effects. Hydrothermal baroque dolomite is most abundant in porous intervals, and occurs as void-filling cement precipitated in interparticle porosity, fracture porosity, along stylolites, and also as a replacement mineral after anhydrite. During diagenetic dissolution and reprecipitation events, certain elements substitute for Ca^{2+} in the $CaCO_3$ lattice, in proportion to the composition of the diagenetic fluids. The behavior of substituting cations in this study is largely indicative of diagenesis by subsurface fluids. It also implies that much of the observed diagenetic alteration occurred in a closed diagenetic system. During diagenesis the isotopic content of a carbonate will re-equilibrate with that of surrounding pore fluids. The depletion of O^{18} implies precipitation at elevated temperatures or from subsurface fluids, while C^{13} consistency reflects original carbon composition. Values from this study coincide with those for other Jurassic carbonates and late dolomites. Petrography and geochemistry indicate that diagenesis occurred in the marine phreatic, mixed phreatic, meteoric phreatic, and subsurface diagenetic environments.

SUTER, JOHN R., Louisiana State Univ., Baton Rouge, LA, and AMY K. MAYNARD, Exxon Co. USA, Houston, TX

Regional Variability of Washover Deposits on South Texas Coast

Overwash processes play an important role in determining the stratigraphy of microtidal barrier islands. Along the microtidal coast of south Texas, regional variability in barrier island geometry produces a spectrum of washover types. South Padre Island is a low profile, transgressive feature with a discontinuous to nonexistent foredune ridge. It displays sheet overwash, coalescing washover terraces, and washover fans fed by large hurricane channels. North Padre and Mustang Islands are high-profile barrier islands with continuous foredune ridges, and thus only small, discrete interdune washovers occur. The relict tidal inlets between Mustang and Padre Islands are the sites of the largest washovers in the system, termed reactivated tidal deltas. This last type, although relatively rare in modern washover deposits, is probably similar in mode of origin to the large lobate back barrier features found on many high profile barriers on the Texas coast.

Internal structures of the washovers were studied by trenching, box coring, and vibracoring. The dominant stratification type is plane beds with extensive heavy mineral laminae. Washover margins display some landward dipping foreset bedding. Hurricane channels show cut and fill structures with shell lags, plane beds, and some trough cross-beds. Directional features indicate that the washovers are formed by storm surge flood, and modified by surge ebb. This is supported by the existence of separate flanking ebb channels on some washovers, as well as current velocity simulations for the storm surge of Hurricane Allen, which show that flood currents are both stronger and longer lived than the ebb.

In the ancient record, low profile barriers should be relatively thin deposits consisting of numerous coalescing washovers. Thicker sand bodies corresponding to high profile barriers should be found along strike. Since back-barrier facies have a higher preservation potential than other barrier environments, such a deposit might be dominated by reactivated tidal deltas.

THOMAS, WILLIAM A., and STEPHEN H. WOMACK, Univ. Alabama, Tuscaloosa, AL

Coal Stratigraphy of Deeper Part of Black Warrior Basin in Alabama

The Warrior coal field of Alabama is stratigraphically in the upper part of the Lower Pennsylvanian Pottsville Formation and structurally in the eastern part of the Black Warrior foreland basin. In the Warrior coal field, the Pottsville Formation has been divided into a lower non-coal-productive sandstone-rich sequence and an upper coal-productive sequence that contains less sandstone. The productive coal beds extend southwestward from the mining area downdip into the deeper part of the Black Warrior structural basin. Because the deep part of the basin is beyond the limits of conventional coal exploration, study of the stratigraphy of coal beds must rely on data from petroleum wells. For example, the density log as run in petroleum wells is sensitive to the presence of coal beds more than a few inches thick, but evidently does not provide a reliable measure of the thickness of individual coal beds. Relative abundance of coal can be stated in terms of numbers of beds, but because of the limitations of the available data, thicknesses of coals presently are not accurately determined. Distribution of coal beds in the Black Warrior basin reflects controls by depositional environments from delta plain to barrier islands; the various depositional environments shifted across the Black Warrior basin through time.

The lower sandstone-rich coal-poor part of the Pottsville has been interpreted as barrier sediments in the mining area. To the southwest in the deeper Black Warrior basin, coal beds are more numerous within the sandstone-dominated sequence. The area of most numerous coals, trends northwestward parallel with the trend of the barrier islands, and evidently is in a back-barrier location.

The coal-productive upper Pottsville is informally divided into "coal groups" (in ascending order, Black Creek, Mary Lee, Pratt, Cobb, Gwin, Utley, and Brookwood), each of which includes several coal beds. The Black Creek, Mary Lee, and Utley coal groups are associated with northeast-trending delta-distributary sandstones. The areas of most numerous coals also trend northeastward and are laterally adjacent to relatively thick distributary sandstones, suggesting coal accumulation in backswamp environments. The most numerous coals in the Pratt coal group are in an area that trends northwestward parallel with and southwest of a northwest-trending linear sandstone, suggesting coal accumulation in a back-barrier environment. Equivalents of the Cobb, Gwin, and Brookwood coal groups contain little coal in the deep part of the Black Warrior basin.

