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INFORMATION CIRCULAR NO. 98

ANNOTATED BIBLIOGRAPHY OF FLORIDA BASEMENT GEOLOGY AND RELATED REGIONAL AND TECTONIC STUDIES

INCLUDING AN APPENDIX OF FLORIDA DEEP WELL DATA

By
Jacqueline M. Lloyd

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LETTER OF TRANSMITTAL

BUREAU OF GEOLOGY
TALLAHASSEE
April 15, 1985

Governor Bob Graham, Chairman
Florida Department of Natural Resources
Tallahassee, Florida 32301

Dear Governor Graham:

The Bureau of Geology, Division of Resource Management, Department of Natural Resources, is publishing as its Information Circular No. 98, "Annotated Bibliography of Florida Basement Geology and Related Regional and Tectonic Studies."

This report summarizes published data on Florida basement geology and includes an appendix of deep well data. As such, it is a comprehensive reference publication for scientists studying Florida's deep geologic strata.

Respectfully yours,

Steve R. Windham, Chief
Bureau of Geology

Printed for the
Florida Department of Natural Resources
Division of Resource Management
Bureau of Geology

Tallahassee
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ABSTRACT

Annotated bibliographies of Florida basement geology and related regional and tectonic studies are presented along with an appendix containing Florida deep well data.

The bibliography of Florida basement geology is a comprehensive reference list. It includes published descriptions of some of the first deep wells drilled in Florida (e.g. Campbell, 1939 and 1940; Cole, 1944) as well as recent tectonic interpretations of the Florida basement. Other topics include the stratigraphy, geochronology, paleontology, and geophysical signature of Florida basement rocks.

The bibliography of related regional and tectonic studies includes papers on the Caribbean, Bahamas, Gulf of Mexico and West Africa. This section is not a complete reference list on these subjects. It is provided as a source for background information for the geologist working on the Florida basement.

Well cutting and core information is summarized in the appendix. These cutting and core samples are the basis for interpretation of Florida basement geology. References for published information on these samples are given; the samples themselves are available for further examination at the Florida Bureau of Geology.

ANNOTATED BIBLIOGRAPHY OF FLORIDA BASEMENT GEOLOGY AND RELATED REGIONAL AND TECTONIC STUDIES

by
Jacqueline M. Lloyd

INTRODUCTION

This annotated bibliography is in two sections: one includes Florida basement studies, the other includes related regional and tectonic studies. Florida basement is generally thought of as including only pre-Mesozoic rocks. However, more specific, and potentially more useful, definitions are found in the cited literature. A consensus defines Florida basement as including igneous and metamorphic rocks of Precambrian and Paleozoic age, sedimentary rocks (primarily red beds) with associated intrusives and extrusives of Jurassic and Triassic (?) age, and unmetamorphosed sedimentary rocks of Paleozoic age. Although some of the authors may define basement differently, each paper in the Florida basement section seems to fit somewhere within this definition. The papers in this section include studies of the petrography, lithology, stratigraphy, geochronology, and paleontology of Florida basement rocks. It also includes papers on the geophysical signature and geotectonic history of the Florida basement.

The second section of the bibliography includes papers covering the regional geology and tectonic history of the Caribbean, Bahamas, Gulf of Mexico, and West Africa. Some of these papers do not directly discuss the Florida basement. They are included because they provide information pertinent to Florida basement geology. Examples are Anderson and Schmidt (1983) and Dillon and Sougy (1974). Anderson and Schmidt (1983) present a model for the evolution of the Gulf of Mexico-Caribbean region. Florida's present and probable Paleozoic position tie it to such models. Dillon and Sougy's (1974) paper is a detailed reference on West African geology and geologic history from Paleozoic to present. It provides information that can be useful in reconstructing the Paleozoic position of Florida.

The appendix contains tabulated data on Florida deep wells which penetrated basement rocks. The data includes location, total depth, depth to basement, type of basement rocks, and references containing information on the particular basement rocks. Other pertinent data, such as age determinations, are listed if available. Well location maps are available from the Florida Geological Survey.

FLORIDA BASEMENT STUDIES

ANDRESS, NOEL E., FRITZ H. CRAMER, and ROBERT F. GOLDSTEIN, 1969, *Ordovician chitinozoans from Florida well samples:* Gulf Coast Association of Geological Societies Transactions, vol. 19, pp. 369-375.

Ordovician chitinozoans recovered from a grayish black shale are described for the first time for subsurface north-central Florida. The bottom-most sample of Sun Oil Company, Earl Odom No. 1 well, Suwannee County, Florida, was bracketed as Late Arenigian to Early Caradocian. The Ordovician is immediately overlain by Silurian sediments. A new chitinozoan species is described. *(authors' abstract)*

APPLEGATE, ALBERT V., GEORGE O. WINSTON, AND JAMES G. PALACAS, 1981, *Subdivision and regional stratigraphy of the Pre-Punta Gorda rocks (Lowermost Cretaceous—Jurassic?) in South Florida:* Supplement to Transactions—Gulf Coast Association of Geological Societies, vol. 31, pp. 447-453.

In recent years several wells have been drilled in the South Florida Basin through carbonate and evaporite sequences to depths as much as 5,300 feet below the Punta Gorda Anhydrite. Correlation of anhydrite beds below the Punta Gorda has revealed several thick anhydrite units (200 to 400 ft.) with regional persistence.

The pre-Punta Gorda section is subdivided into four easily identifiable units listed in order of increasing age—Lehigh Acres (lowermost Comanchean), Pumpkin Bay (upper Coahuilan), Bone Island (lower Coahuilan), and Wood River (Jurassic?) formations, all newly named in this report. In addition, the Lehigh Acres is divided into the West Felda Shale (base), Twelve Mile, and Able members which are also named and defined in this report. Geochemical evidence indicates that the Lehigh Acres unit and the upper part of the Pumpkin Bay unit contain the most likely source beds for petroleum.

Only two production tests have been carried out in the basin in strata below the oil-productive Sunniland Limestone. One was through casing in a Wood River dolomite zone. It reportedly produced water and some gas. The other was a drill stem test in an upper Pumpkin Bay dolomite zone which produced only water. In the Gulf Florida State Lease 826Y (Permit No. 275), a moderately porous, 350-feet-thick Pumpkin Bay dolomite zone was observed. As this well is west of the axis of the basin, better reservior conditions presumably exist on the West Florida shelf than onshore. *(authors' abstract)*

APPLIN, PAUL L., 1951, *Preliminary report on buried pre-Mesozoic rocks in Florida and adjacent states:* U.S. Geological Survey Circular No. 91, 28 p.

This paper is a basic reference work on the subsurface pre-Mesozoic rocks in Florida and adjacent portions of Alabama and Georgia. Available drill hole data is tabulated for 100 deep wells: 78 wells that penetrated Paleozoic sedimentary rocks, 18 wells that encountered Triassic (?) diabase and basalt (8 of these are included in the 78 that reach Paleozoic sedimentary rocks), and 12 significant deep wells that did not penetrate pre-Mesozoic rocks. These data are used to geographically divide the pre-Mesozoic subsurface into areas characterized by (1) Paleozoic sedimentary rocks, (2) extrusive igneous rocks (rhyolite, tuff, and agglomerate), and (3) intrusive igenous rocks (granite, diorite) and metamorphic rocks.

APPLIN, PAUL L., and ESTHER R. APPLIN, 1965, *The Comanche Series and associated rocks in the subsurface in central and south Florida:* U.S. Geological Survey Professional Paper 447, 86 p.

This paper is primarily a discussion of the Coastal Plain Mesozoic sedimentary section in Florida, however, some information on pre-Mesozoic rocks is included. The Coastal Plain floor in central and northern Florida is a truncated surface composed of igneous and sedimentary rocks. These rocks are tentatively classified as primarily early Paleozoic and Precambrian although some may be Triassic in age. The effect of the pre-Coastal Plain structure and topography on the major and minor structural features of the Comanche Series is discussed.

ARDEN, DANIEL D., JR., 1974, *Geology of the Suwannee Basin interpreted from geophysical profiles:* Gulf Coast Association of Geological Societies Transactions, vol. 24, pp. 223-230.

Deep drilling in the eastern Gulf Coast has penetrated the Tertiary and Mesozoic section, but wells have seldom extended very deeply into pre-Mesozoic rocks. Data relating to the deeper pre-Mesozoic section were collected when Geophysical Service, Inc., conducted a seismic reflection survey in the Suwannee Basin (also called the Apalachicola Embayment or the Southwest Georgia Embayment). Associated gravity and magnetic field measurements were taken. The seismic sections provided the framework for initial geologic interpretation. Drilling data established stratigraphic control for the upper part of the sections and verified interval velocity determinations. A computer program generated gravity and magnetic fields for each hypothetical geologic interpretation. These were compared with the observed fields and refinements were made until data were reconciled.

The final interpretation shows Tertiary and Cretaceous sediments lying above a remarkably smooth unconformity developed upon Paleozoic and Triassic rocks. The unconformity dips southward from a depth of 8,400 feet near the Alabama-Florida boundary to about 12,000 feet near Panama City, Florida. Below the unconformity is a folded and faulted sequence of Lower Paleozoic rocks and Triassic continental red beds accompanied by volcanic flows or intrusives. Paleozoic rock types include volcanics, quartzite, and a sandstone-shale sequence. Individual structures suggest broad anticlines developed above thrust faults. The Paleozoic rocks are tentatively correlated with (oil-producing) African counterparts, and it is suggested that their hydrocarbon potential warrants further investigation. *(from authors' abstract)*

BANKS, J. E., 1978, *Southern Florida—subsurface features related to oil exploration:* Gulf Coast Association of Geological Societies Transactions, vol. 28, part 1, pp. 25-30.

Along one trend in southern Florida, 12 oil fields have been found, with an estimated 250 million stock-tank barrels of oil-in-place. Continued discovery of oil and gas in new fields and along new trends may be partly insured by structural mapping of the three types of basement rocks under peninsular Florida; by testing the first porosity in Paleozoic basement; by projecting the structural influence of basement troughs, paleovalleys, ridges and hills into overlying sediments; by distinguishing between two interfingering sedimentary platforms above basement—a northern one deposited on a convex floor, and a thicker, somewhat lower southern one overlying a flat-to-concave floor. *(from authors' abstract)*

BARNETT, RICHARD S., 1975, *Basement structure of Florida and its tectonic implications:* Gulf Coast Association of Geological Societies Transactions, vol. 25, pp. 122-142.

Geologic data from nearly 80 recent wells (1965 through 1975) in Florida and Georgia permit substantial refinement of earlier interpretations of Florida basement structure.

Upper Jurassic, Cretaceous, and Tertiary sediments in Florida onlap the eroded surface of a basement complex which varies from Precambrian to Jurassic in age. As determined by previous workers, the main structural feature underlying Florida is the Peninsular Arch. This is a large Precambrian block covered by Paleozoic sediments. A similar, smaller crustal block (the Decatur Arch or Chattahoochee Anticline), centering on Jackson County, occupies the Florida panhandle. In both blocks, Ordovician to Devonian clastic rocks overlie a deeply truncated Precambrian complex which was affected by Cambrian igneous intrusion. The Paleozoic rocks were subjected to Late Paleozoic uplift with some volcanic activity followed by uplift with tilting, block faulting and post-orogenic igneous intrusion during the Triassic period. The new data presented here clarify the succession and areal distribution of some of the volcanic and hypabyssal rocks, showing that Jurassic basalt flows covered the Peninsular Arch below the 28°N parallel.

The entire Florida portion of the Florida-Bahama platform probably represents crust which has been continental throughout Phanerozoic time.

Subsurface data from Florida do not support the more speculative hypotheses about the history of the Florida-Bahama Platform and the Gulf of Mexico region. Published and new geologic data are consistent with responsible attempts to reconstruct the history of the Gulf of Mexico region by rifting during the opening of the North Atlantic Ocean basin. This agreement so far represents circumstantial evidence (general resemblance between early Paleozoic and Precambrian of Florida and west Africa) for the operation of plate tectonic mechanisms rather than direct, conclusive proof. The evidence, such as it is, favors the hypothesis outlined by Freeland and Dietz (1972). The circumstantial nature of evidence for the former activity of plate tectonic mechanisms in Florida need not hinder the application of new tectonic theories to petroleum exploration in Mesozoic rocks of the Florida-Bahama region and the outer continental shelf of the Atlantic coast. (*authors' abstract;* parenthetical comments added)

BASS, MANUEL N., 1969, *Petrography and ages of crystalline rocks of Florida—some extrapolations:* American Association of Petroleum Geologists Memoir No. 11, pp. 283-310.

The most widespread of the crystalline basement rocks of Florida are rhyolitic ignimbrites. Regional metamorphism has not affected the ignimbrites, and where greenschist-facies rocks are found the metamorphism is incomplete and local in extent. The age of the ignimbrites is unknown. Arguments are presented for Precambrian, late Paleozoic, Triassic, or Jurassic ages.

Intrusive rocks in Florida and Georgia are distributed sporadically except in an area of central Florida where a granitic province can be outlined. Granitic rocks are generally altered. In one well (Humble No. 1 Carroll, Sec. 10, T27S, R34E, Osceola County, P-8, W-1014), the quartz monzonite is cataclastically shattered and veined but not pervasively sheared. Another well (Sun No. 1, Powell Land Company, Sec. 11, T17S, R31E, Volusia County, P-19, W-1118) encountered a quartz-bearing hornblende diorite sill. This diorite is at least 480 m.y. old.

A province of mafic extrusive rocks is proposed for southern or southwestern Florida. The basalt resembles submarine basalt and may be related to buried seamounts. The basalt may be much younger than the acidic volcanic rocks.

The southeastern-most well (the Amerada No. 2, Cowles Magazines, Inc., Sec. 19, T36S, R40E, St. Lucie County, P-259, W-4323) penetrated diabase overlying, and in apparent fault contact with, regional metamorphic rocks. These rocks are mainly quartz-bearing hornblende-andesine amphibolite containing layers of leucocratic quartz diorite gneiss. This amphibolite is 530 m.y. old, or older. It is probably in a branch of the Damaran (or Pan-African) orogen. Meager data suggest that the diabase in this well may be of late Paleozoic, Triassic, or Jurassic age.

The age results for the various rock types indicate that an event about 530 million years ago resulted in amphibolite-facies and retrograde zeolite-facies metamorphism of mafic or intermediate igneous rocks in southern Florida. This event was probably accompanied by either metamorphism or emplacement of the quartz monzonite of the Carroll well and emplacement of the diorite of the Powell well. The country rocks intruded by the diorite were either Precambrian metamorphic rocks or sediments derived, at least partly, from Precambrian rocks.

BRIDGE, JOSIAH, and JEAN M. BERDAN, 1951, *Preliminary correlation of the Paleozoic rocks from test wells in Florida and adjacent parts of Georgia and Alabama:* U.S. Geological Survey Open File Report, 8 p., also in

Florida Geological Survey Guidebook, Association American State Geologists 44th Annual Meeting Field Trip, April 1952, pp. 29-38.

Reported results are based on a preliminary study of cores, cuttings, and fossils from 52 test wells in central and northern Florida and adjacent parts of Georgia and Alabama. The subsurface Paleozoic rocks in this region include strata ranging from Early Ordovician to Early or possibly Middle Devonian. The area underlain by Paleozoic rocks can be roughly outlined by a triangle with sides approximately 250-miles long. It is bounded to the north and southeast by areas underlain by crystalline and volcanic rocks.

The Paleozoic strata are flat-lying, unmetamorphosed clastics, and were apparently deposited in shallow water. The source of the sediments is unknown. The total thickness of Paleozoic sediments is estimated to be not less than 3,000 feet and probably equal to 6,000 feet or more.

The distribution of Paleozoic rocks of different ages indicates the possibility that the wedge of Paleozoic rocks is made up of a series of subparallel belts, each with a general northeast trend, and each separated from adjacent belts by faults. The age of faulting is post-Middle(?) Devonian to pre-Early Cretaceous. Igneous intrusions cutting the Paleozoic sedimentary rocks fall within the same age limits.

CAMPBELL, R. B., 1939, *Paleozoic under Florida?:* American Association of Petroleum Geologists Bulletin 23, No. 11, pp. 1712-1713.

A brief report on the black shales found in the St. Mary's River Corporation Hilliard Turpentine Co. No. 1 well in Nassau County, Florida, is presented in this paper. The black shales are tentatively assigned a Mississippian age because of their similarity to the Chattanooga shales.

CAMPBELL, R. B. 1940, *Outline of the geological history of peninsular Florida:* Florida Academy of Science Proceedings, 1939, vol. 4, pp. 87-105.

Previously unpublished data on eight Florida wells is presented. Paleogeographic changes (Cretaceous through Recent) of the Florida peninsula are depicted. The influence of the three "ancient nuclear land masses"—Appalachia, Llanoria, and Antillia—and the coverage by sea waters are discussed. The conclusion is that the "Florida peninsular area throughout most of its geologic history has been submerged and as such, has been the connecting link from the Gulf of Mexico to the Atlantic, between the nuclear land masses of Appalachia and Antillia, roughly represented today by the Piedmont area of the southern states and the Greater Antilles respectively."

CARROLL, DOROTHY, 1963, *Petrography of some sandstones and shales of Paleozoic age from borings in Florida:* U.S. Geological Survey Professional Paper 454-A, 15 p.

Sandstone, orthoquartzites, other arenaceous sediments and black and red shales occur in the basement rocks of Florida and adjacent parts of

Georgia and Alabama. Most of the sandstones are Early Ordovician in age. The shales range in age from Middle Ordovician to Middle Devonian.

The quartzites range in mineralogic complexity from submature to mature. Feldspars are scarce. Micaceous and clayey sandstones can be classed as subgraywackes. Many of the quartzites grade into siltstones that are intercalated with shaly and micaceous layers. Such beds show disturbed bedding and penetration by worm borings. These beds may be of shallow-water marine origin.

