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TECTONISM OF ATLANTIC AND GULF COASTAL PROVINCE

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ABSTRACT. The Atlantic and Gulf Coastal province, which extends for 5000 kilometers along the southeast side of North America, contains an immense pile of sediments, lenticular in cross section and with maximum thicknesses as great as 15 kilometers; the total volume is of the order of 10 million cubic kilometers. Deposition of these sediments began in the Late Jurassic to Late Cretaceous, according to locality, but was interrupted, at least in large parts of the province, in the Middle Cretaceous (major), at the end of the Cretaceous, of the Paleocene, and of the Early Eocene (relatively minor), after the late Miocene and into the Quaternary (major). Earlier Mesozoic deposition was intermittent and areally more restricted, probably mainly in large deep grabens.

The province is bounded on the continent side by Paleozoic tectonic trends of the Appalachian and Ouachita Mountains from Canada to Texas, but by Laramide (mainly early Cenozoic) Cordilleran tectonic trends from Mexico to Honduras; the latter trends formed after the beginning of deposition in the coastal province. The inner part of the province clearly rests on sialic crust, mainly deformed or metamorphosed Paleozoic rocks at least as far south as northern Mexico, but relations on the oceanward side are uncertain and subject to much speculation. The location of the sedimentary pile was determined, according to alternative views, by the original border of the continent, by change of originally sialic crust to simatic crust, or by attenuation or rifting of sialic crust as a result of global expansion, large-scale wrench faulting, or continental drift, or by some combination of the above.

INTRODUCTION

General.—The Atlantic and Gulf coastal province of southeastern North America, partly a paraliageosyncline of Kay (1951), is a major three-dimensional geologic element of the continent—a Mesozoic-Cenozoic sedimentary mass superimposed upon Paleozoic and Precambrian rocks. The sedimentary prism is roughly lenticular in cross section and is properly considered geosynclinal along the northern and southern margins of the Gulf of Mexico where sedimentary thicknesses are on the order of 15,000 meters. A depoaxis also occurs at the seaward edge of the Blake Plateau where the sedimentary thickness is 7000 to 10,000 meters. Northward, two depoaxes contain sediments 3000 to 6000 meters thick off New England beneath the shelf and slope (see U.S. Geol. Survey tectonic map of U.S., 2d ed., 1961; and Emery, 1965).

The coastal province, underlain by this Mesozoic-Cenozoic sedimentary mass, consists of two approximately equal parts: one part emerged adjacent to the shores of the Atlantic Ocean and Gulf of Mexico, the other submerged beneath these water bodies where they form the continental shelves, slopes, and rises (see fig. 1). Northeast of Cape Cod, however, the coastal province is completely submerged. Contemporaneous sediments underlie the surfaces of the Blake Plateau and the Atlantic abyssal plain and form relatively thick layers beneath the Sigsbee abyssal plain of the Gulf of Mexico. Even *sensu lato,* the coastal province can hardly be extended outward to include these abyssal

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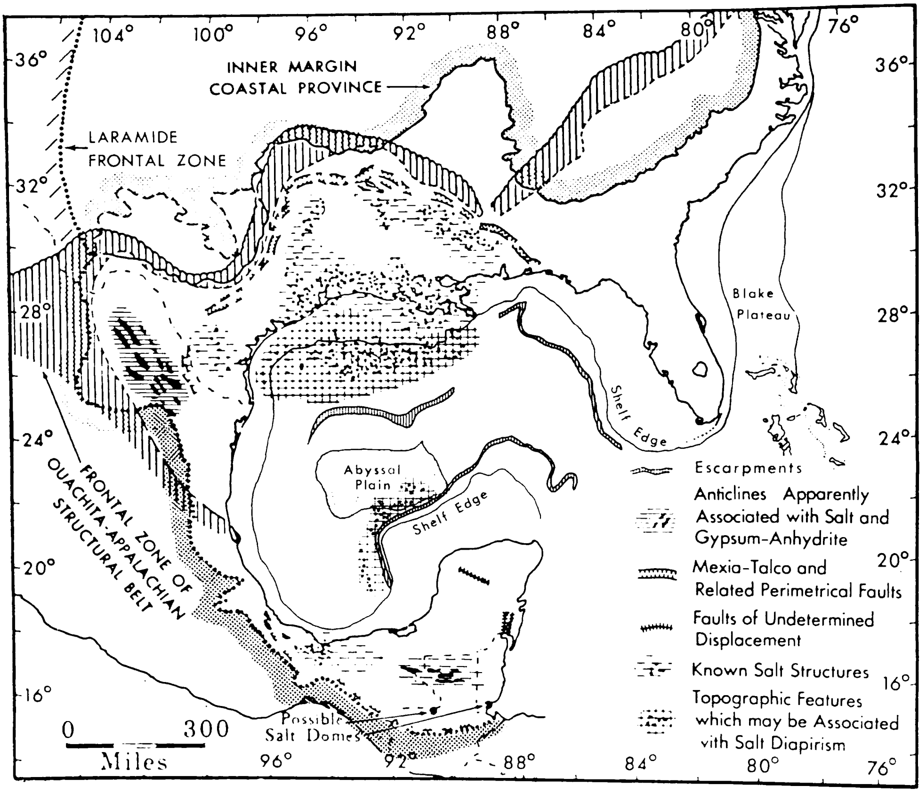


