and a southern offset in Sec. 33, T6S, R15W) and are nearing completion. A northern offset in Sec. 18, T6S, R15W is presently being drilled and further development is planned.

The Catahoula Creek Cotton Valley sands are presently not definable by seismic methods, therefore, structure interpretation is based on the upper Smackover-Haynesville carbonate reflection approximately 950 ft (290 m) below the top of the Cotton Valley sand complex, or the middle Cotton Valley carbonate reflection approximately 1,000 ft (300 m) above the pay zones. The Catahoula Creek field is underlain by a high relief (900 to 1,000 ft; 275 to 300 m) northwest-southeast-trending salt-created closed structure at the upper Smackover-Haynesville carbonate level, bounded by major and minor down-to-the-coast faults. The structure at the middle Cotton Valley carbonate level is almost flat, and only the major faults seem to carry through up to this level, indicating a Late Jurassic time of structural growth.

The Cotton Valley gas sands (Kimmeridgian) in the Catahoula Creek field were deposited in a shelf environment and can be numbered according to porosity zones from 1 through 11. At this stage in the field development only zones 1 through 7 have been perforated, but there are indications of hydrocarbons in all zones.

The reservoir rock exhibits matrix porosity of 4 to 18%, which is directly related to mineralogy, lithology, and diagenetic history. Matrix permeability is low, $0.3 > K > 0.01$ md or less, but intense vertical fracturing is prominent, and fracture permeability has been measured in the range of 1 to 4.3 md, explaining the high flow rates while testing.

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Prediction of Deep-Sea Reservoir Facies

Global changes in sea level, primarily the results of tectonism and glaciation, control deep-sea sedimentation. During periods of low sea level, the frequency of turbidity currents is greatly increased. Episodes of low sea level also cause vigorous contour currents which winnow away the fines of turbidites. In the rock record, the occurrence of most turbidites and winnowed turbidites closely corresponds to global lowstands of paleo-sea level. An important exploration attribute of this model is the possibility of predicting the occurrence of potential deep-sea reservoir facies in frontier areas of exploration. This model may also be useful in resolving the controversy over a shallow-versus deep-water origin for certain Gulf Coast reservoirs.

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Depositional Environment of Carter Sandstone (Chesterian) of Black Warrior Basin in Northwestern Alabama and Northeastern Mississippi

The Late Mississippian (Chesterian) Carter sandstone, which is present in the subsurface of the Black Warrior basin in northwestern Alabama and northeastern Mississippi, was deposited as lower to subaqueous delta-plain facies of a high-constructive delta. Specific deltaic environments identified include bar finger, which is a combination of distributary mouth bar and channel facies, delta front, and prodelta or interdistributary bay. These paleoenvironmental interpretations are based on primary sedimentary rock properties and characteristic spontaneous potential curves.

The Carter delta prograded from the northwest toward the southeast in the basin. The morphology of the delta is elongate through most of the basin; however, in the area of the southeasternmost extent of Carter deposition the morphology becomes lobate. The change in morphology is a result of reworking of the delta-front sands by marine proceses. The overall compositional maturity of the sandstone suggests that the constituents had a long distance of transport, with the source area being most likely a sedimentary source terrane. The direction of transport was from the northwest to the southeast, as indicated by sandstone morphology, grain size and thickness trends, paleontology, and facies distribution.

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Tectonic Evolution of Trans-Pecos, Texas

Southern Trans-Pecos Texas contains parts of two of the major overthrust belts of North America, the older Ouachita and the younger Cordilleran. In addition, this area has been deformed by two other major tectonic episodes. As early as 1,000 m.y. ago, the Van Horn mobile belt was formed by the closure of an inner arc basin during the formation of a proto-Pangea. This mobile belt provided the base upon which the Diablo platform formed. Recent petrologic evidence suggests that the Van horn mobile belt continues southward into Mexico and underlies the Coahuila platform. During Late Pennsylvanian to Early Permian time, this platform, a continental promontory, impeded the northward movement of the overriding Ouachita orogenic thrust sheets, bending them southwestward at the intersection of this thrust complex.

During the late Mesozoic, the Diablo platform acted as a stable buttress, against which sediments of the Chihuahua trough were deformed and thrust. These folds and thrusts comprise the Chihuahua tectonic belt, which forms part of the Cordilleran thrust belt of North America. East of this platform, faulted monoclines may represent the southern limit of the fault-bounded, basement-cored uplifts of the front ranges.

Finally, western Trans-Pecos Texas was overprinted by extensional basin and range faulting during the Cenozoic, with concomitant igneous intrusive and extrusive activity. The igneous intrusions occur in a belt trending roughly north-northwest, following the trend of the basin and range faulting. These intrusions are scattered through most of Trans-Pecos except for an area to the south where the four tectonic belts intersect. Here, extensive crustal fracturing and extension have resulted in the emplacement of a greater density of igneous material into the overlying crust.

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Depositional Environments and Gas Production Trends, Olmos Sandstone, Upper Cretaceous, Webb County, Texas

The Olmos Sandstone is part of the Upper Cretaceous Taylor Group of south Texas. It is overlain by shales and sands of the Escondido Formation, and underlain by shales of the lower Taylor Group. In the subsurface of Webb County, the Olmos has produced over 142 bcf of gas from 11 fields.

The composition, texture, and sedimentary structures of the Olmos were examined from more than 300 ft (91 m) of full-diameter, diamond bit cores and 50 thin sections. The morphology of the sandstones was determined by correlation of over 300 electric logs.

