destroying hundreds of homes and buildings and filling the flood plains of the Toutle and Cowlitz Rivers with thick mud deposits. The mountain continued to erupt throughout the day, sending plumes of ash as high as 62,000 ft (18,897 m) into the atmosphere. The eruption spread pyroclastic ash 150 to 200 mi (242 to 322 km) eastward, covering parts of eastern Washington with 2 to 3 in. (5 to 8 cm) of ash. The ash continued across the United States and eventually circumnavigated the world.

Continuing seismic activity (including harmonic tremors), steam and gas venting, dome formation, periodic major eruptions, and pyroclastic flows keep residents, officials, and scientists speculating about what Mount St. Helens may do in the future. Expectations are that Mount St. Helens may continue erupting for the next two decades.

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Characterization of Uranium Ores from House-Seale Deposit, Catahoula Formation, Texas Coastal Plain

Sandstones and mudstones of the House-Seale deposit, Live Oak County, Texas, contain up to 8,000 ppm uranium as U_3O_8; however, no uranium minerals have been detected in the ore. Autoradiography of slabbed rocks and thin sections show that uranium is inhomogeneously distributed throughout the ore on both a macroscopic and microscopic scale. Thin-section petrography, scanning electron microscopy, and electron microprobe examination of these enriched regions proves that uranium is associated with platy, layered grain-coating material and clayey matrix between grains. Selective dissolution analysis indicates that 61 to 64% of total uranium is held on ion exchange sites and 36 to 39% is associated with amorphous aluminosilicate material. No significant uranium concentrations are found in amorphous iron or manganese oxides or hydroxides, nor is uranium present in other minerals.

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Abnormal Formation Pressures: Recognition, Distribution, and Implications for Geophysical Prospecting, Brazoria County, Texas

The Frio and Anahuac Formations in east-central Brazoria County, Texas, were deposited in deltaic to prodeltaic environments during the active and waning stages of growth of a piercement-style salt diapir, Danbury dome. Growth faulting is prominent in the area and abnormal pore fluid pressure is present in much of the section.

Borehole shut-in pressure measurements, drilling mud density records, and shale transit times are used to interpret distribution of subsurface pressures. Three pressure regimes are defined in terms of vertical pressure gradients: normal pressure (0.465 psi/ft), soft overpressure (0.465 to 0.70 psi/ft), and hard overpressure ($>$ 0.70 psi/ft). Distribution of these pressure regimes is controlled by the distribution of sands in the sedimentary section, and the extent of flow continuity within them. Flow continuity can be cut off by stratigraphic pinch-out or by faulting.

Comparisons of stratigraphic thicknesses measured in boreholes with those derived from seismic reflection data show significant mis-ties if a single velocity function is used for time-depth conversion throughout the area. These mis-ties result from lateral variations in acoustic velocity which can be related to the distribution of normally and abnormally pressured zones in the subsurface.

Abnormally pressured zones have lower acoustic velocities than the normally pressured zones above and below them. Where these abnormal zones exist and dip significantly, lateral velocity variations should be expected.

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Source-Rock Potential of Austin Chalk, Upper Cretaceous, Southeastern Texas

The Austin Chalk is an impure "onshore" chalk deposited marginal to the Gulf of Mexico during the Late Cretaceous. The chalk is a reservoir, producing petroleum from the matrix and from fractures in the rock. In addition, the lower part of the Austin Chalk contains 0.5 to 3.5% organic matter, with some localized zones containing 20% organic matter.

The organic-rich chalks occur principally in deeper (greater than 5,000 ft or 1,524 m), basinward cores, whereas the organic-poor chalks occur in shallow cores on the San Marcos platform. The organic matter is similar in the chalk and in the underlying Eagle Ford Formation, although there is typically more organic matter in the shales of the Eagle Ford Formation. The kerogen is amorphous, sapropelic (Type II) kerogen that yields large amounts of saturated and aromatic hydrocarbons upon burial. Although hydrocarbon generation commences at about 2,000 ft (610 m) burial, the peak zone of petroleum formation is between 6,000 and 8,000 ft (1,828 and 2,438 m). At these depths, mature petroleum occurs in the matrix and in fractures in the chalk, whereas at greater depths gas is forming.

The hydrocarbons in the chalk include those formed in place and those formed elsewhere (probably the Eagle Ford Formation) which have migrated into the chalk. Due to increasing generation and migration of hydrocarbons with depth, the petroleum becomes lighter and enriched in saturated and total hydrocarbons with depth. At less than 3,000 ft (914 m), the petroleum is commonly heavy and depleted in saturated and total hydrocarbons, due to biodegradation or to the immaturity of the autochthonous oils.

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Diagenesis and Secondary Porosity in Vicksburg Sandstones, McAllen Ranch Field, Hidalgo County, Texas

Lower Vicksburg sandstones (Oligocene) at McAllen Ranch field in Hidalgo County, Texas, consist of thin sandstones interbedded with shales. The sands were deposited by turbidity currents as channel and overbank deposits. The sandstones produce gas from depths of 9,300 to 15,000 ft (2,800 to 4,500 m). Depositional patterns were controlled by a diapiric shale uplift and related faults. Petrographic analyses show that primary porosity was reduced during early diagenesis owing to calcite cementation. However, dissolution of calcite cement, feldspar, and volcanic rock fragments, which occurred after deep burial, led to secondary porosity development. Dissolution is evidenced by the formation of intergranular porosity, oversized pores, grain molds, and by microporosity within individual grains. Dissolution was followed by precipitation of quartz overgrowths, formation of authigenic clay minerals (kaolinite, chlorite, illite, smectite, and vermiculite), and by precipitation of iron-rich calcite cement. Scanning electron microscopy confirms that clay minerals are primarily authigenic and uniformly distributed. Chlorite grain coatings and pore lining probably aided in preservation of porosity by inhibiting cementation.

