bling the number of existing fields. Two of these discoveries (Huxford field and Appleton field) were a direct result of Texaco U.S.A.'s aggressive exploration program in Monroe, Conecuh, and Escambia Counties. Texaco also participated in the third field discovery, Lovett's Creek. During the last 4 yr, the company has controlled approximately 250,000 acres under lease and/or option, has shot 2,000 mi of seismic data, and has either drilled or participated in 18 wildcat wells in these 3 counties. Six successful Smackover oil completions, with initial gauges averaging 500 BOPD, yield a 33% success rate. Currently 3 wells are producing, 2 are awaiting production facilities, and 1 is being reworked.

Certain geological and geophysical factors complicated Texaco's Smackover exploration effort. First, the presence of near-surface Citronelle gravel frequently prevented successful transmittal of source energy to deep horizons and contributed both coherent and incoherent noise to the seismic data. Second, pervasive dolomitization in many places completely eradicated original rock texture, making environmental interpretation difficult. Third, facies changes and diagenetic changes in the reservoir rock were found to occur over very short distances, making development drilling high risk. Fourth, the presence of hydrogen sulfide in some successful wells substantially increased the cost of production facilities. However, even with these complications, a successful drilling program was achieved.

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Reworking of Sedimentary Pyrite on Euxinic Sea Floors, Devonian, Western New York

Basinal black and dark-gray facies of the lower Genesee Formation (uppermost Givetian) contain distinctive accumulations of exhumed and resedimented pyrite nodules, tubes, and steinkerns. Pyritic alloclasts occur at 2 stratigraphic levels; each horizon marks an erosional discontinuity overlain directly by anaerobic or marginally dysaerobic, basinal sediments. The most important level is the Leicester pyrite member, marking the base of the formation, where pyrite occurs in starved traction-lenses on or immediately above a widespread unconformity marking a major transgression. This relict pyritic deposit is regionally time-transgressive, as indicated by conodont data and diachronous shingling of lenses with basal Genesee black muds. Similar, but younger, pyritic lenses occur at the level of a diastem associated with the western margin of the Lodi limestone bed near Seneca Lake. Pyrite, chemically unstable in aerobic bottom settings, was apparently exhumed, transported, and concentrated under euxinic conditions. Lenses contain distinctive diagenetic pyrite structures (e.g., steinkerns, burrow tubes) from muds underlying both discontinuities. Erosional transfer of pyrite onto the sea floor is shown by mechanical breakage of pyrite grains, reorientation of geopetal stalactitic pyrite, and compactional features, plus alignment of burrow tubes by bottom currents. General absence of carbonate allochems in lenses is believed to reflect dissolution of carbonate grains, particularly in the lens intergrain environment.

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Geochemistry of Regionally Extensive Dolomites, Burlington and Keokuk Formations (Mississippian), Iowa and Illinois

The Burlington and Keokuk Formations (Mississippian) contain 2 major generations of dolomite throughout the several ten-thousand square kilometers of study area. Dolomite I (oldest) is luminescently zoned, Ca-rich, Fe- and Mn-poor, and has Mississippian $^{87}Sr/^{86}Sr$; dolomite II is unzoned, nearly stoichiometric, Fe- and Mn-rich, and has radiogenic $^{87}Sr/^{86}Sr$; dolomite III, a minor zone, is nonluminescent and very Fe-rich. Dolomites I and II formed before nonmarine calcite cements, and all 3 dolomites formed before Late Mississippian under shallow burial conditions.

