in Sabine, Webster, and Claiborne Parishes. The distribution of lignite in this depth range is governed primarily by the effects of the Sabine uplift on the Wilcox (Paleocene to Eocene) sediments in which the lignite is concentrated. Additional electric log analysis may reveal deep lignite deposits in other parishes affected by the uplift.

By using underground coal gasification (UCG) processes such as those developed at the Lawrence Livermore National Laboratory and in the Soviet Union, deep-basin lignite could produce low-btu methane suitable as a fuel, or carbon dioxide for enhanced oil recovery.

NOEL, JAMES A., G & P Exploration, Houston, TX

Geology and Geophysics of South-Central Zavala and Adjoining Parts of Dimmit Counties, Texas

Gravity, magnetic, and seismic surveys combined with subsurface geologic investigations resulted in very intriguing interpretations of an area east of Crystal City, Texas. The study area includes the south-central part of Zavala County east of the Nueces River and the adjoining parts of Dimmit County to the south. The Elaine field is included in the study area.

Gravity and magnetic residuals were calculated using the least-squares method, and the magnetic surveys revealed several serpentine plugs, which are confirmed by seismic interpretations. Although no geophysics work was done, subsurface study shows that Elaine field is the largest of these plugs. Seismic studies also show that the Austin Chalk, on whose surface the lava was extruded, is highly fractured and faulted. The Austin under the Elaine field is the lowest structural feature in the area.

The Anacacho was deposited on the lava surface, and in the Elaine area it has a reeflike appearance. Isopachs of younger sediments show that they are draped and differentially compacted over the plugs, and that the Elaine plug affects sediments as young as Escondido.

Production in the area is mainly from the San Miguel, but significant amounts of hydrocarbons have also been produced from Eagle Ford, Austin, Anacacho, and Olmos reservoirs.

PITTMAN, JEFFREY G., Southern Methodist Univ., Dallas, TX

Geology of De Queen Formation of Arkansas

Beds of the De Queen Formation are exposed in gypsum quarries within Pike and Howard Counties, Arkansas. The formation lies within the Lower Cretaceous Trinity Group that crops out in an east-west band across southwestern Arkansas. The De Queen Formation consists of a lower sulfate facies and an upper predominantly siliciclastic facies. The lower facies is approximately 40 ft (12 m) thick and is composed of interbedded gypsum, claystone, and limestone. This lower facies is equivalent to the subsurface Ferry Lake Anhydrite of the Gulf coastal plain. The upper facies is also approximately 40 ft (12 m) thick and contains interbedded clastics, limestones, and minor evaporites. Upper beds of the De Queen are equivalent to the lowermost beds of the subsurface Mooringsport Formation.

During Ferry Lake-De Queen deposition, a wide lagoon was located behind an extensive reef stretching around the Early Cretaceous shelf edge. This reef formed a barrier that restricted circulation and led to the deposition of the gypsum beds of the De Queen Formation and the Ferry Lake (later recrystallized to anhydrite during burial). Individual evaporite beds may be traced downdip from the outcrop across southern Arkansas into Louisiana and Texas. The regional extent of these evaporite beds reflects the variable geographic breadth of the lagoon during deposition of the Ferry Lake. Gypsum beds of the outcrop are the equivalent of the more widespread anhydrite beds of the Ferry Lake Anhydrite.

Faunal assemblages, sedimentary structures, and trace fossils (which include numerous dinosaur tracks) are important to the interpretation of depositional environments of rocks of the De Queen Formation. Much of the lower half of the formation was deposited in a shallow subaqueous setting, whereas depositional environments of beds within the upper half of the De Queen varied between subaqueous and exposed conditions.

