Apalachicola River mouth and the bight of Florida, and an apex extending well into southwestern Georgia (Fig. 1); he named this area the "Southwest Georgia Basin." LeGrand (1961, Fig. 3) accepted Murray's name and location of this feature. Murray in 1961 (p. 103, Fig. 3.10) illustrated it in the same place and with the same name as in his earlier report, but in his text he

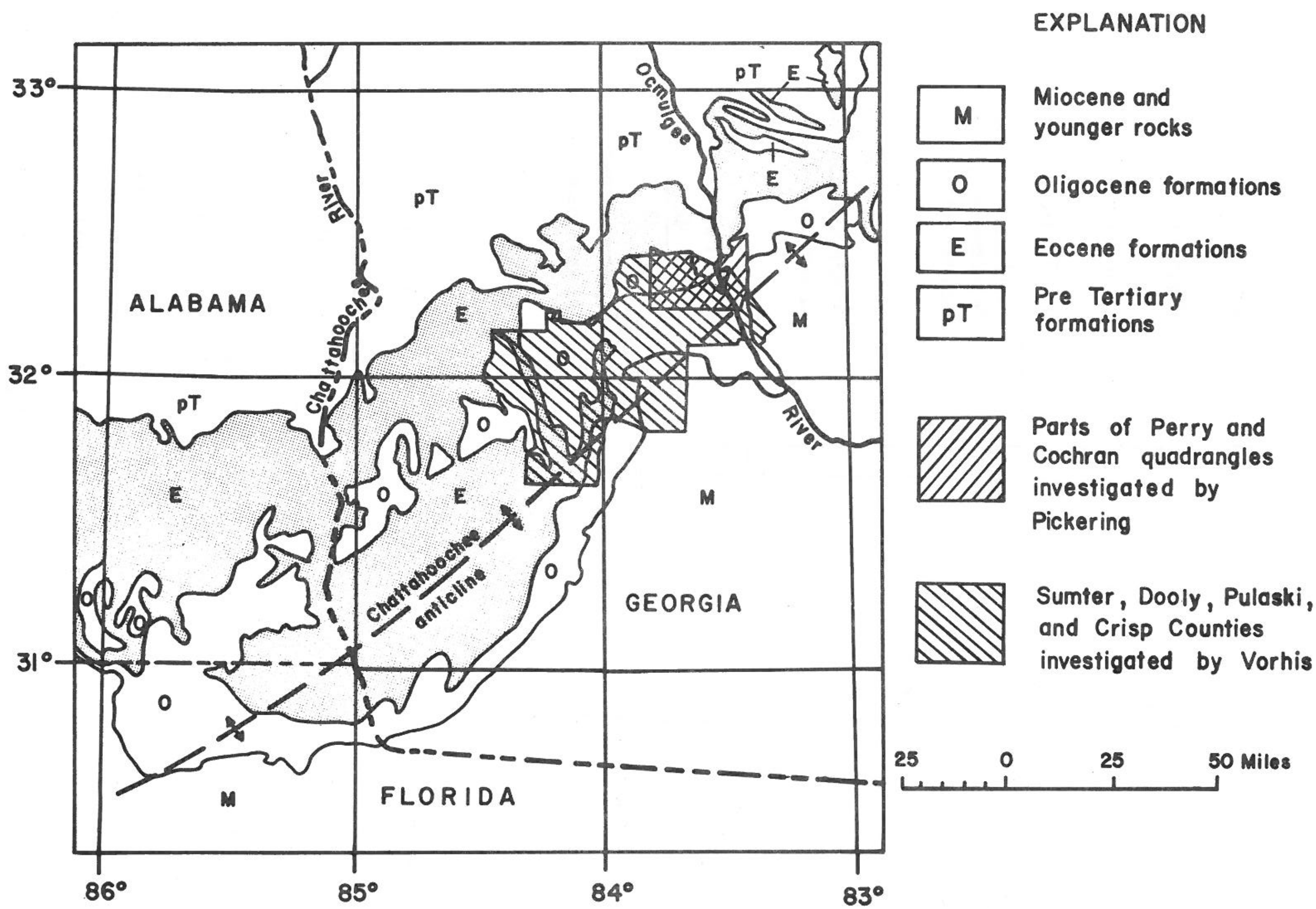


Figure 4. The Chattahoochee Anticline as redefined by Sever (1965), on mapping by Cooke as shown on the geologic map of the United States (U. S. Geol. Survey, 1932).