TURNER, JAMES R., Pruet Oil Co., Shreveport, LA

Problematical Petrophysical Characteristics of Smackover at Bayou Middle Fork Field, Claiborne Parish, Louisiana

Values of irreducible water saturation calculated from conventional electric and porosity logs at Bayou Middle Fork field are commonly greater than 60%. Mercury injection curves reveal that the true water saturation averages about 40%. Scanning electron micrographs show oolitic grains that have been recrystallized and have rough irregular surfaces as well as intercrystalline porosity within the particles. Water adheres to these grain surfaces and occupies some of the intercrystalline porosity in productive zones, causing the calculated water saturations to read too high. Application of the Archie equation, the Guillotte et al technique, and the Rocky Mountain technique provides a different suite of water saturations.

Archie water saturations average about 75% when density-neutron porosity values are used. Density-neutron porosity values tend to read about 2 porosity units low when compared with core porosity values throughout the field. When core corrected porosity is used, the Archie saturation averages about 60%.

The Guillotte et al technique employs a variable textural parameter "w" which is dependent on porosity and permeability. Mean water saturation with this method averages about 49%, which is in better agreement with the mercury injection data.

The Rocky Mountain ratio yields water saturations that are too high until the porosity balance technique is applied. Since R_t is assumed to read too low due to the excess immobile water, the Rocky Mountain derived porosities are too low. When R_t is increased to balance the porosity the water saturation averages about 43%, using $Z = .025$. When the Rocky Mountain R_{t_a} is used in the Archie equation, water saturations more consistent with the mercury injection data result. In addition the difference between the observed R_t and the Rocky Mountain derived R_{t_a} can be plotted as a function of porosity.

VAN SICLEN, C. DEWITT, Univ. Houston, Houston, TX

Early Mesozoic Tectonics of Northern Gulf of Mexico Coastal Plain

Major events in the early Mesozoic development of the northern Gulf Coast region are related to corresponding stages in the opening of the central North Atlantic Ocean from its southern end, as interpreted from three prominent lineaments on aeromagnetic maps of the southeastern United States and its offshore region. The Brunswick magnetic anomaly, which marks the edge of continental crust in the Carolina trough, comes ashore in southern Georgia and follows the subsurface belt of Triassic rocks into southwestern Alabama. This belt continues into eastern Texas, occupying a rift system along which North America was then drawing away from South America.

East of the Brunswick anomaly (and therefore younger) is the East Coast magnetic anomaly, which is generally regarded as marking the eastern edge of the North American continent northward from Norfolk, Virginia. South of there the East Coast anomaly separates from the Brunswick anomaly and diverges from it to a distance of almost 50 mi (80 km) off South Carolina, as a result of restricted clockwise rotation and translation of central eastern North America around the bulge of northwestern Africa. Termination of the East Coast anomaly southward at the Blake Spur fracture zone suggests that spreading had started in the Blake Plateau basin south of it by the time the East Coast anomaly began to form in the Carolina trough to the north.

The start of spreading in the Blake Plateau basin signaled the final separation from South America of the sliver of more or less continental material south of the Triassic rifts, and therefore the opening of the present Gulf of Mexico. All this was powered by a mantle plume located in the Blake Plateau basin, which was also responsible for continuing Jurassic compressional and right-lateral deformation in the southeastern states. Considering the rotations involved, the sequence of initial openings must have been: Gulf of Mexico, Blake Plateau basin, Carolina trough, and finally the northern central North Atlantic Ocean.

The Triassic rift system localized the Interior salt basins of Jurassic age, whose southern rim is a continuous, gently curving trend of positive features that begins on the east with the Florida-Bahama Platform and continues west along the Wiggins arch to the Caldwell-Angelina flexure in southeastern Texas. This composite feature, which defines the northern margin of the Gulf of Mexico structural basin, functioned as an outer basement high that determined the seaward edge of the Early Cretaceous carbonate platform.

The western limit of the Interior rift-basin system is a right-lateral wrench fault, which transferred the extensional movement south-southwest to a rift beneath the present Rio Grande Embayment. The edges of this rift are marked by the Chittim anticline on the north and by Mexico's Salado anticline farther south, which face each other with their steeper flanks, and converge as they approach the Sierra Madre Oriental to the northwest due to compression from the west that formed the Sierra.

VINEYARD, JOHN W., Geological Consulting Services, Houston, TX

Exploration and Development—Gulf Coast Mesozoic, 1982 and 1983

Looking at exploration and development within the Gulf Coast Mesozoic region as a whole, the trend has been toward shallow oil and away from deep gas. The capability of each area to successfully accommodate this shift is dramatically reflected in the comparison of total wells drilled in 1982 as compared to 1981:

	Total 1981	Total 1982	Difference
SE States	343	233	−110
S. Ark.-N. La.	1,679	1,523	−156
East Texas	1,142	1,382	+240

Note: (1) These are G.C.S. figures and may not correspond to some other source. (2) G.C.S. does not keep similar figures for the Mesozoic of south Texas.

