At the type locality of the Kincaid Formation, approximately 30 ft (9 m) of massive siltstone grades upward into a very silty limestone unit. The outcrop is characterized by four resistant units of tightly cemented siltstone and limestone, which separate beds of less resistant, massive siltstone. Bedding is poorly defined throughout the section, largely the result of intensive bioturbation. The grain size of the siltstone increases upward, ranging from medium to coarse. Clay content in the siltstone decreases upward as the amount of calcareous material increases. The upper 4-6 ft (1.2-1.8 m) may actually be considered a silty limestone.

A dramatic facies change is present along the outcrop both east and south of the type section. To the east, the Kincaid Formation is composed of glauconitic and highly fossiliferous limestone. The siltstone present at the type locality thins eastward and is absent less than 20 mi (32 km) away. Eighty miles (130 km) to the south, along the Rio Grande River, approximately 45 ft (14 m) of limestone and shale comprise the Kincaid Formation. The limestone is glauconitic and highly fossiliferous and is very similar to that exposed east of the type locality.

These early Paleocene sediments are interpreted to be shallow marine in origin. The siltstone represents a shallow sublittoral shoreface environment whereas the limestones on the east and south were deposited in shallow nearshore environments beyond the reach of clastic deposition.

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Depositional and Diagenetic History of Bodcaw Sand, Cotton Valley Group (Upper Jurassic), Longwood Field, Caddo Parish, Louisiana

The Bodcaw Sand contains fine-grained sandstones and siltstones deposited within a barrier-bar sequence. Based on vertical changes in sedimentary structures, texture, and mineralogic composition, three distinct lithofacies (upper, middle, and lower shoreface) within the Bodcaw Sand and two associated lagoonal lithofacies were identified. Cross-stratification and low-angle laminations, rarely disrupted by biogenic structures, characterize the fine-grained upper shoreface sandstones. Middle shoreface sandstones have undergone extensive reworking by biotic and abiotic factors. Few primary sedimentary structures or early generation trace fossils are preserved in middle shoreface sandstones. Lower shoreface siltstones and very fine-grained sandstones contain lenticular and wavy bedding features that are disrupted in many places by bioturbation.

The Bodcaw Sand has low porosity and permeability values. Vertical and lateral variation in porosity and permeability values are related to original deposition and subsequent diagenesis of Cotton Valley sediments. The Bodcaw Sand has had a complicated diagenetic history. Compaction, cementation, replacement, and dissolution have modified primary rock properties following deposition of barrier-bar sediments. Authigenic cementation plays an important role in modification of reservoir properties. Important authigenic minerals identified in the Bodcaw include silica, carbonates, and phyllosilicates. Two major diagenetic sequences are recognized on the basis of textural relationships between allogenic grains and authigenic constituents.

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Petroleum Geology of East Dykesville Field, Smackover "C Sand," Claiborne and Webster Parishes, Louisiana

The discovery in 1980 of gas production in the Smackover "C" sand in the East Dykesville field of Claiborne and Webster Parishes, Louisiana, extended the productive limits of this reservoir 6 mi (10 km) south of the production in the Haynesville field. The development of East Dykesville field has revealed three productive fault blocks within an area 6 mi (10 km) by 3 mi (5 km).

The Smackover "C" and "B" sands of East Dykesville are present 700 ft (213 m) above the Louann Salt as a portion of a more or less continuous sand body covering an area 9 mi (15 km) from east to west. This sand body extends southward from the Arkansas-Louisiana state line for more than 10 mi (16 km), and also produces at the Haynesville field. Production has been encountered in the "C" sand at East Dykesville from 10,912 ft (3,326 m) subsea down to 11,605 ft (3,537 m) subsea, an interval of 693 ft (211 m).

The source of the sediments which constitute the Smackover "C" sand appears to be north of the sand body, as it thickens to more than 100 ft (31 m) in the Red Rock-Haynesville area and thins southward. The sand also thins both to the east toward Haynesville and to the west toward Shongaloo. The "C" sand is 60 ft (18 m) thick in the north portion of East Dykesville field and thins to 20 ft (6 m) in the most southern wells. Isopach studies suggest a submarine-fan depositional environment on a stable shelf.

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Gibsland Salt-Stock Family in Northwestern Louisiana

A semiregional isopach map of the Hosston-Sligo interval in north Louisiana suggests the existence of a salt-stock family similar to D. Sanneman's example in the Zechstein basin of northwestern Germany. The "mother salt stock" appears to be the Gibsland salt dome in Bienville Parish, which the isopach map indicates had a well-developed rim syncline during Hosston deposition. Withdrawal of salt into the Gibsland dome appears to have triggered the growth of peripheral salt pillows such as Vacherie, Minden, Athens, Sugar Creek, and Arcadia. Some of these pillows subsequently developed into salt stocks. The centrifugal or outward growth of salt structures continued with the withdrawal of salt from beneath the Minden subbasin into the Minden and Bistineau salt domes. This accentuated growth of the Sligo, Bellevue, and Cotton Valley salt pillows, which in turn triggered development of the Pine Island salt pillow in latest Early Cretaceous time.

