deposits. Study of Hensel outcrops in Kimble, Gillespie, and Blanco Counties, south of the Llano uplift, reveals a facies evolution that is associated with a major marine transgression. This evolution is expressed in both a north-south facies tract and in the overall stratigraphic succession. Four major depositional systems are recognized. (1) Basal, valley-fill deposits are limited to localities proximal to the source area. (2) Low-sinuosity, bedload channel-facies overlie the valley fill and are widely distributed. (3) Low-sinuosity channel-facies evolved into more distal, somewhat finer grained, coastal-plain fluvial systems. (4) Both the fluvial and coastal-plain facies are characterized by extensive flood-basin muds and small, ephemeral arroyos. The pervasive development of calcrete, or caliche, within the overbank deposits, and the overall depositional style of the unit imply a semiarid, seasonal climate. As the marine transgression progressed, the sediment supply decreased and channel gradients lowered. Deposition of the shallow marine or lagoonal carbonates that overlie the Hensel resulted from the final inundation of the source area.

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Depositional Environments of Norphlet Formation (Jurassic) of Southwestern Alabama

The Norphlet Formation in southwestern Alabama has become a primary target for oil and gas exploration. Isopach data show that Norphlet deposition was affected by a subsiding Mississippi Interior Salt basin, early movement of the Louann Salt, and stable Appalachian ridges and paleohighs, such as the Conecuh ridge and the Wiggins arch. The formation is over 1,000 ft (350 m) thick in parts of Washington, Clarke, Baldwin, and Mobile Counties. The Norphlet thins or is absent over areas of penecontemporaneous salt movement and is absent over the stable Wiggins arch.

The Denkman Member of the Norphlet is underlain by a red-bed sequence that grades updip into a conglomerate. The Denkman consists of clean, fine-grained, well-sorted sandstone, including a lower cross-stratified unit and an upper massive unit. The red-bed sequence is mostly sandstone with shale, shaly sandstone, and siltstone at the base. The shales, present in Escambia and Choctaw Counties, were probably deposited as distal portions of alluvial fans. Wadi gravels were deposited adjacent to the Appalachian highlands and grade downdip into the red-bed sequence. Both the gravels and red beds were deposited by sediment-choked braided streams and subjected to reworking and deflation, producing the Denkman Member. The Denkman consists of eolian sands, reworked at the top by the Smackover transgression into a massive sand up to 70 ft (21 m) thick. Thin, massive and horizontally laminated units in the cross-stratified sand indicate that narrow interdunes separated the broad dune sands of the Norphlet. A generalized sequence of diagenetic events affecting porosity may have been compaction, quartz overgrowth, and carbonate cementation, and possible selective dissolution of cements followed by deep cementation.

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Geology and Log Study of Tight Gas Sandstones—Cotton Valley Group

Through a cooperative research program among Schlumberger-Doll Research (Ridgefield, Connecticut), Schlumberger Well Services (Shreveport, Louisiana, and Houston, Texas), and Delta Drilling Co. (Tyler, Texas), a whole core and a conventional (DIT*/BHC, GR/CNL*/FDC*, HDT/FIL*)[1] and experimental-prototype (Digital Sonic, CNT-G, EPT*, GST-A*, NGT*, NML*) suite of logs were examined from the lower and middle Cotton Valley sands (Upper Jurassic) of a 10,200-ft (3,100 m) well (Alice Snider 1). The well is located in the Carthage tight gas sand field, located in Panola County, about 60 mi east of Tyler, Texas. Particular attention was directed to one of the two gas-producing zones (9,354 to 9,638 ft, 2,851 to 2,938 m); a deeper gas-producing zone (9,700 to 10,027 ft, 2,957 to 3,056 m) was not cored.

A synthesis of the rock core and log data leads to the following conclusions.

1. The formation is dominantly a well-laminated and horizontally bedded unit with low-angle, planar cross-bedding, shallow-water ripple marks, and convoluted bedding. Bioturbation and diagenesis have dramatically altered these features in some parts of the core.

2. The lithology is an alternating sequence of lithic sandstones (sublitharenites) and silty shales. Minor amounts of conglomerates, coal laminae, and fossil-bearing zones are also noted.

3. The tight gas sands have low porosities (<10%) and low permeabilities (<0.1 md). Intergranular porosity (2%) is reduced by authigenic quartz and/or calcite overgrowths and/or pore-lining, filling, and bridging clay minerals—illite, chlorite, and illite-chlorite mixed layers. Relatively abundant intergranular and secondary (4%) porosity is also noted.

4. The depositional environment of the gas-producing zone is interpreted as an alternating and transgressive sequence of shallow marine water dominated by barrier bars. Interbedded with the bioturbated shoreface sediments are minor tidal-deltaic sands deposited near the northeast-southwest-trending edge of a sedimentary basin.

[1]Asterisk is mark of Schlumberger.

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"Big Look"—Future Trend of Exploration

New ideas, new techniques, and new methods of exploration must be employed in concert with the conventional methods of the past to meet the ever-increasing demands for energy and strategic minerals. The synoptic view, or "Big Look," provided by satellite imagery and augmented by high-altitude aircraft data affords the explorationist new prospectives resulting in more comprehensive interpretations on a regional basis, and assists in establishing geologic trends.

Integration of all available geologic and geophysical information with that derived from Landsat imagery and other remotely sensed data provides a method of identifying potential petroleum and mineral prospects on a regional basis. Using this consolidated information, specific areas of interest may be identified for evaluation in greater detail through additional investigation. For petroleum prospects, this may involve the designing of a detailed geophysical program. For mineral prospects, this could include a more sophisticated remote-sensing program, conventional airborne and/or ground geophysical surveys, and detailed geologic mapping.