Fig. 1. Tectonic features of the Gulf and southern Atlantic coastal areas.

regions. However, only when we comprehend the genetic relation of the oceanic and continental crusts beneath these areas can we completely understand the coastal geology.

Interior boundaries of the coastal province.—Prior to Middle Cretaceous time the coastal province was limited inward by a Paleozoic tectonic belt, including the Appalachians, the Ouachitas, and the Central American Cordillera, and extending from maritime Canada southwestward 3000 miles (5000 kilometers) to Honduras. Subsequently, pronounced transgressive overlap submerged the marginal areas from Arkansas to Honduras, but no evidence of a similar overlap across the Appalachians is known. In particular, Late Cretaceous exogeosynclinal sediments accumulated in the shallow Rocky Mountain seaway, which connected the Arctic and Gulf basins, and were subsequently uplifted by the Laramide orogeny. From Paleogene to Recent time, the Gulf basin was again delimited on the northwest, west, and southwest.

The modern inner limit of the coastal province from Mexico to Honduras is determined by the southeastward extension of the Laramide structural belt. Northeastward, it is generally located at the inner limit of Gulfian (Late Cretaceous) outcrops, as along the Balcones fault trend in Texas and within the Mississippi embayment farther east, so that it is determined by erosion rather than by original deposition. In general, however, the present inner boundary coincides rather closely with the original depositional limit of Late Jurassic strata, which in turn was delimited by the Paleozoic tectonic belts except in the Mississippi embayment where sediments of the coastal province extend northward onto the craton.

Coastal province geometry and alternate hypotheses of crustal behavior.—The way the Appalachian and Ouachita tectonic belts border the Paleozoic North American craton and, in turn, are bordered by the coastal province and the Atlantic and Gulf basins has suggested to many that these belts originally developed as geosynclines marginal to the Paleozoic continents and that their consolidation by orogeny ultimately enlarged the continent by peripheral "accretion" (Kay, 1951). Unfortunately, the thick sedimentary cover of the coastal province has prevented locating the limit, on the Atlantic and Gulf sides, of these Paleozoic tectonic trends, except where lower and middle Paleozoic sedimentary rocks have been identified by drilling in the Ocala region of northern Florida and southern Georgia. The unmetamorphosed, shallow-water character of these rocks suggests that this region was on the southeast side of the belt of tectonic activity. Thus, the only available evidence does not seem to support the concept that the tectonic trends developed at the continental margins. On the other hand, the evidence does not preclude the possibility that tectonic activity occurred in belts near the continental margins and was a factor in affecting (1) the form of the continent and (2) the location of subsequent geosynclines.

If, as some believe, continental drift formed the Atlantic and Gulf basins in post-Paleozoic time, the Paleozoic tectonic belts might well have been partly intra-cratonic during the Paleozoic and were only subsequently separated by the widening Atlantic from most of the craton originally adjacent to them on the east—Florida and perhaps Yucatán might be fragments of this eastern craton, fragments that drifted westward with North America while most of the craton remained east of the Atlantic.

The original positions of Paleozoic crustal elements might also have been altered by such major fractures as the Bartlett fracture in the Caribbean region and its westward extension through Central America, the Murray, Molokai, and Clarion fractures in the Pacific basin and their eastward extensions into Mexico and Texas, and the probable major fracture in the Atlantic basin that strikes the continent between New Jersey and New England.

If rifting and wrenching have contributed to drift during post-Paleozoic time, one can understand why it is difficult to reconstruct Paleozoic paleogeography from the present spatial distribution of

Paleozoic crustal elements or to determine, for example, the relationship of the Ouachitas to the Appalachians (King, 1950, 1951). Furthermore, the coastal province as well as the Gulf and Atlantic basins may have been affected by horizontal crustal movement.

The location of the geosynclinal axis of the Gulf basin in the northern Gulf of Mexico continentward from the interface between continental and oceanic crust, abnormally thin continental crust beneath this axis, marked subsidence in association with sedimentation in the Gulf through extended spans of geologic time, and basinward slumping of major sedimentary masses conceivably suggest that the continental crust along the Gulf margins may have been thinned by major rifting (drift). The peculiar fit of the escarpments bounding the abyssal plain of the Gulf of Mexico (see fig. 1) also suggests that the Gulf basin, like the Atlantic basin, originated primarily by drift.