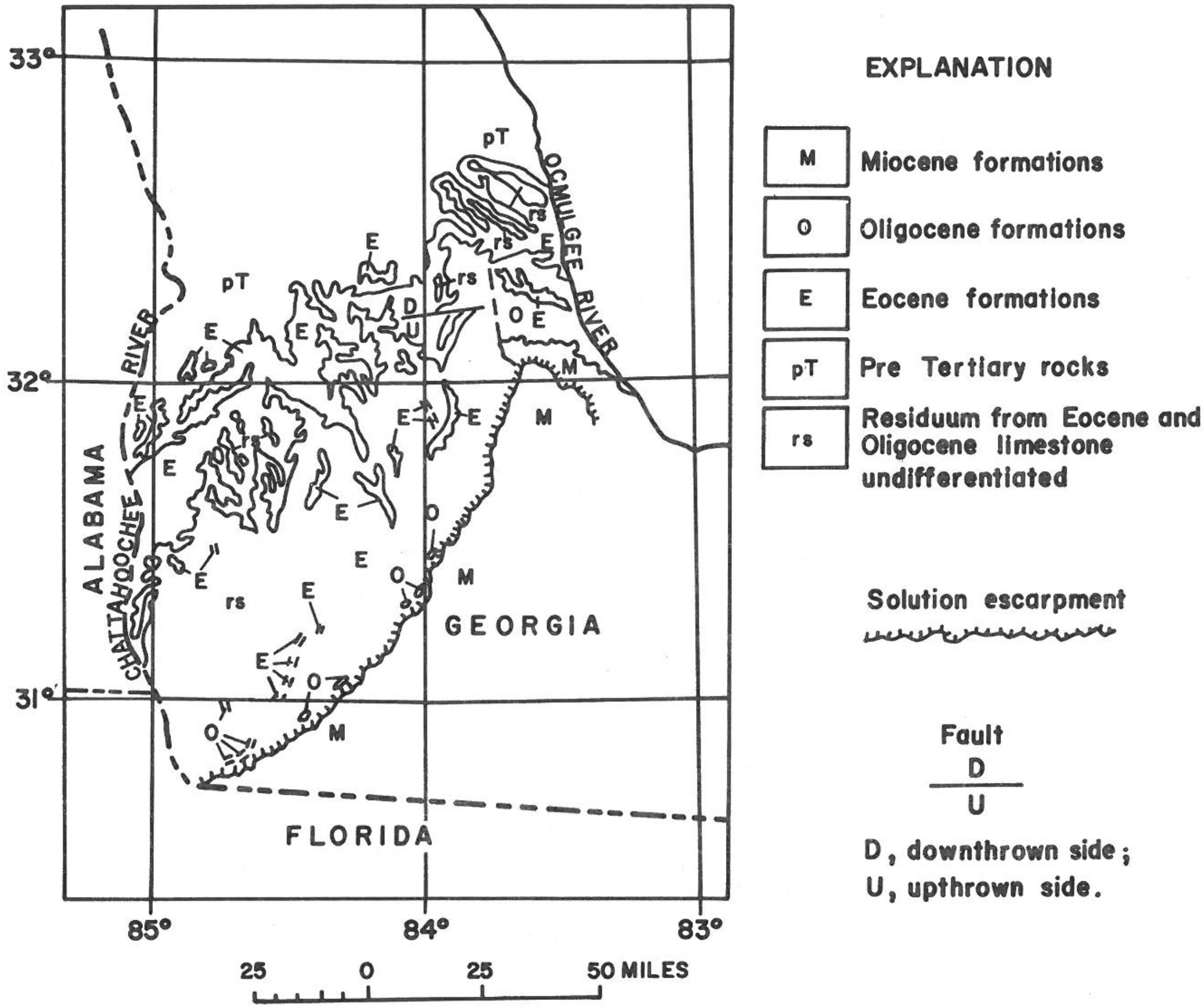


Figure 5. Tertiary formations in southwestern Georgia, generalized from MacNeil (1947).

referred to it as the "Apalachicola (Southwest Georgia) Embayment," presumably to indicate that his and Pressler's structural feature were the same or at least closely related. Stringfield (1966, Fig. 22) used the name "Apalachicola Basin"[3] and illustrated it as having the same extent as Murray indicated. The name "Apalachicola Embayment" has also been used for this feature by Puri and Vernon (1964, Fig. 2), Hendry and Sproul (1966, p. 95), and Sever, Cathcart, and Patterson (1967, p. 28-29, Fig. 1), but they did not outline the feature on a map.

