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.

MATHEW, D., and M. P. ROBERTS, Bur. Econ. Geology, Univ. Texas at Austin, Austin, TX

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

boreholes were made available by private industry for the study. Cross sections and a lithofacies map constructed from the geophysical logs clearly show the stratigraphic and facies relations within the Wilcox Group. The Wilcox in Bastrop, Milam, Robertson, and Limestone Counties can be subdivided into three lithostratigraphic formations: Hooper, Simsboro, and Calvert Bluff. From Freestone County northward, the massive sands of the Simsboro thin and break up, preventing the tripartite division of the Wilcox.

The Calvert Bluff is a fine-grained succession of clays, silts, and lignites with occasional sands. Lignites occur regularly in the lower part of the Calvert Bluff just above the Simsboro and in the upper part of the Calvert Bluff just below the Carrizo. Calvert Bluff sands observed in this study are single to multistory, laterally discontinuous channel sands. Lignites in the Calvert Bluff commonly extend over the top of these sand channels and across some of the projections of mapped subsurface sand belts. Sequences coarsening upward from clay to silt to very fine-grained sand and topped by lignite are common in the Calvert Bluff. The Calvert Bluff, with its continuous lignites and occasional sand units, is interpreted as a fine-grained meander-belt deposit. Calvert Bluff streams were possibly highly sinuous, mixed- and suspended-load streams.

The Calvert Bluff conformably overlies the Simsboro Formation. Mapping of the Simsboro in this study has documented discontinuous lignites in areas where the formation is dominated by massive multistory sands and continuous lignites where the thick sands break up, thin, and interfinger with finer grained sediments. The depositional environment of lignite formation in the Simsboro in Bastrop, Milam, Robertson, and Limestone Counties is characterized by thick multistory, multilateral channel sands, interpreted as coarse-grained meander-belt deposits, with the lignites accumulating in swamps located in narrow interchannel basins. Simsboro streams were possibly bed-load, low-sinuosity streams. From Freestone County north, the Simsboro succession is interpreted as being a predominantly fine-grained meander-belt deposit. Sites of peat accumulation were swamps that formed in more extensive interchannel areas.

Lignites occurring in the Hooper are commonly associated with upward-coarsening units, possibly deltaic in orgin. The paucity of data for the near-surface Hooper Formation limited the study of these sediments.

The exploitability of Texas lignites depends not only on the occurrence of thick regular seams of favorable quality lignite, but also on the hydrologic setting of the lignite deposits. Detailed mapping of the depositional systems, facies, and individual sand units, together with hydrologic parameters of flow, transmissivity, and recharge, may aid in predicting hydrologic problems before mining.

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Income Tax Consequences of Oil and Gas Property Interests Received for Services

Overriding royalties or working interests in oil and gas prospects received in consideration for geologic services can be structured to be nontaxable upon receipt. Under the so-called "pool-of-capital" doctrine, established in case law and recognized by the Internal Revenue Service, to be nontaxable the interest received must be an interest in the prospect to which the services are provided and the services must "directly" contribute to the exploration or development of the specific prospect.

It is possible to take the position that interests in partnerships or joint ventures engaged in the business of oil and gas exploration received for qualified services also qualify. However, the position of the Internal Revenue Service is that such interests may not qualify for tax-free treatment, and this position is supported by some, though inconclusive, case authority.

Where interests are received in circumstances such that there is a material risk that they will not qualify for tax-free treatment, it will be important to consider carefully both the question of how to value the interest for federal tax purposes and when such interest may be reportable. These issues are related in that if an interest is deemed to be taxable and subject to either substantial restriction or risk of forfeiture upon receipt, then in the absence of a Section 83(b) election, the interest will not be reportable in income until the restrictions or risk of forfeiture lapse, at which time the interest will be includable in income at its then fair market value. This may result in the interest first becoming reportable after the prospect in which the interest is received has been proven.

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Petrophysical Properties of Sligo Oolite of Northern Louisiana and Arkansas

The petrophysical examination of the rock and log characteristics of the Sligo oolite (Lower Cretaceous) in Arkansas and northern Louisiana has led to new ideas in the interpretation of oolitic deposit characteristics. Thin-section and SEM analyses determined four different kinds of porosity and four types of water saturation in oolite deposits. These observations were significant in the evaluation and interpretation of this oolite reservoir. Tests were undertaken on oolite core plugs and the cementation factor (m) was determined to be 1.83, the saturation exponent (n) to be 2, and the intersect (a) to be 1. Acoustic velocity tests on core plugs showed a relation to the cementation factor. Mercury capillary pressure tests on the oolite core plugs resulted in a new method for the interpretation of these curves. Examination of various well logs resulted in different methods of determining pay from nonpay in the Sligo Formation.

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Coal—The Alternate Fossil Fuel

Coal formed from the remains of plants that probably grew in swamplike conditions. There are four main classes of coal based on the ratio of fixed carbon, volatile matter, and moisture content. Of the estimated reserves of 550 billion tons, more than 400 billion tons can be mined by known methods. At the present rate of consumption these reserves would last 300 years. The most important use of coal in the United States is for electric-power generation. There are three major types of pollutants caused from the burning of coal. Approaches to the problem of burning coal cleanly to help eliminate pollutants include removing offending contaminants before the coal is burned by gasification, liquefaction, or solvent-refining; burn it more cleanly; or clean the coal smoke after it has been burned by using precipitators, scrubbers, or filter bags. A lead time ranging from 7 to 10 years is needed to bring coal to market. Texas lignite is currently strip-mined from the Wilcox Group in east and central Texas and includes estimated near-surface reserves of 10 billion tons. The lignite is primarily used in steam-electric plants where environmental problems are present.