Conversely, the crustal elements may have remained generally in the same relative positions. If so, they may have been transformed from one type of crust to the other by *in situ* phase changes, or they may have retained their original crustal character. Worzel (1965) supports the latter hypothesis and suggests the possibility that slight global expansion may account for the presence of depoaxes along the margins of the continent.

Each of these possibilities—rifting, wrenching, slight extension, stability, or phase change, singly or in combination—presumably would have produced a somewhat different geologic history of the coastal province. It is the purpose of this paper to summarize geologic events of the region that may be pertinent to an indirect understanding of possible post-Paleozoic crust-mantle relationships.

TECTONIC FRAMEWORK

General.—Although the major problems concerning the behavior of the crust and upper mantle through time are still unsolved, it is possible to demonstrate the influence of known tectonic trends on the evolution of the coastal province. Two are of primary importance, each a segment of a worldwide pattern transcending not only the coastal province but even North America. The orogenic phase of the Paleozoic trends of Eastern North America was completed prior to the initiation of the coastal province whereas orogenies in the Cordilleran trend culminated during the evolution of the coastal province in the Mesozoic and Cenozoic.

Sediments of the coastal province rest unconformably on rocks varying greatly in type, age, and degree of deformation. In addition to the unmetamorphosed early to middle Paleozoic strata in Georgia and Florida, rocks underlying coastal province strata include cratonic Paleozoic sediments in the Mississippi embayment; deformed sediments and metamorphics of the tectonic belts, some of which may be Precambrian in age; post-orogenic upper Paleozoic sediments; and Late Triassic taphrogenic sediments.

Paleozoic tectonic belts.—Although the Appalachian orogenic cycle did not terminate until after the Early Permian, climactic orogenies occurred earlier in various segments of the Paleozoic tectonic belts. In these areas, post-orogenic erosion and sedimentation produced upper Paleozoic sequences that rest unconformably on the rocks deformed or metamorphosed in the preceding orogeny (see de Cserna, 1958; Murray, 1961). Thus, post-orogenic Carboniferous sediments occur in maritime Canada and New England, in southern Arkansas and northern Louisiana, and in northeastern Mexico in Chihuahua, Nuevo León, and Tamaulipas. Similarly, post-orogenic strata of Permian age occur in West Texas, and sediments of both Carboniferous and Permian age are present in Chiapas, Guatemala, and British Honduras.

During the early Mesozoic, epeirogenic and taphrogenic activity (block faulting) occurred over a considerable length of the Paleozoic tectonic trend, regardless of the timing of the preceding orogeny. The Newark Group, consisting of graben-fill detritals, is the best known deposit of this phase. Of Late Triassic age, such sediments are known to extend from Newfoundland to Georgia. Faulting, contemporaneous with sedimentation, tilted the Newark deposits toward boundary faults of the grabens. Basic igneous activity characteristically accompanied the taphrogeny. Sequences similar in lithology, tectonic setting, and age occur beneath sediments of the coastal province in southern Arkansas and northern Louisiana (Eagle Mills Formation) and in northeastern Mexico (La Boca Formation). (See de Cserna, 1958; Mixon, Murray, and Diaz, 1959; Scott, Hayes, and Fietz, 1961.)

Because the basal beds of the coastal province sequences consist of detritals somewhat similar to the Late Triassic sediments, the two sequences have sometimes been confused. For example, Mixon, Murray, and Diaz (1959) demonstrated that failure to recognize the unconformity separating the tilted and eroded taphrogenic Triassic sedimentary rocks (La Boca Formation) in eastern Mexico from the overlying lithically similar Jurassic basal sediments of the coastal province sequence (La Joya Formation) resulted in these formations being grouped together as the Huizachal Formation by previous workers. In still other areas, as Guatemala, similar lithic types of Jurassic age (Todos Santos Formation) are believed to have been associated with taphrogenic activity (Bonis, ms). In the northern Gulf coastal region taphrogenic sediments occur only in the subsurface; they were generally considered the initial deposits of the coastal province until Scott, Hayes, and Fietz (1961) demonstrated their lithic, tectonic, and chronologic analogies to the Newark Group.

Louann Series, initial coastal province sediments?—There is still some doubt whether the succeeding Louann sequence, mainly halite, should be regarded as the terminal stage of sedimentation associated with the taphrogenic phase of the Ouachita trend or the opening phase of coastal province sedimentation. Most likely, it is transitional between these phases, in view of Rhaetic age (Jux, 1961), only slightly younger than the Eagle Mills-Newark sequences but considerably older than the overlying late Jurassic (Sabinasian).