All the arenaceous sediments contain small amounts of heavy minerals. Three characteristic heavy-mineral assemblages were recognized that could be used to correlate different beds in the sequence. The minerals indicate sources in granitic and metamorphic rocks, although rounding of the grains suggests that most of the rocks were derived finally from second- or third-cycle sediments.

The black shales contain abundant organic matter, pyrite, and commonly, interlaminations of siderite and calcite. The color of the red shales is due to minute blebs of hematite in the micaceous matrix. *(from author's abstract and summary)*

CHOWNS, T. M., and C. T. WILLIAMS, 1983, *Pre-Cetaceous rocks beneath the Georgia Coastal Plain—regional implications:* in Gohn, Gregory S. (editor), *Studies related to the Charleston, South Carolina, earthquake of 1886—tectonics and seismicity:* U.S. Geological Survey Professional Paper 1313-L, 42 p.

The records of 78 wells that have penetrated pre-Upper Jurassic(?) rocks beneath the Georgia Coastal Plan were analyzed and used as the basis for a regional interpretation of the "basement" of the southeastern U.S. Coastal Plain. These results were compared with the results of similar studies in Florida, Alabama, and South Carolina. With the addition of regional aeromagnetic data, regional interpretations were made.

Felsic volcanic and associated rocks found in the Georgia subsurface are identical to those found beneath the Apalachicola embayment in Alabama and the Florida panhandle, on the southeast flank of the Peninsular Arch in central Florida, and in south Florida. Evidence suggests that, aside from those found in south Florida, the volcanic rocks are Proterozoic Z (Late Proterozoic) or early Paleozoic in age. Available data indicate a Mesozoic age for the south Florida rocks. The Proterozoic to Paleozoic volcanic rocks probably represent a disjunct fragment of the African craton, sutured to North America during the late Paleozoic. The position of the suture is unknown, but the boundary between the Piedmont rocks of the Appalachian orogen and African platform rocks may be traced in the subsurface east-northeast from Alabama to South Carolina. Before the opening of the Atlantic, this boundary was continuous with the overthrust on the east side of the African Mauritanide orogenic belt.

The most extensive terrane beneath the Southeastern Coastal Plain is a broad basin (the South Georia Basin) filled with red beds, associated diabase intrusions, and possibly basalt. These red beds occupy an estimated 50,000-65,000 sq. km in Georgia and a similar area in adjacent parts of Florida, Alabama, and South Carolina. The diabase and basalt are Early Jurassic in age; the red beds are Late Triassic(?) to Early Jurassic(?). For simplicity, the red beds are referred to as Triassic. Much of this Triassic terrane has undergone zeolite-facies alteration. The alteration is most pronounced, but not restricted to, contact aureoles of the diabase bodies.

The Triassic terrane probably represents a complex graben structure, formed during the early stages of the opening of the North Atlantic (215-175 million years ago). The southeastern corner of North America was close to the triple junction between the North Atlantic, South Atlantic and the Gulf of Mexico, therefore, complex rifting and transform faulting would be expected. The position and size of the South Georgia basin, as well as the large volume of mafic igneous rock and evidence of high heat flow, suggest that during the Late Triassic and Early Jurassic, incipient spreading centers in the Gulf of Mexico and the North Atlantic may have been linked beneath this basin.

The Brunswick magnetic anomaly, which swings through South Georgia, is probably of late Paleozoic origin. It may be caused by a thick section of African-plate rocks, which was formed by overthrusting during continental collision. This similarity in trend between the early Mesozoic East Coast anomaly at the margin of the Carolina shelf and the Brunswick anomaly suggests that the position of the Atlantic spreading center may have been influenced by this Paleozoic structure. *(partially extracted from authors' abstract)*

COLE, W. STORRS, 1944, *Stratigraphic and paleontologic studies of wells in Florida—No. 3:* Florida Geological Survey Bulletin No. 26, 168 p.

This document includes a detailed stratigraphic and paleontologic description of the St. Mary's Oil Corporation, Hilliard Turpentine Company No. 1 well, Sec. 19, T4N, R24E, Nassau County (W-336, no permit number). The well was completed in 1940 at a depth of 4,817 feet. The well encountered a black shale at 4,640 to 4,795 feet and a diabase sill or dike at 4,795 to 4,817 feet. The black shale and the diabase are both believed to be Triassic in age, although the age of the shale has been the subject of much debate.

CRAMER, FRITZ H., 1971, *Position of the North Florida Lower Paleozoic block in Silurian time; phytoplankton evidence:* Journal of Geophysical Research, vol. 76, no. 20, pp. 4754-4757.

The Silurian reconstruction of Pangea leaves a space inside the divergence of the 1,000-fathom contours of the African and South American continental blocks. Palynological evidence suggest this space as a pre-Late Devonian location for the North Florida Lower Paleozoic block. It was brought to its present position with respect to the Appalachians when the proto-Atlantic closed in the Late Devonian.

CRAMER, FRITZ H., 1973, *Middle and Upper Silurian chitinozoan succesion in Florida subsurface:* Journal of Paleontology, vol. 47, no. 2, pp. 279-288.

Unmetamorphosed Paleozoic rocks are present in the subsurface of Florida. Silurian acritarchs, chitinozoans and miospores have been recovered from black to gray shales of four wells in the north-central portion of the state. On account of its palynomorphs, mainly chitinozoans, this material is dated as very latest upper Llandoverian though upper Ludlovian or very basal Gedinnian. The Florida ranges of 28 stratigraphically valuable chitinozoan taxa are plotted; nearly all taxa are illustrated by photomicrographs.

The Florida palynomorph spectra and their chronological succession are quite similar to age-equivalent material from Portuguese Guinea and, in part, to material from North Africa.

The palynological data suggest that the environment of deposition in north-central Florida was holomarine, and not lagoonal as was supposed before. *(author's abstract)*

GOLDSTEIN, ROBERT F., FRITZ H. CRAMER, and NOEL E. ANDRESS, 1969, *Silurian chitinozoans from Florida well samples:* Gulf Coast Association of Geological Societies Transactions, vol. 19, pp. 377-384.

Chitinozoans of Silurian age were recovered from four wells in north peninsular Florida: Humble-Cone No. 1 (Sec. 22, TIN, R17E, P-77, W-1789); Sun Oil-Tillis No. 1 (Sec. 28, T2S, R15E, P-57, W-1548); St. Mary's River-Hilliard No. 1 (Sec. 19, T4N, R24E, no permit number, W-336); and Gulf-Kie Vining No. 1 (Sec. 2, T4S, R15E, P-124, W-2164). An attempt was made to establish a correlation between these four wells using the chitinozoan evidence. The youngest assemblage encountered is probably Ludlovian in age; the oldest is of late Llandoverian age. *(from authors' abstract)*

GRASTY, R. L., and J. TUZO WILSON, 1967, *Ages of Florida volcanics and of opening of the Atlantic Ocean:* Tectonophysics Abstracts, American Geophysical Union Transactions, vol. 48, pp. 212-213.

Four basalts from Florida deep wells were obtained and dated. Ages ranged from 140 to 180 million years; the older age is believed to be more correct. It agrees with similar ages reported for basic intrusives along the coast. It is also compatible with the view that the North Atlantic Ocean began opening at that time and that the Florida-Bahamas ridge may have formed along the boundary with the pre-existing Gulf of Mexico. *(from authors' abstract)*

GRIFFIN, GEORGE M., DAVID A. REEL, and RICHARD W. PRATT, 1977, *Heat flow in Florida oil test holes and indications of oceanic crust beneath the southern Florida-Bahamas platform:* in Smith, Douglas L., and George M. Griffin (editors), *The geothermal nature of the Florida Plateau:* Florida Bureau of Geology Special Publication 21, pp. 43-64.

Heat flow values were obtained for three deep oil-test holes. Two test holes in southern Florida yielded values of 0.71 and 0.76 HFU*, one in northern Florida yielded a value of 0.92 HFU. This trend on land parallels a similar trend offshore and is approximately the same in magnitude. The low values for southern Florida support the hypothesis that oceanic crust (low heat generating capacity) underlies the southern part of the Florida-Bahamas platform.

*Note: 1 HFU (or heat flow unit) = 1×10^{-6} cal/cm^2 sec. The average heat flow from continental areas is about 1.5 HFU.

KING, ELIZABETH R., 1959, *Regional magnetic map of Florida:* American Association of Petroleum Geologists Bulletin, vol. 43, pp. 2844-2854.

A regional magnetic map of Florida reflects the structural trends of the magnetically heterogeneous Paleozoic and Precambrian rocks underlying the coastal plain rocks. Many trends and features on the magnetic map have gravity counterparts, indicating a common source. On the basis of the regional magnetic trends, Florida is divided into two tectonic provinces with an intervening zone of intrusive rocks. Depth estimates from aeromagnetic data suggest the possibility that faulting may be a factor in the profound downwarping and accumulation of sediments in the southern province. The trends of the northern province parallel those of the Appalachian system to which they are probably related. The southern province, distinguished by northwest trends, is structurally discordant with the northern province. The magnetic evidence suggest that the southern province is a continuation of the Ouachita system which has been traced beneath the Gulf Coastal Plain to within 60 miles of the subsurface extension of the Appalachian system in Mississippi, where the two systems approach each other at nearly a right angle. *(author's abstract)*

KLITGORD, KIM D., PETER POPENOE, and HANS SCHOUTEN, 1984, *Florida: a Jurassic transform plate boundary:* Journal of Geophysical Research, vol. 89, no. B9, pp. 7753-7772.

Magnetic, gravity, seismic, and deep drill-hole data integrated with plate tectonic reconstructions substantiate the existence of a transform plate boundary across southern Florida during the Jurassic. On the basis of this integrated suite of data the pre-Cretaceous Florida-Bahamas region can be divided into the pre-Jurassic North American plate, Jurassic marginal rift basins, and a broad Jurassic transform zone including stranded blocks of pre-Mesozoic continental crust. Major tectonic units include the Suwannee basin in northern Florida containing Paleozoic sedimentary rocks, a central Florida basement complex of Paleozoic age crystalline rock, the west Florida platform composed of stranded blocks of continental crust, the south Georgia rift containing Triassic sedimentary rocks which overlie block-faulted Suwannee basin sedimentary rocks, the Late Triassic-Jurassic age Apalachicola rift basin, and the Jurassic age south Florida, Bahamas, and Blake Plateau marginal rift basins. The major tectonic units are bounded by basement hinge zones and fracture zones (FZ). The basement hinge zone represents the block-faulted edge of the North American plate, separating Paleozoic and older crustal rocks from Jurassic rifted crust beneath the marginal basins. Fracture zones separate Mesozoic marginal sedimentary basins and include the Blake Spur FZ, Jacksonville FZ, Bahamas FZ, and Cuba FZ, bounding the Blake Plateau, Bahamas, South Florida and southeastern Gulf of Mexico Basins. The Bahamas FZ is the most important of all these features because its northwest extension coincides with the Gulf basin marginal fault zone, forming the southern edge of the North American plate during the Jurassic. The limited space between the North American and the South American/African plates requires that the Jurassic transform zone, connecting between the Central Atlantic and the Gulf of Mexico spreading systems, was located between the Bahamas and Cuba FZ's in the region of southern Florida. Our plate reconstructions combined with chronostratigraphic and lithostratigraphic information for the Gulf of Mexico, southern Florida, and the Bahamas indicate that the Gulf was sealed off from the Atlantic waters until Callovian time by an elevated Florida-Bahamas region. Restricted influx of waters started in Callovian as a plate reorganization, and increased plate separation between North America and South America/Africa produced waterways in the Gulf of Mexico from the Pacific and possibly from the Atlantic. *(authors' abstract)*

KRIVOY, HAROLD L., and THOMAS B. PYLE, 1972, *Anomalous crust beneath West Florida Shelf:* American Association of Petroleum Geologists Bulletin, vol. 56, no. 1, pp. 107-113.

A new Bouguer gravity anomaly map of the west Florida continental margin reveals a landward salient of high positive values in the vicinity of St. Petersburg. A 20,000 sq km area of the shelf characterized by anomalies greater than +30 mgal is thought to be underlain by a crust having a thickness intermediate between that of continents and that of oceans. A transition from oceanic toward continental crust in this area may have been accomplished by reef progradation across an ancient oceanic embayment. Alternatively, a transition from continental toward oceanic crust may have been produced by rotation of Florida and consequent rifting. The reef-progradation hypothesis is most consistent with what is known of the deep structure and tectonic setting of the Florida platform. *(authors' abstract)*

MILTON, CHARLES, 1972, *Igneous and metamorphic basement rocks of Florida:* Florida Bureau of Geology Bulletin 55, 125 p.

This report describes in detail all the cores and cuttings available from a large collection of wells which were drilled in the Florida Coastal Plain, which penetrated rocks older than the Late Cretaceous, Tuscaloosa Formation. The petrography of basement rock from 27 Florida wells is described; also some 14 isotopic datings from six wells in Florida and three in Georgia, and chemical analyses of rocks from seven Florida wells are given.

Although many wells have been drilled into the Florida pre-Cretaceous basement and Paleozoic strata have been recognized widely in the northern part of the state, the nature of the truly metamorphic basement underlying Paleozoic sedimentary rocks still may be considered virtually unknown. Twenty-seven wells have penetrated igneous or metamorphic rocks which appear mostly to be either Mesozoic or Paleozic intrusive and related volcanic sedimentary rocks, or contact-metamorphic rocks affected by such volcanic activity. Because drilling generally was terminated when such rocks were penetrated, little or nothing is known of what may underlie them, or the extent and thickness of the basement rocks themselves. *(from author's introduction)*

MILTON, CHARLES, and ROBERT GRASTY, 1969, *"Basement" rocks of Florida and Georgia:* American Association of Petroleum Geologists Bulletin, vol. 53, no. 12, pp. 2483-2493.

Petrographic, chemical (11 rock analyses), and age determination (7 whole-rock K-Ar) were made on 27 "basement" well samples from 22 Florida counties north of Lake Okeechobee, and three additional K-Ar determinations were made on samples from Georgia. Most of the specimens are diabase, basalt, rhyolite, and basaltic and rhyolitic ash, generally fresh and unaltered, although contiguous sedimentary rocks may show considerable alteration. The igneous rocks are relatively young, the youngest age determined being 89.3 ± 2.2 m.y. (Late Cretaceous). Metamorphosed "granite" and "diorite" which may be altered arkosic sedimentary or igneous rocks gave older ages, up to 480 to 570(?) m.y. (Early Ordovician to Early (?) Cambrian). These older ages were found in two metamorphosed rocks from the central east coast of Florida, where other granitic metamorphic rocks have been reported; similar rock (undated) is present on the central west coast of Florida, and a Paleozoic age (middle Carboniferous) also was found for a metamorphic rock (hornblendite) from western Georgia. These older dated rocks have been considered to be part of a metamorphic basement intruded by the younger igneous rocks; however, hydrothermal alteration of igneous rocks may produce metamorphic textures, and sedimentary rocks may be "granitized" by contiguous igneous intrusives. No unambiguous Piedmont-type crystalline metamorphic rocks, such as mica schist, garnet schist, or sillimanite-andalusite-kyanite schist, have been found by drilling in Florida.

The chemical anlayses of these rocks *per se* have little correlative value because of the small size of available samples and the undoubted variability of the rock bodies represented. However, they apparently are the first and only such analyses made of Florida igneous-metamorphic rocks. *(authors' abstract)*

MUELLER, PAUL A. and JON W. PORCH, 1983, *Tectonic implications of Paleozoic and Mesozoic igneous rocks in the subsurface of peninsular Florida:* Gulf Coast Association of Geological Societies Transactions, vol. 33, pp. 169-173.

The extensive Mesozoic and Cenozoic sedimentary sequence of

peninsular Florida rest unconformably upon a basement of dominantly volcanic rocks. Major and trace element analyses of samples from six deep oil test wells in north-central and south-central peninsular Florida suggest the existence of two distinct volcanic provinces. The northern province contains calc-alkalic andesitic to rhyolitic rocks similar to those found along modern convergent (ocean-continent) plate boundaries. The southern province is apparently a bimodal suite of basaltic and rhyolitic rocks. These rocks exhibit certain geochemical features which suggest they were generated in a continental rifting environment associated with a mantle plume. Available age data indicate the northern volcanic province is at least early Paleozoic in age while the volcanism in the south occurred during the early Mesozoic. *(authors' abstract)*

ODOM, A. LEROY and FLETT J. BROWN, 1976, *Was Florida a part of North America in the Lower Paleozoic?:* Geological Society of America Abstracts With Programs, vol. 8, pp. 237-238.

Detrital zircons from Lower Paleozoic cuttings of deep test well W-994 (P-1, Ohio Oil-Hernasco No. 1, Sec 19, T23S, R18E, Hernando County, Florida) were sampled and dated. Analysis of a 10 mg split of the entire zircon sample yielded a $^{207}Pb/^{206}Pb$ age of 685 m.y. Analysis of approximately 2 mg of dark, well-rounded zircons yielded a $^{207}Pb/^{206}Pb$ age of not less than 1850 m.y.

It appears that these older zircons were derived not from North America, but from the West African or Guinean shield. This being the case, Florida probably represents a fragment of another continent attached to North America during closing of the Iapetus and left behind after the opening of the Atlantic. *(from authors' abstract)*

PILGER, REX H., JR., 1980, *The Florida-Guinean connection: a constraint on pre-Atlantic reconstructions* (abstract) in: Pilger, R. H. (editor), *The origin of the Gulf of Mexico and the early opening of the central north Atlantic Ocean:* Proceedings of a symposium, March 3-5, 1980, Louisiana State University, Baton Rouge, La, p. 101.

The immediate, pre-Atlantic reconstruction of either Bullard and others (1965) or LePichon and others (1977), in addition to providing difficulties of gaps and overlaps in the Gulf of Mexico-Middle America region, also presents difficulties in the juxtaposition of west Africa and the Florida-Bahamas platform. The overlap of the platform with Africa could be explained by faulting and deformation of the platform during opening, or formation of the Bahamas portion by post-opening, oceanic processes.

