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.

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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.

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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.

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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 from crystalline sources, and thus it probably represents the contribution from such a "highland source terrane." Both assemblages are found in sands of both provinces, inasmuch as the major rivers in these provinces, which act as conduits for these sediments, drain both source terrane types. However, the amount of area of these terranes drained by the rivers differs between the two provinces; therefore the relative proportions of these assemblages in the sands of the two provinces also differ. Rio Grande province sands contain on the average 59% of the assemblage associated with the highland source terrane, whereas western Gulf province sands contain only 34% of this assemblage. Thus, it is the difference in the relative proportion of these two assemblages in the samples which can be used to identify and distinguish the sands from the two provinces.

The results of this pilot project indicate that the analysis of gross grain shape can indeed differentiate sediments from different sources in the Gulf of Mexico.

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Distribution and Provenance of Trace Elements in Gulf of Mexico Sediments

By knowing the dispersion patterns of river-borne sediments in marine environments, one can predict the spatial distribution of selected minerals, elements, and particle-bound pollutants. One potentially useful method for determining sediment pathways is by contouring selected trace metals in the sediments seaward of the river outflow. Using computer techniques involving trend surface analysis and a massive data set, we have contoured the regional distribution of chromium, copper, iron, nickel, and lead in surficial sediments from the Gulf of Mexico. Spatially, these metals range from very low concentrations in the sediments of the west Florida shelf to highest values on the Mississippi delta and along portions of the south Texas shelf. Intermediate concentrations are interspersed between these areas. Observed contour patterns are referenced to suspended matter trace metal data for the Apalachicola, Mobile, Mississippi, Brazos, and Rio Grande Rivers to determine sediment-metal provenance and thus infer river dispersal patterns. Statistical treatment of our trace metal and sediment data was also carried out to identify the important geochemical variables (grain-size, carbonate content, and clay mineralogy) that control the observed sediment trace metal patterns.

Late Rocky Mountain Abstract

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Structural Control of Sedimentation and Distribution of Uranium Deposits in Westwater Canyon Member of Morrison Formation, Northwestern New Mexico

Isopleth mapping of the Westwater Canyon and Brushy Basin Members of the Upper Jurassic Morrison Formation in the southern San Juan basin, New Mexico, constructed from approximately 1,800 geophysical logs and 100 measured sections, show that structural elements controlled depositional patterns in these two members. These compilations, which include isopach, sandstone-mudstone ratio, percent sandstone, net sandstone, and average number of shale interbeds per 100 ft (30.5 m) of section, illustrate the geometry of depositional units, the distribution of sandstone depocenters, and large-scale facies variations within the units. Paleotopographic mapping of the base of the Westwater Canyon compiled during this study shows a series of highs and lows trending east-southeast. The Westwater Canyon is thin and sand-poor over the paleotopographic highs and thick and sandy along the paleotopographic lows, suggesting active structural control of facies distribution during deposition of this unit. Sedimentation of the Brushy Basin also was affected by some of the same active structural elements. Basement faults, reactivated through time and defined by detailed reflection seismic studies conducted by other workers, apparently exerted a significant influence on depositional patterns in the Morrison Formation.

Depositional patterns appear to control the location of uranium deposits. Primary uranium ore in the Westwater Canyon Member is restricted to sandstone depocenters associated with east-southeast-trending isopach thicks and large sandstone-mudstone ratios. Redistributed ore deposits also are concentrated in the vicinity of isopach thicks but in rocks with relatively low sandstone-mudstone ratios. Their location, however, is much more closely related to the position of a regional oxidation-reduction interface whose three-dimensional configuration was influenced regionally and locally by Laramide structures. Remnant ore deposits are relict primary deposits that lie updip of the redox interface in oxidized ground. Sedimentologic controls are similar to those of primary ore. In general, these remnant deposits have been preserved from oxidation by a unique stratigraphic or structural setting.