The distribution of thick Louann salt is better known than that of any other stratigraphic unit in the coastal province because its existence throughout wide areas can be demonstrated through the occurrence of salt diapirs where the parent Louann bed itself is too deeply buried to be reached by the drill (see fig. 1). The trend of interior salt domes suggests the possibility of thick salt accumulation in taphrogenic grabens that remained active during Louann deposition (Murray, 1961, 1966). Coastal and offshore salt-dome trends, as well as those possibly present under the Sigsbee abyssal plain (Ewing and Antoine, 1966), suggest that the Gulf basin began to form at least as early as the taphrogenic phase. There is the possibility that the Sigsbee knolls represent clay rather than salt diapirs or, if they are salt structures, that the parent bed is younger than Louann. Late Jurassic salt has been drilled in Alabama, and Middle Cretaceous evaporites are also widespread in the marginal areas of the basin. Nevertheless, it appears likely that the Gulf basin was already in existence during Louann deposition, but that sedimentation of evaporites in peripheral areas of the basin may have been confined to taphrogenic graben trends.

The succeeding strata in the peripheral areas belong mainly to a carbonate, inundative sequence—the Zuloago-Smackover—and are Late Jurassic (Sabinasian) in age. These are the base of a more or less continuous sequence, and a considerable unconformity separates them from the Louann salt in the northern peripheral portion of the Gulf basin. Even so, effects of the taphrogenic activity persisted longer. Eaton (1965) concluded that basement control of stratigraphic trends persisted until deposition of the Cotton Valley Group (upper Sabinasian). Even this may be a conservative opinion.

Cordilleran tectonic trend.—The northern and eastern portions of the province show best the effects of the Paleozoic orogenic belts on the subsequent development of the coastal province. Although there are indications that the Paleozoic orogenic trends extend from the Big Bend region of Texas and Chihuahua southeastward through Mexico, especially in Tamaulipas, Chiapas, Guatemala, and British Honduras, the subsequent activity of the Cordilleran orogenic trend has obscured much of the evidence in Mexico. Through this entire region, the Cordilleran structural trend coincides generally with the earlier Paleozoic one, and it may represent recurrent activity in that trend. At any rate, this southwestern portion of the coastal province underwent orogeny during the Cenozoic while the rest of the province had an orderly development.

The Cordilleran tectonic belt, a circum-Pacific feature and the controlling geologic element of western North America, diverges from the coastal province northwestward from Mexico. During the Cretaceous, a shallow exogeosynclinal seaway, extending from the western Gulf to the Arctic, was filled by detritus from the southwest side, where the Late Jurassic-Cretaceous (Nevadan) orogeny led to marked uplift and erosion. Subsequently, this exogeosyncline itself underwent orogeny, the Laramide, earlier in the States (end of the Cretaceous), intermediate in northeast Mexico (post-Paleocene), and still later in Chiapas-Guatemala (post-Eocene), though here tectonic activity commenced with serpentine emplacement in the Late Cretaceous (Bonis, ms). These orogenies successfully reestablished a western boundary to the Gulf coastal province, for the first time since the mid-Cretaceous transgression submerged what was left of the earlier Paleozoic structural trends.

COASTAL PROVINCE TECTONIC ACTIVITY

Sedimentary distribution.—Except for the taphrogenic and orogenic activity discussed above, epeirogeny has characterized crustal behavior in the coastal province. Downwarp has predominated and has permitted