PRESLY, MARK W., Valero Producing Co., Dallas, TX, and CHRIS H. REED, Reed and Strawn Exploration Consultants, Tyler, TX

Jurassic Exploration Trends of East Texas

Gas and some oil are produced from both clastic and carbonate units in the Jurassic of the East Texas basin. In the Smackover Formation, the reservoir facies are generally shallow marine carbonates that formed in shoal-water environments in the western and northern parts of the basin during late Smackover deposition. Productive intervals contain interbedded dolomites and oolitic grainstones. The dolomite beds are laterally persistent and contain the necessary porosity. Traps are found (1) over low-relief salt structures, (2) against faults and in fault closures, (3) in relatively shallow updip areas over basement structures, and (4) in the northeastern part of the basin, in Cass and Marion Counties, where there are deep basement ridges. In theory, there is potential for Smackover stratigraphic traps in many parts of the basin. However, increased exploration for such traps in East Texas will probably be sparked only after the first significant stratigraphic-trap discovery.

The Haynesville (Cotton Valley) limestone was deposited in carbonate-shelf environments in the western part of the basin and in shallow water along the western part of the Sabine platform. On the western edge of the East Texas basin, a distinct narrow carbonate shelf can be documented. The shelf edge has been encountered in McSwane and Branton fields as a narrow basement-supported feature. Landward, to the west, shallow lagoonal facies grade into evaporites and terrestrial red beds. In this western area, both structural and stratigraphic traps are present. In the eastern part of the basin, Haynesville production is distributed around the western edge of the Sabine platform. Reservoirs overlie both the platform and salt-supported highs just basinward of the platform. Several elongate north-south-trending gas fields have been established in this area. For the Haynesville limestone, continued development of known trends is still possible. In addition, this unit has not been extensively tested along the Mt. Enterprise fault system or in the central part of the basin.

Sandstones of the Cotton Valley Group on the Sabine platform produce gas with fracture stimulation at depths from 8,000 ft (2,450 m) to more than 10,000 ft (3,050 m). These sandstones can occur over an interval of as much as 1,400 ft (425 m); they generally have low porosity and permeability and are interbedded with gray to black shales, which probably serve as local source rocks. The underlying Bossier shales may also be a source of the hydrocarbons. Traps are stratigraphic with permeability pinch-out in individual beds. Gas-bearing Cotton Valley sandstones can be found almost anywhere on the Sabine platform, as well as other parts of the basin, but commercial production is typically dependent on the presence of multiple beds with significant porosities. The Cotton Valley sandstone can be a favorable exploration target for the future with the development of appropriate pricing and a strong market for gas.

In places across the East Texas basin, thin sandstone or siltstone beds punctuate intervals of thick Bossier shale. These sandstone beds commonly release gas under relatively high initial pressures. Traps are stratigraphic with permeability pinch-out in individual beds, and confinement of the gas by thick shale above and below. The shales are also probably source beds. The sandstones are considered coarser grained facies of submarine fan systems that accumulated along the margins of the Bossier marine basin. Much of the Bossier production that has been developed to date is in structural lows in Haynesville reservoir trends. Presumably, the Bossier fans preferentially filled these lows, because structural position of the lows between Smackover-Haynesville structural highs had probably been established by the time of Bossier deposition, and paleobathymetry followed structure.

ROY, EDWARD C., JR., Trinity Univ., San Antonio, TX

Stratigraphy and Sedimentology of Kincaid Formation, Midway Group (Paleocene), Upper Rio Grande Embayment, Texas

Sedimentary rocks of the Kincaid Formation crop out along the northern and western edges of the Rio Grande Embayment. Siltstones are exposed at the type locality of the Kincaid Formation along the Frio River in Uvalde County, Texas. On the east and south, the Kincaid Formation changes facies to richly fossiliferous carbonate rocks; however, basinward, it grades into a shale facies that contains interbedded units of fine-grained sandstone.

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.

RUSSELL, BILLY JOE, JR., Marshall Exploration, Inc., Marshall, TX, and AUSTIN A. SARTIN, Stephen F. Austin State Univ., Nacogdoches, TX

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.

SARTOR, C. LANE, and STEPHEN R. HOWARD, Wheless Industries, Inc., Shreveport, LA

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.

SAUCIER, A. E., Bur. Econ. Geology, Univ. Texas, Austin, TX

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.

SHAUB, F. JEANNE, Univ. Texas, Austin, TX

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.

SIMMS, MICHAEL, Johns Hopkins Univ., Baltimore, MD

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