lapse feature, was a tear fault with a vertical component up on the north; (4) the Wind River fault is a zone consisting of segments that moved separately; and (5) there are at least two unmapped fault zones along which the core of the Wind River Range was uplifted.

These interpretations suggest that compression in the Wyoming foreland continued significantly later than early Eocene. An imbricate thrust model is proposed to accommodate these observations and interpretations.

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Sedimentological Cross Section of Cambro-Ordovician Carbonate Shelf (Knox Group, Conasauga Formation) in Central Alabama: Facies, Diagenesis, Potential Reservoirs

Cambro-Ordovician thrust-imbricated carbonates in central Alabama are the focus of renewed exploration interest. Samples from east-west-trending core holes within the surface-most thrust plates reconstruct the carbonate shelf and shelf-edge facies before deformation. The Upper Cambrian shelf margin now is in the subsurface of Talledega County; coeval dolostones in the western part of the state represent the former shelf interior. Rock analogs to former environments include the following. (1) Barrier shoals (Conasauga Formation)—dark colored, partially dolomitized ooid and skeletal grainstones. (2) Submerged back-barrier and offshelf dolomitized sediments (lower Knox Group)—western belt: finely crystalline algal thrombolites, fenestral dolopelmicrites, rippled beds; eastern belt: finely laminated dolostones, slope-derived pebbles and graded beds. (3) Tidal flats (upper Knox Group)—light-colored, crystalline dolostones, dolomitized pellet grainstones, algal laminites, pseudomorphs after sulfates and early diagenetic chertification. (4) Former emergent shelf-(Knox unconformity)—pelmicrite, skeletal wackestones, erosional chert pebble conglomerate.

Multiple possibilities for hydrocarbon reservoirs appear throughout the sequence. Vuggy and intercrystalline dolostone porosity is primarily in the lower Knox formations. Primary interparticle pores are retained in lower Knox algal buildups. Breccia porosity occurs in the strata below the Knox unconformity through solution of the underlying Knox Group. Fractures in the subsurface are believed to enhance permeability in all porosity types.

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Predicting Pore Pressure and Porosity from VSP Data

Presently, VSP is being used to predict interval velocity and depth beneath the drill bit. The method is to exploit special properties of the VSP to produce a successful inversion to acoustic impedance. Depth and interval velocity are derived from the acoustic impedance prediction. This technique is often a valuable aid in making drilling decisions. Other rock properties may be computed from the same data.

Pore pressure is one such rock parameter that can be computed from interval transit times and depth. The product of interval transit times, depth, normal compaction ratios, and an area constant is pore pressure. Pore pressure prediction is as reliable as the predicted velocities and depths. In reservoir evaluation, and sometimes in the well completion program, porosity is the important rock property. The interval transit times predicted beneath the bit can be used to compute porosity. Unlike pore pressure, porosity computations require knowledge or assumptions about the rock matrix and shale percentages. For certain conditions these values are know. Further penetration of a reef in search of deeper porous zones is an example of a viable condition for porosity prediction.

For both these rock properties the same conventions employed by well log analysis in modifying and interpreting results are needed. Where the parameters assumed fit the actual conditions, the results should have merit. If not, further interpretation is required.

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Porosity Type and Distribution in Selected Richfield Oil Fields, Middle Devonian, Central Michigan Basin

The Richfield zone of the lower Middle Devonian Lucas Formation has been a source of significant quantities of hydrocarbons in the north-central and Saginaw Bay area of Michigan. Production through 1980 totaled 91,639,006 bbl of oil.

Prior work, which interpreted the Richfield's environment of deposition to be sabkha, neglected any detailed study of porosity type and distribution within the zone.

Integration of data from core analysis, contemporary geophysical well logs, and thin-section analysis provided a basis for delineating porosity types and porosity distribution within the fields. Porosity type and origin were determined by using the guidelines of Choquette and Pray. Patterns of porosity were mapped within producing fields and presented as "time-slice" contour maps and cross-sectional fence diagrams.

This approach will allow better understanding of the development of porosity in these sabkha carbonates and provides a more reliable method of predicting porosity trends.

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Mineral Oxidants and Porosity Enhancement

In many important hydrocarbon reservoirs, aluminosilicate framework grain dissolution constitutes an important part of the porosity (i.e., the Gulf Coast). Our experimental work has shown that difunctional carboxylic acids can increase aluminum solubility by three orders of magnitude. Oil field brines are observed to contain concentrations of monofunctional carboxylic acids up to 10,000 ppm, but only traces of difunctional acids. Oxidative degradation of kerogen is a commonly used technique in the study of kerogen structure, and results in extremely high concentrations of difunctional carboxylic acids (up to 40% of the carbon released from type 3 kerogen is in the form of oxalic acid).