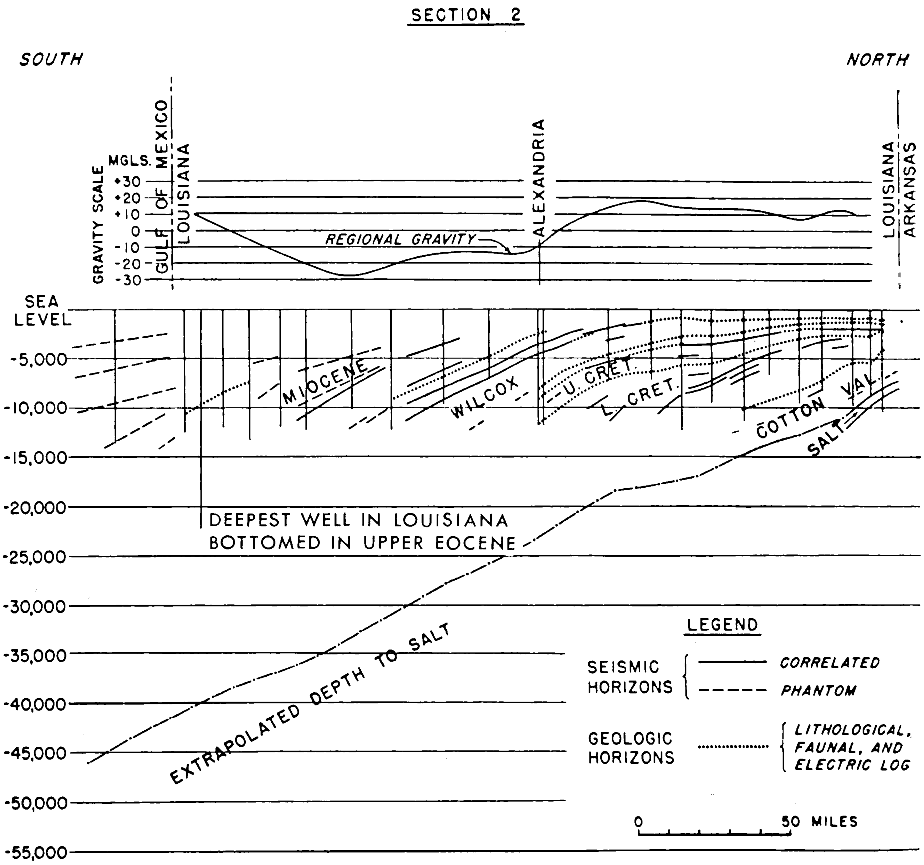


Fig. 2. Cross section of downwarped Gulf Coastal sequence in Louisiana (modified from Nettleton, 1952).

the accumulation of tremendous volumes of sediment (see fig. 2). A 1950 study estimated 1,150,000 cubic miles of known Mesozoic and Cenozoic sedimentary materials beneath the emerged portion of the coastal province from Chiapas to Georgia (Murray and others, 1952). The presence of an additional 500,000 cubic miles in this area can now be reasonably documented. Furthermore, the 1950 estimates in Mexico did not include Yucatán nor the belt subsequently deformed by orogeny and now occupied by the Sierra Madre Oriental and the extension of the Cordilleran southeastward into Honduras. Furthermore, sparse information suggests an additional 200,000 cubic miles in the emerged portion of the Atlantic coastal plain, and geophysical and geologic data indicate that the sedimentary volume of the submerged portion of the Gulf and Atlantic coastal province considerably exceeds that of the emerged portion (Murray, 1961). Hence, at least several million cubic miles (perhaps ten million cubic kilometers) of sediments have accumulated in the coastal province since its inception in the early Mesozoic.

Most of these sediments are detritals. Their distribution in time, place, and amount was determined by tectonic events outside the province. The adjacent ancient Paleozoic tectonic belts—still epeirogenically positive—and the cratonic hinterland supplied the earliest sediments in the province. The Appalachian region and adjacent craton have continued as the source of detritals in the Atlantic and eastern Gulf areas until the present time. However, the western and southern margins of the province from Texas to Honduras foundered during the Late Jurassic to Middle Cretaceous interval, and carbonate sedimentation then ensued. Detritus was again transported into these areas in quantity in the late Cretaceous, as exogeosynclinal deltaic deposits eastward from a far western source in the Nevadan tectonic belt. The exogeosyncline in turn was uplifted by orogeny in the Cenozoic to form a southeastern extension of the Laramide trend. Resultant erosion supplied voluminous detrital sediments to the western and northwestern margins of the Gulf throughout the Cenozoic. In the late Paleocene and early Eocene there was also thick detrital sedimentation (the Wilcox delta) around the northern margin of the Gulf. Widespread uplift of the entire continent during the Neogene caused emergence of the inner portions of the province, including the formation of Pleistocene terraces, and progressively increased detrital influx to the shrinking basin, particularly in the northern Gulf region.

Although the bulk of the sediments in the province are detrital, tremendous volumes of carbonates and evaporates accumulated: (1) in the Florida and Yucatán peninsulas throughout the late Mesozoic and the Cenozoic, (2) from Texas to Honduras commencing in Late Jurassic and extending to Late Cretaceous, and (3) to a lesser extent in the northern Gulf region during portions of the Late Cretaceous. Such thick sequences show that the characteristic downwarp of the province was not due primarily to the importation of detritals.

Within these detrital and carbonate sequences there are many cyclic fluctuations, some controlled by variation in supply of detritals, some by transgression and regression produced by variable epeirogenic movements in the sedimentary basin, and some perhaps by eustatic fluctuations (see Murray, 1961). A catalogue of the detailed stratigraphy of the province would require too comprehensive a review for this paper.

