Five factors warrant particular consideration to assure maximum success. One, is the relative dependence placed on effective judgments of experienced workers, as compared to that placed on any predetermined geologic models or apparent implications of data sets. Second, is having effective contributors who can properly apply newly-accepted or evolving geologic principles affecting hydrocarbon occurrence. Third, is the degree to which contributors identify and use geologic analogs properly or improperly. Fourth, is how correctly assessors view the exploration maturity for basins being studied. Fifth, is the manner in which members of an assessment team communicate with each other regarding such elements as geologic concepts and models, adequacy and significance of data bases, statistical approaches, and constructive criticism—"communicating" involves both transmitting and receiving.

Continuing to advance our science is paramount for preparing future and better resource assessments. Concurrently, correctly identifying, educating, organizing, and supporting the right earth scientists for the assessment task is of equal importance.

AMAJOR, LEVI C., Univ. Port Harcourt, Port Harcourt, Nigeria

Lower Cretaceous Viking Barrier Island, Southwestern Alberta, Canada

A subsurface study of cores and electric well logs from the lower Cretaceous (Albian) Viking reservoir sandstone near Calgary, Alberta, reveals its deposition as a regressive barrier island along the shores of the *Haplophragmoides gigas* sea.

The barrier island trends northwest-southeast parallel to the paleostrandline for more than 120 km (75 mi) and attained a maximum thickness of more than 30 m (100 ft). Swales characterized by isopach thinning suggest that the island was probably breached by two tidal channels. Bentonite chronostratigraphy indicates that the barrier island prograded in a northeasterly and/or easterly direction for up to 24 km (15 mi). This seaward growth was briefly interrupted by an isostatic transgression. Thus, sandstone depositional pattern is of the imbricate type with younger units successively displaced seaward in the direction of progradation.

The barrier-island facies sequence comprises eleven intergradational facies, i.e., ebb-tidal delta, marginal (spillover) channel, middle shoreface, marine shales, upper shoreface beach, dune, back-barrier mud flat, marshy lagoon and overwash, mixed tidal flat, tidal creek channel, and overbank. This sequence differs slightly from that of the Recent classic regressive Galveston Island, Texas, and the ancient Muddy barrier island, Montana, in the presence of an ebb-tidal delta and marine shelf shales beneath and above the middle shoreface facies, respectively. On this basis the South Carolina Recent barrier islands are considered closer modern analogs.

The writer suggests that this sand body be explored further for oil and/or gas accumulations because of its excellent reservoir properties and the generally low well density.

AMBROSE, M. L., M. L. W. JACKSON, W. R. KAISER, and D. J. FLY, Bur. Econ. Geology, Univ. Texas at Austin, Austin TX

Lignite Occurrence in Relation to Depositional Facies, Eocene Wilcox Group, Sabine Uplift Area, East Texas—Regional and Local Comparative Studies

Lignite occurrence was related to sandbody geometry in two subsurface studies: a 12-county regional study and a local study of the Trawick gas field area, north-central Nacogdoches County. For both studies, the Wilcox Group was informally divided into lower progradational (deltaic) and upper aggradational (fluvial) units. The local study utilized closely spaced data to investigate a more detailed Wilcox stratigraphy.

The most continuous lignite-bearing zone lies at the transition between lower and upper Wilcox strata. Mapping of lignite occurrence in both studies shows this zone to be coincident with distributary channels indicative of delta-plain settings. Lignites and laterally equivalent muds rest on platforms of sandy sediments. Initiation of peat accumulation in interdistributary basins, with upward and subsequent lateral development as blanket peat, is inferred from the local study. Thickest and most laterally extensive seams occur in Shelby and Panola Counties on the flanks of major delta lobes.