Of potentially greater significance is the contrast between the adjacent geologic terranes of Florida and west Africa in the pre-Atlantic reconstructions. The Florida basement appears to consist of Precambrian-Cambrian age metavolcanics and metasediments, and intrusive granite of probable Cambrian age. This basement is apparently nonconformably overlain by essentially undeformed, non-metamorphosed sedimentary rocks ranging in age from Ordovician to Devonian, including quartzitic and quartzofeldspathic sandstone and shale. A similar sequence of rocks is observed in Guinea, 200 km northeast of the west African shoreline; there the rocks, also sandstones and shales, are of the same age, Ordovician-Devonian. Similarly, they unconformably overlie a deformed and metamorphosed basement of pre-Cambrian and Cambrian age. These similarities between the Florida and Guinea terranes . . . suggest their correlation and consequently, their relevance to pre-Atlantic reconstructions.

In the reconstruction of LePichon and others (1977) the two terranes are separated by several hundred kilometers. A more northerly position of Africa-South America with respect to North America results in a closer correspondence of the two terranes. Since the reconstruction of LePichon and others (1977) and the subsequent seafloor spreading history are well justified from marine data, the more northerly position of Africa was probably achieved in the latest Paleozoic or early Mesozoic, prior to opening of the present-day Atlantic Ocean. *(author's abstract)*

POJETA, JOHN, JR., JIRI KRIZ, and JEAN M. BERDAN, 1976, *Silurian-Devonian pelcypods and Paleozoic stratigraphy of subsurface rocks in Florida and Georgia and related Silurian pelecypods from Bolivia and Turkey:* U.S. Geological Survey Professional Paper 879, 32 p.

The subsurface sedimentary Paleozoic rocks beneath northern Florida and adjacent parts of Georgia and Alabama comprise a sequence of quartzitic sandstones and micaceous shales, dark-gray shales, and red and gray siltstones ranging in age from Early Ordovician to Middle Devonian. The Silurian-Devonian pelecypod faunas from four wells (three of which, the Ragland, Cone, and Tillis wells, are in Florida, and one of which, the Chandler, is in Georgia) are described and illustrated. Also described are Silurian pelecypods from one locality in Bolivia and one in Turkey.

Biostratigraphically, the faunas from the American wells range in age from Wenlockian or Ludlovian (Silurian) to Middle Devonian; the Bolivian specimens are probably Ludlovian (Late Silurian); and the Turkish specimens are probably Wenlockian or Ludlovian (Silurian). Paleocologically, the strata in the American wells represent shallow-water normal marine environments, and all pelecypods known from them belong to one of three life-habit groups—byssally attached, burrowing, or reclining. The Bolivian and Turkish pelecypods likewise belong only to these three life-habit groups. Analysis of the geographic distribution of the Florida Paleozoic pelecyod genera shows that they are closest to the forms found in central Bohemia and Poland; elements of this fauna also occur in Nova Scotia, North Africa, and South America. *(authors' abstract)*

SHERIDAN, ROBERT E., J. T. CROSBY, G. M. BRYAN, and P. L. STOFFA, 1981, *Stratigraphy and structure of Blake Plateau, northern Florida Straits, and northern Bahama Platform from multichannel seismic reflection data:* American Association of Petroleum Geologists Bulletin, vol. 65, pp. 2571-2593.

Approximately 2,100 km of 24-fold multichannel seismic reflection data reveal much about the subsurface geology for a large part of the continental margin east of Florida. Discordance between the westward-dipping pre-breakup sediments and the eastward-sloping basement along the edge of the Blake Plateau is interpreted as an effect of a splinter of continental margin derived from the African plate by a spreading-center jump in the Middle Jurassic. Early rifting centered under the main part of the Blake Plateau became inactive, as a spreading-center jump shifted the active rift to east of the present Blake Escarpment along the Blake Spur magnetic anomaly.

In the northern Florida Straits the data reveal that the breakup unconformity, underlain by Triassic-Lower Jurassic(?) arkosic volcaniclastics, extends from southern Florida to the western Bahama Banks. These volcaniclastics are associated with the rift-crust of intermediate nature formed just prior to and during breakup of the North American and African continental plates.

Back-reef platform deposits of limestones, dolomites, and evaporites of Late Jurassic to Albian age extend from the Blake-Bahamas Escarpment westward beneath Florida. These deposits formed what once was a megabank extending over a wider area than the present smaller isolated Bahamas Banks. The formation of the Florida Straits and Bahamas channels occurred during the Cenomanian transgression. Only on the present Bahamas Banks and Florida platform did shallow-water carbonate deposition persist to maintain a shallow-bank environment.

Evidence of recurring scour by current erosion is found in the Florida Straits. Erosional events apparently occurred in the middle Cenomanian, middle Paleocene, early-middle Eocene, and Eocene-Oligocene, which coincidentally are times of lower eustatic sea level according to Vail et al. (1977). This evidence of Florida current scour indicates that the current was present as far back as the Cenomanian.

Major faulting appears to have dropped the Northeast Providence Channel relative to the western Bahamas after the Albian. Submarine erosion and bank buildup created the channels and smaller relief features like Great Abaco Knoll beginning in about the Cenomanian.

A carbonate bank margin and reef complex was present along the Bahamas Escarpment since the Middle Jurassic. Apparently these organic buildups seeded on originally shallow structural relief on oceanic basement created during the spreading-center jump to the position of the Blake Spur magnetic anomaly. The bank margin apparently has retreated at least 15 km from a Late Jurassic-earliest Cretaceous position now marked by a bench below the A^u unconformity*.

Active faulting occurred along the Great Abaco fracture zone at least through the Late Cretaceous and perhaps into the Tertiary. These relatively young tectonic events, together with the post-Albian faults in Providence

*Note: The A^u reflector, or horizon, is a hiatus between lower Miocene and possibly Cenomanian rocks.

Channel, indicate interactions between the Atlantic and Caribbean plates and that extensions of faulting have taken place far to the northeast of Cuba and the Greater Antilles. *(authors' abstract)*

SHERIDAN, ROBERT E., C. L. DRAKE, J. E. NAFE, AND J. HENNION, 1966, *Seismic refraction study of continental margin of Florida:* American Association of Petroleum Geologists Bulletin, vol. 50, pp. 1972-1991.

Data from 31 seismic-refraction profiles are interpreted and presented in five structure sections. The subsurface structure east of Florida under the Blake Plateau is similar to that of the margin north of Cape Hatteras. Basement plunges seaward from Florida into a deep sedimentary trough under the Blake Plateau. A basement ridge parallels this north-south-trending trough on the seaward side, along the eastern edge of the plateau.

The basin under the Blake Plateau was separated from the South Florida-Andros Island basin, at least until the Early Cretaceous, by a southeastward extension of the Peninsular Arch. This seaward extension trends from just east of Cape Kennedy to the western end of Little Bahamas Bank.

The marked relief of the Florida shelf, the Florida Straits, and the Blake Plateau is evident only in the sedimentary layers and is the result of significant changes in thickness of the post-Paleocene section, especially the Eocene. The top of the Paleocene extends beneath the present physiographic irregularities with slight relief, whereas the Eocene thickness ranges from about 500 m on Florida to about 70 m on the Blake Plateau. Strong currents sweeping the Florida Straits and Blake Plateau probably are responsible for the absence of a thick post-Paleocene section. The present orientation of the Florida current may have existed as early as Paleocene time.

Besides the changes in relief within the sedimentary section, there are lateral facies changes and velocity variations. These variations are primarily dependent on the depth of burial. Nearly similar velocity-depth distributions are found for the Blake Plateau, the Florida Straits, the Bahamas Banks, and the Florida Platform. The variations in thickness of the sediments in these areas result in variable velocities in the stratigraphic units, and correlation of the refraction data is difficult. *(authors' abstract)*

SMITH, DOUGLAS M., 1983, *Basement model for the panhandle of Florida:* Gulf Coast Association of Geological Societies Transactions, vol. 33, pp. 203-208.

Core samples from deep boreholes in panhandle Florida form the basis of a basement model involving at least eight separate fault blocks and basins, each with a distinct depositional history. The dominant structures are a northwest-trending fault and a large northeast-trending Triassic graben which encompasses several secondary fault blocks and forms the Southwest Georgia Embayment (Apalachicola Embayment). This graben as well as associated and perpendicularly-oriented (northwest-southeast) faults were formed in response to tensional forces related to the Mesozoic separation of North American and South American land-masses and the consequent formation of the Gulf of Mexico. Granitic basement blocks, perhaps Early Cambrian in age, experienced differential subsidence and changing relationships with various sedimentary source terrains. Thus, the separate basins accomodated different combinations of Triassic Eagle Mills red beds and Jurassic deposits ranging from the Louann Salt to the Cotton Valley sandstones and shales. *(author's abstract)*

SMITH, DOUGLAS M., 1982, *Review of the tectonic history of the Florida basement:* Tectonophysics, vol. 88, pp. 1-22.

This paper provides a comprehensive review of the lithological, geochronological, paleontological, and geophysical data used to interpret the tectonic history of Florida. Comparison with similar data on African rocks yields a model for the tectonic history of the Florida basement. The author's abstract summarizes the model as follows:

> "Lithological similarities between the Suwannee Basin deposits of undeformed Ordovician and Silurian sandstone and shale lying 0.9-1.9 km below the north Florida surface and equivalent-aged strata from Senegal to Sierra Leone in western Africa suggest an African location for the Florida basement during the early Paleozoic. The southern edge of the Paleozoic sediments laps onto a Pan-African granitoid batholith which is considered representative of a nearly Paleozoic Afro-South American assemblage. A late Paleozoic (Allegheny) continental closure brought the Florida basement, and much of the present-day Gulf Coastal margin, into juxtaposition with North America, but the arrangement of continental promontories precluded a direct application of deforming stresses to the overlying basin sediments. Numerous occurrences of early Mesozoic rhyolitic tuffs and ignimbrites in deep (2.7-5.5 km) bore holes from central and south Florida are interpreted as indicative of a Triassic hot spot that initiated rifting and the opening of the North Atlantic. Subsurface rhyolitic rocks are also present in northern Florida, but the position of the hot spot dictated that the Florida Plateau remain appended to North America as radially propagating rifts from the hot spot created a new configuration of plate boundaries from those of the Paleozoic. Other continental terrains adjacent to southern Florida were either altered and foundered to underlie the Bahamas or stayed with Africa and/or South America."

WALPER, JACK L., 1974, *The origin of the Bahamas Platform:* Gulf Coast Association of Geological Societies Transactions, vol. 24, pp. 25-30.

The origin of the Bahama platform and its continued subsidence to permit the accumulation of a thick carbonate cap has been a problem of middle American geology. The relation of this feature to previously published reconstructions of the late Paleozoic-early Mesozoic "fit" of North America, Africa and South America has also posed a problem. A new model incorporating the volcano-tectonic rift and ignimbrite sheet association is proposed to explain the origin of the Bahama platform as an integral part of Caribbean plate tectonics. A new North America-South America join is utilized to account for the major geologic and tectonic continuities of Paleozoic age throughout Mexico and Central America.

The clockwise rotation of North America as it separated from South America and Africa caused the counterclockwise bending of the entire peninsula of Mexico and Central America, with the newly accreted Caribbean plate into a subduction zone that was to evolve into the arc-trench system of the Greater Antilles. The rotation and beginning of subduction of this Caribbean plate into the Cuban trench, in Jurassic time, triggered volcanic eruptions that provided the foundations for the Cuban volcanic arc and the usual thick and widespread ignimbrite sheet behind the arc in the area now occupied by peninsula Florida and the Bahama Banks.

Not only is evidence for this feature found in wells drilled in Florida but it also provides the foundation upon which was deposited the thick sequence of carbonate strata that forms the Bahama Banks. This interpretation eliminates the overlap of the Bahama salient onto Africa, explains the origin of the Old Bahama Channel, serves the same purpose as the sedimentary prism proposed by Dietz and other (1970) and has the volcanic character to meet the geophysical requirements indicated by Uchupi and others (1971). *(author's abstract)*

WICKER, RUSSELL A., and DOUGLAS L. SMITH, 1977, *Florida basement—an isometric view:* American Association of Petroleum Geologists Bulletin, vol. 61, pp. 2143-2145.

An isometric view of the Florida basement surface, based on available core data from more than 150 boreholes, has been derived by application of the SYMAP and SYMVU computer programs. This visualization shows numerous topographic features which can be associated with structural patterns in the overlying formations and illustrates a significant contrast in basement depth between northern and southern Florida. *(authors' abstract)*

WICKER, RUSSELL A., and DOUGLAS L. SMITH, 1978, *Reevaluating the Florida basement,* Gulf Coast Association of Geological Societies Transactions, vol. 28, pp. 681-687.

A generalized representation of the basement and overlying sedimentary rocks of peninsular Florida has been developed utilizing available gravity anomaly values, deep test-well data, and a variation of the Talwani, et al. (1959) two-dimensional gravity modeling technique. Subsurface density and depth values along 10 profiles were adapted to an iterative calculating process to generate gravity anomaly profiles conforming to those observed. Modeled cross-sections along these profiles were then used to interpolate basement and sedimentary configurations for the entire peninsula. The final models display the low density (1.95-2.15 gm/cm^3) near-surface rocks of Late Cretaceous to Recent ages extending to depths ranging from approximately 0.8 to 2.6 km. Depths of the underlying Lower Cretaceous rocks (density of 2.30 to 2.55 gm/cm^3) extend to approximately 1.4 km in north Florida and more than 4.7 km in south Florida. An abrupt north-to-south increase in average basement rock density from 2.73 to 3.00 gm/cm^3 is evident along a general east-west trending zone passing through the central portion of the peninsula. This supports a concept of a north-to-south transition from continental to oceanic type rocks underlying the thick sedimentary sequence of the central Florida peninsula. *(authors' abstract)*

WILSON, GARY V., 1975, *Early differential subsidence and configuration of the northern Gulf Coast Basin in southwest Alabama and northwest Florida:* Gulf Coast Association of Geological Societies Transactions, vol. 25, pp. 196-206.

Deep test-well information in southwest Alabama and northwest Florida indicates that early differential subsidence of the basement had a marked influence on the thickness and distribution of accumulating coastal plain sedimentary deposits, especially carbonates, evaporites and thick marine shale units. Geophysical data reveal that these differential movements were either directly or indirectly related to lateral variations in the thickness of crustal layers. These crustal thickness variations may have been either the cause of differential subsidence of the basement or the result of deep-seated forces that induced or affected subsidence. Regional gravity anomalies reflect crustal thickness variations associated with the Wiggins uplift and the Mississippi interior salt basin. In the study area a basement high and stratal thinning correspond to the easternmost extension of the Wiggins uplift and a regional gravity minimum. A basement low and stratal thickening correspond to the eastern limb of the Mississippi interior salt basin and a regional gravity maximum.

The configuration of the basin margin during much of Late Jurassic time was controlled by a hinge line that roughly coincided with a system of dense intracrustal masses. These masses probably locate a zone of structural weakness within the crust, basinward from which initial subsidence and marine deposition took place. The basin margin and extent of early marine deposition was also influenced by the Wiggins uplift and the related Conecuh arch. This influence continued until Cretaceous seas advanced beyond the northern extent of this positive feature. *(authors' abstract)*

RELATED REGIONAL AND TECTONIC STUDIES

ANDERSON, THOMAS H., and VICTOR A. SCHMIDT, 1983, *The evolution of Middle America and the Gulf of Mexico-Caribbean Sea during Mesozoic time:* Geological Society of America Bulletin, vol. 94, pp. 941-966.

A plate-tectonic model for the evolution of Middle America and the Gulf of Mexico-Caribbean Sea region is presented. The model, which is based upon the existence of the Mojave-Sonora megashear, incorporates into the

Triassic Pangea reconstruction three microplates between North and South America, thus avoiding the overlap of the Bullard fit. During late Jurassic time, as North America split away from Europe, Africa, and South America, shear, with left-lateral sense of displacement, occurred along the transform faults that bounded the microplates. *(from authors' abstract)*

BALL, M. M. and C. G. A. HARRISON, 1969, *Origin of the Gulf and Caribbean and implications regarding ocean ridge extension, migration, and shear:* Gulf Coast Association of Geological Societies Transactions, vol. 19, p. 287-294.

The Gulf and Caribbean are a zone of north-south extension and left lateral shear opened between the Americas as these continents moved westward from Africa. The movements are related to ocean floor spreading away from the mid-Atlantic ridge. In order to accommodate spreading, the ridge itself migrates westward from Africa. Ridge migration is radial outward from Africa and results in opening triangular sheared grabens with apexes against Africa. A new ridge segment extends across these openings. Spreading rates vary and the migrating and extending ridge is sheared on fracture zones in response to these variations.

The currently popular related concepts of plate tectonics and transform faults are inconsistent with ridge migration and shear because these theories deny shear on fracture zones beyond ridge offsets and in the sense indicated by the position of ridge segments. Ridge migration and shear are a necessary complication of the spreading hypothesis. T-intersections of ridges are explained as intersections between a spreading and migrating ridge and a shear. The shear is only active on the side of the ridge toward which the migration is taking place. The junction of the mid-Atlantic ridge with the Azores-Gibraltar ridge is an example of such a feature. *(authors' abstract)*

BEALL, ROBERT, 1973, *Plate tectonics and the origin of the Gulf Coast Basin:* Gulf Coast Association of Geological Societies Transactions, vol. 23, pp. 109-114.

The origin of the Gulf Coast basin and many of the structures in the basin are explained by a proposed Gulf basin miniplate. The miniplate lies between a large right lateral megashear which extends from under the eastern Gulf of Mexico to the east end of the Ouachita Mountains, and a left lateral megashear of similar proportions which parallels the Mexican coastline and extends to the Marathon uplift. The Llano uplift acted as a buttress against northwestward movement of the Gulf basin plate.