The growth of the salt structures progressed outward from deeper to shallower portions of the North Louisiana salt basin. An older salt-stock family may be centered on the Winnfield or Cedar Creek salt domes in the deepest part of the salt basin. Centrifugal growth of these stock should be discernible in seismic profiles. A knowledge of the relative ages of these structures is important in predicting sites of Lower Cretaceous reefs and hydrocarbon migration paths.

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Internal Framework of Southwestern Florida Bank

The University of Texas Institute for Geophysics has collected 550 nmi of multichannel reflection seismic data from the western half of the southern Florida Bank. These data indicate that the structural framework underlying the area consists of several elements. Along the north, the Pinellas County arch is a basement feature oriented northeast-southwest and overlain by a relatively thin carbonate sedimentary section that thickens into the Tampa Embayment to the northwest and the South Florida basin to the southeast. The western margin of the bank is underlain by the Sheffield arch, a basement feature trending northwest-southeast and flanked by the Florida Escarpment on the west and the South Florida basin sedimentary section to the east. It is most likely a southeastward continuation of the Pinellas County arch. The southern terminus of the Sheffield arch is overlain by a structure interpreted as a buried Tertiary shelf margin, possibly a reef, within the present bank. Within the South Florida basin sedimentary section, there are two secondary basins trending approximately northeast-southwest. They probably originated in Jurassic to Early Cretaceous(?) time and were continuously reactivated into the Tertiary. In addition, an off-bank seismic facies is present between the southern end of the Sheffield arch and the Tortugas Bank. This feature is interpreted as a Jurassic(?) to Tertiary reentrant into the southern Florida Bank. Finally, the present southern shelf break is underlain by a series of prograding clinoforms estimated to be late Tertiary to Quaternary in age.

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Dolomitization by Ground-Water Flow Systems in Carbonate Platforms

Dolomite occurs throughout the subsurface of modern carbonate platforms such as the Bahamas. Groundwater flow systems must be responsible for delivery of reactants needed for dolomitization. Reflux, freshwater lens flows, and thermal convection are large-scale flow systems that may be widespread in active platforms. I have evaluated some aspects of the dynamics and characteristics of these processes with ground-water flow theory and by scaled sandbox experiments. Reflux is not restricted to hypersaline brines, but can occur with bankwaters of only slightly elevated salinity such as those found on the Bahama Banks today (42 ‰). The lack of evaporites in a stratigraphic section, therefore, does not rule out the possibility that reflux may have operated. Flows associated with freshwater lenses include flow in the lens, in the mixing zone, and in the seawater beneath and offshore of the lens. Upward transfer of seawater through the platform margins occurs when surrounding cold ocean water migrates into the platform and is heated. This type of thermal convection ("Kohout convection") has been studied by Francis Kohout in south Florida. The ranges of mass flux of magnesium in these processes are all comparable and are all sufficient to account for young dolomites beneath modern platforms. Each process yields dolomitized zones of characteristic shape and location and perhaps may be distinguishable in ancient rocks. The concepts presented here may have application to exploration for dolomite reservoirs in the Gulf Coast and elsewhere.

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Deposition, Compaction, and Mineralogic Alteration of Miocene Sandstones, South Louisiana

Miocene sandstones of Iberia and St. Mary Parishes, Louisiana, cored at depths of 12,000-16,000 ft (3,600-4,800 m), were deposited in fluviodeltaic and shallow marine environments. The reservoir quality of these sandstones is not only dependent on the environment of deposition, but also on the diagenetic history of these rocks.

Pore volume reduction due to mechanical compaction (ΔV_{mc}) was determined petrographically for the three sandstones by assuming $\Delta V_{mc} = 40 - (C + P)$, where 40 is the original porosity, C the amount of cement, and P the amount of pore space (all in percents). Of the three sandstones studied, the "S" sand has experienced the least mechanical compaction and the *Planulina* 6 sand the most. The difference in mechanical compaction between these sandstones is due to the depth at which calcite cementation effectively stopped compaction.

During early (shallow) stages of diagenesis, chlorite rims and quartz overgrowths precipitated in the pore spaces of the sands. As silica cementation proceeded, calcite cementation began. Mechanical compaction occurred contemporaneously with these cementation events but was hindered by the calcite cement when it developed in abundance. Mechanical compaction and calcite cementation was completed at a burial depth of 6,300 ft (1,920 m) for the "S" sand. Fluids from nearby shales that had undergone smectite-to-illite conversion and organic maturation caused partial to complete dissolution of this calcite cement when a burial depth greater than 10,000 ft (3,050 m) was reached. Dissolution created the present secondary porosity. Kaolinite precipitated in the sands during cement dissolution. As the pH of the pore fluids in the sand increased, late mixed-layer illite/smectite and chlorite precipitated.