Thick upper Wilcox lignites (> 5 ft, 1.5 m) occur regionally between major fluvial channel sand belts and cap 30 to 40-ft (9 to 12-m) upward-coarsening sequences (crevasse splays?). These lignites are surface-mined in Panola and Harrison Counties at Martin Lake and Darco. Westward, in northern Cherokee County, our drilling shows thick lignites (up to 11 ft, 3.4 m) have limited lateral extent in channel sand belt areas. Similarly, the local study lies within a major sand belt; small interchannel basins limit lateral continuity of lignites.

AMBROSE, WILLIAM, and NOEL TYLER, Bur. Econ. Geology, Univ. Texas at Austin, Austin, TX

Regional Distribution of Wave- and Fluvial-Dominated Deltaic Deposits of Olmos Formation (Upper Cretaceous) in Maverick Basin, Southwest Texas

Regional subsurface analysis in southwest Texas indicates that the Olmos Formation (Gulfian) was deposited by a complex of wave- and fluvial- dominated delta systems in two depocenters. Sediment influx was from the north and northwest. Five deltaic subunits, A through E, were deposited in the western depocenter. Three other deltaic wedges (F, G, H) formed the second depocenter farther east in present-day Frio and LaSalle Counties. Subsidence was greater in the western half of the Maverick basin where thickest (1,300 ft; 395 m) deltaic sediments were deposited. Lower Olmos strata represent a succession from wave-reworked, strike-elongate deltas of subunit A, similar to those of the underlying San Miguel Formation, to fluvial-dominated, dip-elongate deltas of subunits B and C. Extensive (1,200 mi^2 or 3,100 km^2 in Texas) aggradational floodplain deposits of B and C are characterized by diverse electric-log patterns; variation in log character is a response to complex depositional facies on the delta platform. Downdip, toward the Cretaceous shelf edge, delta-plain facies merge with upward-coarsening delta-front sandstones.

Uppermost subunits D and E were deposited by a prograding barrier-island system in an interdeltaic embayment marginal to high constructive deltas of the eastern depocenter. Lagoonal and fluvial-channel deposits are recognized from cores. Eastward migration of deposition was accompanied by an abrupt change of depositional style in the western depocenter from deltaic to coastal-interdeltaic.

AMSBURY, DAVID L., Consulting Geologist, Seabrook, TX

Relationships of Bexar Shale, Hensel Sandstone, and Hensel Dolomite (Basal Upper Trinity, Comanchean Cretaceous) in South-Central Texas

The Bexar Shale has been considered the offshore equivalent of the Cow Creek Limestone, the overlying Hensel sandstone, or of the disconformity between them in outcropping sections.

Cores and outcrops in Comal, Kendall, and northern Bexar Counties preserve calcitic and dolomitic caliche in the top of the Cow Creek Limestone. Above the caliche is 8-16 m (25-50 ft) of laminated or bioturbated, dolomitic siltstone and silty dolomite (Hensel dolomite). Dolomite is euhedral and silt-sized. The lower part contains collophane grains and oyster shells replaced partly by chalcedony. Carbonate grains within the upper part include angular and well-rounded mollusk and echinoid fragments; many are pyritic and coated by glauconite. Terrigenous grains in Hensel dolomite grade upward from silt to coarse subarkose sand from central Texas.

In southern Bexar County, about 35 m (115 ft) of silt-, clay-, and calcite-mudstone referable to the Bexar Shale sharply overlie shallow marine Cow Creek Limestone, and grade abruptly upward into about 7 m (23 ft) of Hensel dolomite. Dolomite is overlain by calcarenite of the Glen Rose Formation containing subarkose sand grains. Similar distinctive sand grains occur in well cuttings of basal Glen Rose beds northeastward through Travis County.

The Bexar represents a flood of clay-sized sediment from a distant source, spread across the San Marcos arch during a rapid transgression. Slightly younger sand, silt, and local clay of the Hensel sandstone were eroded from central Texas by a few flash floods during a major period of caliche formation in that area.

