this assumption is the assemblage of abundant *Lenticulina* and *Globigerina* genera, and common occurrence of *Uvigerina, Nonion,* and *Cibicides* genera. This typical assemblage indicates a paleodepth of 90-300 m, which is analogous to depth ranges of extant foraminifera of the Gulf of Mexico. Further evidence of an outer-shelf to upper-slope depositional environment is the benthic to planktonic ratio of 4:1, a common ratio found in modern foraminiferal assemblages of the Gulf of Mexico at these depths.

Rare specimens of *Textularia* and *Globulina* genera present in the assemblage may have been displaced downslope of their natural habitat via ocean currents or influx of fluvial discharge from the Eocene age Cape Fear River.

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Depositional and Diagenetic Aspects of Siliciclastic and Carbonate Reservoirs in Glorieta Formation (Permian), Northern Midland Basin, Texas

The Glorieta formation is oil productive in the northern Midland basin. Production through 1982 totaled over 25 million bbl of oil. Carbonate as well as siliciclastic facies are productive in different locations on the shelf. This production is largely diagenetically controlled, with secondary porosity enhancement prevalent in both clastic and carbonate reservoir types.

The Glorieta formation is composed of cyclicly deposited siliciclastics, carbonate, and carbonate-evaporite units. Environments of deposition range from supratidal sabkha through shallow subtidal to open-marine conditions. The siliciclastics are eolian-derived sediments that prograded onto the shelf of the northern Midland basin. The overall coarsening-upward sequence, the gently seaward dip of the clastics, and the open-marine characteristic of adjacent carbonate sediments suggest a subaqueous deposition similar to that described by Shinn along the leeward, southeast coast of Qatar Peninsula in the Persian Gulf.

Diagenetic features affecting porosity development in the siliciclastic intervals include etching of quartz grains and penecontemporaneous precipitation of pore-filling, poikilotopic anhydrite cement. Subsequent partial dissolution of anhydrite cements increased porosity in clastic reservoir facies. The carbonate units have undergone pervasive dolomitization of mud matrix, leaching of allochems, and extensive anhydrite void filling. Replacement of dolomicrite by anhydrite and later solutioning of replacement fabric anhydrite contributed to secondary porosity in carbonate reservoirs. A better understanding of these diagenetic relationships could aid in predicting porosity trends in these distinctly different reservoir types within the Glorieta formation.

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Wrenching and Oil Migration, Mervine Field, Kay County, Oklahoma

Since 1913, Mervine field (T27N, R3E) has produced oil from 11 Mississippian and Pennsylvanian zones, and gas from 2 Permian zones. The field exhibits an impressive asymmetric surface anticline, with the steeper flank dipping 30°E maximum. A nearly vertical, basement-involved fault develops immediately beneath the steeper flank of the surface anticline. Three periods of left-lateral wrench faulting account for 93% of all structural growth: 24% in post-Mississippian–pre-Desmoinesian time, 21% in Virgilian time, and 48% in post-Wolfcampian time.

In Mesozoic through early Cenozoic times, the Devonian Woodford Shale (and possibly the Desmoinesian Cherokee shales) locally generated oil, which should have been structurally trapped in the Ordovician Bromide sandstone. This oil may have joined oil already trapped in the Bromide, which had migrated to the Mervine area in the Early Pennsylvanian from a distant source. Intense post-Wolfcampian movement(s) fractured the competent pre-Pennsylvanian rocks, allowing Bromide brine and entrained oil to migrate vertically up the master fault, finally accumulating in younger reservoirs.

Pressure, temperature, and salinity anomalies attest to vertical fluid migration continuing at the present time at Mervine field. Consequently, pressure, temperature, and salinity mapping should be considered as valuable supplements to structural and lithologic mapping when prospecting for structural hydrocarbon accumulations in epicratonic provinces.

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Geophysical Model of Gravity-Magnetic High, Virginia Coastal Plain

The Coastal Plain province of Virginia is characterized by a coincidental gravity and magnetic high parallel with the northeast-southwest Appalachian trend in the north changing to a north-south trend in the south. Both ends of the anomaly steeply grade into the regional field in Maryland and North Carolina.

Interpretation of 2 cross-strike geophysical profiles indicates that the anomaly is due to a high-density mafic unit flanked by low-density granitic(?) units. Geophysical signatures to the east of the anomaly are not parallel with Appalachian regional trends that characterize areas to the west.

Gravity models extending to 3 km depths on the southern profile (parallel with I-64 USGS line) and 4 km on the northern profile were chosen experimentally for optimal estimation of density contrasts. First approximations of the profile using vertical blocks to obtain density contrasts showed that east-dipping ($\approx 60°$) crustal blocks better represent the data. Well logs show that the anomaly is characterized by metagabbro, metabasalt, and amphibolite flanked by coherent lower-density granitic crustal blocks. Triassic-Jurassic clastic basins on the flanks of the anomaly to the west are fault-bound, but occur as vast basin infills to the east.