Stable isotopes of dolomite I average +2.3 ‰ $\delta^{13}C$ and −0.3 ‰ $\delta^{18}O$ PDB. Dolomite I is slightly depleted in ^{13}C and ^{18}O with respect to estimated Mississippian marine dolomite. Thus, dolomite I may have formed in waters only slightly depleted in ^{18}O and ^{13}C compared with seawater at low temperatures (~25°C). Dolomite II averages −4.1 ‰ $\delta^{18}O$ PDB, +2.8 ‰ $\delta^{13}C$ PDB, and has a wide range of $\delta^{18}O$ (−0.5 to −6.6 ‰PDB) and a narrower range of $\delta^{13}C$ (+1 to +4 ‰). These data suggest that temperatures of precipitation were less than the 80°C-110°C ranges implied by the contained 2-phase fluid inclusions, unless the waters were isotopically heavy (~ +3 to 11‰ $\delta^{18}O$ SMOW). Dolomite II shows a regional geographic trend of decreasing $\delta^{18}O$ and increasing $\delta^{13}C$ from north to south. This trend can be accounted for by either a northward decrease in temperature or in ^{18}O content of diagenetic waters.

We suggest a model in which dolomite I precipitated in marine-dominated mixed waters at low temperatures, the bulk of the dissolved constituents being derived intraformationally. Dolomite II formed as a replacement of dolomite I in a system dominated by nonmarine waters and/or slightly elevated temperatures, deriving much of their constituents from sub-Burlington strata.

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Composition of Ultradeep Gas—Theoretical and Experimental Study

Increasingly greater numbers of wells are being drilled below 25,000 ft, and considerations of methane stability in the deep subsurface are becoming more important. We have calculated equilibrium gas compositions corresponding to conditions down to 40,000 ft for low, average, and high geothermal gradients, for hydrostatic and lithostatic pressures, and with and without graphite. Calculations have been made for sandstone reservoirs with various amounts and combinations of feldspars, clays, carbonate cements, and iron oxides with and without graphite, and for limestone and dolomite reservoirs with various combinations of clays, iron minerals, anhydrite, and sulfur, again with and without graphite. Natural gas shows considerable stability in sandstone reservoirs under most conditions, but its concentration in deep carbonates is much more variable and tends to a H_2S-CO_2 mixture except when an appreciable concentration of iron is present.

The thermodynamic predictions can (in principle) be checked by direct analysis down to the depth limit of available gas samples. In practice, considerable problems exist due to partial gas loss during sample retrieval. The analysis of gases trapped in fluid inclusions in late-stage cements offers one solution to this problem. This gas is being analyzed by thermally rupturing inclusions in the inlet system of a fast-scanning, computer-controlled mass spectrometer. Each bursting inclusion is analyzed separately, and several hundred individual inclusions can be analyzed using only 10 mg of sample. A wide variety of compositions, including water-rich, methane-rich, and H_2S-rich, is found in samples from below 20,000 ft.

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North Pecan Island Field: a Mature Trend Discovery in Miocene of Southern Louisiana

The Exxon 1 M. J. Epley discovery well for North Pecan Island field was completed in early 1982 as a discovery of significant new gas and condensate reserves in the mature Miocene trend of south Louisiana.

The field is located in Vermilion Parish within a large megablock between 2 major down-to-the basin growth-fault systems and is on the southern end of a south-plunging structural nose. Traps in 2 fault segments are formed in southeasterly dipping beds upthrown to 2 north-dipping, sealing faults. Six separate *Robulus chambersi* sandstones contain gas and condensate reserves.

Major gas and condensate reserves from sandstone reservoirs in the *R. chambersi* section were discovered in the mid-1960s 3.3 mi. west in the Pecan Island field and in the North Freshwater Bayou field, 5 mi northeast of the North Pecan Island field discovery. Several earlier dry holes just north of the discovery were drilled seeking to extend production from the upstructure Fire Island field (3 mi north), which produced a limited amount of gas and condensate from *R. chambersi* sandstones. Extensive structural and isopach mapping, aided by new high-resolution seismic data, revealed the North Pecan Island prospect to be structurally high to production at Pecan Island and that the prospective section was deposited over a growing paleostructure.

Four wells have been completed to date in the field, with flow rates as high as 30 MMCFGD. Current estimates place the new field recoverable at approximately 250 bcf of gas and 6 million bbl condensate.