The reduction of mineral oxidants and consequent oxidation of organic matter may be as effective in releasing peripheral difunctional carboxylic acid groups from kerogen as thermal degradation in the natural system. The coincidence in time, temperature, and space of smectite/illite ordering (release of $Fe^{+3}$ from octahedral layers) and the peak concentrations of carboxylic acids suggests a possible mechanism for the generation of difunctional carboxylic acids. This mechanism would allow highly soluble difunctional carboxylic acids to be swept through adjacent sandstones just prior to hydrocarbon generation. Thus, an ideal mechanism is available for dissolving carbonates and/or aluminosilicates out of pores and pore throats, thereby enhancing porosity and permeability in hydrocarbon reservoirs.

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Nature and Significance of Austin-Taylor Unconformity on Western Margin of East Texas Basin

The Taylor Marl unconformably overlies the Austin Chalk on the western margin of the East Texas basin. Along this contact, up to 275 ft (84 m) of upper Austin is missing in the Waco area and up to 450 ft (137 m) in Bell County. However, the Austin Chalk appears to have been more-or-less uniformly deposited throughout the study area. Apparently regional uplift caused a regression that terminated Austin deposition and was related to the erosion of the upper Chalk. While the unconformity is areally extensive, slightly angular, and accounts for a relatively long period of time, the mechanism of erosion that caused the unconformity is still uncertain. Erosion was terminated by the deposition of the lower Taylor Marl. Taylor "A", the lowermost subdivision of the lower Taylor, was deposited in a near-shore environment that was highly variable.

Of particular interest is the relationship of this unconformity to structure and probably to oil occurrence in the Austin Chalk in McLennan and Falls Counties. Major Austin fracturing, which apparently does not extend into the Taylor in Falls County, clearly indicates that structure in the Chalk, at least in part, antedates Taylor deposition.

Oil occurrence in the Chalk is clearly related to fracturing and probably is localized by post-Austin-pre-Taylor fracture systems.

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Late Quaternary Shelf Margin Deltas, Northwest Gulf of Mexico

Deltaic deposition during a eustatic sea level fall occurs in two phases, each controlled primarily by the morphology of the sea floor and the rate of subsidence. The initial, or shelf phase of deposition, produces deposits similar to most modern deltas, although the rates of progradation are enhanced by the cumulative effects of sedimentation and absolute sea level fall. Such deposits are relatively thin and widespread, and internally are characterized by low angle clinoform reflections. The second, or shelf margin phase, results when sea level reaches the shelf edge and deposition occurs on the upper continental slope, where steeper sea floor gradients and more rapid subsidence produce a more localized deposit.

Interpretations of over 35,000 km of single channel high-resolution seismic profiles of the continental shelf and upper continental slope of the northwest Gulf of Mexico indicate the existence of 5 late Wisconsinan shelf margin deltas, including the ancient Rio Grande and Mississippi deltas. The deltas were recognized by geomorphic pattern, high angle clinoform seismic reflections, and association with buried river systems. Isopach patterns show that the deltas range in size up to 5,000 $km^2$ (1,930 $mi^2$) and reach thicknesses of over 160 m (525 ft). The deposits are elongate parallel to depositional strike, indicating subsidence of the shelf margin as a whole, as well as reworking by marine processes. Internal reflection patterns show the deltas to be fluvially dominated. Multiple lobes can be recognized in most of the deltas studied, resulting both from short term eustatic sea level fluctuations and delta switching.

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Geologic Framework of Sand Shoals on Muddy Mississippi Delta Shelf

More than 1,000 km 620 mi) of high resolution ore-Boomer and 3.5 $kh_z$ subbottom seismic profiles correlated to seventeen 10-12 m (33-56 ft) vibracores provide the data base for analyzing the sedimentologic and stratigraphic framework of transgressive sand shoals on the Louisiana inner continental shelf. Trinity and Ship Shoals are comprised of reworked sands of the abandoned Holocene Teche and Maringouin deltas and provide a possible modern analog for some Cretaceous shelf sandstones of the Western Interior.

Ship Shoal transgressive sands lie disconformably over Maringouin deltaic muds. The sand body pinches out seaward on the erosional inner shelf and is terminated landward by a depositional surface. Maximum sand body thickness is 7 m (23 ft) in the western shoal region. Internally, the sand body is characterized by landward dipping subhorizontal reflectors. The underlying Maringouin deltaic sequence contains a series of low-angle seaward-dipping clinoforms and numerous small channels in the western shoal area. Core analysis reveals a 3-7 m (10-23 ft) thick upward-coarsening sequence of very fine to fine-grained (100-125$\mu$) well-sorted, clean, quartzose sand. Grain size, percent sand and shell, and percent cross bedding increase upwards. The shoal sequence is capped by a 1-2 m (3-6 ft) thick deposit of horizontally laminated fine-grained (125-175$\mu$) sand and shell. The lower two-thirds of the shoal sequence is massive in appearance with minor amounts of burrowing. The shoal sequence abruptly overlies a dark, organic rich, silty clay (prodelta?) with numerous wavy and lenticular interbeds of silt; burrowing is rare.