[3]Stringfield (oral commun., July, 1969) now believes that the Apalachicola feature should be referred to as an embayment instead of a basin, because it is not closed on its southern end.

The Tertiary sediments in the Apalachicola Embayment are exceptionally thick, and an elongate belt of thick sediments extends northeastward into Georgia from the embayment. The southern part of this belt occupies the area of the trough or channel recognized by Applin and Applin (1944, p. 1727), and the trough therefore included much of the embayment. However, the trough extends much farther than the area most authors have illustrated for the Apalachicola Embayment. A belt of thick Miocene sediments has been shown to exist through middle Georgia in an isopachous

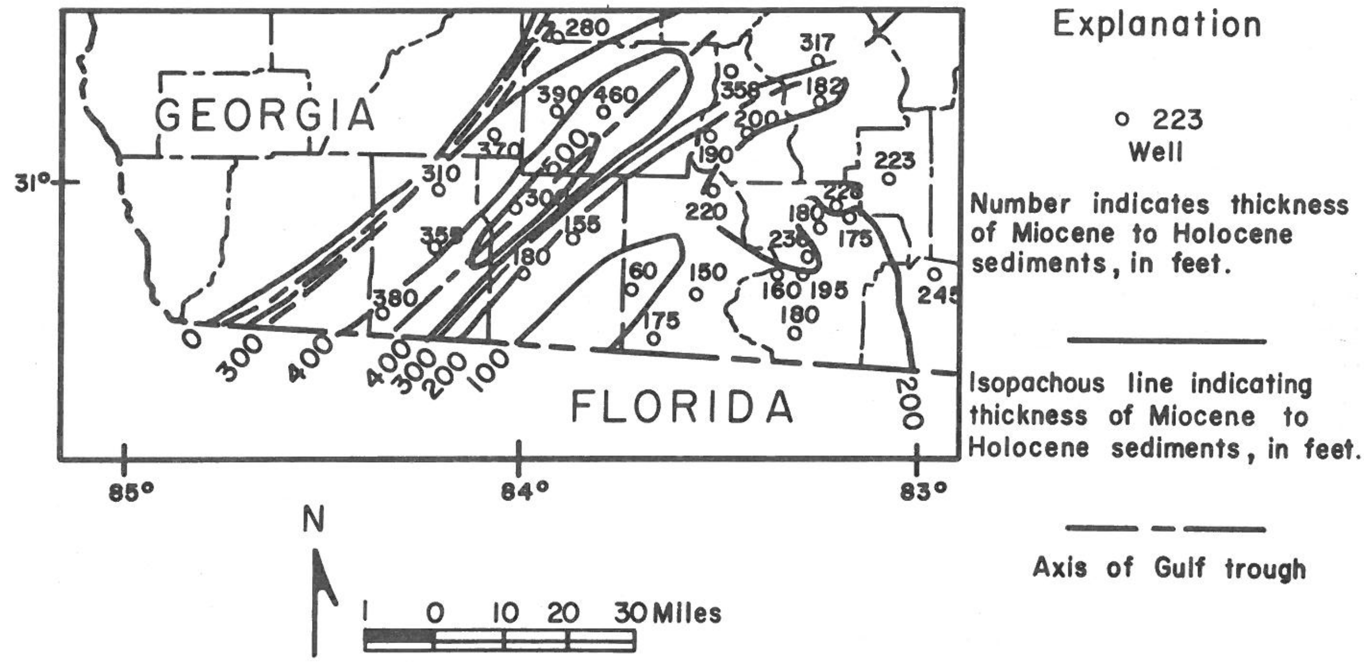


Figure 6. Thickness of Miocene to Holocene sediments in Gulf Trough in southwestern Georgia, modified from Herrick and Vorhis (1963, Fig. 2).