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Validity of Use of Spontaneous Potential Curve Shape in Interpretation of Sandstone Depositional Environments

The shape of spontaneous potential curves is frequently used in the interpretation of sandstone depositional environments. The "cylinder-," "funnel-," and "bell-shaped" SP profiles are among the most frequently employed. However, the validity of this commonplace practice has never been thoroughly established.

Theoretical and experimental work and actual field examples suggest that the trend of the SP deflection does not display a direct relationship with the trend of variables known to be controlled by the sandstone paleoenvironment. The trend of quartz grain size shows a low linear correlation with the trend of SP deflection. The trend of clay content shows a higher correlation, but changes in clay type and cation exchange capacity can have more impact on the SP than the simple volume of clay.

Field examples from the Upper Cretaceous and Tertiary of the Gulf Coast show that hydrocarbons, local variations in the mud filtrate salinity, and regional differences in formation water salinity can greatly alter the shape of the SP curve. This can result in erroneous interpretations of sandstone origin.

Curve shapes derived from the microresistivity measurements of the dipmeter tool are an alternative to those of SP curves. The greater sensitivity of the the dipmeter tool, its immunity to the problems of hydrocarbons and Rmf/Rw contrasts, and the relationship of microresistivity to primary rock properties are factors favoring the use of microresistivity curve shapes for the interpretation of sandstone depositional environments from subsurface data.

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Smackover and Haynesville Facies Relationships in North-Central East Texas

The Smackover Formation was deposited as a coarsening-upward carbonate unit that developed first with the deposition of transgressive laminated silty limestones in deep anoxic waters. Mudstones and wackestones were deposited during a slow rise in sea level as the carbonate system became established. Packstones and grainstones were deposited at the Smackover shelf margin in thick coarsening-upward sequences. Local lenses of anhydrite and dolomitic mud developed on the shoreward side of the shelf break. Pelleted sands also developed in the low-energy Smackover lagoon. Ultimately, a thin blanket of ooid sands covered the shelf.

During Haynesville deposition, a carbonate barrier at the shelf margin created an evaporative lagoon in which Buckner anhydrite and halite precipitated. As sea level rose, limestones and dolomites were deposited along the downdip margin of the Buckner lagoon. Terrigenous clastics began to prograde into the updip areas. Continued sea level rise flooded the shelf, and Gilmer limestones were deposited as far updip as the present Mexia-Talco fault zone. At the end of Haynesville deposition, limestones and shales were deposited on either side of the Gilmer shelf margin as quartzose clastics continued to prograde into updip areas.

Evidence in east Texas suggests that the depositional model for the Smackover followed a shelf margin rather than the generally accepted ramp model. The shelf margin is clearly identified as a carbonate barrier during Haynesville deposition, outlining a Buckner lagoon as the depocenter that continued to subside at least through the end of Haynesville deposition.

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Petrology of Lower and Middle Eocene Carbonate Rocks, Floridan Aquifer, Central Florida

Study of cores from a U. S. Geological Survey test well near Polk City, Florida, indicates that the Avon Park-Lake City (Claibornian) and Oldsmar (Sabinian) Limestones, which comprise most of the Floridan aquifer in central Florida, can be divided into six microfacies: foraminiferal mudstone, foraminiferal wackestone-packstone, foraminiferal grainstone, nodular anhydrite, laminated dolomicrite, and replacement dolomite. Dolomite containing variable amounts of nodular anhydrite forms more than 90% of the Avon Park-Lake City interval, whereas the Oldsmar is chiefly limestone. The depositional model inferred for these units is a broad, shallow-water marine platform with environments ranging from supratidal-sabkha to shallow water shelf.

Diagenetic pathways vary with rock type, but generally include: (1) marine phreatic—grain micritization and radially fibrous cementation within foraminiferal tests, (2) meteoric vadose—minor leaching of aragonitic grains, and (3) meteoric phreatic—neomorphism of unstable grains, dissolution of aragonitic allochems, formation of isopachous equant calcite cement and coarse spar in grainstones, and syntaxial calcite overgrowths on echinoderms.

Several episodes of dolomite formation are recognized. Laminated dolomicrite formed syngenetically in a supratidal-sabkha environment. Crystalline dolomite with nodular anhydrite formed early by replacement of limestone through reflux of dense, magnesium-rich brines. Replacement dolomite not associated with evaporites and containing "limpid" crystals probably formed later by a mixed-water process in the subsurface environment. Late diagenetic processes affecting crystalline dolomites include hydration of anhydrite to gypsum, partial dissolution of gypsum, minor alteration of gypsum to calcite, and dissolution of calcian dolomite cores in stoichiometric crystals.