Interruptions in the sedimentary regime.—The rate of coastal subsidence has varied in time and place, and subsidence has been replaced intermittently by stability or upwarp characterized by nondeposition or erosion. Major interruptions in sedimentation principally affected the inner margin of the province, whereas probably, in some cases certainly, sedimentation was uninterrupted seaward. Noteworthy regional unconformities include (1) the hiatus preceding onset of coastal province sedimentation, which commenced as early as the beginning of Late Jurassic in some areas—under this interpretation, the Louann group is preunconformity—and as late as Late Cretaceous elsewhere; (2) Middle Cretaceous disconformity separating the Comanchean and Gulfian series, most pronounced from East Texas into Georgia; and (3) Late Miocene to Recent continent-wide emergence and associated stratigraphic offlap, which has continued and perhaps been intensified during the Quaternary.

To these major unconformities numerous other disconformities of varying extent and significance can be added. Among them are (1) the widespread hiatus at the Cretaceous-Tertiary contact; (2) the emergence accompanied by laterization at the end of the Paleocene (Midway-Wilcox boundary in marginal areas); (3) the overlap by the basal Claiborne sediments in the northwestern Gulf area, and so on. Detailed stratigraphic studies have recognized many other disconformities, most subregional in distribution.

Posiments.—Murray (1961) emphasized the diverse epeirogenic behavior of individual geologic elements of local to subregional or even regional nature by calling them "posiments" and "negaments". These terms are especially applicable where the basement appears to have been positive or negative and to have affected the form and shape of the overlying sedimentaries. In predominantly sedimentary provinces, the posiments tend to receive disproportionate emphasis because they are the sites of subregional unconformities, stratal thinning, and facies changes. Furthermore, many of these features are conducive to hydrocarbon accumulation, and thus they have been more intensively explored.

Nine posiments of varying extent and importance are depicted on the figures. Those in Mexico—the Tamaulipas arch, the Jalapa uplift, and the Tuxtla uplift—are characterized by Late Cenozoic volcanics and intrusives and probably represent Gulfward outliers of the Cordilleran orogenies, perhaps along rejuvenated Paleozoic trends. The Cockscomb or Mayan uplift is a similar feature in British Honduras but without associated volcanics (see fig. 3). In the United States a relationship between coastal province posiments and the ancient Paleozoic trends has