The Trinity Shoal sand body is 5-7 m (16-56 ft) thick and lies disconformably over Teche deltaics. Internally, the sand body is composed of a set of westward-dipping clinoform reflectors. Three levels of channeling related to sea level stands in the early Wisconsin, late Wisconsin, and Holocene (Maringouin delta) underlie and occur seaward of Trinity Shoal. Continued Atchafalaya delta sedimentation will soon encase Trinity Shoal in mud.

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Some Ostracoda from Rodessa, Pearsall, Sligo, and Upper Hosston Formations (Lower Cretaceous) of Louisiana

A preliminary study of Ostracoda from core samples in the Rodessa Formation (lower Trinity Group), and from the Pearsall, Sligo, and upper Hosston Formations (Coahuila Series), Lower Cretaceous, of the subsurface of northern Louisiana, has yielded 52 species. Only a small fraction of the known ostracode assemblage is dealt with here.

On the basis of present limited knowledge, the Rodessa Formation contains common *Eocytheropteron, Hechticythere, Rehacythereis?*, and *Cornicythereis* suggesting an open shelf environment. The Sligo Formation contains common Schuleridea, probably representing an open shelf environment, as well as *Fabanella* and *Hutsonia*, representing brackish lagoonal or estuarine environments. The upper part of the Hosston Formation contains common Paraschuleridea (open shelf) and *Fabanella* (brackish water) and a variety of other forms that suggest a range of conditions from lagoonal and estuarine to open shelf habitats.

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Variations in Mg/Ca as a Control on Distribution of Strontium Concentrations and $\delta^{18}O$ in Upper Tertiary Dolomites from Bahamas

Strontium concentrations and $\delta^{18}O$ are commonly used to infer the gross composition of dolomitizing waters, yet the bases for such inferences are not firmly established. A new approach to calibrating these 2 parameters is suggested from analyses of a section of upper Tertiary dolomites from the Bahamas.

In an interval of dolomite, 120 m (394 ft) thick from a core taken on San Salvador Island, mole % $MgCO_3$ is correlated positively with $\delta^{18}O$, and negatively with strontium. Strontium substitutes mainly for calcium, thus the negative correlation with mole % $MgCO_3$. Dolomites are enriched between 3 to 7% in $\delta^{18}O$ as compared with coprecipitated calcite, and thus the positive correlation. These two covariations indicate the need to consider the stoichiometric coefficient of dolomites, and to normalize strontium concentrations and $\delta^{18}O$ with their respective stoichiometric coefficients before inferring their relationship with fluid composition.

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Tectonic Development of Baltimore Canyon Trough

New well data and a new gravity model across the southern end of Baltimore Canyon Trough provide a more complete history of the basin's tectonic evolution and deep crustal structure than was previously known. The basin, which formed during the separation of North America from Africa, narrows and shallows along strike, as basement depth decreases from about 18 km (59,000 ft) in the north near New York to about 4-6 km (13,123-19,685 ft) in the south near Cape Hatteras. Previous analysis of the Continental Offshore Stratigraphic Test (COST) B2 and B3 wells using "backstripping" techniques showed a seaward increase in the amount of stretching during the basin's formation. The new biostratigraphic and paleoenvironmental interpretations are from the USGS Island Beach well 1 just landward of the hinge zone in the basin. This well, along with the COST B2 and B3 data, provides a sampling of the sedimentary sections overlying continental, transitional (rift-stage), and oceanic crust. The subsidence histories derived from these data give a cross-sectional view of the basin's evolution.

A gravity model of the southern end of the basin, along USGS multichannel seismic line 28, primarily analyzes a 60-mgal shelfedge anomaly. This anomaly reflects the change in bathymetry and more important a change toward the continent in underlying crustal thickness from typical oceanic to thinned continental crust. The crustal thinning is compared to the broad thinning zone to the north. Well-defined rift structures on the landward edge of the basin are modeled as rift grabens near the hinge zone.

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Rifting Mechanism of the Early South Atlantic and Its Control of Oil Reserve Distribution in Brazil

Drilling and geophysical observations in the Cretaceous coastal basins of Brazil, both onshore and offshore, coupled with published information on the African margin, have led to a better understanding of the rifting mechanism of the south Atlantic and the way it controls the distribution of oil reserves. This information is crucial at a time when high exploration cots and unstable oil process make it imperative to select