of clastic and organic floodplain deposits which accumulated on the newly formed coastal plain. The terminal phase is documented by sediments deposited during a period of instability when a marine transgression either continuously or intermittently forced estuarine conditions on the rivers entering the basin. Throughout the terminal transgression the finite zone of active deposition adjacent to the shoreline was shifted landward. Basinward of this active zone of deposition, hiatal conditions existed, and at the instant of maximum transgression, when the depositional episode was terminated, all points on the hiatal surface were synchronous.

The bounding surfaces of depositional sequences represent natural stratigraphic breaks and are related to hiatal conditions imposed by marine transgressions. Within the Quaternary section, the repetitive alternation of depositional episodes and significant hiatuses is due to the glacioeustatic fluctuations of sea level. As a result, worldwide correlations of the Pleistocene sequences and hiatuses can be made.

M. G. FREY and W. H. GRIMES, Chevron Oil Co., New Orleans, La.

BAY MARCHAND—TIMBALIER BAY—CAILLOU ISLAND SALT COMPLEX, LOUISIANA

This salt complex, more than 28 mi long and up to 12 mi wide, may be part of a much longer salt feature that extends both east and west. The mother salt bed, of probable Late Triassic-Early Jurassic age, is buried at depths of 40,000–50,000 ft, whereas the tops of the individual domes along the trend rise to within 2,000–3,000 ft of the surface.

Production to date on the three-field complex has been more than 0.7 billion bbl of oil. Oil reserves are estimated to range from 0.75 billion to 1.0 billion bbl. Significant gas reserves also are present.

Hydrocarbon accumulation occurs in sands of Pleistocene through late Miocene ages and ranges in depth from 1,000 to below 20,000. A wide variety of traps is found, including supradomal arching, shale and salt truncations, stratigraphic traps, and those resulting from faults.

Production was established on this complex in 1933. The total hydrocarbon production for 1968 was approximately 99 million bbl.

ROBERT W. FREY and JAMES D. HOWARD, Univ. Georgia, Sapelo Island, Ga.

PROFILE OF BIOGENIC SEDIMENTARY STRUCTURES IN HOLOCENE BARRIER ISLAND—SALT MARSH COMPLEX, GEORGIA

Biogenic sedimentary structures, many of which are characteristic of particular depositional environments, are abundant among Holocene barrier island–salt marsh habitats of coastal Georgia. The major environments represented are (1) beaches, including the shoreface, lower and upper foreshore, backshore, dunes, and washover fans; (2) salt marshes, consisting of the low marsh, high marsh, and salt pans; and (3) estuaries and tidal streams, including channel deposits, point bars, stream banks, and natural levees. Biogenic sedimentary structures in these environments consist of bioturbate textures and tracks, trails, burrows, and dwelling tubes, and are produced chiefly by polychaetes, gastropods, pelecypods, decapods, amphipods, and insects. Such structures, either singly or as assemblages of lebensspuren, are ordinarily sufficient to delimit major habitats. Further, most of these structures are capable of preservation, and many of them have been documented in the Pleistocene of Georgia and Florida.

STEFAN GARTNER, JR., Inst. Marine Sci., Univ. Miami, Miami, Fla.

CORRELATION OF NEOGENE PLANKTONIC FORAMINIFER AND CALCAREOUS NANNOFOSSIL ZONES

From the uppermost Miocene (Messinian) to the Holocene six planktonic foraminifer zones have been recognized in tropical and subtropical latitudes. Using overlapping segments from deep-sea cores previously dated by use of planktonic foraminifers, the calcareous nannofossils for this same interval were analyzed in order to relate nannofossil ranges to established foraminiferal zones.

With the light microscope nine calcareous nannofossil zones are readily distinguishable for this interval, one for the uppermost Miocene (Messinian), four for the Pliocene, and four for the post-Pliocene. The planktonic foraminifer zones N-18 through N-20 have roughly corresponding nannoplankton zones, although zone N-20 appears to represent a shorter stratigraphic interval than the corresponding nannoplankton zone. Zone N-21 is divisible into two nannofossil zones of about equal duration. The top of zone N-21, which is marked by the first evolutionary occurrence of *Globorotalia truncatulinoides*, corresponds rather closely to the extinction of discoasters in deep-sea sediments. Above this horizon for additional nannofossil zones can be recognized, based on partial ranges or concurrent ranges of three placolith genera that successively dominate the nannofossil assemblages.

J. A. GILREATH, J. S. HEALY, and J. N. YELVERTON, Schlumberger Offshore Services, New Orleans, La.

DEPOSITIONAL ENVIRONMENTS DEFINED BY DIPMETER INTERPRETATION

A new method of dipmeter interpretation gives an estimation of water depth during deposition. This method is applied to high-resolution dipmeter surveys in which short-interval correlations are machine computed at closely spaced levels of the well.

The major premise is that these short-interval dip computations reflect the energy of the depositional environment. High-energy marine environments lead to a large scatter of dip magnitudes. Conversely, low-energy environments, such as found in deep water, lead to "layer-cake" deposition, and appear as uniform dip magnitudes on the dipmeter plot. Thus, the scatter of dip magnitude in a formation is the key by which the depositional water depth is interpreted to be shallow (less than 50 ft), medium, or deep (greater than 300 ft).

Comparisons with paleoecologic data indicate the interpretation method to be both valid and useful. Exceptions to the rules for dipmeter interpretation occur when the original bedding planes are distorted or overshadowed, as in fault zones, weathered formations underneath unconformities, marine slides, and heaving shales. Even with these exceptions, and partly because of them, the dipmeter interpretation and paleoecologic data augment each other in defining depositional environments.

ROBERT F. GOLDSTEIN, FRITZ H. CRAMER, and NOEL E. ANDRESS, Florida State Univ., Tallahassee, Fla.