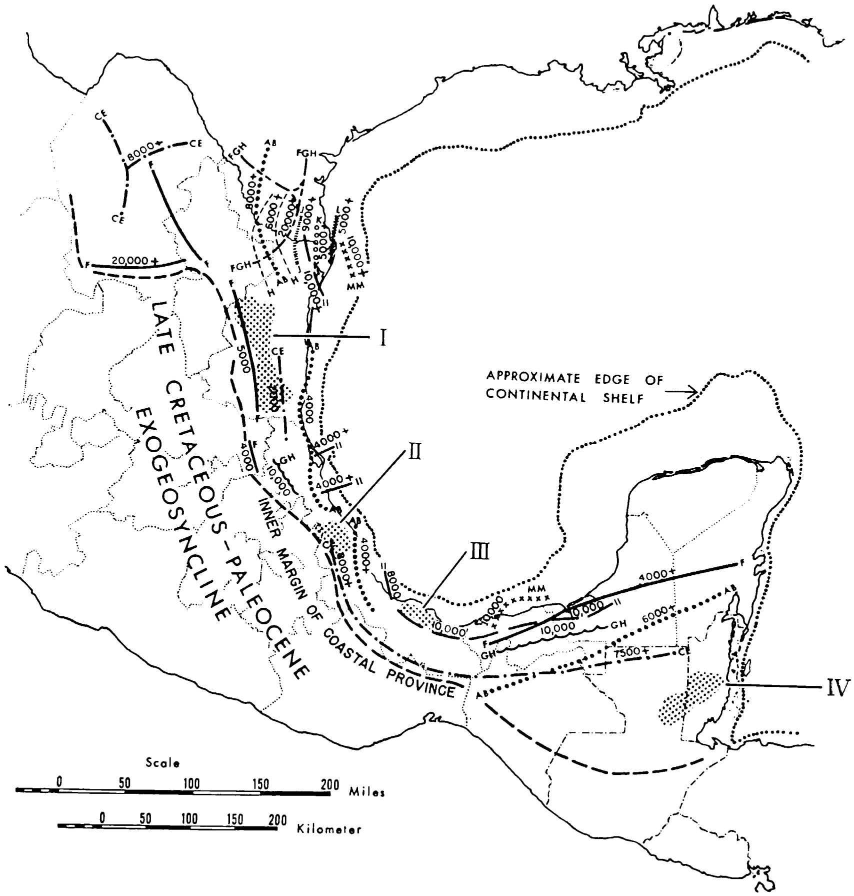
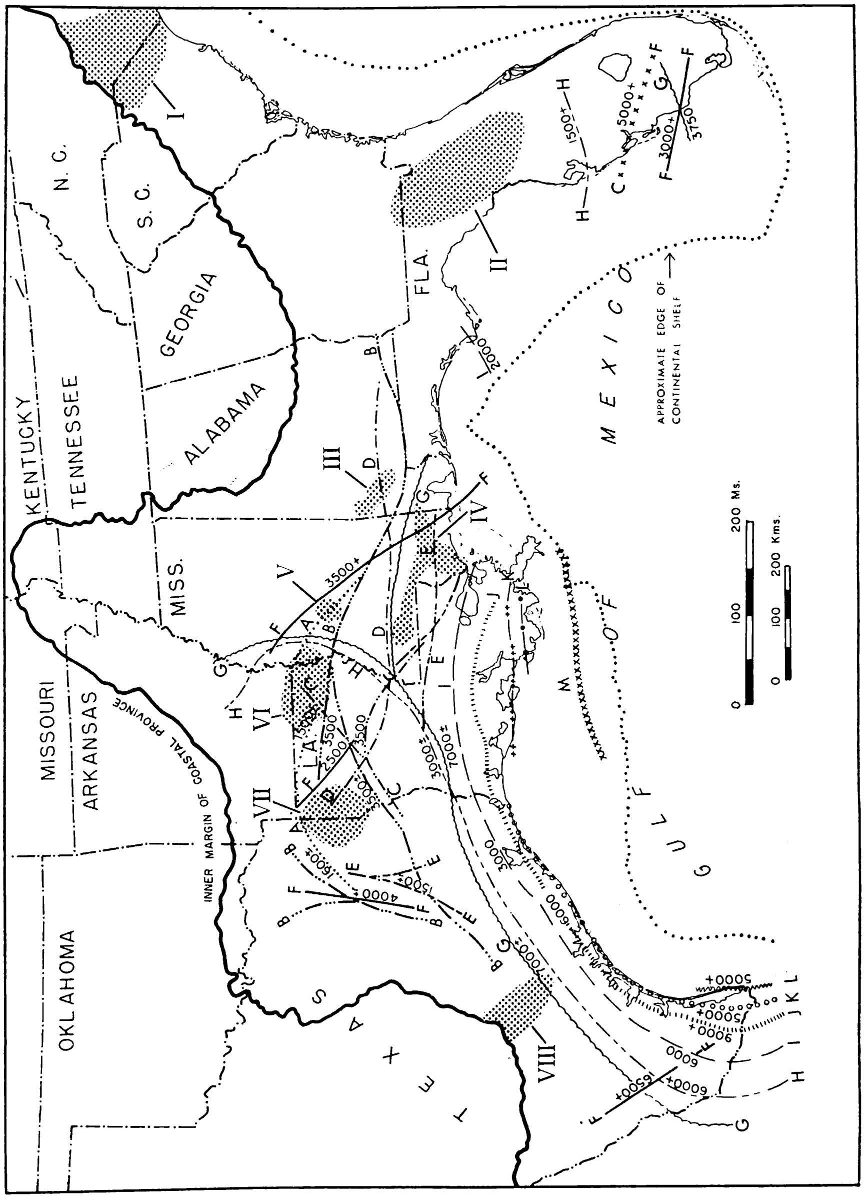


Fig. 3. Posiments and approximate depocenters and depoaxes in the Gulf Coastal Province of Mexico, Guatemala, and British Honduras. Posiments are: I. Tamaulipas Arch; II. Jalapa uplift; III. Tuxtla uplift; IV. Cockscomb or Mayan uplift. Depocenters and depoaxes are: AB. Upper Jurassic; CE. Early and Middle Cretaceous; F. Late Cretaceous; FGH. Late Cretaceous-Paleocene-Eocene; GH. Paleocene-Early Eocene; H. Middle Eocene; I. Upper Eocene-Oligocene; J. Late Oligocene-Early Miocene; K. Early Miocene; LMN. Miocene (undifferentiated) (modified from Murray, 1962; in part, after Guzman, 1952).

been postulated (Murray, 1961), particularly for the Cape Fear arch, the Ocala uplift, the Hatchetigbee anticline, the Wiggins-Hancock uplift, and the San Marcos arch. The Jackson dome, the Monroe uplift, and the Sabine uplift may be related to Mesozoic intrusives rather than to ancient Paleozoic trends, or perhaps to both (see fig. 4).

Local variations in epeirogenic activity have been documented for the larger posiments. Vernon (1951) concluded that the surface position of the Ocala structure produced by uplift of Tertiary beds, commencing in the Miocene, is displaced westward from the older axis of Cretaceous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uplift (see also Murray, 1961). On the Monroe uplift the discordance between Gulfian strata and the overlying calcarenite is present on the south flank of the structure only. Granata (1963) demonstrated that non-deposition and erosion occurred during Woodbinian (Cenomanian) time on the western side of the Sabine uplift but somewhat later during Eaglefordian (Turonian) time on the eastern side.