The plate is believed to have moved more than 400 miles to the northwest during a Precambrian-Paleozoic compression cycle. When compression ceased, at or near the end of the Paleozoic Era, the Mesozoic Gulf Coast basin was formed over the slowly tilting plate. Rebound, associated with the cessation of compression, caused tension faults to form along old zones of crustal weakness. The graben and other fault trends in and adjacent to the interior salt basins are believed to overlie these crustal faults as are some of the similar structural features of the coastal basin. *(from author's abstract)*

BEHRENDT, JOHN C., JOHN SCHLEE, JAMES M. ROBB, and KATHERINE M. SILVERSTEIN, 1974, *Structure of the continental margin of Liberia, West Africa:* Geological Society of America Bulletin, vol. 85, pp. 1143-1158.

Geophysical surveys made by R/V Unitedgeo I (USGS-IDOE Cruise Leg 5), combined with earlier surveys and available geologic information, provide the basis for interpreting the structure of the continental margin of Liberia. This area lies at the junction of the Americas and Africa in published reconstructions of Gondwanaland prior to the opening of the North and South Atlantic in Jurassic and Cretaceous time, respectively.

Three fracture zones (St. Paul, Cape Palmas, and Grand Cess) are inferred in the area southeast of 9° 30′ W. on the basis of magnetic and gravity data, which is supported by bathymetric and seismic reflection data. The three fracture zones appear to exist as separate lineaments near the African coast. Farther seaward, they may be part of the same transform fault crossing the Atlantic (St. Paul fracture zone). The magnetic anomalies associated with these fracture zones, which may have originated in Cretaceous time at the opening of the South Atlantic, are continuous with magnetic anomalies over crust of Eburnean age (approx. 2,000 m.y.) in southeast Liberia and its continental shelf. This suggests that Eburnean age structures may have been zones of weakness that were reactivated in Cretaceous time.

A positive gravity anomaly (approx. 50 mgal) along the coast and continental shelf of Liberia is attributed to deep crustal rocks that were uplifted and exposed in Pan-African time (approx. 500 m.y.). The land boundary of this anomaly coincides with a shear zone that marks the boundary between the Pan-African and the Liberian age province (approx. 2,700 m.y.); the shearing (in a thrust-fault sense) may be the result of compressive stress associated with the closing of a proto-Atlantic ocean. Liberian age magnetic anomalies in the area northwest of 9° 30′ W. cross the Pan-African province (and the positive coastal gravity anomaly) and continue over the continental shelf and slope to about the 3,000 m bathymetric contour; the seaward limit of the anomalies is interpreted as representing the seaward limit of the old continental crust. This westward extension of the continental crust does not completely fill the gap in fit in various published reconstructions of Gondwanaland, and we suggest that the northern Florida block may have been located near the Liberian margin at one time.

Magnetic data indicate a thick section of sedimentary rock, possibly as great as 8 km, on the continental slope. Comparison of gravity data over magnetically inferred basins in the shelf, slope, and rise suggests that low-density sedimentary rocks constitute a greater proportion of the section in basins beneath the slope and rise northwest of 9° 30′ W. than beneath the slope and rise in the area of the fracture zones. The gravitational attraction that corresponds to a crust-mantle boundary dipping 45° to 60° can be computed to fit observed data—as might be expected at a rifted continental margin. A shallow high-density block beneath the coast and continental shelf is required to fit the coastal positive anomaly; this block is represented by exposures on land of granulite-grade metamorphic rock of the Pan-African province. *(authors' abstract)*

BUFFLER, RICHARD T., JOEL S. WATKINS, JEANNE F. SHAUB, and J. LAMAR WORZEL, 1980, *Structure and early geologic history of the deep central Gulf of Mexico basin,* in Pilger, R. H. (editor), *The origin of the Gulf of Mexico and the early opening of the central North Atlantic Ocean:* Proceedings of a symposium, March 3-5, 1980, Louisiana State University, Baton Rouge, Louisiana, pp. 3-16.

Multifold seismic reflection data (27,000 km) and OBS refraction data collected recently by the University of Texas Marine Science Institute in the deep Gulf of Mexico provide the basis for a preliminary interpretation of the early (pre-middle Cretaceous) geologic history of the basin. The following observations can be made regarding the structure and stratigraphy of the deep central Gulf: 1) a thinned and rifted "transitional" crust (6-20 km thick) underlies the southern part of the deep central Gulf and extends up to 100 km seaward of the Campeche Escarpment; 2) the upper part of this transitional crust in places contains rift basins; 3) a major unconformity (strong, smooth reflector) truncates this transitional crust; 4) an oceanic crustal layer (5-6 km thick) underlies the rest of the central Gulf. The top of this layer corresponds to a strong irregular reflector seen on the seismic reflection data; 5) an outer basement high occurs along the boundary between oceanic crust and transitional crust; 6) a thick salt section overlies the transitional crust. It is bounded on the north and west by the outer basement high and pinches out depositionally to the south along the base of the Campeche Escarpment against the major unconformity (3 above). Salt appears to be absent or possibly very thin in the areas of oceanic crust; 7) there was an early period of deformation of salt and sedimentary rocks probably due to gravity flowage of the salt associated with the early rapid subsidence of the basin; 8) a younger undeformed sedimentary sequence onlaps the oceanic crust, the outer basement high and the deformed salt and sedimentary rocks. The upper part of this sequence probably represents the deepwater equivalent of the Lower Cretaceous carbonate banks that rimmed the early Gulf basin; 9) these older sedimentary sequences are truncated by a major regional unconformity that is tentatively correlated with a major middle Cretaceous (Cenomanian – 97 m.y.) unconformity and drop in sea level.

The symmetrical distribution of transitional crust and thick salt on either side of oceanic crust as well as other data suggest that the Gulf basin evolved somewhat along the same lines as the North Atlantic, both as to timing and as to structure and stratigraphy. A model for the early evolution of the Gulf is proposed based on our interpretations and consists of four main phases as follows: a) a long period (Triassic-Early Jurassic) of regional uplift, doming, rifting, erosion and filling of rift basins with continental sediments and volcanics *(Rift Phase).* Formation of thinned continental crust or transitional crust; b) formation of a medial uplift due to mantle upwelling *(Late Rift Phase).* Initial subsidence, incursion of seawater and deposition of thick shallow-water evaporites in basins on either side of medial uplift (Middle Jurassic); c) a period of seafloor spreading in Late Jurassic-Early Cretaceous and formation of oceanic crust *(Drift Phase).* Rapid subsidence of the basin due to cooling of the crust. Deposition of deep-water sediments in the central Gulf and shallow-water sediments on adjacent margins overlying the salt. Early deformation due to gravity flowage of salt basinward; and d) abortion of seafloor spreading due to major plate reorganization about 130 m.y. ago. Continued subsidence of the basin through Lower Cretaceous as crust continues to cool *(Subsidence Phase).* Deposition of deep-water sediments across the deep basin and buildup of carbonate banks on the margins controlled by a structural hinge zone. Formation of a major middle Cretaceous (97 m.y.) unconformity due to a combination of a continued subsidence and a major drop in sea level. *(authors' abstract)*

DANIELS, DAVID L., ISADORE ZEITZ, and PETER POPENOE, 1983, *Distribution of subsurface Lower Mesozoic rocks in the southeastern United States as interpreted from regional aeromagnetic and gravity maps,* in Gohn, Gregory S. (editor), *Studies related to the Charleston, South Carolina, earthquake of 1886—tectonics and seismicity:* U. S. Geological Survey Professional Paper 1313-K, 24 p.

Aeromagnetic data, in conjunction with data from deep wells, are used to interpret the nature of the pre-Cretaceous "basement" beneath the Coastal Plain in Georgia and South Carolina. These data reveal some of the complexity of the broad early Mesozoic rift basin, which appears to extend at least from the Gulf of Mexico to the Atlantic Ocean. Along the northern edge of this rift, in the Savannah River region, depth-to-magnetic-source calculations delineate two interconnected basins, which are separated from the main rift by a broad horst of crystalline basement. The Riddleville (Ga.) basin appears to contain at least a 2.2-km thickness of basin fill; it is deeper than the Dunbarton (S. C.) basin, which has at least a 1.0 km thickness of fill. A maximum thickness of 3.5 km near Statesboro, Ga., is indicated for the main basin, called here the South Georgia rift.

Abundant lower Mesozoic diabase dikes in the South Carolina Coastal Plain are revealed on the magnetic map by narrow anomalies that have two dominant trends, northwest and north. One set of several north-trending anomalies can be traced continuously northward across the Coastal Plain, Piedmont, and Blue Ridge for 480 km. The two sets, which may represent two episodes of intrusion, have characteristic distributions within the study area: northwesterly trends are to the southwest and northerly trends to the northeast. A broad area of overlap extends from 80° W., in South Carolina, to northern Virgina. Several lower Mesozoic diabase sills within the rift are indicated by circular, low-amplitude magnetic anomalies.

Intense magnetic highs and corresponding gravity highs indicate the presence of abundant large bodies of mafic rocks in the pre-Cretaceous "basement" in addition to the dikes and sills; two groups of mafic rocks are distinguished. Circular or oval anomalies are interpreted as largely gabbroic plutons, which may be as young as early Mesozoic and which are present both within and outside the rift. Elongate anomalies, which form a northeast-trending belt across Georgia and South Carolina, may reflect deformed pre-Mesozoic mafic rocks.

The largest and least understood magnetic feature of the region is the Brunswick anomaly, a long-wavelength anomaly system 1,100 km long, which is mostly offshore but which also bisects the Georgia Coastal Plain. The anomaly divides two regions of differing magnetic character and magnetic trend, which suggests that it is closely related to a Paleozoic suture between a Florida-South Georgia microcontinent and the North American craton. *(authors' abstract)*

DICKINSON, WILLIAM R., and PETER J. CONEY, 1980, *Plate tectonic constraints on the origin of the Gulf of Mexico:* in Pilger, R. H. (editor), *The origin of the Gulf of Mexico and the early opening of the central North Atlantic Ocean:* Proceedings of a symposium, March 3-5, 1980, Louisiana State University, Baton Rouge, Louisiana, pp. 27-36.

Drift history and plate interactions within the Caribbean region place severe constraints on hypotheses for the origin of the Gulf of Mexico. Various crustal elements of South America and Mesoamerica were sutured against North America when a Paleozoic ocean closed along the Ouachita segment of the Hercynian orogenic belt. Triassic positions for crustal blocks within Pangaea leave little or no space for a pre-Jurassic oceanic area in the region south of the North American craton. Lack of evidence for any Mesozoic or Cenozoic subduction around most margins of the present Gulf implies that the crustal blocks which separated during the Mesozoic to form the oceanic floor of the central Gulf were largely those that still rim the Gulf today. Prior to Jurassic opening of the Gulf, the Yucatan block including the Campeche bank thus nestled against the southern United States and eastern Mexico. Subsequent independent motion of Yucatan later in the Mesozoic was accommodated either by a northwesterly trending megashear that sliced through Mexico, or by a northerly trending transform that crossed the present Isthmus of Tehuantepec. The positioning of Cuba across the mouth of the Gulf between Yucatan and Florida was accomplished by subduction along the northern flank of the Greater Antilles from medial Cretaceous to mid-Paleogene times. The western limit of the subduction zone was a transform or trans-tensional rift along the eastern edge of the Yucatan block. Northward motion of the greater Antilles relative to North America continued until collision of Cuba with the Bahama platform, whose crustal bulk effectively resisted subduction. Subsequent Neogene subduction of Atlantic lithosphere beneath the Caribbean plate has been confined to the Lesser Antilles arc-trench system. Coordinate Neogene transform slip along the north side of the Caribbean plate has

opened the Cayman trough, and displaced nuclear Central America from its original Paleogene position south of the Sierra Madre del Sur. *(authors' abstract)*

DIETZ, ROBERT S., JOHN C. HOLDEN, and WALTER P. SPROLL, 1970, *Geotectonic evolution and subsidence of Bahama Platform:* Geological Society of America Bulletin, vol. 81, pp. 1915-1928.

The thick section (greater than 5 km) of flat-lying Cretaceous and younger carbonates capping the Bahama platform implies an unusual geotectonic history, characterized by great subsidence. We suggest that this platform is underlain neither by sial nor by a volcanic foundation creating a "mega-atoll." Instead we propose a basement of oceanic crust about 11 km down which has undergone slow subsidence. Triassic rifting in the Atlantic probably initially created a closed small ocean basin, or mediterranean, in the Bahama region. This was accomplished by a rotational movement of the North American plate away from North Africa accompanied by shearing across the top of the South American plate which remained stationary and attached to Africa. A wedge-shaped sphenochasm resulted which became a sediment trap within Pangaea and quickly filled to sea level with turbidites. With renewed continental drift, the Bahama platform became a subsiding marginal plateau attached to the North American craton upon which algal-coral growth exposively flourished under holo-oceanic conditions, providing sufficient upbuilding to offset subsidence and maintain a sea level freeboard.

This interpretation obviates the overlap of the Bahama salient onto the African craton when the Atlantic Ocean is closed under continental drift reconstruction. It accounts for the long history of subsidence without calling on "oceanization." It also explains the inference, based on some Cuban-Soviet geophysical evidence, that there is a thick sedimentary section beneath the Bahamian carbonates. An underlying clastic sequence could also include the source of the probable salt domes at the bottom of Exuma Sound. *(authors' abstract)*

Note that, as the authors point out in their development of the model, although the discussion is primarily restricted to the Bahama platform, the explanation could possibly include contiguous geologically similar regions, i.e., the southern one-fourth of Florida and a portion of the Blake marginal plateau. Also, as discussed in the conclusion of the paper, if the inferred Lower Mesozoic clastic section is verified, it should offer good oil and gas prospects with deep drilling.

DILLON, WILLIAM P., and CHARLES K. PAUL, 1982, *Summary of development of the continental margin off Georgia based on multichannel and single-channel seismic-reflection profiling and stratigraphic well data:* in Arden, Daniel P., Barry F. Beck, and Eleanor Morrow, (editors), *Proceedings of the second symposium on the geology of the Southeastern Coastal Plain:* Americus, Georgia, March 5-6, 1979, Georgia Geological Survey Information Circular 53, pp. 197-200.

The U. S. Geological Survey has collected a grid of 9,000 km of deep penetration, common-depth-point, seismic reflection profiles on the U. S. southeastern continental margin in order to study the structure, development, and petroleum potential of the region. Profile TD-5 extends from the outer part of the Southeast Georgia Embayment, across the northern end of the Blake Plateau basin, and eastward to the deep sea. It passes through three deep drill sites which provide stratigraphic control. Along with knowledge gained from the remainder of the grid, profile TD-5 is used to characterize the development of the continental margin off Georgia. A summary of this development is given by the authors:

> "The continental margin off Georgia probably began to form with rifting, mafic intrusive and extrusive activity, and rapid sediment deposition which led to development of a transitional basement. Early subsidence was rapid for the basement beneath the present Blake Plateau basin, and the Upper Jurassic deposits form the thickest unit. Reefs acted as sediment dams at the seaward side of the basin. Near the end of the Neocomian, the reefs died, but a new reef formed slightly to landward and continued to form a sediment dam until the end of the Early Cretaceous. Subsequently, the Blake Plateau has been a moderately deep water environment (several hundred meters) until present. The Gulf Stream became significant on the Blake Plateau near the Paleocene-Eocene boundary, and since then has prevented the shelf sediments from prograding across the plateau."

DILLON, WILLIAM P. and JEAN M. A. SOUGY, 1974, *Geology of West Africa and Canary and Cape Verde Islands:* in, Nairn, Alan E. M. and Francis G. Stehli, (editors), *The ocean basins and margins; Volume 2, The North Atlantic:* Plenum Press, New York, pp. 315-390.

Research and study of the geotectonic history of the Florida basement requires familiarity with West African geology. This paper is an excellent reference work on West African geology. It includes detailed descriptions of the structural framework and geologic history, from Precambrian to Quaternary, of West Africa and the Canary and Cape Verde Islands.

DRAKE, C. L., J. HEIRTZLER, and J. HIRSHMAN, 1963, *Magnetic anomalies off eastern North America:* Journal of Geophysical Research, vol. 68, pp. 5259-5274.

Numerous magnetic profiles have been made across the continental margin of eastern North America by the U. S. Geological Survey, the U. S. Navy Hydrographic Office, and the Lamont Geological Observatory. These data, supplemented by areal studies in parts of the region, reveal an anomaly pattern which is essentially parallel to the margin and to the major structural features on shore. Calculations show that, while basement topography may contribute, the principal causes of the anomalies are compositional changes within the basement. Two exceptions to the pattern are noted; one is southern Florida, suggested by E. R. King (1959) to be an extension of the Ouachita system, and the other is a major feature normal to the coast at latitude 40° N interpreted as being associated with a transcurrent fault. Other geophysical and geological observations indicate a right lateral displacement of the fault of about 100 miles and a total length in excess of 600 miles. The implications of this and the possibility of other transcurrent movements along the Atlantic margin are examined. *(authors' abstract)*

FREELAND, GEORGE L., and ROBERT S. DIETZ, 1971, *Plate tectonic evolution of Caribbean-Gulf of Mexico region:* Nature, vol. 232, pp. 20-23.

A geotectonic model for the evolution of the "American Mediterranean" (Caribbean-Gulf of Mexico region) is presented. Microcontinents, which are later translated, eliminate the overlaps and oceanic areas in the Paleozoic reconstruction of the region by Bullard et al. (1965). Areas underlain by pre-Mesozoic basement are included in the microcontinents; neo-cratons (i.e. "new ground" created during Mesozoic-Cenozoic time) are eliminated. The microcontinents included Oaxaca (southern Mexico), Yucatan, Honduras-Nicaragua, and southeastern Bahama platform (the nature of the Blake-Florida-Bahama platform basement is still unknown; for this reconstruction it is assumed to be pre-Mesozoic). The evolution of the Caribbean-Gulf of Mexico region, including the rotation and translation of these microcontinents, as related to the tectonic motions of the North American, South American, and African plates, is shown in seven time-sequence reconstructions from Paleozoic to present.