Highest porosities and permeabilities are found where the sandstones have the highest secondary porosities as determined by petrographic study. Porosity increases from about 15% to as much as 20% in the section from 9,642 to 12,586 ft (2,939 to 3,836 m). This increase is related to the abnormally high pressure gradient of about 0.92 psi/ft (20.8 kPa/m) and to an elevated geothermal gradient of about 2°F/100 ft. Optimum reservoir properties are present where late stage cementation by clays and iron-rich calcite has not been extensive.

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Geology of Subsurface Eocene Cockfield Formation, Southern Allen Parish, Louisiana

A regional study of the subsurface Cockfield Formation (Eocene), southern Allen Parish, Louisiana, reveals that it was deposited as a result of the action of longshore currents and deltaic distributary channels within a nearshore marine environment. The juxtaposing of reservoir quality sands and marine shales within this environment created favorable conditions for the formation and entrapment of hydrocarbons. The Cockfield trend, a major oil and gas producing belt through the study region, appears to be composed mainly of fields that have combination stratigraphic-structural style entrapments. Localized sand pinch-outs and permeability barriers on "rollover" anticlines that developed on the downthrown sides of faults are responsible for most accumulations. Faults evidently controlled sand deposition in some parts of the study area, resulting in thicker deposits of sand on their downthrown blocks. Thickening of section within the Cockfield is present in isolated areas, and is confined to relatively short stratigraphic intervals.

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Petroleum Geology of South Carlton Field, Lower Tuscaloosa "Pilot Sand," Clarke and Baldwin Counties, Alabama

Petroleum production from South Carlton field, southern Clarke and northern Baldwin Counties, Alabama, is primarily from the lower Tuscaloosa "Pilot Sand" of Late Cretaceous age. The Pilot is a massive, green-brown micaceous, fossiliferous, glauconitic, very fine to medium-grained, quartzose sandstone. Texturally, the sandstone is submature with the quartz grains being subangular to subrounded and moderately to moderately well sorted. The sand body displays a decrease in grain size, sorting, and roundness from the base to the top of the unit. The sandstone has a maximum thickness of 71 ft (22 m) in the northern part of the field. Usually overlying the Pilot is a gray, silty, oyster-bearing packstone. The packstone is overlain by the "Marine Shale" which consists of dark-gray, silty, micaceous, fossiliferous, laminated claystone. This claystone contains a diverse fossil assemblage, indicating open marine-shelf sedimentation. The Pilot Sand is underlain by an interbedded sandstone and claystone interval, which is separated from the "Massive Sand" by a silty claystone.

The spontaneous-potential pattern for the Pilot Sand illustrates a gradational lower contact and a sharp upper contact. Constructed cross sections indicate the Pilot thins and becomes argillaceous immediately east and west of the field. The sedimentary rock characteristics, including an elongate northeast to southwest strike-trending morphology, and well-log properties of the sandstone suggest it accumulated as part of a marine-bar complex.

Porosity in the Pilot is principally intergranular and averages 27.3%. Average permeability is 183 md, and oil saturation can be as much as 42%. The Marine Shale above the Pilot Sand and claystone from the interbedded interval underlying the Pilot have potential as petroleum source rocks. The overlying packstone and Marine Shale make excellent seal rocks. The petroleum trap is a combination of stratigraphy and structure. The structural element is most critical and involves salt movement which has resulted in a domal feature. The crude oil trapped by the salt dome is a heavy oil having a chemical composition of an immature oil.

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Estimation of Uncertainty in Coal Resources

The use of alternate energy sources to supplement dwindling domestic petroleum resources will increase in the future. Among alternate resources, coal will contribute greatly to the future energy mix. Official estimates of the United States coal resources published during the past 15 years range from less than 1.7 to as much as 3.9-trillion short tons (1.5 to 3.5-trillion metric tons). These differences imply that a high degree of uncertainty exists in resource assessment.

A comparison of variability in coal resource estimates in areas of different ancient depositional environments is examined in an attempt to utilize depositional systems for improved coal resource estimates.

The Texas Gulf Coast basin was chosen to develop the methodology of resource evaluation because it exhibits a full range of ancient depositional environments. Two lignite deposits are evaluated, one from the alluvial plain setting of the Wilcox Group in east Texas and the other from the delta plain setting of the Jackson Group in east Texas.

Important sources of uncertainty in resource estimation include variability of seam thickness and areal distribution. To test the degree of uncertainty caused by variations in seam thickness, the numbers of boreholes considered in each lignite deposit are reduced and resources are calculated for each reduction in data.

Classical statistical methods are used to determine the number of boreholes required to obtain resource estimates of individual seams within a given confidence interval and specified conditions. Geostatistics (variograms and kriging) are used to measure variability in resource estimates.

These studies show that the minimum number of boreholes required to characterize coal resources within an accuracy of 20% for example, is substantially less than might be expected intuitively, and that the degree of assuredness depends on the coefficient of variation of the data analyzed.

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Near-Surface Lignites of Wilcox Group in East-Central Texas

As lignite becomes a major energy resource in Texas, information concerning the distribution, quality, and quantity of lignite available for utilization is becoming necessary for future planning. This paper presents the findings of an ongoing study concerning the distribution, depositional environments, and exploitability of near-surface lignites in the Wilcox Group of east-central Texas.

Fifteen hundred geophysical logs from closely spaced