Each posiment also has its own epeirogenic history. For example, the Jackson, Monroe, and Sabine posiments are adjacent features similarly underlain by igneous rocks. All three exhibit an unconformity between the Comanchean and Gulfian sequences. Subsequently, calcarenite indicative of stable conditions accumulated on both the Jackson and Monroe structures during the latest Cretaceous and earliest Cenozoic while the Sabine posiment apparently subsided in conformity with regional pattern. However, the Sabine uplift was rejuvenated later in the Tertiary, as was the Jackson dome, but not the Monroe structure. The former two exhibit surface inliers of Tertiary beds, but no surface reflection of the Monroe structure is apparent.

Negaments.—Marked negaments, which were the sites of maximum deposition during the particular depositional epochs involved, were termed "depocenters and depoaxes" by Murray (1961), who suggested that sedimentary accumulations to thicknesses of 1000 meters or more resulted in a shift in the locale of major deposition (see figs. 3 and 4). Depocenters are not generally known to occur vertically above immediately older ones. They generally shifted seaward during the evolution of the coastal province. However, a major reversal in this progression occurred in late Cretaceous and Tertiary times, for certain Gulfian and Cenozoic depocenters are superimposed above older ones. During the Neogene, depocenters shifted northeastward from South Texas into Louisiana along the periphery of the basin.

The sedimentary masses in depocenters are often ladle-shaped in cross section, with a long dimension parallel to the perimeter of the basin. The inner or updip limit is usually formed by a prominent monoclinal flexure zone or else by a down-to-the-basin fault ("growth" fault of Ocamb, 1961). Both flexures and faults developed concurrently with sedimentation in the adjacent depocenters and are genetically related to it. These features are generally regarded as forming on the outer, unstable shelf, and the boundary faults are ascribed to basinward slumping under sedimentary load.

Fig. 4. Posiments and approximate depocenters and depoaxes in the Gulf and southern Atlantic province of the United States. Posiments are: I. Cape Fear Arch; II. Ocala uplift; III. Hatchetigbee anticline; IV. Wiggins-Hancock structure; V. Jackson dome; VI. Monroe uplift; VII. Sabine uplift; VIII. San Marcos arch. Depocenters and depoaxes are: A. Late Jurassic (lower: Smackover-Haynesville); B. Late Jurassic (upper: Cotton Valley); C. Early Cretaceous; D. Middle Cretaceous (lower: Trinity); E. Middle Cretaceous (upper: Fredericksburg-Washita); F. Late Cretaceous (Gulf); G. Paleocene-Early Eocene; H. Middle Eocene; I. Late Eocene-Oligocene; J. Late Oligocene-Early Miocene; K. Miocene; L. Late Miocene-Pliocene; M. Pleistocene.

In areas where a thick salt layer underlies the sedimentary column, varying patterns of overburden accumulation affect, if not control, the migration of the salt into ridges, massifs, and diapirs. Salt tectonics in turn produce local posiments and negaments which accentuate the variations in sedimentary thicknesses (Ocamb, 1961). However, salt movement is not required for the development of depocenters and "growth" faults, since these features also occur in the domeless areas of South Texas and elsewhere.

Flexure faults.—"Growth" faults are distinct from regional flexure faults, which also are down-to-the-basin or graben structures but lie inland from concurrent areas of major sedimentation. They result from regional stresses developed by basinward downwarp and continental uplift. The most prominent flexure-fault trend extends in an arcuate belt from the Alabama shoreline (Mobile graben), nothwestward through Alabama and Mississippi (Gilbertown-Pickens system), westward through southern Arkansas (South Arkansas system), and southwestward through Central Texas (Talco-Mexia-Luling and Balcones systems) (see fig. 1). This trend frames the areas of major deposition in this part of the coastal province on the landward side and, in part, determines the margin of the province. Other flexure faults with similar trend occur farther basinward.

Conclusions.—The close correlation between sedimentation and crustal downwarp has encouraged the idea that the two processes are in part genetically related. Shifting of depocenters suggests a limit to the amount of crustal downwarp possible during a given interval of geologic time. Various past authors have also postulated a genetic relationship between depocenters and adjacent posiments exercised by lateral transfer within the crust or upper mantle, but evidence is inconclusive. Since we do not know how the present relations of continental and oceanic crust developed, we can hardly draw firm conclusions. Processes such as rifting, attenuation of the crust, and *in situ* phase changes could produce similar patterns of deposition in the overlying sediments.

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