map by Toulmin (1952, Fig. 7). Herrick and Vorhis (1963, p. 55, Figs. 2 and 3) show this belt (Fig. 6) much as Toulmin illustrated it, and they applied the name "Gulf Trough of Georgia" to it. Hendry and Sproul (1966, p. 97), in referring to the Florida part of this feature, dropped the Georgia restriction from the name and used the more practical term "Gulf Trough," which was also used by Sever, Cathcart, and Patterson (1967, p. 29, Fig. 1). Other authors who have recognized this trough as a sediment-filled depression, but who do not apply a name to it, include Sever (1962, 1964), Owen (1963a, p. 24), Buie and Gremillion (1963, p. 22), and Gremillion (1965, p. 47-48).

The preceding paragraphs deal primarily with the complex nomenclature of the Apalachicola Embayment and Gulf Trough, and still other terms have been proposed for features thought to be related to these. Rainwater (1956, p. 1727) expressed the opinion that part of the Suwanee Strait, a Tertiary channel, extends along the Georgia-Florida boundary eastward from beyond the southwest corner of Georgia, and thus directly across the area where the embayment and the trough probably merge. However, the Suwanee Strait was originally defined by Dall (in Dall and Harris, 1892, p. 111, 121-122) as extending along the Suwanee River in Florida and through the Okefenokee Swamp in Georgia, and was shown at this location by Puri and Vernon (1964, Fig. 2). No redefinition of this feature has been made that would permit the use of the name as far west as Rainwater suggested. A second term, the "Meigs Basin," was introduced by Sever (1966a, p. C12, Figs. 1-3; 1966b, p. 8, Figs. 2-4) for part of the Gulf Trough in northwestern Thomas County, Georgia. This so-called basin may actually be a depression in the much larger trough, but Sever failed to demonstrate that it is closed on its northeastern end, and the use of the term is questionable.

Discussion

Differing opinions of the nature of the Gulf Trough and its origin have been expressed by several geologists. Those who have favored the hypothesis that the trough is a graben include Sever (1962), Gremillion (1965, p. 47-48), Tanner (1966, p. 85, Fig. 1), and Hendry and Sproul (1966, p. 96). Murray (1961, p. 103) also would seem to be of the same opinion, and he describes the "southwest Georgia Embayment" as being a downfaulted area; however, a downfaulted embayment might be quite different from a graben. Owen (1963a, p. 24) referred to the trough as a syncline or a "down faulted area." Sever (1964, Fig. 2) illustrated it in a cross section as a syncline, but in his later reports (Sever, 1966a, 1966b) it is shown and described as a syncline with a fault on its southeast side. Applin and Applin (1944, p. 1727), in their original recognition of this feature, refer to it as a trough or channel. Herrick and Vorhis (1963, p. 55, Figs. 3, 6, and 8) simply refer to it as a structural basin or depression, without indicating whether it is a graben, syncline, or something else.

Another possibility is that the Gulf Trough may be a large solution valley. Evidence that rocks older than Oligocene have undergone much solution in the region has been presented by Toulmin and Winters (1954) and Stringfield (1966, p. 76-88). Evidence of solution of the Oligocene rocks in the area discussed in this report follows:

1. Drillers frequently report that their tools drop when they are drilling below the Miocene section, indicating that a cavern has been penetrated.

2. Well cores from depth commonly contain abundant solution cavities and vugs.

3. Widespread subsurface solution is indicated by the abundance of sinkholes, which mark the surface of the region and occur even where the uppermost formations are mainly sand. Not only are sinkholes known to be abundant because of their topographic expression, but probably many have been completely filled by younger sediments, and no suggestion of their presence appears at the surface. One such sinkhole filled by slumped material is illustrated by Sever (1966b, Fig. 5), who indicated that it is evidence of folding.

4. Well cuttings and cores of carbonate rocks of Oligocene age and older from the trough area commonly have been dolomitized, and some units are nearly pure dolomite. Much of the dolomite is in euhedral crystals, indicating a post-depositional origin and suggesting rather intense chemical alteration, during which much of the original carbonate rock was dissolved.