HALL, D. J., T. D. CAVANAUGH, J. S. WATKINS, and K. J. McMILLEN, 1982, *The rotational origin of the Gulf of Mexico based on regional gravity data:* in Watkins, J. S. and C. L. Drake (editors), *Studies in continental margin geology:* American Association of Petroleum Geologists Memoir 34, pp. 115-126.

Regional free-air gravity data from the Gulf of Mexico define deep-seated linear features which we interpret as outer marginal basement highs. Highs are arranged symmetrically around the deep water Gulf. Abrupt changes in trend occur along three well-defined zones on both sides of the central Gulf. The marginal high off Galveston parallels the Cretaceous Edwards Reef trend 230 km to the northwest. We interpret the seaward limits of these outer marginal highs as close to the landward edges of oceanic crust. The crust in the area from the continental hinge zone (near which the Edwards Reef developed) to the outer high is thinned, faulted, and intruded by mafic dikes, but probably has a nearly continental overall composition.

We infer that the Gulf opening followed a pattern of early rifting and subsequent sea-floor spreading. Our model implies that the thick salt deposits underlying the modern Texas slope were deposited on sediments overlying oceanic crust. Thinner salt deposits overlie pre-salt sediments on rift-stage crust both northwest of the Texas outer marginal high and in the Sigsbee Knolls. A change in the location of the sea-floor spreading center led to separation of the two main salt depo-centers beneath the Sigsbee Knolls and along the Texas-Louisiana shelf and slope. Recent paleomagnetic evidence (L. Sanchez Barreda, personal communication, 1981) indicates a post-Permian, 24° clockwise rotation of Chiapas relative to Oaxaca (this is consistent with our rotational model). The Salina Cruz fault, crossing the Isthmus of Tehuantepec between the Permian outcrops in Chiapas and Oaxaca, was probably a major transform fault active during the Gulf opening. *(authors' abstract)*

HORTON, J. WRIGHT, JR., ISIDORE ZIETZ, and THORTON L. NEATHERY, 1984, *Truncation of the Appalachian Piedmont beneath the Coastal Plain of Alabama: Evidence from new magnetic data:* Geology, vol. 12, pp. 51-55.

A new aeromagnetic survey of a part of southern Alabama reveals that magnetic signatures of the Appalachian Piedmont are truncated by a major magnetic lineament beneath the Gulf Coastal Plain. Mylonitic rocks have been recovered from a drillhole along this lineament, which is probably a fault zone of late Paleozoic and/or Triassic-Jurassic age. We suggest that this fault zone may initially have been the Alleghanian convergent suture between the North American craton and accreted terranes to the southeast. The zone may have been locally reactivated as part of an extensive buried Triassic-Jurassic graben system. *(authors' abstract)*

IBRAHIM, ABOU-BAKR K., J. CARYE, G. LATHAM, and RICHARD T. BUFFLER, 1981, *Crustal structure in Gulf of Mexico from OBS refraction and multichannel reflection data:* American Association of Petroleum Geologists Bulletin, vol. 65, pp. 1207-1229.

Results from 12 reversed refraction profiles each 110 km long have been combined with multichannel reflection data to produce a series of crustal structure sections across the Gulf of Mexico. These data show as many as three layers of sedimentary rocks with total thickness between 5 and 9 km and layer velocities between 1.7 and 3.5 km/sec. Beneath most of the Gulf, this sedimentary section is underlain by a layer with velocity between 4.5 and 5.5 km/sec. The acoustic basement as defined by reflection data is confined within this layer. Beneath this layer in most of the deep Gulf is an oceanic crustal layer, 3 to 6 km thick which thickens to about 12 km under the Mississippi fan and 10 km in the southeastern Gulf where it is interpreted to be transitional crust. This layer has a velocity between 6.4 and 7.0 km/sec and overlies a mantle with velocity between 7.6 and 8.2 km/sec.

These data confirm earlier refraction interpretation that most of the deep Gulf basin is underlain by an oceanic crustal layer flanked by transitional crust. This layer may have been formed by a mantle thermal event accompanied by a period of rapid sea-floor spreading. *(from authors' abstract)*

IBRAHIM, ABOU-BAKR K. and ELAZAR UCHUPI, 1982, *Continental oceanic crustal transition in the Gulf Coast geosyncline:* in, Watkins, J. S. and C. L. Drake (editors), *Studies in continental margin geology:* American Association of Petroleum Geologists Memoir 34, pp. 155-165.

Seismic refraction measurements indicate that the transition from rifted continental crust to oceanic crust takes place at a water depth of over 3000 m northwest of Cuba between the Florida and Campeche escarpments. Along the eastern flank of the Mississippi Embayment, the transition occurs at about 2500 m deep and on the embayment itself inboard of the coast. Off south Texas the boundary between the rifted continental crust and oceanic crust is near the shelf's edge, off Mexico the boundary is on the continental slope, and off Campeche Bank the boundary is about 100 km northwest of Campeche Escarpment. In the northern Gulf an oceanic crustal high may lie beneath the upper continental slope. This high served as a foundation for a Mesozoic reef. Maximum sediment accumulation took place along the contact between the rifted continental crust and oceanic crust. *(authors' abstract)*

KLITGORD, KIM D., WILLIAM P. DILLON, and PETER POPENOE, 1983, *Mesozoic tectonics of the southeastern United States Coastal Plain and continental margin:* in Gohn, Gregory S. (editor), *Studies related to the Charleston, South Carolina, earthquake of 1886—tectonics and seismicity:* U. S. Geological Survey Professional Paper 1313-P, 15p.

Many of the major structures associated with Paleozoic and Mesozoic tectonic events along the Southeastern U. S. Coastal Plain and continental margin have distinctive geophysical and geological properties, which are described in this integrated study of magnetic, gravity, seismic-reflection, and drill-hole data. These data are used to identify three major tectonic boundaries that separate terranes of Paleozoic, Triassaic, and Jurassic tectonic activity and to map sedimentary basins that were formed by Triassic and Jurassic rifting events. The major tectonic boundaries are: (1) An offshore hinge zone in basement that separates an area of crustal subsidence associated with the Jurassic-age marginal basins from an area of significantly less subsidence associated with Triassic and older basement structures to the west; (2) a line of narrow grabens, associated with the magnetic low in the Brunswick magnetic anomaly, that separates a Paleozoic basin underlying northeastern Florida, which was not greatly affected by late Paleozoic or Triassic tectonic activity, from a broad zone of considerable Triassic tectonic activity and sediment accumulation in the Charleston, S. C., region; and (3) a narrow east-west zone near 33° N that separates the geophysically distinctive northeast-trending Piedmont to the north from the Charleston region. The Triassic sedimentary basins are of two types: (1) narrow basins or grabens within the Piedmont and along the major tectonic boundaries and (2) broad zones of sediment accumulation over a block-faulted Paleozoic basin in northwestern Florida and in areas delineated by low-gradient magnetic and gravity fields in parts of the Charleston region. Deep continental margin basins, containing sedimentary rock as much as 14 km thick, formed at sites of Jurassic rifting and subsequent ocean opening seaward of the basement hinge zone. Reconstruction of the positions of the North American, South American, and African continents during the Early Jurassic provides a framework for relating the Mesozoic tectonic events and structures to major Paleozoic orogenic events and lithotectonic units. *(authors' abstract)*

LADD, JOHN W., 1976, *Relative motion of South America with respect to North America and Caribbean tectonics:* Geological Society of America Bulletin, vol. 87, pp. 969-976.

Magnetic anomalies in the North Atlantic have been analyzed by Pitman and Talwani (1972) to determine a sequence of finite difference poles of relative motion of North America with respect to Africa for the time period 180 m.y. B.P. to the present. A similar analysis of South Atlantic magnetic anomalies by the writer determines a sequence of finite difference rotations of South America with respect to Africa for the time period 127 m.y. B.P. to the present. The two sequences of finite difference rotations are used to calculate the relative motion of South America with respect to North America for late Mesozoic and Cenozoic time.

From Triassic to Early Cretaceous time, South America moved to the southeast away from North America. From Early Cretaceous to Late Cretaceous time, South Amerca moved eastward with respect to North America. Southeastward motion of South America occurred again from Late Cretaceous to early Tertiary time followed by northward motion from early to late Tertiary. Tectonic styles in the Caribbean region change when major plate motions change; however, the details of Caribbean geology cannot be explained by simple plate margins between North and South America. Tertiary compressional structures on the northern and southern margins of the Caribbean can be attributed to Tertiary closure between North and South America, but earlier tectonic regimes are not so easily related directly to North America-South America motions. *(authors' abstract)*

MULLINS, HENRY, T., and GEORGE W. LYNTS, 1977, *Origin of the northwestern Bahama Platform: Review and reinterpretation:* Geological Society of America Bulletin, vol. 88, pp. 1447-1461.

The origin of the Bahama Platform has been the subject of debate for more than a century. The major points of disagreement are (1) whether the Bahamian basement is continental or oceanic, and (2) the age and origin of the deep Bahama channels. Geophysical data indicate only that the Bahamian basement is of intermediate density, seismic velocity, and thickness. We propose that this basement was originally pre-Triassic continental material that was pervasively intruded by mafic and ultramafic material during the rifting of North America from Africa and South America in Late Triassic time. To alleviate the Bahama overlap in reconstructions of the North Atlantic we suggest that the Bahama Platform has been rotated approximately 25° to the northeast by the relative impinging motion of the Caribbean plate during Cretaceous and early Tertiary time. By accounting for this postulated rotation, the Bahama Platform forms an excellent fit between Africa and South America.

We propose the following model for the origin of the northwestern Bahama Platform: (1) The platform is continental and was originally part of Africa. (2) Rifting of North America from Africa and South America began in the vicinity of the northwestern Bahamas during the Late Triassic, preceded by a large domal uplift of the continents that initiated the deep Bahama Channels as grabens. (3) The Bahama Platform rifted from Africa principally along a large right-lateral shear and thus evolved as a transcurrent-type continental margin. (4) During the incipient development of the deep Bahama channels, Late Triassic continental arkosic rudites and arenites were deposited at the base of these grabens; (5) Initial marine conditions in Early to Middle Jurassic time may have resulted in the deposition of salt and organic-rich shales in the channels due to restricted circulation. (6) With the onset of more open marine conditions 3 to 6 km of Jurassic to Holocene deep-water carbonate and bioclastic turbidite sediments were deposited in the channels. (7) Most of the intraplatform relief of the northwestern Bahamas appears to be the result of the build-up of the banks relative to the channels during regional subsidence. *(authors' abstract)*

PILGER, REX H., JR., 1978, *A closed Gulf of Mexico, pre-Atlantic Ocean plate reconstruction and the early rift history of the Gulf and North Atlantic:* Gulf Coast Association of Geological Societies Transactions, vol. 28, pp. 385-393.

Several diverse lines of evidence indicate that the pre-Gulf of Mexico position of South America was adjacent to the northern Gulf Coast of North America in earliest Mesozoic time, as originally suggested by Walper and Rowett (1972). These include: 1) correlation of the boundary between Hercynian and pre-Hercynian terranes in Africa with the subsurface boundary between the southern Appalachians and the Florida platform in North America, 2) similarities in the inferred Triassic history of the Gulf and Atlantic coasts of North America; 3) recognition of significant left-lateral faulting in Mexico and Central America, which indicates more westerly positions of the various crustal blocks of Middle America prior to initiation of drift and, consequently, eliminates overlap of South America and Mexico of other reconstructions; 4) accommodation of the Florida-Bahama platform (assumed to be continental) by subsequent crustal extension and left-lateral faulting; 5) accommodation of Atlantic coast-Africa overlaps by crustal extension reflected in the on and offshore Triassic basins, and 6) satisfaction of paleomagnetic data which seem to require more northerly positions of the Gondwana continents relative to the Laurasian continents in latest Paleozoic and earliest Mesozoic time.

The post-rifting history inferred from the reconstructions and other constraints suggests the Gulf began opening in a north-south direction in early Mesozoic time, while right-lateral, obliquely divergent movement was occurring along the Atlantic coast between Africa and North America. Such motion was accommodated in part by formation of the Triassic rift basins. Subsequently, in late Triassic time, Africa and South America began moving in a southeasterly direction relative to North America. During this period, and into the early Jurassic, the Florida-Bahama platform was extended and emplaced along left-lateral faults roughly parallel to the direction of plate motion. Eastward motion of Mexico and Central America along left-lateral faults continued with opening of the Gulf of Campeche in Jurassic time, and movement of the various crustal fragments of Middle America into the Caribbean region during the Cretaceous and early Cenozoic. Contemporary east-west left-lateral movement is occurring along the plate boundary separating the North American and Caribbean plates.

These inferences suggest that the Gulf of Mexico is older than the Atlantic, and is underlain by the oldest oceanic crust still preserved in the world ocean basins. Further, it is likely that initial fragmentation of Gondwana from Laurasia involved a large component of strike-slip motion, concentrated along the axes of the older Appalachian-Hercynian mountain belts. *(author's abstract)*

SHERIDAN, ROBERT E., and WILLIAM L. OSBURN, 1975, *Marine geophysical studies of the Florida-Blake Plateau-Bahamas Area:* in Yorath, C. J., E. R. Parker and D. J. Glass, (editors), *Canada's continental margins and offshore petroleum exploration:* Canadian Society of Petroleum Geologists Memoir 4, pp. 9-33.

Marine seismic refraction and reflection profiles correlated with deep wells on land reveal that the Blake Plateau is underlain by 7-11 km of Jurassic and younger carbonates and evaporites, with some terriginous sediments. Rock dredges and cores show that the area is bordered by an apparently continuous reefal complex of Cretaceous and earlier age which extends from the Blake Escarpment through the Bahamas and Cuba to the West Florida Escarpment. JOIDES drilling on the Blake Plateau indicates that the Tertiary sedimentary section is abbreviated due to the erosional sweeping of the Gulf Stream. JOIDES Deep Sea Driling Project results and more recent piston coring reveal a complex Cenozoic history of hemipelagic and turbidite deposition in the Blake-Bahama Basin and on the Blake Outer Ridge. Contour currents apparently built the Outer Ridge then shifted deposition west of the ridge into the basin in the Late Miocene.

The origin of the basement under the Blake Plateau and Bahamas is still unknown from direct evidence. Indirect geophysical evidence, including magnetic anomalies, and Rayleigh Wave dispersion data, suggest the possibility that the basement is about 10 km deep and of intermediate density and seismic velocity. Such a crust might be correlated with that of the present Red Sea, and the Blake Plateau-Bahamas crust could be interpreted to have formed in a similar way in the Jurassic, or possibly the Triassic, as North America and Africa rifted apart. Basement faulting associated with the rifting and plate rotation of North America controlled the formation and subsidence of the deep geosynclinal basin under the Blake Plateau.

Porous dolomite horizons and cavernous reefal limestone are known in the area. Regional dip caused by differential subsidence of compaction over reefs, faults affecting Cretaceous and older strata, and possible salt doming might offer entrapment situations for these existing reservoirs. Golden Lane analogies and Smackover continuations are possible and stratigraphic traps are very probable. The potential for large petroleum reserves is real but their exploration and exploitation will be difficult. *(authors' abstract)*

TANNER, WILLIAM F., 1965, *The origin of the Gulf of Mexico:* Gulf Coast Association of Geological Societies, Transactions, vol. 15, pp. 41-44.

The Gulf of Mexico dates from approximately the Paleozoic-Mesozoic time boundary. From structural considerations, the hypothesis is developed that the present Gulf is the result of a slowly-widening rift, or tension gap, between North America and Central America and the Caribbean block. A general program of investigations, designed to test or at least explore the hypothesis, is outlined. *(from author's abstract)*

TODD, R. G., and R. M. MITHCUM, JR., 1975, *Seismic stratigraphic identification of eustatic cycles in Late Triassic, Jurassic, and Early Cretaceous rocks, Gulf of Mexico and West Africa:* Gulf Coast Association of Geological Societies Transactions, vol. 25, pp. 41-43.

Seismic stratigraphic techniques permit identification of Late Triassic, Jurassic, and Early Cretaceous eustatically controlled sequences in strata from the North American Gulf Coast and West Africa. Several distinct sequences are remarkably persistent from the Florida panhandle around the perimeter of the Gulf Coast into northern Mexico, a distance of over 1,500 miles. Their identification requires the integration of seismic data with lithologic, environmental-facies, biostratigraphic, radiometric, and well log information. A comparison with strata of comparable age in offshore West Africa are interpreted to be eustatically controlled because they occupy the same time-stratigraphic positions and display coastal onlap patterns similar to those previously recognized by us elsewhere in the world. *(from authors' abstract)*

VAN DER VOO, R., F. J. MAUK, and R. B. FRENCH, 1976, *Permian-Triassic continental configurations and the origin of the Gulf of Mexico:* Geology, vol. 4, pp. 177-180.

Previously published reconstructions of Pangea during the late Paleozoic-early Mesozoic time have suggested that (1) the Gulf of Mexico has existed as an oceanic basin from at least the late Carboniferous onward or (2) the Gulf of Mexico was created since Permian time by a process of microplate reorganization, macroplate drift, or oceanization *(sensu stricto)*. On the basis of paleomagnetic data, we favor macroplate drift. Major geologic and tectonic features of the Pangea segments bordering the Gulf of Mexico are in agreement with a newly proposed alternative fit of North America, Europe, and Gondwanaland for late Paleozoic time. This reconstruction closes the Gulf of Mexico by juxtaposition of North and South America. *(authors' abstract)*

WALPER, JACK L., 1980, *Tectonic evolution of the Gulf of Mexico:* in Pilger, R. H. (editor), *The origin of the Gulf of Mexico and the early opening of the central North Atlantic Ocean:* Proceedings of a symposium, March 3-5, 1980, Louisiana State University, Baton Rouge, Louisiana, pp. 87-98.