Lithologic and petrologic analysis indicates that the Olmos was formed in two major sedimentary environments. Deltaic distributary channel, levee, marine bay, marsh, and crevasse splay sequences are recognizable in cores from updip wells. However, cores from downdip wells show open marine shelf sequences, occasionally interrupted by ordered, graded, and thin-bedded sandstones deposited by density flows.

Net sandstone isopach maps of the Olmos show that the Olmos was deposited updip as a series of overlapping, lobate sand bodies. Downdip sands have a sheetlike morphology and are much thinner. Structure maps of the top of the Cretaceous show gentle southeast dip in updip areas, indicating stratigraphic trapping of gas in those areas. However, downdip, gas is trapped against a series of down-to-the-coast normal faults.

Gas production trends closely parallel depositional trends. Updip wells produce an average of 52 mmcf/year/well, whereas downdip wells average only 33 mmcf/year/well. Depositional environment is the controlling factor on Olmos sand thickness and morphology, and thus, gas production.

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Ecostratigraphic Model for Shelf Platform Development of Middle Cretaceous (Stuart City) Limestones of South-Central Texas

A new shelf platform model has been developed for the middle Cretaceous strata of south central Texas based on an ecostratigraphic basin analysis. The concept of ecostratigraphy integrates the various ecologic parameters along time planes so that sequential distribution of magnafacies is observed.

Analyses of the Stuart City trend and associated facies suggest that the shelf platform is formed in a subsiding basin and is developed in two stages. The first involves a platform stage, the second a vertical stacking stage.

Shelf platform development is a continuous process beginning in the ramp limestones assigned to the lower Glen Rose Formation. These Trinitian carbonates develop barrier reefs and prograde across the shelf. The debris slope at the base of the barrier reefs forms an elevated platform that maintains the reef organisms within their preferred shallow-water habitat and above the relatively deeper waters of the shelf. When the debris slope reaches the early Fredericksburgian shelf edge, which is maintained by the continental slope, the material is carried beyond the point of stabilization of the debris slope and moves down the continental slope to the abyssal plain. Progradation ceases, but barrier-reef development continues and forms a nearly vertical zone of barrier reefs associated with the continental shelf edge.

The barrier trend, which is created at the close of the platform stage, forms the base upon which vertical barrier growth is initiated. In this region, the vertical stage formed during the Fredericksburgian, continued into the Washitan, and developed as a result of stretched, upward-shoaling cycles.

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Regional Jurassic Lithostratigraphy of Alabama

Jurassic units in the subsurface of Alabama include the Werner Formation, the Louann Salt, the Norphlet Formation, the Smackover Formation, the Haynesville Formation (including the Buckner Anhydrite Member), and the Cotton Valley Group. These units range in age from early Callovian to late Tithonian, (Middle to Late Jurassic) with the Jurassic-Cretaceous boundary possibly occurring in the upper part of the Cotton Valley Group. Deposition was controlled by pre-Jurassic paleohighs, diapiric salt structures, and the peripheral fault system that rims the Gulf Coast basin. Climates during the Jurassic ranged from hot and dry during Early Jurassic to hot and humid during Late Jurassic. The Werner Formation consists of a lower sandstone and shale sequence, overlain by an evaporitic unit, and lies disconformably either on the Paleozoic basement or the Eagle Mills Formation of Late Triassic age. Deposition of the Werner represents the initial transgression of marine waters into the Gulf Coast basin. The Louann Salt is a massive halite unit that formed a southward tilting ramp on which younger Jurassic strata were deposited. The Norphlet Formation is a sandstone sequence with thin interbedded shale that lies disconformably on the Louann. The Smackover Formation consists of two units, a lower laminated mudstone and brown dense limestone, and an upper dolomitic grain-supported limestone. The Smackover lies conformably on the Norphlet, and in places is gradational with it. The Haynesville is a sequence of calcareous, anhydritic sandstone and interbedded, anhydritic, micaceous shale. The Haynesville may consist of either a sequence of interbedded, calcareous mudstone, anhydritic shale and sandstone, limestone, dolostone, and salt stringers, or a massive anhydrite (Buckner) at the base. In places the Buckner is gradational with the upper Smackover. The Cotton Valley Group is a sequence of fine to very coarse-grained to conglomeratic sandstone, interlayered with silty micaceous shale, very thin limestone beds, and in the Mississippi Interior Salt basin, thin coal and lignite beds. The Cotton Valley was deposited in a terrestrial to littoral environment and the absence of fossils, to date, makes it difficult to distinguish from the sandstone units of the overlying Hosston of Early Cretaceous age.

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Use of High-Altitude Color Infrared Imagery in Structural Mapping of Monument Spring Area, West-Central Marathon Uplift, Brewster County, Texas

The Monument Spring area of the Marathon uplift, was analyzed using a Kelsh plotter and NASA high-altitude color infrared (CIR) imagery.

Structurally, the Marathon uplift is a broad dome from which the Cretaceous cover has been eroded, exposing the Paleozoic structures. These Paleozoic rocks, ranging in age from Late Cambrian to Pennsylvanian, are complexly deformed and exhibit a variety of structural attitudes.

The Marathon region was originally mapped extensively by P. B. King in 1937. The Monument Spring area contains two of the most prominent structural features described by King: the Marathon anticlinorium and the Pena Colorada synclinorium. These features are characterized by tight folds and thrust faults striking in a northeasterly direction. North-trending shears are also found within the area.

Although there is a general agreement between present maps and King's original interpretation, the use of high-altitude specialized photography and quantitative Kelsh data provides additional information on the structural complexities of the area. This information, derived from the high-resolution model (obtained with the Kelsh Plotter) is perhaps not readily apparent in the field. The interpretations derived from this information are outlined in the detailed mapping of the Rock House Gap, Sunshine Spring area, and one additional area southeast of Monument Creek.