These techniques have been applied to frontier areas as an inexpensive preliminary source to localize prospects. Prospects have also been identified by these techniques in older, mature, producing areas.

In order to integrate accurately and cost effectively the wealth of data needed and to evaluate and identify prospect areas, computer technology is employed. Through computerization, inputs varying in scale and information content can be registered to a common scale and integrated into a single geographic data base. Establishment of a geographic data base provides the explorationist a simpler, faster, and more cost-effective method to plan geophysical programs and field work. Most important, investment decisions can be made with greater confidence when all pertinent information is current and accurately presented. Several models illustrate that satellite technology applied to exploration allows costly on-site investigations to be focused on the most promising targets.

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Field Size Distributions and Exploration Efficiencies by Depth Zones in Gulf Coast Area

The results of an extensive series of analyses of the field size distributions and discovery rates observed in the main producing provinces of the United States focus on the successive depth zones in the onshore Gulf basin. The analyses deal with the relationships between exploratory drilling density (feet/cubic mile of sediment) and (a) corresponding field size distributions, and (b) hydrocarbon discoveries. They distinguish between oil and gas. This analysis by depth zones can be used to develop estimates of the ultimately discoverable hydrocarbon resources in the various producing zones of United States basins.

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Modern Benthic Foraminifera from Gyre Intraslope Basin, Northern Gulf of Mexico

The Gyre basin, situated 155 mi (250 km) off the Texas coast, is the site of a preliminary study of living benthic foraminiferal assemblages from oxic (oxygenated) intraslope basin environments. The Gyre basin was formed by the blockage of a submarine canyon by rising salt diapirs, and is similar to other intraslope basins in the northern Gulf of Mexico. The environmental conditions are markedly different at the basin rim and floor, and this is reflected in the composition of the modern foraminiferal assemblages. Rim sediments are composed primarily of pelagic tests and detrital clay particles which have accumulated at a slow and steady rate, whereas the deeper sediments are derived chiefly from the slumping of basin walls, the result of diapiric uplift. Sediment accumulation is considerably faster on the bottom than on the rim of the basin, and occurs intermittently. Thirty-seven species of living benthic Foraminifera, including *Ammobaculites gyrensis* n. sp., and 82 nonliving species are found in rim sediments, but samples from the deepest region of the basin contain only one living specimen within the 26 species collected there. A total of 38 living and 85 dead species was identified. Sediment accumulation rate and mode appear to determine assemblage composition.

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Gulf Coast Magic

Our Gulf Coast region is, in a sense, magical. It is widely thought to hold the most important oil and gas reserves of the lower 48 United States—found and unfound. This northern limb of a continuously evolving petroliferous basin may be the finest place in the world to observe and confirm the workings of an active oil and gas-making system. Not only is it remarkably accessible, but the quantity and variety of information available are probably unmatched anywhere.

A few simple, but vital, principles may help to explain the Gulf Coast magic. Those who know the Gulf Coast are qualified to judge the validity of the reasoning.

Attention centers on interactive sediment-fluid relationships characteristic of shelf and hinge-line situations. Differential compaction, subsidence, growth-faulting, diapirism, and abnormal pressures are relevant to water movement. The hydrologic interplay of offshore compaction effluent and onshore meteoric recharge enhances the entrapment of water-borne materials (especially hydrocarbons) in the coastal belt. Probably, the same magic can be projected backward (and forward) in the geologic history of the Gulf Coast province, explaining many of the inland productive trends paralleling the present coastal belt.

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Future Energy Invulnerability

The forces of supply and demand in a free-market economy will result in increased supplies and lower consumer prices for energy resources in the United States. A review of post-World War II trends in oil and gas resources shows the relationships between market price and the supply of oil and gas, and verifies the importance of profits in the economic cycle of energy development.

One of the main points considered in this analysis is the effect of government regulation on the oil and gas markets. Government price ceilings on both oil and gas have encouraged excessive consumption of scarce oil and gas resources while at the same time discouraging producers from searching for new supplies. This excess demand, coupled with the lid on prices, has resulted in shortages in several periods and a general misallocation of resources in the energy sector.

The abundance of domestic reserves of oil and gas remaining to be discovered in the United States is ample to carry our nation into the next century without excessive dependence on unstable foreign sources of supply. Free-market forces and successful "team effort" exploration will not only allow the efficient development of those reserves, but will also bring forth supplies of substitutes for oil and gas, such as coal, nuclear, thermal, wind, and synthetic fuels, as prices and costs warrant.

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Catahoula Creek Field—a Complex Structural and Stratigraphic Trap in Downdip Cotton Valley Sands

Catahoula Creek field, one of Mississippi's most significant discoveries, is located in Hancock and Pearl River Counties approximately 14 mi northwest of Bay St. Louis. The field was discovered in August 1981, with the successful completion and testing of the 1 Rhoda Lee Brown, Sec. 28, T6S,R15W, by Hunt Energy Corp./Saga Petroleum et al. Stabilized flow rates of 10 to 13 MMCFGD were encountered with pressure of 9,100 to 9,250 lb through 28/64 in. choke from Cotton Valley sands at a depth of 19,816 to 20,038 ft (6,039 to 6,100 m). A total of 114 ft net sand was perforated and acidized. Two additional field wells have been drilled (a western offset in Sec. 29, T6S, R15W,