A modification, by Walper and Rowett (1972), of the Paleozoic reconstruction of Pangea by Bullard et al. (1965) closed the Gulf of Mexico and placed Mexico and Central America adjacent to northwestern South America. Further modification of this reconstruction adds another three degrees of rotation to the 20-degree clockwise rotation of Gondwanaland proposed by Van der Voo et al. (1976). While this does not significantly affect the alignment of the pre-Mesozoic orogenic belts of West Africa and North America, it greatly improves the fit of North and South America. It also provides a better explanation of late Paleozoic history and the initiation of rifting that formed the Gulf of Mexico and Caribbean. This history of the Gulf of Mexico-Caribbean region is given in the author's abstract as follows:

> "As the Late Pennsylvanian collision of the Afro-South American plate with the North American formed Pangea, convergence with a Pacific plate produced a Permo-Triassic arc-trench system along much of western North America. It remained active as North America moved away from a Triassic spreading ridge that passed from the Pacific into the Gulf and beyond into the North Atlantic, creating a narrow seaway similar to the Red Sea, in which thick salt deposits accumulated. As spreading continued and this sea widened, a Scotia-like arc developed between the diverging North and South American plates. The Gulf of Mexico evolved on the trailing margin of the North American plate while the Caribbean grew from the arc segment as North and South America diverged and the spreading ridge shifted from the Caribbean to the South Atlantic. Laramide tectonism, the result of continued convergence with a Pacific plate, transported Mexico eastward, initiating events that displaced part of the salt basin and changed the Gulf of Mexico from a normal trailing plate margin to a vast sediment trap for Cenozoic erosional debris derived from rejuvenated hinterland sources."

WALPER, J. J., F. H. HENK, JR., E. J. LOUDON, and S. N. RASCHILLA, 1979, *Sedimentation on a trailing plate margin: the northern Gulf of Mexico:* Gulf Coast Association of Geological Societies Transactions, vol. 29, pp. 188-201.

The breakup of Pangaea and the splitting of South America from North America in the early Mesozoic left a rifted and attenuated trailing margin on the latter plate which became the initial depositional surface for a

sedimentary sequence of Late Triassic to Recent age. The Late Triassic Eagle Mills Formation and its equivalents are interpreted as being the initial deposits confined to rift grabens of the attenuated plate margin. Deposition of Jurassic evaporites resulted from sedimentation by the brine mixing process in the restricted circulation of a young and narrow seaway similar to the Red Sea. Late Jurassic and Cretaceous strata represent the transgressive deposits formed as open marine conditions prevailed as the plates diverged and the North American plate margin subsided. Laramide tectonism in the continental interior provided a rejuvenated hinterland source area that supplied the voluminous sediment for the regressive and prograding Cenozoic clastic wedge.

Studies of this entire sedimentary record reveal the influence of the tensional effects of continental splitting and lower crustal creep that established the initial depositional surface that slowly subsided as indicated by crustal thinning and the thermal decay curve of cooling oceanic lithosphere. In addition, these studies also reveal the control and influence of: 1) inherited structures of the rifted margin; 2) hinterland source area; 3) the timing and amount of differential subsidence between continental and ocean crust; 4) active syndepositional faults; 5) hingelines; and 6) post depositional rejuvenation due to contemporary plate movement.

Not only do these studies add to our understanding of the geologic history of the area, which is most important for development of successful exploration programs, but they provide a guide for the study of sedimentary infills within ancient lithospheric plates, a neglected but important task facing all who are confronted by the complex problem of interpreting the sedimentary record of ancient basins. *(authors' abstract)*

WALPER, JACK L., and C. L. ROWETT, 1972, *Plate tectonics and the origin of the Caribbean Sea and the Gulf of Mexico:* Gulf Coast Association of Geological Societies Transactions, vol. 22, pp. 105-116.

Previously published reconstructions of the late Paleozoic "fit" of crustal plates and continents fail to explain many geological features present in southwestern United States, Mexico, Central America and northern South America. In particular, they fail to consider major geologic and tectonic continuities of Paleozoic age observable in the Southern Appalachians, the Ouachita and Marathon fold belts, the fold belts of southern Mexico and Central America, and the eastern Andean Mountain belt of northern South America, as well as the significance of a number of major transcurrent fault systems or megashears that cross these regions.

With the well documented Africa-North America join as a control for the positioning of South America relative to North America, this report suggests a somewhat different "fit" than any heretofore proposed. Instead of truncating North America in northern Mexico and filling in the Gulf of Mexico with fragments as is most commonly done, this reconstruction wraps Mexico and Central America around the western margin of South America, thus placing in juxtaposition the major tectonic belts of both continents. Evidence is also presented indicating that the late Ordovician Taconic orogeny was an *arc-continent* collision rather than a *continent-continent* collision as has previously been suggested. Similar evidence indicates that the late Paleozoic Ouachita and Marathon orogenies were arc-continent collisions. Correlative periods of deformation for both of these orogenies have been documented from many places in northern and northwestern South America.

The early Paleozoic history of the Cordilleran mobile belt appears to have been independent from that of the eastern mobile belt. In the late Paleozoic, however, these mobile belts seem to have become tectonically coupled to produce regional stresses that were released along several major megashears. In southern and southwestern North America these include the Wichita and Texas megashears; a third megashear is probably present in northern Mexico. Late Paleozoic movement is probably present in northern Mexico. Late Paleozoic movement on these fault zones produced numerous basins and uplifts throughout all of these regions.

Modifications of the model proposed by Malfait and Dinkelman (1972) for the origin of the Caribbean region are proposed that include the opening of a sphenochasm in the Gulf of Honduras and regional tensional and compressional stresses resulting from the clockwise rotation of North America. The Gulf of Mexico and the present dislocated positions of the Ouachita and Marathon fold belts are explained as the result of an opening sphenochasm under the present Mississippi embayment and the westward displacement of the Ouachita and Marathon fold belts by left lateral movement on the Wichita and Texas megashears. *(authors' abstract)*

WILSON, J. TUZO, 1966, *Did the Atlantic close and then reopen?:* Nature, vol. 211, pp. 676-681.

Paleontologic, structural, tectonic, and geometric evidence is presented for the hypothesis that, in the Paleozoic, an existing proto-Atlantic Ocean closed and that, in the Cretaceous, the present Atlantic Ocean opened. In Early Paleozoic time, the proto-Atlantic formed the boundary between two distinct faunal realms. During Middle and Late Paleozoic time this ocean closed by stages, bringing the dissimilar realms together. Available geological evidence suggests that the present Atlantic Ocean started opening at the beginning of the Cretaceous. The opening occurred along a different line than the earlier closing. Fragments of the continents which were brought together during Middle and Late Paleozoic time thus traded sides when the present Atlantic opened during the Cretaceous. This resulted in some regions of similar faunas being separated by the Atlantic while other regions of dissimilar faunas became adjacent to one another.

WOOD, MICHAEL L., and JACK L. WALPER, 1974, *The evolution of the Interior Mesozoic Basin and the Gulf of Mexico:* Gulf Coast Association of Geological Societies Transactions, vol. 24, pp. 31-41.

The evolution of the Interior Mesozoic Basin is presented in terms of an evolving Gulf of Mexico which had its origin with the rifting and breakup of Pangea, particularly with the separation of North and South America. This

Mesozoic event was preceded by the formation of Pangea in the late Paleozoic when plate collision produced the Appalachian-Ouachita-Marathon orogeny. As a result of this orogenic episode of plate collision and accompanying crustal dislocation along three major transcurrent fault systems, the Texas, Wichita and Mississippi megashears, a proto-Atlantic was closed and a distributive pattern of pre-Mesozoic rocks was created that was to have a lasting effect on the shape of the Interior Mesozoic Basin.

Rifting in the early Triassic created an incipient Gulf of Mexico with associated peripheral grabens that defined the shape of Mesozoic sedimentation. Crustal thinning and attenuation accompanied the divergent rifting of Pangea and early sedimentation in rift grabens is represented by the Eagle Mills Formation. Deltaic prisms are postulated, coincident with the three megashears, and represent the positions of ancestral Rio Grande, Red and Mississippi Rivers. They augment the continental red beds of the grabens formed during early rifting and the succeeding marine shelf sediments of a diverging plate margin and constitute exploratory objectives.

The thick evaporite deposition, represented by the Werner Evaporite and Louann Salt, in a shallow basin on a subsiding plate margin is the result of an unique combination of events. The updomed rift margin of the trailing plate formed a restricting barrier that allowed the continued influx of sea water into the attenuated and rifted portion of the plate that was subsiding to form the Interior Mesozoic Basin. The sea water, upon encountering the highly saline waters of this subsiding basin initiated rapid salt deposition by the brine mixing method. Eastward rotation of Mexico into its present position deepened the Gulf of Mexico and peripheral rifting aided in continued submergence with normal marine deposition being established in late Jurassic time. *(authors' abstract)*

WOODS, R. D., and J. W. ADDINGTON, 1973, *Pre-Jurassic geologic framework, Northern Gulf Basin:* Gulf Coast Association of Geological Societies Transactions, vol. 23, pp. 92-108.

Early history of the Gulf basin is conjectural. It was once believed the basin formed by late Paleozoic foundering of Llanoria, a postulated large offshore landmass occupying much of the present basin area. Currently, there are two schools of thought: (1) the basin has existed since late Precambrian; (2) it was formed by early Mesozoic seafloor spreading in the Gulf, a product of the general breakup of old Pangaea into continental blocks.

Upper Paleozoic orogeny, in phase with or a part of a west-southwestward continuation of Appalachian folding, created a northern structural rim for the basin which strongly influenced subsequent sedimentation and structural trends. Post-orogenic tension faulting along and south of this rim was particularly active during the Triassic. Jurassic sediments along the flank and gulfward from the structural rim overlie this faulted basin floor and are in unconformable contact with rocks ranging in age from Triassic to Mississippian.

Triassic sediments are fluvial to deltaic red beds. Paleozoic deposits include both "Ouachita facies" and unmetamorphosed fluvial to offshore marine clastic and highly fossiliferous shallow water carbonates. Seismic data suggest Traissic and/or late Paleozoic sediments underlie Jurassic throughout the Gulf Basin. These pre-Jurassic rocks comprise a large, very sparsely tested frontier for oil and gas. *(authors' abstract)*

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AUTHOR INDEX

SUBJECT INDEX

Related Regional and Tectonic Studies:

APPENDIX

FLORIDA DEEP WELL DATA

Well location maps are available from the Florida Geological Survey.

FLORIDA DEEP WELL DATA
(Primarily wells which penetrated basement, but including some significant wells which did not)

County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
Alachua	W-1465 P-49	Tidewater Assoc. Oil Co.—R.H. Cato No. 1	Sec. 23 T8S R18E	1947	112	3150	Applin, 1951	quartzitic sandstone & shale, Paleozoic	3135/15	
	W-1472 P-52	Tidewater Assoc. Oil Co.—J.A. Phifer No. 1	Sec. 24 T9S R21E	1947	132	3228	Applin, 1951	quartzitic sandstone & shale, Paleozoic	3217/11	
	W-1487 P-54	Tidewater Assoc. Oil Co.—Josie Parker No. 1	Sec. 33 T7S R19E	1947	168	3220	Applin, 1951	quartzitic sandstone & shale, Paleozoic	3170/50	
	W-11447 P-536	Chevron-Container Corp. 1	Sec. 7 T8S R21E	1972	168	2861	Barnett, 1975	Ordovician quartzite; no volcanics	2606/255	
	W-12226 P-709	Chevron-Donaldson 1	Sec. 34 T8S R21E	1974	150	3340	Barnett, 1975	Ordovician quartzite; no volcanics	3314/26	
Baker	W-1500 P-59	Hunt Oil Co.-H. L. Hunt No. 1	Sec. 21 T1N R20E	1947	130	3349	Applin, 1951	Paleozoic quartzitic sandstone	3342/7	
Bay	W-12498 P-690	Charter Expl. 2-St. Joe Paper Co.	Sec. 27 T1S R17W	1973	67	12313	Barnett, 1975	granite	12258/55	
	W-14644 P-1010	Houston Oil & Minerals—SW Forest Industries 13-3 No. 1	Sec. 13 T2S R12W	1980	105	12486				No published information.
Bradford	W-1466 P-41	Tidewater Assoc. Oil Co.—M.F. Wiggins No. 1	Sec.15 T6S R20E	1947	141	3167	Applin, 1951	Quartzitic sandstone & shale, Paleozoic	3140/27	
	W-10798 P-465	Inexco Oil Co. Gilman Paper	Sec. 22 T45S R22E	1970	148	3154	Barnett, 1975	Paleozoic quartzitic sandstone	2984/170	
Calhoun	W-12812 P-777	Mallard Exploration Inc.-International Paper Co. 31-2	Sec. 31 T1S R10W	1975	111	12140				No published information.

1. Florida Bureau of Geology well number.
2. Unless otherwise indicated, these are drill floor elevations (in feet above MSL).

FLORIDA DEEP WELL DATA
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County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
Charlotte	W-979 P-5B	Humble Oil & Refining Co.—Lowndes-Treadwell No. 1A	Sec. 17 T42S R23E	1945	20	13304	Applin, 1951			Did not reach basement; TD in Lower Cretaceous.
	W-8139 P-375	Mobile Oil 1 — State Lease 224B	S23°20'28"W 42,424' from USGS Englewood	1967	64	12931	Barnett, 1975	pseudospherulitic granophyre	12877/54	170 ± 4 my (Mobil).
	W-10717 P-459	Exchange O&G 1-Payson	Sec. 7 T41S R27E	1970	80	13432	Barnett, 1975			Did not reach basement; TD in upper part basal clastic section, L. Cret.
Citrus	W-7534 P-358	Mobil Oil 1 — Camp Phosphate	Sec. 12 T17S R18E	1965	115	4490	Barnett, 1975	Paleozoic quartzitic sandstone; no volcanics	4430/60	
	W-7538 P-353	Mobil Oil 1—Harbond	Sec. 25 T17S R16E	1965	24	4794	Barnett, 1975	Paleozoic quartzitic sandstone; no volcanics	4738/56	
	W-7543 P-350	Mobil Oil 1 — Garby	Sec. 8 T19S R17E	1965	13	5556	Barnett, 1975	Paleozoic quartzitic sandstone; no volcanics	5520/36	
	W-8304 P-382	Mobil Oil A1 — State Lease 224A	28°50'00"N 82°49'42"W	1967	11	6041	Barnett, 1975	quartzitic sandstone	5886/34	Devonian (Mobil paleo).
Clay	W-1590 P-50	Humble Oil & Refining Co. — Foremost Properties Corp. No. 1	Sec. 4 T6S R25E	1947	115	5862	Applin, 1951	Paleozoic quartzitic sandstone	3725/2137	
Collier	W-961 No permit	Humble Oil & Refining Co. — Gulf Coast Realities Corp. No. 2	Sec. 30 T48S R30E	1944	34	13512	Applin, 1951			Did not reach basement; TD in Lower Cretaceous.
	W-12838 P-778	Bass Enterprises Prod. Co. — Collier Co. 12-2	Sec. 12 T52S R27E	1975	(KB)30	18670	Applegate, et al., 1981	Igneous rock	18610/60	
	W-15122 P-1042	Exxon, Collier Co. Well No. 20-2	Sec. 20 T48S R30E	1981	45	17200				No published information.

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FLORIDA DEEP WELL DATA
(Primarily wells which penetrated basement, but including some significant wells which did not)

County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
Columbia	W-1789 P-77	Humble Oil & Refining Co. — J.P. Cone No. 1	Sec. 22 T1N R17E	1948	141	4444	Applin, 1951	Weathered zone;	3482/10	
								Paleozoic black shale;	3492/952	
								diabase and amygdular basalt sills encountered in the black shale	3529/33 3564/1 4191/1 4193/2 4248/3 4267/3	 Not studied petrographically. Not studied petrographically.
	W-1832 P-93	Sun Oil Co. — M. W. Sapp No. 1A	Sec. 24 T2S R16E	1948	138	3311	Applin, 1951	Paleozoic black shale	3303/8	
	W-1915A P-104	Sun Oil Co. — W. F. Johnson No. 1	Sec. 27 T4S R16E	1949	87	3051	Applin, 1951	Paleozoic quartzitic sandstone	3033/18	
	W-1923 P-107	Sun Oil Co. — Clarence Loyd No. 1	Sec. 11 T5S R17E	1949	124	2929	Applin, 1951	quartzitic sandstone & shale, Paleozoic	2922/7	
	W-1981 P-111	Sun Oil Co. — Ruth M. Bishop No. 1	Sec. 10 T4S R17E	1949	174	2828	Applin, 1951	quartzitic sandstone & shale, Paleozoic	2813/15	
	W-2164 P-124	Gulf Oil Corp. — Kie Vining No. 1	Sec. 2 T4S R15E	1950	117	3470	Bridge & Berdan, 1951	Late Silurian or Early Devonian black shale	not given	Age estimate based on fossil and lithologic correlations
							Goldstein, et al., 1969	Late Silurian or Early Devonian black shale	3350/?	Silurian(?) chitinozoans recovered from sample: 3350-3450 ft.
	W-8585 P-399	Richard C. Bradley 1 — J. M. Carter	Sec. 25 T6S R16E	1968	80	3115	Barnett, 1975	Paleozoic quartzitic sandstone, no volcanics	3104/11	
	W-8586 P-390	Richard C. Bradley 1 — Brunswick Pulp & Paper	Sec. 18 T6S R17E	1968	96	3097	Barnett, 1975	Paleozoic quartzitic sandstone, no volcanics	3084/13	
	W-11830 P-653	Getty Oil Co. 1 — Holmes 21-8	Sec. 21 T3S R17E	1973	191	2898	Barnett, 1975	Paleozoic (Getty)	2848/42	Barnett did not examine.

