solved at the same time, without denying the nation the benefits of adequate, low-cost energy and an environment of acceptable quality.

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OIL IS FOUND IN THE MINDS OF MEN

Wallace Pratt, one of the great and most eminent petroleum geologists of our time, stated that "oil is found in the minds of men."

It seems that in the decades from 1930 to 1970, a span of more than 40 years, the explorationists have forgotten this one fact. We have depended on black boxes, green boxes, small computers, big computers, and first-dimensional, second-dimensional, and third-dimensional processes and techniques to tell us where to drill a well.

This dependence on instruments has been our profession's greatest mistake and one which was compounded by the petroleum industry which supported and perpetuated this practice. In fact, petroleum management forced our profession to cease thinking about petroleum being found in the minds of men and told us that it could be better found in the transistors of the black boxes and the computers.

A point has been reached where we cannot find the so-called structures on land with these gadgets. Therefore, we have said to ourselves, and industry has said to itself, "A new breakthrough is needed." Unfortunately, in reference to this need, geologists and industry are still thinking of new gadgets for the "breakthrough." The breakthrough should be in the minds of the explorationist. This should be the paramount tool. All of the other gadgets, old and new, will have to be supplements to the minds of men.

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NANNOPLANKTON BIOSTRATIGRAPHY AND SEDIMENTARY PETROLOGY OF A VERTICAL FACIES SEQUENCE CROSSING THE CAMPANIAN-MAESTRICHTIAN BOUNDARY IN CENTRAL ALABAMA

On the basis of the occurrence of calcareous nannoplankton in Upper Cretaceous sediments, exposed in a series of road cuts near Pine Level, Alabama, the sequence is placed in the uppermost *Kamptnerius magnificus* zone, the *Tetralithus aculeus* zone, and the lower *Chiastozygus initialis* zone (Campanian-lower Maestrichtian). The Cusseta Sand lithology, which is considered to be of Campanian age in western Georgia and eastern Alabama, is shown to be basal Ripley or Maestrichtian at this locality, based on the occurrence of *Chiastozygus initialis*. This age difference suggests that the clastic wedge, building southeastward from central Georgia and represented by the Cusseta Sand in east and central Alabama, is time-transgressive as the unit progrades from east to west.

Although a Demopolis Chalk lithology (calcareous clay) appears above the basal Ripley Sand (Cusseta Sand), it is not Campanian as suggested by previous workers, but is instead lower Maestrichtian.

Through the use of planktonic-benthonic foraminiferal ratios, textural analyses, clay mineral ratios, and stratigraphic and biogenic structures, the following 5 sedimentary environments, in vertical sequence, were established: (1) delta-front silts and sands (regressive), (2) offshore clay (transgressive), (3) marginal-shelf sands (basal Ripley), (4) offshore clays (transgressive), and (5) barrier bar-shoal sand complex (regressive).

The gradational boundaries between the various facies produced by a fluctuating strand demonstrates that there is no major break in the sedimentary record in crossing the Campanian-Maestrichtian boundary.

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GULF COAST PHOTOGEOLOGIC APPLICATIONS

The Gulf Coast is an important province for photogeologic applications even though much of it is of low dip and low relief and commonly covered by Pleistocene terrace deposits.

The Gulf Coast is a very active and dynamic province, characterized by clastic sediments that were laid down very rapidly. As a result the sediments are out of equilibrium and considerable compaction and settling have occurred, and many structures have formed. It is this movement and adjustment, acting throughout geologic time, that allow a subsurface structure to continually extend toward the surface, where it can be detected by subtle photogeologic techniques.

Photogeologic or photogeomorphic techniques, including analyses of drainage, topography, vegetation, deposition, and lineation, can definitively locate surface structures. Many of the Gulf Coast oil and gas fields have surface expression. Fields with good expression include those located in areas of current exploration interest, such as Sunniland and Felda in South Florida, Flomaton and Blackjack Creek in the Alabama-Florida Jurassic play, Edgewood and Fruitvale in East Texas, and Big Wells and Los Tiendos in Southwest Texas. Many other fields have good expression including Citronelle, Blacklake, Neale, Reyes, Mathis, and North Government Wells.

