phase I/S layers in subparallel orientations relative to each other, commonly with branching and interfingering relationships. Electron diffraction patterns of these shallower samples show very diffuse basal reflections, prominent turbostratic structure, pronounced streaking along z*, and multiple z* orientations in the same diffraction pattern. All of these features indicate a poorly defined interstratification of the mixed-phase I/S: the diffuse basal reflections are probably due to the presence of only a few layers in a diffraction position; the turbostratic structure is due to misalignment of individual layers relative to each other; the z* streaking is due to stacking disorders of the layers in a direction perpendicular to the layers; and the multiple z* orientations are due to rotational disorder of the layers about an axis parallel with the layers.

TEM lattice fringe images from deeper samples show mixed-phase I/S layers arranged in a more parallel fashion, with less branching and interfingering. Electron diffraction patterns for these deeper samples show well-defined basal reflections, and both turbostratic structure and z* streaking are less pronounced. These relationships indicate a more regular interstratification for deeper layers: more layers are in diffraction position, the misalignment of individual layers is less evident, and the stacking disorder perpendicular to the layers is less pronounced.

X-ray powder diffractograms have been interpreted to indicate ordering of illite and smectite layers within the mixed-phase I/S. This order is first observed below the "soft" geopressure boundary (0.465 psi/ft) and is prominent below the "hard" geopressure boundary (0.7 psi/ft). However, neither the TEM lattice fringe images nor the electron diffraction patterns show ordering of illite and smectite layers within mixed-phase I/S.

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Surface Exposures of Late Cretaceous Strata at Rayburns Salt Dome, Bienville Parish, Louisiana

Surface exposures of Cretaceous strata in Louisiana are restricted to isolated occurrences associated with salt domes in the northwestern part of the state. The best known Cretaceous exposures are associated with the Rayburns salt dome in Bienville Parish. Strata exposed at this structure previously have been correlated with formations exposed in southwestern Arkansas, in particular, the Marlbrook Formation and the Saratoga Chalk.

Several distinct Upper Cretaceous lithologic units can be identified at the Rayburns locality. Detailed stratigraphic relationships of these units are obscured by the incomplete nature of the exposures and by dense vegetation. Strata on the west side of the outcrop area include a basal olive-gray marl that is locally glauconitic. This unit is thought to correlate with the Brownstown Marl in Arkansas. The basal marl is overlain in part by a massive glauconitic sandstone at the western end of the outcrop area and by a gray chalky marl at the eastern end. These lithologies are thought to correlate with the Buckrange Sand Lentil or basal Ozan Formation exposed in Arkansas. The sandstone and gray chalky marl units are directly overlain by a hard white chalk. This chalk lithology correlates faunally and lithologically with the upper Ozan and the Annona Chalk in Arkansas.

Exposures along the east side of the outcrop area, adjacent to an abandoned quarry, are blue-gray marl and chalk whose fauna and lithology correlate with the Saratoga Chalk in southwest Arkansas. The concretionary clays of the Midway Group, of Paleocene age, lie unconformably on the truncated surface of this Saratoga equivalent. The unconformity is marked by a thin layer of bored, calcareous nodules. The uppermost portions of the Navarro Group, which occur elsewhere between Cretaceous and Paleocene strata, have apparently been eroded at this locality.

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Depositional Controls on Porosity and Permeability Evolution in Upper Smackover Formation at Tubal Field, South Arkansas

Hydrocarbon production at Tubal field is from secondarily enhanced, preserved primary porosity in an interval of carbonate grainstones at the top of the Upper Jurassic Smackover Formation. These grainstones were deposited as an ooid shoal over a topographic high on the south Arkansas shelf. The degree of porosity and permeability preservation in these sediments ranges greatly and is controlled by both depositional and diagenetic processes.

Porosity and permeability are reduced mostly by pressure solution and the precipitation of late sparry cements. The chemical stability of a grain type determines its resistance to pressure solution, whereas pore size is critical to retaining porosity and permeability after cementation. Therefore, the ability of particular facies types to preserve permeability is controlled chiefly by the types, sizes, and sorting of the constituent grains. Using these parameters, pay facies (facies in which porosity and permeability are commonly preserved) can be defined and identified. Pay facies at Tubal field include the poorly sorted coarse ooid facies, the ooid-composite grain facies, and the pellet-grainstone facies. By studying the distribution of analogous modern facies, the ability to predict the distributions of upper Smackover pay facies, and thus production, can be improved.

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Oil and Gas Prospects in Arkansas Ouachitas

The Arkansas Ouachitas is a frontier area for exploration for oil and gas. To date, drilling has been so limited as to prove meaningless as far as subsurface exploration is concerned. This area provides a rare opportunity to examine various techniques, criteria, indicators, and even hunches using only foresight without the benefit of hindsight in assuming that it will be productive of oil and gas. Time will tell if these predictions are true.

Criteria that one would look for in exploration in a new province include the following in the Ouchitas: (1) sedimentary column that in its entirety exceeds 50,000 ft (15,240 m); (2) numerous oil seeps, gas shows, and residual asphaltic deposits; (3) numerous source beds, reservoir beds, and seals in the stratigraphic column; (4) potential for various entrapping mechanisms in the form of structure, faulting, stratigraphic traps, and reefing in ordovician carbonates under the overthrust; (5) a north-south seismic line that shows definite stratification of beds across the entire thrust area; and (6) Landsat interpretation which indicates areas of structural and tonal anomalies.

The next 5-10 years will witness an extensive and expensive exploration effort in this area. Only after drilling has probed the area will this story be concluded.

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Computerized Particle Size Analyzer—An Exploration Technique, Saint Mary Field, Lafayette County, Arkansas

Grain size frequency and cumulative weight percentages, mean grain size, standard deviation, and skewness provide the geologist with information necessary for studies assessing rock complexity and heterogeneity, and in some cases, depositional environment. Although grain size distribution data are important to the exploration geologist, they are not normally available in sufficient quantity or on a timely basis.

The new computerized Particle Size Analyzer (PSA) enables the explorationist to obtain grain size distribution information rapidly and economically on sidewall and conventional cores. The porosity and the measured grain size distribution, which includes silt and clay sizes, are used to "index" the quality of the reservoir rock. This quality grading or "indexing" is then used to evaluate changes in formation water saturation and/or electric log resistivity, thereby better identifying hydrocarbon productive intervals and oil-water contacts.

Data generated from conventional core samples in the Mitchell sand of the Rodessa Formation in Saint Mary field, Lafayette County, Arkansas, illustrate the use of particle size data for improved well evaluation.

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Variation in Chemical Composition of Oil Field Brines with Depth in Northern Louisiana and Southern Arkansas: Implications for Mechanisms and Rates of Mass Transport and Diagenetic Reaction