Still other possible origins of the Gulf Trough are that it may have been a submarine valley or a strait, and the elongate depression may have formed mainly by the erosion of sediments or by the impeding of sedimentation by ocean currents. In connection with the strait idea, it should be noted that the depression in the present ocean floor in part of the Straits of Florida between the mainland and the Great Bahama Bank, as illustrated on a map by Uchupi (1966), is not much different from the shape of the Gulf Trough. The idea of a strait separating peninsular Florida from the mainland is not new and was first published by Dall (Dall and Harris, 1892, p. 111, 121-122) to explain a belt of thick Miocene sediments filling an elongate depression he called the "Suwanee Strait." Dall's Suwanee Strait is east of the Gulf Trough and is apparently a separate feature. However, Rainwater (1956, p. 1727) suggested that the Suwanee Strait extended across the area that the Apalachicola Embayment and Gulf Trough are thought to occupy. Accordingly, Rainwater deserves credit for favoring the idea that the Gulf Trough represents a strait.

The foregoing outline should make it clear that, in the authors' judgment, the origin of the Gulf Trough is not understood. Further discussion of the graben hypothesis is necessary, because it is favored by several geologists, although none have presented convincing evidence of the existence of faulting and a downthrown central block. As noted by Cramer (1969, p. 117), the southeast side of the "South Georgia Graben" (Fig. 2, h) of Tanner (1966, p. 85, Fig. 1) would be the so-called "Ochlockonee Fault" of Sever (1966a, p. C12, Figs. 1-3; 1966b, p. 8, Figs. 2-4). Inasmuch as these structural features, if they exist, would exert a major influence on the fuller's earth and ground-water resources of the area, the authors reexamined the geologic data on which the so-called Ochlockonee Fault was proposed. We found, during our studies of well logs, cuttings and outcrops, that the most reliable and persistent key horizon on which to base structural interpretations in southwestern Georgia is the top of the Suwannee limestone of Oligocene age. Younger units are characteristically discontinuous, and horizons within them can be traced only short distances, hence, they are unsatisfactory for structural interpretations. Criteria for distinguishing the Suwannee Limestone from the overlying Miocene carbonate rocks are its lower quartz sand content, higher dolomite content, Oligocene microfossils, and higher porosity and permeability.

Our restudies of the geologic data, on which the Ochlockonee Fault of Sever is based, lead us to the conclusion that the existence of this feature is not supported by reliable or convincing evidence. The elevations of the top of the Suwannee that were determined at many well sites and outcrops do not differ greatly from those illustrated by Sever (1966a, Fig. 1; 1966b, Fig. 2). We therefore agree with Sever to the extent that the top of the Suwannee is high in the vicinity of his "Barwick Arch" (Fig. 1), which is a short distance east of the proposed fault, and is at lower elevations in the central part of the Gulf Trough. The top is at an elevation of 175 feet above sea level along the crest of the proposed arch, and 195 feet below sea level in well GGS-495 near the town of Meigs. The distance between these points is 18 miles, and the average lowering of the top is about 15 feet per mile. However, no evidence was found in any of the well data or outcrops to suggest that movement along a fracture had taken place, which is a critical requirement for the existence of the Ochlockonee fault.[4] We therefore conclude that this fault is no more than a hypothetical possibility.

The "high" in the top of the Suwannee Limestone along the so-called Barwick Arch of Sever (1966a, Fig. 1; 1966b, Fig. 2) does not prove the existence of this anticline, and it too should be questioned. One of the reasons for questioning this arch is that water wells in this vicinity do not penetrate through Oligocene rocks, and there is little information to prove or disprove the existence of such a feature. With the evidence now available, we cannot rule out the possibility that the apparent reversal of the regional dip from the arch into the Gulf Trough is an initial dip resulting from deposition on the east side of a strait or a submarine valley. The apparent dips in this vicinity also may have been modified significantly by carbonate solution, inasmuch as structure contour maps on the top of the Oligocene in areas south of the arch (Hendry and Sproul, 1966, Fig. 16; Yon, 1966, Fig. 10) show a buried karst topography having high areas of the same magnitude as that illustrated by Sever for the Barwick Arch.