Normally, photogeologic interpretation must terminate at the coastlines, but a relatively new sonar-subsea mapping device allows exploration to continue onto the shelf areas. The Institut Français du Pétrole has developed a wide-range scanning sonar that can provide sea-bottom sonar images that rival aerial photographs.

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DISTRIBUTION AND ISOTOPIC COMPOSITION OF URANIUM IN A LOWER SOUTH TEXAS RIVER AND ESTUARY

The uranium concentration and isotopic composition of water and suspended sediment from a South Texas river and estuary were determined by alpha-spectroscopy. The average dissolved uranium concentration and radioactivity ratio (U^{234}/U^{238}) of the river water were determined to be 2.44 ug/l and 1.15, respectively. Water from a tributary of the river was found to contain an average dissolved uranium concentration of 42.8 ug/l with an isotopic radioactivity ratio of 1.56. Close inspection of the lateral concentration and isotopic activity ratio of uranium revealed an increase below the confluence of a tributary and the river. A model was derived based on equations used in isotopic dilution analysis, which predicts these increases within analytical error. This model may be useful in future studies to locate extraneous uranium within the hydrologic environment.

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BOTTOM CHARACTERISTICS OF NORTHERN GULF OF MEXICO CONTINENTAL SHELF

Photographs of the Gulf of Mexico continental shelf floor between Panama City, Florida, and Galveston, Texas, were examined for evidence of sediment texture, structure, and biologic activity. Sediment size is distinctively coarser in areas of reef growth near the continental slope. Bioturbation was recognized by the presence of burrows, mounds, furrows, tracks, and excrements. Water turbidity of varying degrees at times obscured the real water-sediment interface. Current direction and inferred velocity were indicated by compass and sediment cloud. A program of extensive photography, complemented by shallow cores, grab samples, and box samples, is needed to understand fully the different physiographic provinces of the Gulf of Mexico and their local variations.

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USE OF DOWNHOLE GRAVITY DATA IN FORMATION EVALUATION

It has been shown by several workers that the downhole gravity meter is a high-precision, large-volume, bulk-density tool. It is unique in that bulk densities can be measured directly, *i.e.*, with no calibration and in place. The large rock volume measured ensures that the measurements are relatively unaffected by mud cake, infiltrated zones, washouts, or casing. The use of large-volume density measurements has added a new dimension (depth) to some formation evaluation problems.

Bulk densities measured with the borehole gravity log in wells in the Gulf Coast area show considerable deviation from densities measured with the gamma-gamma log. Moreover, they do not show a density change in the over-pressured shale zone. These results suggest that although the physical parameters measured by small volume tools may be quite accurate, they may not be representative of true formation characteristics.

With only one exception, densities from a borehole gravity log in a carbonate-shale sequence agree closely with densities measured by the gamma-gamma log. This difference in densities of 0.18 g/cc is attributed to either porosity lateral to the borehole, a lateral change in lithology, or a fault.

The high precision and large rock volume measurement capabilities of the borehole gravity meter make it especially useful in measuring low porosities as, for example, that of a fractured quartzite in Libya, and in measuring fluid density behind casing, for example, gas in Texas.

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APPRAISAL OF COMPUTER MAPPING TECHNIQUES AS APPLIED TO MIOCENE FORMATIONS OF BAYOU CARLIN AND LAKE SAND FIELDS, SOUTHWESTERN LOUISIANA

A computer-aided subsurface mapping program of the middle Miocene section (-9,500 to -15,000 ft) was attempted for a 160-sq mi tract in the structurally "low" part of the famous "Five Islands" trend of Louisiana.

Seven resistivity features were picked from most of 136 electric logs and were correlated and used to make one isopach map, and conventional (manually contoured) structural maps of 4 zones. The same data were then employed to generate computer maps by 2 different approaches: weighted-moving-average (contour maps) and least-square-fits of polynomial surfaces up to the fifth order (trend maps). Numerous computer maps were generated on the high-speed printer and plotter, including structural maps, isopach maps, trend maps, and various residual maps. However, all of them do not appear to convey geologic sense, and some, particularly high-order trend maps, may be of little use.