SILURIAN CHITINOZOANS FROM FLORIDA WELL SAMPLES

Chitinozoans of Silurian age were recovered from four wells in Florida: Cone No. 1, Tillis No. 1, Hilliard No. 1, and Kie Vining No. 1. An attempt was made to establish a correlation between the four wells using the chitinozoan evidence, and the results are presented. The youngest assemblage probably is of Ludlovian age; the oldest is of late Llandoverian age.

VITO A. GOTAUTAS, Consultant geologist, Lafayette, La., GEORGE E. GORDON, Dow Chemical Co., Brazos Division, Houston, Tex., JOHNNIE JOHNSON, Dow Chemical Co., Brazos Division, Lafayette, La., and CLYDE LEE, Magnetape Service Inc., Lafayette, La.

SOUTHWEST LAKE ARTHUR FIELD, CAMERON PARISH, LOUISIANA

Southwest Lake Arthur field is a classic example of one of the rare, non-salt-associated stratigraphic traps found in southwest Louisiana by geologic-geophysical exploration techniques. The stratigraphic trap is constituted by an E-W-trending sandstone barrier bar and a tabular shaped marine sandstone that grades laterally into shale toward the north, west, and south. The sandstone deposits are superimposed on a present day southeast-dipping homocline.

Integration and review of the geology and geophysics of this documented stratigraphic trap were undertaken to determine whether the *Planulina* no. 2 Sand pinchout could be observed visually on the available conventional split-spread reflection seismic-record section and if essential criteria could be developed to locate similar fields.

The procedure employed was: (1) a thorough geologic study was made from logs, cores, and production data of numerous wells in and around the field from which structure and isopach maps were made of the reservoirs constituting the stratigraphic trap; (2) the original field records were transcribed onto magnetic tape and then to a processed seismic-record section; (3) a synthetic seismogram was constructed from a sonic log of a well near the seismic line along with the spontaneous-potential and resistivity curves of the same well plus another well along the section; (4) the digitized spontaneous-potential and resistivity curves for these wells were converted to a time scale using the values of time depth derived from the integrated sonic log; and (5) the synthetic seismogram and digitized logs were superimposed and compared with the record section. A change of character was observed which showed thickening of the section approximately equal to the developed sandstone. Because conventional seismic recordings in the area are generally plagued with various noise problems, this change of character may be coincidental. Additional work is needed to confirm such a liberal interpretation.

Production is from the *Planulina* no. 2 Sand in the Erath member of the Anahuac Formation. This member coincides with the *Planulina palmerae* biostratigraphic zone which is early Miocene.

G. M. GRIFFIN, P. A. TEDRICK, D. A. REEL, and J. P. MANKER, Univ. South Florida, Tampa, Fla.

GEOTHERMAL GRADIENTS IN FLORIDA AND SOUTHERN GEORGIA

Bottom-hole temperatures from electric-log surveys were collected from all nonconfidential oil tests that recorded temperature data. These data are from 287 wells in Florida and 33 in Georgia. Computed gradients were compiled into county averages, and a preliminary geothermal gradient map was drawn.

Peninsular Florida, south of a NE-SW-trending zone through Taylor and Nassau Counties, is characterized by gradients generally less than 1.0°F/100 ft. Northern Florida and southern Georgia are characterized by gradients that generally exceed 1.0°F/100 ft. A weak and questionable increase in gradient may occur over the Sunniland field in southwest Florida.

The observed NE-SW geothermal trend parallels the Appalachian Mountain belt and coincides with known magnetic and gravity features of the area. It also parallels the Cretaceous to Holocene clastic-nonclastic boundary in northern Florida.

EDWARD F. HAYE, Photogravity Company, Inc., Houston, Tex.

PHOTOGEOLOGIC APPLICATIONS IN GULF COAST

Much photogeologic interpretation depends upon late structural movement at the surface, either by rejuvenation or compaction around older structures. The Gulf Coast is one of the more active provinces from the standpoint of tectonism and compaction.

Actually, far more surface structure is mappable at the surface than many Gulf Coast geologists realize. By using special modern photography, and some of the more detailed geomorphic procedures that have been developed, much structural information can be obtained.

Detailed study of the air photos of the entire state of Louisiana, the Gulf coastal part of Mississippi and Alabama, and large parts of the Texas Gulf Coast have resulted in some interesting conclusions:

1. Far less distortion than can be measured with usual well control, or shallow seismic interpretation, is needed to create surface structural indications with the more sensitive geomorphic criteria.

2. A large percentage of the structural oil fields have recognizable surface features.

3. Some surface expressions associated with up- and down-to-coast faulting are not as expected from subsurface studies.

4. Geomorphically, an expression of the deeper causative structure commonly lies directly above on the surface, even in grabens and on the downthrown side of normal faults.

5. Special photography and more detailed and experienced interpretative effort are needed on the Gulf Coast.

6. Because the surface has been neglected by many explorationists, and because of the importance of inter-well control to prospecting, detailed photogeologic interpretation is an economical way to develop many prospect leads. Through better localization it substantially reduces seismic costs.

Subsurface-surface relations, and many air photo examples depicting the surface expression of pertinent oil fields and prospects, from both the Jurassic trend and the down-dip Gulf Coast, document the conclusions.

E. HOPKINS, S. CHESSER, J. MAY, D. POCHE, and H. G. GOODELL, Florida State Univ., Tallahassee, Fla.

RELICT NATURE OF SEDIMENTS AND SUBMARINE TOPOGRAPHY OFF ALLIGATOR HARBOR, FLORIDA

An offshore area south of Alligator Harbor, Florida, contains several linear offshore shoals separated by relatively flat-floored "valleys." Eighty-six samples from