A conceptual model suggests that the anomaly may represent a suture zone between the North American crustal block to the west and possibly a remnant Avalonian(?) microplate to the east. Marked lineaments observable on computer-enhanced Landsat images closely parallel the subsurface trend of the anomaly.

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Experimental Fabric-Selective Porosity in Phylloid-Algal Limestones

Secondary fabric-selective porosity was experimentally produced in Pennsylvanian phylloid algal limestones from the outcrop in southeastern Kansas and from the subsurface in southeastern Utah (Ismay field, Paradox basin). Plastic-jacketed cylindrical specimens of well-cemented limestones were subjected to pressures simulating burial at 12,000 and 15,000 ft in a specially designed triaxial apparatus that permitted circulation of weakly acidic (pH 6) pore fluid (CO_2-enriched distilled water) under constant pressure and temperature. Thin sections revealed that the experiment produced algal moldic pores by selective dissolution of coarse low-magnesian calcite cement and pseudosparite. Dissolution was initiated along intercrystalline and intracrystalline pores (crystal boundaries and cleavage planes). Experimental pore systems were identical to natural porosity in Ismay reservoirs. Moldic porosity formed in the early stages of tests when flow rates were slowest; prolonged experimentation and more rapid rates of fluid circulation promoted the formation of vugs and channels.

These experiments document, for the first time, a potential for moldic-porosity formation during late diagenesis in deeply buried, mineralogically homogeneous phylloid algal limestones; thereby, extending the known depth range for porosity in late Paleozoic algal carbonates. Reservoir-quality algal moldic porosity may, therefore, exist within deep, as yet undrilled, parts of basins where mesogenetic decarbonatization has been operative.

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Sedimentary and Reservoir Geology of Upper Cretaceous Doe Creek Sandstone, Alberta, Canada

Northwest of Edmonton, Alberta, in the Valhalla area, recent drilling has proven the Upper Cretaceous Doe Creek Member of the Kaskapau Formation to be an oil-bearing sandstone. Based on core examination, the oil-bearing sandstone is interpreted to have been deposited on the transition from lower shoreface to inner shelf adjacent to a progradational wave-dominated coastline. Mapping indicates a northeast-southwest-trending reservoir sandstone body. The reservoir sandstone is a well-sorted fine-grained sublitharenite. The principle framework min-

eral is monocrystalline quartz and the matrix components are ferroan calcite, siderite, and kaolinite. Porosity appears primarily secondary in nature. Core analysis has shown 23% average porosity and 210 md permeability. Oil-base cores indicate an irreducible water saturation of 44% and residual oil saturation of 22%. In the area of study, estimated reserves are 22.27 million m^3 of oil in place.

The produced oil has a density of 844 kg/m^3, a viscosity of 3.3 cp, and a gravity of 37° API. The produced oil is undersaturated in relation to gas and the initial reservoir pressure was 3,960 kPa. The absence of a gas cap and an active aquifer has resulted in implementation of a secondary-recovery waterflood mechanism based on a 5-spot injection pattern. Primary recovery is estimated to be 10%, with an additional 31% from waterflood.

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Regional Appraisal of Hydrocarbon Potential of Trans-Pecos Texas: Methodology and Conclusions

Evaluation of large areas requires a different approach from that used to develop prospects. Regional cross-section networks generally ignore minor correlation problems. We examined and related all potentially significant parameters, and used reduced scales to subdue nonessentials and to cover a large area. Organization and planning must permit free interchange of ideas and close cooperation among those working on the project.

Regional structural and stratigraphic analysis of Trans-Pecos Texas strongly suggests that widespread trap-destruction by faulting and erosion led to hydrocarbon leakage and induction of fresh water into prospective zones, which reduced the likelihood of accumulation and preservation of economic reserves.

At least 4 major periods of tectonism, pervasive fresh water, mineralization, basic igneous intrusives and extrusives, high heat-flow regime, increasing percentage of carbon dioxide southwestward from the Delaware basin, and contemporaneous vertical movement suggest that the opportunity for major reserves is minimal.

A review of 1,000 mi of CDP seismic data from 4 areas disclosed 65 structural leads or traps, of which 45 had significant tests. All these tests were failures; many gave indications of sizable amounts of fresh water.

None of the areas have been completely condemned. However, only relatively small reserves can be anticipated for nearshore to continental Jurassic and Cretaceous sections in the Chihuahua Trough, Pennsylvanian and Permian reefs formed on a shelf environment or on the flanks of major uplifts, or in areas such as the Marfa basin.