The degree of similarity the computer maps bear with the manual maps varies widely with the map type and technique used. The contour-type maps may best serve as "quick-look" maps, bringing out the major structural elements and guiding the choice of horizons for hand contouring. Others, such as the isopach maps, yield the growth-fault effect and can guide later interpretations. The polynomial surface maps depict regional trends which can be used to make predictions away from known areas, to suggest "highs" and "lows" of significance, and to display meaningful thickness variations. The residual maps show promise of distinguishing structural traps, the locale of growth faulting, and typical tectonic and sedimentational patterns.

Computer maps do not supplant manually contoured maps. Some of them, if used early in a mapping program, could aid in picking horizons for hand contouring and could be used as a guide for contouring. Others should be used to suggest corrections in the structure, and still others as guides to the final interpretation.

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STRATIGRAPHIC UTILITY OF SOME MIOCENE AND YOUNGER ARENACEOUS FORAMINIFERA

Miocene and younger sediments of the Gulf Coast locally contain numerous arenaceous Foraminifera. Certain genera and species are particularly useful in subsurface stratigraphy. Arenaceous forms present especially difficult problems in identification. These problems are compounded by the fragmentary condition of specimens present in the washed residues usually available to industrial paleontologists. Special care in washing is required if arenaceous forms are to reach the paleontologist in identifiable condition.

Bigenerina, Clavulina, and *Martinotiella* commonly can be identified when only uniserial fragments are available. These three genera are valuable guides in the recognition of depositional energy regimes. *Bigenerina* is typically found in high-energy lithotopes. Specimens are commonly present in beach and offshore-bar deposits. *Clavulina* requires a lower energy regime. It can be found in protected bays, or seaward from the surf zone on the open marine shelf. *Martinotiella* is restricted to low-energy environments. It is a minor component of middle Miocene and younger outer neritic faunas. Whereas all three genera are locally useful as stratigraphic markers, they have a broader utility in suggesting probable sand conditions. Under most conditions, the higher the energy level of the depositional environment, the more abundant and coarser the sand.

Several species of arenaceous Foraminifera used by oil industry paleontologists for subsurface correlations on the Gulf Coast are found in the same relative stratigraphic positions at least as far as the Caribbean basin. *Textularia crassisepta,* which marks the Pliocene-Pleistocene contact (*Valvulina* "H" datum) in offshore Louisiana, seems to have a similar level in Jamaica. *Textularia subplana* is typical of middle Pliocene (*Buliminella* "1") deposits in Louisiana. Specimens from samples of the same(?) age were found in northern Colombia and in Jamaica. *Bigenerina humblei,* a middle Miocene index species in Texas and Louisiana, may be a junior synonym for *Textularia falconensis* Cushman and Renz, a Venezuelan stratigraphic marker. Renz believed the latter to be useful throughout the Caribbean region.

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SIGNIFICANCE OF CHANGES IN SHORELINE FEATURES ALONG TEXAS GULF COAST

The open Texas coast is characterized by 3 distinct types of shoreline: (1) barrier islands consisting of sand beaches, fore-island dunes, and a vegetated or barren back-island area; (2) peninsulas where beaches are dominated by shell (shell ramps with or without incipient dunes form the crest of the peninsula), and storm channels and washover deposits dominate the back-island area; and (3) strand plain a few to several hundred feet across, where shell material and rock fragments are dominant over terrigenous sand. Physiographic features of strand plains are a steep forebeach and a wide shell ramp that terminates as a steep avalanche face. Only the barrier islands and peninsulas are associated with bays and lagoons.

When viewed separately, these shoreline features appear to have a random distribution. However, when their occurrence is considered in the context of Pleistocene and Holocene depositional history of the Texas coastal zone, there is order in their distribution. Barrier islands develop in the same areas as do sand-rich Pleistocene deltas with broad strand plains. Peninsulas are positioned along Pleistocene interdeltaic areas. Strand plains are situated along the distal parts of mud-rich Pleistocene and Holocene deltas.

Distribution of these 3 shoreline types along the Texas coast cannot be explained adequately by a sand source from modern rivers being transported by longshore drift. Occurrence of the 3 shoreline types can be explained best by local Pleistocene and early Holocene sediment sources. Broad, sand-rich barrier islands are presently moving toward an equilibrium state where sediment input is about equaled by intensity of physical pro-