The southeastern states were hard hit because this area was so strongly oriented toward deep Hosston and Cotton Valley gas plays, and there were no viable shallow oil plays available as quick alternatives. South Arkansas and north Louisiana suffered some from the downturn in Smackover and Cotton Valley exploration (note total wells much greater than in the southeastern states), but there were numerous plays to be made in the Upper Cretaceous Sands, Wash.-Fred., Paluxy, Rodessa, Sligo, and Hosston. East Texas actually faired better in 1982 than 1981, in part because of the many shallow oil plays to be made, but also because, according to G.C.S. statistics, the shift to shallow oil had actually begun between 1980 and 1981, so momentum in this direction was already present. South Texas saw the demise of the Austin Chalk play within the Giddings trend through Lee and Fayette Counties. Nevertheless, the Chalk play remains active in Atascosa and Wilson Counties.

The most significant trends in the southeastern states during 1982 were the Rodessa-Cotton Valley play centered in Warren and Hinds Counties, Mississippi, and the Miocene play of Baldwin and Mobile Counties, Alabama. The most significant discovery was the Movico Smackover field on the west flank of the Mobile graben in Mobile County, Alabama. In 1983, an apparent major Smackover discovery has been made by Beau Coupe Oil & Gas in extreme southeastern Escambia County, Alabama.

Also, there is an important play developing in the lower Tuscaloosa on the shelf slope between the low relief anticlines of northwestern Mississippi and the Tuscaloosa growth faults of southern Louisiana.

Although exploration in north Louisiana and south Arkansas was relatively strong, most activity was concentrated in or around existing fields. The west and north flanks of the Pine Island dome located in Caddo Parish, Louisiana, were the sites of very intense activity. Exploration and development are directed toward the Sligo with secondary pays in the Rodessa and Hosston. In all, 44 wells have been drilled to these pays in and around the shallow Pine Island Pettit oil field.

East Texas activity was dominated by discoveries and development of Rodessa and Pettit fields in the basin and on the west and south flanks of the Sabine uplift. However, the most significant discovery last year was the East Ginger Smackover field in Rains County. In early 1983, Cities Service made headlines with what appeared to be a major discovery in eastern Cass County. A 40-ft (12-m) pre-Smackover sand made a strong flow of oil and gas before going to water.

As 1982 came to a close, it appeared that south Texas would have an important play in the Sligo, seaward of the Stuart City Reef trend. However, at this time, commercial production from the Sligo has not been established definitely.

WILSON, FORREST, Sohio, San Francisco, CA, and JAMES A. NOEL, G & P Exploration, Houston, TX

Gravity Analysis of West-Central Calcasieu Parish, Louisiana

A gravity study of about 306 mi^2 (793 km^2) of west-central Calcasieu Parish, Louisiana, was completed. The data used were from a very old Bouguer map of unknown origin. The data on the map were obscure, so a grid was drawn over the map and the points of intersection and the gravity contour lines were digitized. With the Bouguer values, these points served as input to least squares and model analysis systems.

The least squares trend surfaces were calculated and mapped using STAMPEDE, an IMB system modified by Wright State University. The data were processed by an IBM 370 computer and mapped with a Calcomp plotter.

The residual map was generated by calculating a first-order surface and subtracting it from the Bouguer map. The similarity between the residual gravity map and the structure contour maps on the Vinton and Edgerly salt domes is striking.

Models using densities from five deep wells and an array of vertical prisms with square cross sections were calculated. A theoretical gravity map drawn from the models is almost identical to the residual gravity map. Profiles of the theoretical gravity and the residual gravity are compared. These profiles match exactly over the salt dome areas and show little divergence elsewhere.

Gravity studies, no matter the age of the survey, are still a definitive exploration technique, especially in areas of marked density contrasts.

WITHERS, K. D., and JIM MAZZULLO,* Texas A&M Univ., College Station, TX

Differentiating Sediments from Different Sources in Gulf Basin by Grain-Shape Analysis: Example from Late Pleistocene–Holocene Sediments of Northwestern Gulf of Mexico Continental Shelf

It has been shown previously that different source rocks produce quartz sand grains with unique gross shape characteristics. These gross shape characteristics cannot be altered by abrasion, and are thus an immutable record of sediment source. Therefore, sand grains in a sedimentary basin should contain in the gross shape a "fingerprint" of their source unaffected by the amount of reworking to which the sands have been subjected.

To test this idea, shapes of late Pleistocene-Holocene sand grains from two sources in the northwest Gulf of Mexico (the Rio Grande and western Gulf province) were analyzed with the Fourier grain-shape technique. The results indicate that two gross grain-shape assemblages are present in the sands of these two provinces. One assemblage is associated with a mineralogical suite typical of relatively mature coastal plain sediments, and thus it probably represents the contribution of sediment from such a "coastal plain source terrane." The other assemblage is associated with a relatively immature mineralogical suite more typical of sediments derived