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Expert Systems in Seismic Exploration

Artificial intelligence research has produced few practical results in most of its branches. However, "expert systems" in limited fields of expertise are potentially practical and cost-effective tools in many fields of exploration geophysics. Recent breakthroughs, such as writing expert systems in languages less exotic than *Lisp*, have made it possible to install a practical expert system on even the smallest computer. A recently published expert system written in *Forth* compiles a rule base into very compact code, and then uses it to reach decisions based on data supplied by the user. Such a system makes it possible for a small computer to be the geophysicist's advisor on many different subjects, because one expert system can use any number of rule bases. The expert system then becomes a practical tool for standardizing the decision-making process, even in comparatively trivial areas.

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Geotectonic Evolution of Bering Sea Area, Alaska

The geologic, structural, and tectonic history of the Bering Sea area since Paleozoic time is best viewed in terms of major plate-tectonic interactions. The geotectonic style of disparate areas is apparently related to the nature of plate motion at the time of tectonic imprint. Three major structural belts that have existed since the Mesozoic can be traced from the Siberian sector across the Bering Sea and into Alaska. The northern belt, the Verkhoyansk-Chukotsk-Seward-Brooks, consists of miogeosynclinal sediments that were deposited beginning in earliest Mesozoic time. The middle belt, the Okhotsk-Chukotsk-Yukon-Koyukuk, consists of a Mesozoic magmatic arc and numerous allochthonous terranes, formed due to the convergence-subduction of a southern oceanic plate. The southern belt, the Koryak-Anadyr-Peninsular, consists of terranes accreted during Cretaceous time and forms the southern limit of Mesozoic subduction.

During Late Cretaceous to early Tertiary time, these belts were oroclinally bent southward by an east-west compressional event, causing the subduction zone to shift to a more southerly location, thus forming the current Aleutian Island arc system, behind which the fragments of 2 Cretaceous oceanic plates were "trapped." These oceanic plate fragments may consist of an Early Cretaceous plate and a portion of the Kula plate(?), which carried a northward-migrating arc system. The hypothesized Early Cretaceous plate may have had a counterpart separated by a spreading ridge, both of which have been subducted beneath the Beringian margin.

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Geology and Petroleum Potential of Saba Bank Area, Northeastern Caribbean

Recent exploratory activity on Saba Bank in the northeastern Caribbean has provided geologic information showing that this frontier area possesses all of the attributes necessary for the commercial accumulation of hydrocarbons. The first well drilled in the area penetrated 9,370 ft (2,856 m) of sediments including 3,021 ft (921 m) of Eocene carbonates containing zones of good to excellent porosity. Geochemical studies show the presence of good but immature source rocks with the extractable hydrocarbons being migrated rather than indigenous. The geothermal gradient and vitrinite reflectance data indicated the threshold of the oil window would be reached around 10,000 ft (3,048 m). The second well was drilled to test a postulated reef on a basement high at a sufficient depth to fall within the oil window. The well bottomed in Eocene andesite at 13,881 ft (4,231 m). Reef carbonate was not encountered; the well penetrated turbidite sandstones and siltstones with low to moderate porosity and permeability. A test of gas shows recovered small amounts of C1-C5, but the formation is believed to have been badly damaged by severe mud loss during drilling. Geochemical studies confirm the presence of good source rocks. Reworked unmetamorphosed organic matter of probable early Eocene to Cretaceous age suggests that the Cretaceous cannot be considered economic basement in this area. Reinterpretation of the seismic data explains why the two wells were dry and indicates the presence of a submarine fan area, reefs within the oil window, and large structures in an area of thick sediments of probable Cretaceous age.

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Depositional and Diagenetic History of Buda Limestone in Central Texas and Its Relationship to Petroleum Potential

The upper Comanchean Buda Limestone (Cretaceous) is a known reservoir for hydrocarbons in central Texas, producing from depths as shallow as 700 ft. Understanding the character of the Buda Limestone and its complex depositional and diagenetic history is essential to developing a sound exploration strategy and to insure maximum production.

In central Texas, the Buda Limestone may be divided into a lower, micritic facies, and a dense, in places dolomitized, intrasparite upper facies. The upper Buda is more porous and contains most of the producible hydrocarbons in the formation. The upper contact is an undulating erosional surface, unconformably overlain by impermeable Woodbine shales.

Porosity enhancement appears greater in areas of faulting and fracturing, especially where occurring along erosional drainage divides. Because of the apparent correlations between favorable structure and marketable oil production, economic prospecting methods should seek to delineate zones of faulting and fracturing along areas where the upper Buda was exposed to weathering.