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2. Unless otherwise indicated, these are drill floor elevations (in feet above MSL).

FLORIDA DEEP WELL DATA
(Primarily wells which penetrated basement, but including some significant wells which did not)

County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
	W-11910 P-666	Getty Oil Co. 1 — J. C. Marsh	Sec. 33 T2S R17E	1973	157	3196	Barnett, 1975	Paleozoic (Getty)	3125/71	Barnett did not examine.
	W-14379 P-986	Shepherd Oil & Gas, Inc. — Shepherd-Rayonier No. 1	Sec. 8 T4S R18E	1979	194	3013				No published information.
Dade	W-889 No permit	Humble Oil & Refining Co. — State of Florida No. 1	Sec. 30 T55S R36E	1945	15	11794	Applin, 1951			Did not reach basement; TD in Lower Cretaceous.
DeSoto	W-11766 P-609	Shell Oil 1 — Shell Punta Gorda	Sec. 22 T39S R27E	1972	(KB)77	1300	Barnett, 1975			Did not reach basement; TD in basal clastic section, Lower Cretaceous.
	W-12393 P-679, 679A	Amoco Prod. 1 — Opal Knight	Sec. 19 T36S R27E	1974	119	11655	Barnett, 1975	Jurassic diabase, resembling Polk & Hardee County wells	11627/28	
Dixie	W-1114 P-11	Stanolind Oil & Gas Co. & Sun Oil Co. — Perpetual Forest, Inc. No. 1	Sect. 5 T11S R11E	1946	33	7510	Applin, 1951	Paleozoic quartzitic sandstone	5228/2282	
	W-1405 P-36	Sun Oil Co. — Hazel Langston No. 1	Sec. 8 T8S R14E	1946	33	3671	Applin, 1951	quartzitic sandstone & shale, Paleozoic	3645/26	
	W-1863 P-97	Sun Oil Co. — P. C. Crapps "A" Well No. 1	Sec. 36 T8S R10E	1949	41	5104	Applin, 1951	Paleozoic sandstone & shale	5016/88	

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FLORIDA DEEP WELL DATA
(Primarily wells which penetrated basement, but including some significant wells which did not)

County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
Duval	W-8881 P-402	T. A. Durham 1 — Monticello Drug	Sec. 23 T1S R25E	1969	91	4192 (logger) 4250 (Barnett)	Barnett, 1975	Paleozoic; no volcanics	4151/41 4151/99	Penetration using logger's TD. Penetration using Barnett's TD.
	W-8898 P-410	T. A. Durham B1 — Gilman Paper	Sec. 17 T3S R23E	1969	94	3521	Barnett, 1975	Paleozoic quartzitic sandstone; no volcanics	3458/63	
	W-10392 P-404	T. A. Durham 1 — Gilman Paper	Sec. 11 T3S R23E	1969	95	3743	Barnett, 1975	Paleozoic quartzitic sandstone; no volcanics	3637/106	
Escambia	W-15013 P-1027	Chevron USA Inc. — La Floresta Well No. 2-1	Sec. 2 T3N R33W	1981	256	17950				No published information.
Flagler	W-1473 P-44	Humble Oil & Refining Co. — J. W. Campbell No. 1	Sec. 8 T11S R28E	1947	31	4632	Applin, 1951	tuff & volcanic agglomerate of rhyolitic composition	4588/44	Mixed tuff derived from igneous complex. Origin sedimentary or explosive igneous.
							Bass, 1969	tuff, richer in CaO than rhyolite	(Bass examined core from this lower interval; exact depth unknown due to mislabeling.)	Mineral comp. indicates incomplete adj. to conditions of greenschist facies.
Franklin	W-8487 P-387	Mobil Prod. 1C — State Lease 224A	N42°03′47″E 121,639.31′ from Tri-Station St. George lighthouse	1973	37	(Barnett) 14824 (Subsequently drilled to 14369)	Barnett, 1975	Eagle Mills Fm. First diabase sill	13850/434 13926/37	Penetration using original TD of 14,284. No information published on subsequent drilling.
Gilchrist	W-1003 P-5	Sun Oil Co. — Alto Adams No. 1	Sec. 15 T9S R15E	1946	93	3753	Applin, 1951	quartzitic sandstone & shale, Paleozoic	3588/165	
	W-1819 P-89	Sun Oil Co. — Williams Bros. No. 1	Sec. 12 T8S R15E	1948	77	3348	Applin, 1951	quartzitic sandstone & shale, Paleozoic	3348/18	

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2. Unless otherwise indicated, these are drill floor elevations (in feet above MSL).

FLORIDA DEEP WELL DATA
(Primarily wells which penetrated basement, but including some significant wells which did not)

County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
Gulf	W-12483 P-670	Charter Expl. & Prod. 1 — St. Joe Paper Co.	Sec. 26 T8S R10W	1973	34	14297	Barnett, 1975	dacite porphyry (ash fall tuff, red brown, massive appearance)	14261/36	core: 14261-14297 oblique fractures: 14264 & 14267.
	W-12509 P-746	Hunt Oil 30-4 — International Paper	Sec. 30 T3S R11W	1974	81	13284	Barnett, 1975	granodiorite, Late Precambrian or Early Cambrian?	12898/386	
							Krueger Enterprises, 1981[3]			12,950-12,990: 709 ± 25my, K-Ar age determined from feldspar concentrate
	W-12617 P-762	Charter Expl. Prod. 6 — St. Joe Paper Co.	Sec. 12 T8S R10W	1975	22	14574	Barnett, 1975	Upper Paleozoic or Lower Triassic	14499/75	Coarse quartzitic ss with lithic & feldspathic fragments, orange claystone & red shale. Weathered zone at top.
	W-14173 P-957	Mesa Petroleum— St. Joe Paper Co. 29-4 Well No. 1	Sec. 29 T5S R9W	1980	47	14186				No published information.
Hardee	W-1655 P-62	Humble Oil & Refining Co. — B. T. Keen No. 1	Sec. 23 T35S R23E	1948	83	11934	Applin, 1951	Lava & pyroclastic rocks	11828/106	
							Bass, 1969	basalt	(Bass examined core from 11930-11932)	Least altered of volcanic rocks studied from Florida.
							Milton & Grasty, 1969			11,853; whole rock K-Ar age determinations: 143 ± 7 my, 147 ± 3 my

1. Florida Bureau of Geology well number.
2. Unless otherwise indicated, these are drill floor elevations (in feet above MSL).
3. Unpublished age determination (memo on file at Fla. Bureau of Geology); material submitted by H. Kelley Brooks to Krueger Enterprises, Inc., Geochron Laboratories Division.

FLORIDA DEEP WELL DATA
(Primarily wells which penetrated basement, but including some significant wells which did not)

County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], Ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, Ft.	Comments
Hendry	W-11504 P-565B	Phillips 1C — Seminole Tribe	Sec. 28 T48S R33E	1972	(KB)36	17028	Barnett, 1975	tuffaceous detritus (? - see comments)		TD in basal clastic section, Low Cret. top = 16882 (Phillips). Exxon reports tuffaceous detritus in last samples.
	W-12696 P-768	Shell Oil Company 1 — Alico Land & Dev.	Sec. 19 T45S R32E	1975	44	16000	Applegate, et al., 1981			Did not penetrate basement. TD in Wood River Fm., probably Late Jurassic.
Hernando	W-994 P-1	Ohio Oil Co. — Hernasco Corp. No. 1	Sec. 19 T23S R18E	1946	47	8472	Applin, 1951	Paleozoic quartzitic sandstone	7720/752	
	W-8188 P-378	S. Davis & G. Thayer 2 — Hill	Sec. 32 T22S R21E	1968	82	6209	Barnett, 1975	quartzitic sandstone; no volcanics	6190/19	
	W-8533 P-391	S. Davis & G. Thayer 1 — Davis	Sec. 11 T23S R20E	1968	151	6764	Barnett, 1975	quartzitic sandstone; no volcanics	6640/124	
Highlands	W-966 P-B-1	Humble Oil & Refining Co. — C.C. Carlton Estate No. 1	Sec. 34 T38S R29E	1946	114	12985	Applin, 1951	Amygdaloidal basalt, rhyolite porphyry and related volcanic rocks	12618/367	
							Milton & Grasty, 1969			12,664; whole rock K-Ar age determination: 183 ± 10 my
	W-3578 P-225	Continental Oil Co. — C. C. Carlton et al. Well No. 1	Sec. 20 T38S R28E	1955	88	12630	Applin & Applin, 1965	Pre-Mesozoic volcanic rocks	12602/28	
	W-13502 P-862	Amoco Prod. Co. No. 1 — Andrew B. Jackson 6-2	Sec. 6 T39S R30E	1977	25	12625				No published information.

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FLORIDA DEEP WELL DATA
(Primarily wells which penetrated basement, but including some significant wells which did not)

County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
Hillsborough	W-1005 P-29	Humble Oil & Refining Co. — T. S. Jameson No. 1	Sec. 7 T31S R22E	1946	112	10129	Applin, 1951	rhyolite & volcanic agglomerate	10,010/119	
							Bass, 1969	intermediate to basic composition	(Bass examined core from 10,106-10,115)	Incomplete adj. to conditions of greenschist facies.
Holmes	W-12199 P-716	Sonat Expl-Randall Hughs	Sec. 32 T4N R17W	1974	140	11201	Barnett, 1975	Eagle Mills fm. — red arkosic sands & granite wash.	10240/861	
								Diabase, greenish & weathered top	10940	
Indian River	W-3783 P-243	Amerada Petroleum Corp. — Fondren Mitchell Well No. 1	Sec. 28 T31S R35E	1956	60	9488	Applin & Applin, 1965	Pre-Mesozoic volcanic rocks.	9410/78	
Jackson	W-1886 P-94	Humble Oil Refining Co. — C. W. Tindel No. 1	Sec. 8 T5N R11W	1949	128	9245	Applin, 1951	Paleozoic red & gray sandstone & shale.	8440/805	
								Two (Triassic?) basalt sills in Paleozoic strata.	8890/42 8970/13	Porphyritic hornblende basalt. Intrusive or flow. Not studied petrographically.
Jefferson	W-1854 P-95	Coastal Petroleum Co. — E. P. Larsh No. 1	Sec. 1 T2S R3E	1949	51	7913	Applin, 1951	Triassic (?) diabase & related igneous rocks. (Sills or dikes in clastic rocks of Triassic (?) age.)	7763/29 7850/40	
								Paleozoic (?) quartzitic sandstone.	7909/4	

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FLORIDA DEEP WELL DATA
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County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
	W-10915 P-468	Amoco Prod. 1 — Buckeye	Sec. 17 T2S R5E	1971	55	7034	Barnett, 1975	Eagle Mills fm.	6600/160	
								Paleozoic sandstone.	6748/286	
								Diabase.	6696/8	
								Gabbroic diabase.	6730/13	
								Gabbroic diabase.	6793/131	
Lafayette	W-968 P-4	Sun Oil Co. — P. C. Crapps No. 1	Sec. 25 T6S R12E	1946	70	4133	Applin, 1951	quartzitic sandstone & shale, Paleozoic.	4030/103	
	W-1696 P-67	Humble Oil & Refining Co. — R. L. Henderson No. 1	Sec. 20 T4S R11E	1948	52	4235	Applin, 1951	quartzitic sandstone & shale, Paleozoic	4205/30	
	W-1866 P-100	Coastal Petroleum Co. — Ronald Sapp No. 1	Sec.18 T6S R14E	1949	45	3507	Applin, 1951	quartzitic sandstone & shale, Paleozoic	3480/27	
	W-2000 P-114	Gulf Oil Corp. — Brooks Scanlon Inc., Block 49, Well No. 1	Sec. 36 T5S R10E	1949	87	4505	Applin, 1951	Paleozoic quartzitic sandstone.	4505/7	
	No. W-no. P-725A	Hunt Oil 1A — P.C. Crapps	Sec. 21 T6S R13E	1974	74	5501	Barnett, 1975	Paleozoic shade & sandstone, no volcanics	3716/1785	No samples available.
	W-15078 P-1052	Amoco Prod. Co. — P. C. Crapps No. 1	Sec. 33 T6S R11E	1981	82	10078				No published information.

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FLORIDA DEEP WELL DATA
(Primarily wells which penetrated basement, but including some significant wells which did not)

County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
Lake	W-275 No permit	Oil Development Co. of Fla. — J. Ray Arnold No. 1	Sec. 17 T24S R25E	1937	120	6120	Applin, 1951	granite	6103/17	
	W-11499 P-574	Hamilton Bros. 1 — Keen	Sec. 25 T20S R26E	1972	92	5397	Barnett, 1975	weathered basic igneous rock	5195/202	
	W-11771 P-629	Amoco Prod. 1 — Arnold Ind.	Sec. 5 T24S R25E	1972	127	5778	Barnett, 1975	alaskite weathered igneous	5690/10 5747/31	
	W-12891 P-795	Amoco Prod. 1 — USA 29-13	Sec. 29 T16S R28E	1975	(KB)56	4894				No published information.
Lee	W-10566 P-407	Humble 1 — Lehigh Acres	Sec. 14 T45S R27E	1970	57	15710	Barnett, 1975	altered quartz diabase	15675/35	163 m.y. (Exxon)
Leon	W-12293 P-717	Phillips Petr. 1 — St. Joe A	Sec. 14 T2S R1E	1974	33	10466	Barnett, 1975	Eagle Mills fm. Diabase sills	8450/2016 8488/68 9208/46 9316/5 9356/10 9380/2 9394/8 9430/29 10239/33	
Levy	W-1007 P-13	Sun Oil Co. — J. T. Goethe No. 1	Sec. 31 T14S R17E	1946	34	3997	Applin, 1951	Paleozoic quartzitic sandstone	3960/37	
	W-1537 P-66	Coastal Petroleum Co. — J. B. & J. T. Ragland No. 1	Sec. 16 T15S R13E	1947	14	5850	Applin, 1951	Paleozoic black shale	5810/40	

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FLORIDA DEEP WELL DATA
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County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
	W-2012 P-105	Humble Oil & Refining Co. — C. E. Robinson No. 7	Sec. 19 T16S R17E	1949	58	4609	Applin, 1951	Decomposed igneous rock	4317/27	underlies L. Cret. ss.
								Triassic? basalt	4344/33	
								Paleozoic-altered black shale	4377/0.5	
								Paleozoic quartzitic sandstone	4377.5/231.5	
	W-8305 P-383	Mobil Oil 1B — State Lease 224A	S38°41'36" 45,733 ft from USGS "Lukens"	1967	24	4735	Barnett, 1975	quartzitic sandstone, very fine grained, well sorted, tight	4595/140	Devonian (Mobile paleo)
Liberty	W-12496 P-730	Placid Oil 26-4 USA	Sec. 26 T3S R5W	1974	62	12131	Barnett, 1975	Eagle Mills fm.	11753/378	
								Diabase sills	12060/10 12095/36	
	W-12497 P-745	Placid Oil 16-3 USA	Sec. 16 T4S R6W	1974	74	12400	Barnett, 1975	Altered granophyre	12040/360	
	W-12739 P-769	Placid Oil 10-3 USA	Sec. 10 T4S R7W	1975	75	12654	Barnett, 1975; Applegate, et al., 1981			TD in Louann (Jurassic).
Madison	W-1596 No permit	Hunt Oil Co. — J. W. Gibson No. 2	Sec. 6 T1S R10E	1944	107	5385	Applin, 1951	Triassic? diabase	4589/39	Underlies L. Cret. or older Mesozic rock.
								Paleozoic black shale	4628/757	
	W-1598 No permit	Hunt Oil Co. — J. W. Gibson No. 4	Sec. 5 T2S R11E	1945	73	4096	Applin, 1951	Triassic? diabase	4044/16	Underlies L. Cret. or older Mesozoic rock.
								quartzitic sandstone & shale, Paleozoic	4060/36	
	W-15017 P-1033	Amoco Prod. Co. No. 1 — Gilman Paper Co.22-2	Sec. 22 T2S R9E	1981	114	10149				No published information.

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FLORIDA DEEP WELL DATA
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County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
Manatee	W-12691 P-759	Amoco Prod. 1 — St. Petersburg	Sec. 35 T33S R20E	1975	130	11500	Barnett, 1975			TD in basal clastic section, L. Cret.
Marion	W-18 No permit	Ocala Oil Corp. No. 1 — York (Applin, 1951 refers to this well as Ocala Oil Corp. — Clark-Ray Johnson No. 1)	Sec. 10 T16S R20E	1928	80	6180	Applin & Applin, 1944	mica schist & quartzite, age uncertain	4100/2080	Campbell, 1939, assigned Jurassic age.
								Paleozoic quartzitic sandstone	4100?/2080?	Cooke, 1945, gave a probable Paleozoic age.
	W-901 No permit	J. S. Cosden — W. L. Lawson No. 1	Sec. 25 T13S R20E	1928	195	4334	Applin, 1951	Paleozoic quartzitic sandstone	3660?/674?	

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County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
Marion, (cont.)	W-1482 P-53	Sun Oil Co. — Henry N. Camp No. 1	Sec. 16 T16S R23E	1947	74	4637	Applin, 1951	Paleozoic (Lower Ordovician) quartzitic sandstone	4240/375	
								Volcanic agglomerate or tuff of rhyolitic composition	4615/22	derived from an igneous complex
							Bass, 1969	quartzitic sandstone	4240/350	Possible Cretaceous age for the quartzitic ss & the arkosic congl. & ss should not be excluded in favor of Paleozoic.
								volcanic aggolmerate or tuff	4615/22	Arkosic rocks are lithologically different from those of equiv. age elsewhere in Fla.; therefore, a nearby fault scarp is postulated, along with a crystalline source east of the well.
	W-1904 P-101	Sun Oil Co. — H. T. Parker No. 1	Sec. 24 T14S R22E	1949	79	3845	Applin, 1951	Paleozoic quartzitic sandstone	3679/166	
							Krueger Enterprises, 1981			3845′: 424 ± 15 my;[3] K-Ar age determined from muscovite concentrate.