Other proposed faults, which could have some bearing on the graben hypothesis, include: (1) two inferred elongate northeast-southwest-trending faults (Callahan, 1964, Fig. 5) approximately on the east side of the Gulf Trough (Fig. 2, b); (2) an inferred fault on the same trend west of the Gulf Trough (Fig. 2, g), which was apparently proposed by Moore (1955, p. 26-29, Pl. 1) and called the Cypress Fault. This fault was extended into southwestern Georgia by Callahan (1964, Fig. 5); and (3) the Bainbridge-Chattahoochee-Blountstown Fault (Tanner, 1966, p. 87, Fig. 1), which is presumably the northwest fault of the South Georgia Graben. With the exception of Moore's discussion of the Cypress Fault, none of the reports in which faults outlined above were proposed, present adequate supporting evidence. Insofar as the authors of this article are aware, most of these faults are hypothetical. We support our questioning of the existence of many of these faults by Rainwater's (1956, p. 1727) statement in reviewing the Cypress Fault, one of the best documented of the proposed faults, as follows "Proof of such a fault is inadequate although the upper Eocene is thinner and of more shallow deposits northwest of Cypress than the contemporaneous beds on the southeast. This area is probably in the southwest part of the Suwannee Strait, a Tertiary channel comparable with the present Florida Strait....."

Conclusions

So many different ideas on the location and extent of the Chattahoochee Anticline have been published (Fig. 1) without supporting evidence that anyone who reviews them has difficulty in distinguishing the imagined from reality. Accor-

[4]Patterson was a coauthor (Sever, Cathcart, and Patterson, 1967) of a report containing the names Ochlockonee Fault and Barwick Arch; however, that report contains an introductory statement to the effect that the structure discussed is Sever's responsibility alone.

dingly, interpretations of this feature, presented without evidence, should be considered as no more than hypothetical. Sufficient geologic evidence is now available to conclude that the original proposal of the existence of this anticline by Veatch and Stephenson (1911), and the redefinition by Sever (1965) should be considered invalid. Probably the name Chattahoochee Anticline should be dropped by the geologic profession because of the confusion attached to it. Use of the name Decatur Arch also should be discouraged until such time as evidence for its existence is presented.

Apparently, the small Gordon Anticline actually exists in the southern part of the area that so many geologists have illustrated as occupied by the Chattahoochee Anticline (Fig. 1). Probably the influence of this small anticline on regional dips has been one of the main reasons for the many conflicting interpretations of the structure of the region. A second reason is that the dip of Coastal Plain rocks is mainly in the direction of the Atlantic Ocean in Georgia and toward the Gulf of Mexico in Alabama, the change in strike taking place approximately along the Chattahoochee River. This change in strike results in apparent dips to the east in Georgia and to the southeast in Alabama, which is probably most of the reason for the numerous different interpretations of the Chattahoochee Anticline.

The thick elongate belt of Miocene rocks filling the Gulf Trough indicates that this feature was a depression of major dimensions. It probably was an extension of the Apalachicola Embayment during at least part of its history, as is suggested by its apparent mergence with the embayment on the south. The origin of the trough, however, has never been satisfactorily explained. In the absence of adequate evidence for the Gulf Trough having been formed by tectonic forces, the authors believe its shape (Fig. 6) is indicative of a sediment-filled strait or marine valley. However, the ample evidence of deep carbonate solution makes it probable that the shape of the trough has been modified by this process. The second author favors the idea that the trough is mainly a solution valley, and has suggested this origin for a similar feature farther east in Georgia (Herrick, 1967, p. 95-96).

Insufficient evidence for the Ochlockonee Fault was presented by Sever (1966a, p. C12, Figs. 1-3; 1966b, p. 8, Figs. 2-4) to justify the existence of this feature. Furthermore, the authors could find nothing to support a conclusion that movement along a fracture had taken place in the area where this fault was proposed. Accordingly, the Ochlockonee Fault of Sever can be no more than hypothetical, and this formal name should be considered invalid. Several other faults have been proposed in southwestern Georgia (Fig. 2). The existence of the Andersonville Fault, which is in older rocks than referred to in this report, has been well documented by Zapp (1965, p. 9, Pl. 1) and Owen (1963b, p. 38, Pl. 1), but convincing evidence for the other faults has not been published.

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