pore anisotropies of tight sandstones. Several analysis methods were used; each indicated that little anisotropy was present in the pore structure.

Statistical-shape parameters, derived from the measured perimeters and areas of the pores, suggest that most of the pores within each sample are tabular rather than tubular in shape. Knowledge of the pore structure suggests that the pores should be treated as oblate rather than prolate spheroids in modeling the electromagnetic or fluid-flow properties of these rocks.

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Cretaceous-Tertiary Boundary, San Juan Basin, New Mexico and Colorado

The Cretaceous-Tertiary boundary in the San Juan basin, New Mexico and Colorado, has been variously placed at the base, at the top, and somewhere within the Ojo Alamo Sandstone. New evidence bearing on the location of this boundary includes palynologic analyses, vertebrate paleontology, paleomagnetism, and trace-element analyses.

The Ojo Alamo Sandstone is a series of fluvial, high-energy, braided stream deposits consisting of from one to several conglomeratic sandstone sheets separated by overbank or floodplain shales. The conglomerates contain pebbles and cobbles of quartzite, jasper, and andesite on the west side of the San Juan basin. The pebbles and cobbles diminish in size eastward and are rare to nonexistent on the east side of the basin. There is a major unconformity at the base of the Ojo Alamo.

The Cretaceous-Tertiary boundary, as determined earlier from palynologic criteria, is below the base of the Ojo Alamo Sandstone in the uppermost part of the underlying Kirtland Shale on Mesa Portales. New evidence from the Star Lake area, New Mexico, tends to confirm that boundary location. Other new data based on vertebrate remains, also from the Star Lake area, indicate that the boundary is within the Ojo Alamo Sandstone. Recently published paleomagnetic data and trace element studies now underway may also help in solving the Cretaceous-Tertiary boundary problem.

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Upper Cretaceous Tocito Sandstone Lentil of Mancos Shale, San Juan Basin, New Mexico—Is There Any Oil Left?

The Upper Cretaceous Tocito Sandstone Lentil of the Mancos Shale consists of a series of northwest-trending linear sandstone bodies in the San Juan basin of New Mexico. This sandstone unit, which has produced most of the basin's crude oil (more than 125 million bbl to date), was referred to as the "Gallup" Sandstone for many years. Recent stratigraphic studies of the Tocito by several authors clearly demonstrated that the Tocito Sandstone Lentil is a totally different stratigraphic unit from the Gallup; thus, the Tocito name was reinstated as a lentil of the Mancos Shale. (Actually, the "Tocito" was thought to be part of the Gallup years ago and the Tocito name was dropped in favor of the "Gallup" name.) Even though hundreds of holes drilled to produce natural gas from the deeper Dakota Sandstone have penetrated the Tocito, these holes cannot be thought of as Tocito dry holes because, for many of them, no attempt was made to test the Tocito for its possible oil potential. There is still a good chance that significant amounts of oil remain to be found in the Tocito.

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Facies Distribution and Reservoir Quality of Biogenic Gas Reservoirs of Northern Great Plains—Example From Eagle-Telegraph Creek (Upper Cretaceous) Interval

The quality of reservoirs containing biogenic gas in the northern Great Plains is predictable on the basis of facies distribution. Rocks of the Upper Cretaceous Eagle Sandstone-Telegraph Creek Formation stratigraphic interval include excellent examples of several reservoir types.

Conventional reservoirs of the Eagle Sandstone are restricted to a north-south trending band of coastal sandstones in central Montana. These reservoirs are highly porous and permeable and display evidence of extensive diagenetic alteration. Conventional Eagle reservoirs are exemplified by gas fields in the vicinity of the Bearpaw Mountains, where gas is found in structural traps.

Coarsening-upward sequences of the Shannon Sandstone Member of the Gammon Shale were deposited on a shallow shelf seaward (eastward) of the coastal sandstones. Reservoir quality improves upward through each sequence, and depends upon the distribution and amount of sand accumulation. The Shannon reservoirs are transitional between conventional reservoirs of the Eagle Sandstone and low-permeability (tight) reservoirs in the Gammon Shale. The Liscomb Creek field, in southeastern Montana, produces gas from the Shannon in a structural-stratigraphic trap.

Gas reservoirs in offshore marine mudstones of the Gammon Shale consist of thin, discontinuous lenses and laminae of siltstone enclosed in silty shale. The reservoirs are tight with permeabilities of 0.1 md or less. They have high irreducible water saturations ($>80\%$; however, they produce little free water). The reservoirs are extremely susceptible to formation damage when exposed to water-based fluids used during drilling and hydraulitc fracturing. The Gammon reservoirs have low productivity but volumetrically make up the greatest part of rocks equivalent to the Eagle-Telegraph Creek sediments, and they probably have the greatest potential for reserves of shallow gas in the northern Great Plains. Examples of low-permeability reservoirs include pay zones in the Little Missouri field in southwestern North Dakota and in Gammon-equivalent rocks of the Milk River pool in southeastern Alberta.

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Progress in Modeling Natural Fracture Distributions

Recent interest in the influence of rock fractures on fluid movement through rock has created a need for modeling techniques which can predict fracture geometry, spacing, and opening in large, heterogeneous rock bodies. A suggested approach involves the simultaneous development of (1) a rock body model which represents the distribution of rock physical properties and the boundaries between property domains; (2) an empirical model representing fracture geometry, distribution, and opening for as much of the rock body as is feasible; and (3) a theoretical strain model which allows the strains indicated by the empirical model to be generalized over the body model. The theoretical model is based on the analysis of strain mechanisms during field work for the empirical model. This methodology has been applied to a complex nearshore sedimentary rock sequence in an area having widely spaced basement-rooted faults of the Laramide type. The resulting model was sufficiently powerful to predict acceptably fracture aperture size and spacing in the strata of interest. These predic-