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3. Unpublished age determination (memo on file at Fla. Bureau of Geology); material submitted by H. Kelley Brooks to Krueger Enterprises, Inc., Geochron Laboratories Division.

FLORIDA DEEP WELL DATA
(Primarily wells which penetrated basement, but including some significant wells which did not)

County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
Martin	W-14960 P-1032	Kanaba Oil Corp. — Allapattah Properties 21-1	Sec. 21 T38S R39E	1981	44	13198				No published information.
Monroe	W-445 No permit	Peninsular Oil & Refining Co. — J. W. Cory No. 1	Sec. 6 T55S R34E	1939	14	10006	Applin, 1951			Did not reach basement; TD in Lower Cret.
	W-972 P-22	Gulf Oil Corp. — State of Fla. Lease No. 373	Sec. 2 T67S R29E	1947	23	15455	Applin, 1951			Did not reach basement; TD in Jurassic(?).
Nassau	W-336 No permit	St. Mary's River Oil Corp. — Hilliard Turpentine Co. No. 1	Sec. 19 T4N R24E	1940	110	4824	Applin & Applin, 1944;	Paleozoic black shale	4640/168	The black shale has been variously assigned Mississippian, Pennsylvania, Triassic & Jurassic ages — age still appears to be uncertain.
							Applin, 1951	Triassic: Diabase sill or dike	4808/16	
							Cole, 1944	Triassic black shale Igneous rock	4640/155 4795/29	
								Triassic? diabase sill or dike.	4808/16	
	W-10715 P-449	Amoco Prod. 2-1-TT Rayonier	Sec. 50 T3N R27E	1970	34	5469	Barnett, 1975	Paleozoic quartzitic sandstone	5086/373	
								Triassic diabase sills	5260/15 5310/15 5418/51	
Okaloosa	W-11467 P-590	Sonat Expl. 1 — J. G. Moore 3-11	Sec. 3 T3N R24W	1972	170	14514	Barnett, 1975	Eagle Mills fm	14095/419	14100-14480: quartzitic sandstone; 14480-14514: contact welded quartzite & v. coarse diabase.
								Diabase (log Sonat)	14478	

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	W-12301 P-731	Cabot Corp. 1-9-USA	Sec. 9 T3N R25W	1974	185	15250	Barnett, 1975	Eagle Mills fm.	15160/90	quartzitic ss containing broken pebbles of quartzite & volcanic material.
	W-14583 P-970	Mattie Kelly Sims et al. Trustees No. 1	Sec. T2S R22W	1980	26	14919				No published information.
	No W-number P-1105	Tenneco Oil Co., USA-Fla. State Lease 3229F, 31-3	Sec. 31 T3N R25W	1983	107	15362				No published information.
Okeechobee	W-3739 P-237	Amerada Petroleum Corp. — Marie Swanson No. 1	Sec. 5 T36S R34E	1955	55	10838	Applin & Applin, 1965	Pre-Mesozoic volcanic rocks	10750/88	
	W-12541 P-710	Shell Oil 1 — Shell Soan 35-1	Sec. 35 T35S R26E	1974	60	11277	Barnett, 1975	Weathered diabase	11220/57	
	W-12542 P-732	Shell Oil 1 — Jean M. Davis	Sec. 9 T35S R35E	1974	(KB)86	10767	Barnett, 1975	Weathered diabase	10642/103	Core samples 10764-10772.67: 191 ± 15 m.y. (Rb/Sr from feldspar by Shell)
								granophyric dacite porphyry	10745/29	
Orange	W-3673 P-230	Warren Petroleum Co. — George Terry No. 1	Sec. 21 T23S R31E	1955	100	6589	Applin & Applin, 1965	granite	6550/39	
	W-10778 P-441	Texaco 1 — Deseret Farms	Sec.15 T23S R33E	1970	79	7119	Barnett, 1975	granite (Texaco, Barnett did not examine)	7070/49	

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County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
Osceola	W-1014 P-8	Humble Oil & Refining Co. — N. Ray Carroll No. 1	Sec. 10 T27S R34E	1946	62	8049	Applin, 1951	altered & veined biotite granite	8035/14	
							Bass, 1969	altered & veined biotite granite	(Bass examined core from 8042-8044)	Original rock had low temp. of cryst. induced by high water-vapor pressure. Later "cataclasis" & hydrothermal alteration. Age greater than 400 m.y. is virtually certain, probable age of 530 m.y. is supported by ages from other wells.
	W-1411 P-31	Humble Oil & Refining Co. — W. P. Hayman No. 1	Sec. 12 T31S R33E	1946	86	8798	Applin, 1951	rhyolite	8740/58	
							Milton & Grasty, 1969			8781: whole rock K-Ar age determination 173 ± 4 my
	W-11341 P-543	Atlantic Richfield 2 — Bronsons Inc.	Sec. 24 T27S R29E	1972	78	6898	Barnett, 1975	granite	6840/58	Cuttings 6880-6900: biotite granite pegmatite.
	W-11342 P-539	Atlantic Richfield 1 — Bronsons Inc.	Sec. 3 T29S R31E	1972	86	7935	Barnett, 1975	granite	7890/45	Cuttings 7920-35: biotite granite pegmatite.
Palm Beach	W-1471 P-47	Humble Oil & Refining Co. — Tucson Corp. No. 1	Sec. 35 T43S R40E	1947	34	13375	Applin, 1951			TD in Jurassic (?).
	W-12569 P-740	Shell 1 — Gulfwater 7-4	Sec. 7 T46S R35E	1975	30	16848	Barnett, 1975	Igneous fragments in Lower Cretaceous basal clastic section 16710-16770		TD in lower part of basal clastic section, Lower Cret. Top, basal clastics of 16440.

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Pasco	W-11867 P-608A	Atlantic Richfield 1 — J. B. Starkey	Sec. 16 T26S R17E	1973	(KB)58	9600	Barnett, 1975			TD in lower part of basal clastic section, Lower Cret.
	W-12399 P-743	Amoco Prod. Co. 1 — Larkin Co. 8-4	Sec. 8 T25S R22E	1974	134	7148	Barnett, 1975	basal clastics	6495/634	
								weathered augite diabase (Jurassic)	7129/19	
	W-12528 P-742	Amoco Prod. Co. 1 — Cummer 35-3	Sec. 35 T23S R22E	1974	106	6646	Barnett, 1975	granite, late Precambrian or Early Cambrian	6636/11	cuttings 6640-45: weathered & kaolinized biotite granite, coarse grained.
	W-13928 P-875	Harry A. Holton No. 1 — J. B. Starkey 14-1	Sec. 14 T26S R17E	1978	(KB)60	9333				No published information.
Pinellas	W-1669 P-75	Coastal Petroleum Co. — E. C. Wright No. 1	Sec. 7 T30S R17E	1948	13	11507	Applin, 1951			Did not reach basement TD in Lower Cretaceous.
	W-6278 P-304	California Co. 3 — State Lease 224B	28°05′32″N 82°52′50″W	1963	57	10600	Barnett, 1975			Did not reach basement TD in basal clastic section, Lower Cretaceous.
Polk	W-8741 P-403	Sun Oil 1 — Shepard Dairy	Sec. 19 T32S R27E	1969	169	9670	Barnett, 1975	altered diabase (Jurassic?)	9660/10	
Putnam	W-1514 P-58	Sun Oil Co. & Seaboard Oil Co.— Q. I. Roberts No. 1A	Sec. 19 T9S R25E	1947	206	3328	Applin, 1951	Paleozoic quartzitic sandstone	3320/8	

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County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
	W-1838 P-96	Sun Oil Co.— H.E. Westbury et al. No. 1	Sec. 37 T11S R26E	1949	32	3892	Applin, 1951	volcanic ash & tuff	3873/19	
							Bass, 1969	volcanic tuff & agglomerate, mostly rhyolitic composition	3876/16	Mineralogy consistent with metam. of greenschist facies or lower.
	W-11530 P-607	Thayer & Davis 1 — Johnson Malphure	Sec. 27 T11S R27E	1972	34	5572	Barnett, 1975	rhyolite (not examined)	4426/1146	
St. Johns	W-10653 P-435A	Carolina Resources 1 — Cummer Co.	Sec. 70 T6S R29E	1970	42	4850	Barnett, 1975	Paleozoic quartzitic sandstone	4830/20	
	W-11084 P-506	Kerr McGee Corp. 1 — H. W. Mizell	Sec. 35 T7S R28E	1971	40	4583	Barnett, 1975	Paleozoic quartzitic sandstone	4562/21	
St. Lucie	W-4323 P-259	Amerada Petroleum Corp. — Cowles Magazine No. 2	Sec. 19 T36S R40E	1957	32	12748	Applin & Applin, 1965	Pre-Mesozoic metamorphosed igneous intrusive rocks	12680/68	12680-725: weathered igneous rock.
							Bass, 1969	diabase	12734/approx. 10	
								metam. rocks — predom. amphibolite	12744/approx. 4	faulted against overlying diabase. age, based on analysis of biotites = 530 m.y.
							Milton, 1972			Report of Age determinations — footnote 3.
	W-13082 P-772	Amoco 1 — Peacock Fruit and Cattle 26-1	Sec. 26 T36S R39E	1975	26	12652	Barnett, 1975			no comments, had not been completed.

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3. Age determination—Amerada Petroleum Corp. Cowles Magazine No. 1

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County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
Santa Rosa	W-15391 P-1097	Getty Oil Co. — State Lease 2338 No. 1	Sec. 1 T2S R28W	Spud 6/1983	30	projected to 17800				
Suwannee	W-1450 P-45	Sun Oil Co. — Earl Odom No. 1	Sec. 31 T5S R15E	1947	73	3161	Applin, 1951	Paleozoic black shale	3040/121	
	W-1548 P-57	Sun Oil Co. — J. H. Tillis No.1	Sec. 28 T2S R15E	1947	162	3572	Applin, 1951	Paleozoic black shale	3500/72	
	W-1924, 1924A P-109	Sun Oil Co. — A. B. Russell	Sec. 8 T5S R15E	1949	96	3139	Applin, 1951	Paleozoic quartzitic sandstone	3163/3	

Sample Depth	Material	Analyst	Method	Age
12734	Basalt	Grasty	K-Ar	89.3±2my
12744	Granite	"	"	226 ±6my 224 ±3my
"	Chloritized biotite from schist and quartz diorite gneiss	Bass	Sr^{87}/Sr^{86}	530 my
"	" " "	"	K-Ar	399 my
"	Plagioclase from quartz diorite gneiss	"	"	148 my
12748	Diorite	Grasty	"	308 ± 5 m.y.
"	Hornblende in diorite (amphibolite)	Bass	"	470 m.y. 503 m.y.

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County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
Suwannee, (cont.)	W-12246 P-724	Hunt Petr. 1 — C. R. Howes	Sec. 16 T2S R12E	1974	96	4520	Barnett, 1975	Paleozoic dark grey to black shale	3726/284	coarsely micaceous, thin ss interbeds.
								Paleozoic quartzitic sandstone	4010/350	fine-med, white-grey, highly micaceous streaks
								Paleozoic shale and sandstone	4360/150	red and brown stain.
								quartzitic sandstone & shale, Paleozoic	4510/10	
	W-12247 P-723	Hunt Petr. 1 — T. P. Hurst	Sec. 5 T3S R13E	1974	106	4496	Barnett, 1975	quartzitic sandstone & shale, Paleozoic	3640/390	
								black micaceous shale, Paleozoic	4030/466	greasy lustre, thin sands zones, some pyritic streaks.
Taylor	W-1877 P-85	Humble Oil & Refining Co. — G. H. Hodges No. 1	Sec. 12 T5S R6E	1948	36	6254	Applin, 1951	Triassic? basaltic rock	6153/12	Underlies clastics of Triass? or Jur? age.
								Triassic? diabase gabbro	6165/89	
	W-2099 P-116	Gulf Oil Corp. — Brooks — Scanlon Inc., Block 42 No. 1	Sec. 9 T8S R9E	1949	41	5438	Applin, 1951	Triassic? diabase, prob. a lava flow	5438/79	underlies clastics of Triass? or Jur? age.
	W-2106 P-119	Gulf Oil Corp. — Brooks — Scanlon Inc. Block 33 No. 1	Sec. 18 T4S R9E	1950	96	5243	Applin, 1951	Triassic? diabase gabbro	5200/43	underlies clastics of Triass? or Jur? age.

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FLORIDA DEEP WELL DATA
(Primarily wells which penetrated basement, but including some significant wells which did not)

County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
	W-10912 P-466	Amoco Prod. 1 — Canal Tbr. Co.	Sec. 12 T3S R6E	1970	62	7036	Barnett, 1975	Paleozoic	5807/1229	
								Diabase	6256/113 6417/247 6708/65	
	W-12697 P-774	Hunt Petr. 2 — Buckeye Cellulose	Sec. 34 T6S R18E	1975	28	7475	Barnett, 1975			No comments, had not been completed.
	W-12781 P-776	Hunt Petr. 1 — Buckeye Cellulose	Sec. 22 T5S R5E	1975	16	7503				No published information.
	W-14718 P-1015	Amoco Frances Exnom 34-5 No. 1	Sec. 34 T3S R29E	1980	113	6477				No published information.
	W-15445 P-1112	Amoco Prod. Co. — Buckeye Cellulose 7-4	Sec. 7 T4S R9E	1983	113	9000				No published information.
Union	No W-No. P-649	Getty Oil 1 — K. O. Dicks	Sec. 20 T5S R18E	1973	139	3037	Barnett, 1975	Paleozoic (Getty)	3029/6	No samples available.
	W-11870 P-650	Getty Oil 1 — R. Billing 4-1	Sec. 4 T6S R18E	1973	156	3015	Barnett, 1975			No comments, samples & logs not examined.
	W-11912 P-680	Getty Oil 1 — W. Croft	Sec. 31 T4S R19E	1973	145	3061	Barnett, 1975	Paleozoic (Getty)	3046/15	

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County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
Volusia	W-1118 P-19	Sun Oil Co. — Powell Land Co. No. 1	Sec. 11 T17S R31E	1946	48	5958	Applin, 1951 Bass, 1969	Hornblende diorite. Transported material and/or weathered basement.	5910/48 5918/12	Bass concludes that the diorite is probably a sill and the country rock meta-sedimentary. Total rock age: 480 my. The diorite is older but not greater than 524 my old. Hornfels is prob. Precambrian or derived from a sediment that was derived from Prec. source.
								Less weathered, cuttings contain chlorite & plagioclase, some quartz & no hornblende.	5930/10	
								quartz-bearing hornblende diorite.	5940/10	
								hornblende diorite with diabase-like texture.	5950/5.5	
								hornfels derived from clayey volcanic-quartzose ss.	5955.5/2.5	
							Milton & Grasty, 1969			5953-5954′; K-Ar: 480 my (dated by H. Thomas, R. Marvin, P. Elmore, & H. Smith, USGS).
	W-1746A P-78	Grace Drilling Co. — Retail Lumber Co. No. 1	Sec. 2 T15S R30E	1949	44	5424	Applin, 1951	rhyolitic? volcanic rock	5403/21	
Wakulla	W-12114 P-696	Placid Oil Co. 1 — USA Unit 27-2	Sec. 27 T2S R3W	1973	99	OH 12242 STH 11747	Barnett, 1975	Eagle Mills fm.	11674/526	
								Paleozoic grey-black shale	12200/20	micaceous, fissile
								Diabase sill.	12220/22	

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FLORIDA DEEP WELL DATA
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County	Well[1] and Permit No.	Well Name	Location	Completion Date	Elev. of Well[2], ft.	Total Depth of Well, ft.	Reference	Type of Basement Rock Encountered	Depth to and Penetration of Basement, ft.	Comments
Walton	W-11182 P-519	Coastal Prod. 1 — Brady Belcher	Sec. 9 T3N R21W	1971	214	12340	Barnett, 1975	Metamorphosed volcanic sandstone & granule conglomerate. Cambrian or U. Precambrian.	12285/55	Core 12333-12340: 3′ volc. granule congl. & ss, 3′ slightly metamorphosed red & green sh, 1′ pebble congl. & ss.
Walton	W-11374 P-587	Texas Gas Expl. 1- International Paper Co.	Sec. 5 T5N R20W	1972	294	12028	Barnett, 1975	Eagle Mills fm.	11386/442	
								Diabase sills	11610/30 11997/31	
	W-11601 P-612	McCulloch 1 DS Rudman 1 — Indian Crk Ranch	Sec. 24 T2N R19W	1972	140	11533	Barnett, 1975	Eagle Mills fm.	11422/111	cuttings at 11533: very coarse red ss.
	W-12309 P-721	Charter Oil 4 — St. Joe Paper	Sec. 31 T2S R20W	1974	43	14515	Barnett, 1975	granite	14480/35	cuttings 14510-15: coarse red granite wash & weathered biotite granite pegmatite.
Washington	W-11398 P-549	R. Mosbacher et al. 1 — First Nat. Bank of Akron	Sec. 28 T1N R15W	1972	(KB)128	11692	Barnett, 1975	Cambrian or U. Precambrian meta-arkose & quartzite	11554/138	rhyolite, Arden, 1974.
	W-11822 P-644	Rudman Resources 1 — FNB of Akron 31-2	Sec. 31 T2N R15W	1973	153	11593	Barnett, 1975	Cambrian or U. Precambrian meta-arkose & quartzite	11480/113	
	W-12347 P-738	Hunt Petrl. — International Paper Co.	Sec. 11 T4N R14W	1974	84	14044	Barnett, 1975	Eagle Mills fm.	10760/180	
								Late Paleozoic	10940/240	
								Ordovician	11180/2864	11200-300: *Siphonochitina* cf. *formosa* Jenkins, M. Ord. (Hunt paleo).

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