ANDERSON, JOHN B., ROBYN WRIGHT, and ELIZABETH WATKINS, Rice Univ., Houston, TX

Grain Size Vertical Progressions as an Exploration Tool

Previous studies of grain size as an indicator of sandstone depositional environments have had mixed results; for that reason, the method is seldom if ever used as an exploration tool. The problem with these previous studies is that they concentrate on grain-size parameters for individual samples, and fail to recognize that various depositional environments are characterized by a number of discrete facies, each with its own characteristic sedimentary structures and grain-size populations. For that reason, vertical progressions in grain-size data are far more diagnostic of depositional environment than are scatter diagrams in which one grain-size parameter is plotted against another.

Grain-size progressions for ancient sequences of the Upper Cretaceous Point Lookout formation and Eocene Queen City Formation demonstrate the value of the technique. The data show that distinctions can be made between fluvial, estuarine/tidal distributary, flood-tidal delta, foreshore, and shoreface sandstones. More importantly, our method relies on analysis of samples collected at random intervals (generally 2 ft or .6 m), so that it is applicable where sidewall cores are available. Diagenetic complications (other than those resulting from silica cementation) do not appear to threaten the sensitivity of the method. Using automated settling analysis, these data are obtained rapidly and can aid in subsurface correlation as well as determining the depositional environments of sandstones.

ANDREWS, JEAN A., and WALTER C. PITMAN, III, Lamont-Doherty Geol. Observatory of Columbia Univ., Palisades, N.Y.

A Model for Evolution of Small Pull-Apart Basins

A preliminary model for the evolution of small extensional or pull-apart basins is presented. The very rapid subsidence, sediment accumulation, and hydrocarbon maturation observed in many basins of this type are explained using a McKenzie-type approach. Lateral heat loss is shown to be a critical factor in controlling the rate of heat loss in basins of finite width. In a simple two stage model where stretching and cooling are assumed to occur as separate processes, more than one-third of the total thermal subsidence occurs in the first 200,000 yr of cooling for a basin 30 km (20 mi) across. This allows for the accumulation of over 2 km (6,500 ft) of sediment. Because the time required for a 10-km (6-mi) long block to be stretched to 30 km (20 mi) is substantially greater than 200,000 yr, much of the cooling and subsidence must take place during stretching. This simultaneous stretching and cooling is approximated by alternating short periods of stretching and cooling.

The resulting model is applied to the development of the basins associated with the San Andreas fault in southern California. These basins have recently (Miocene to Present) undergone rapid (up to 6 km, 4 mi) subsidence and sediment accumulation as well as rapid maturation of hydrocarbons. They appear to have been initiated in an extensional regime along irregularities in the strike-slip motion of the fault, even though some of the basins have been modified by subsequent compression. These basins are therefore excellent candidates for testing the proposed model.

AQUING, FELIX R., Trinidad and Tobago Oil Co. Ltd., Penal, Trinidad, West Indies

Multi-Disciplinary Approach to Biostratigraphic Mapping—Two Case Studies: Bass Basin, Australia, and North Soldado, Trinidad

Palynologic zones were used to subdivide the Late Cretaceous to late Eocene beds in the Bass basin, Tasmania, Australia and the Late Miocene to Pliocene beds in the S.484/S.498 area, North Soldado, Trinidad. These zones are related to discrete genetic sedimentary cycles bounded by unconformities which are marked by abrupt changes in the environment of deposition. In both areas, the environments range from shallow marine to continental.

Owing to wide sample spacing (up to several hundred feet in some wells), it was impossible to locate precisely each biostratigraphic boundary, based on palynological data alone. The composite use of sedimentology, wire-line log characteristics, dipmeter interpretation, and reservoir fluid properties was integrated with the palynologic data, providing a practical technique that was used to delineate the sequence boundaries in wells where spore-pollen data was inadequate.

This method enabled the development of accurate zonation and a detailed correlation between wells within both the Bass basin and the S.484/S.498 area.

ARMENTROUT, JOHN M., Mobil Oil Corp., Dallas, TX

Distribution of Organic Richness in Time and Space

Distribution of organic facies is related to interaction between productivity and preservation, both the consequence of environmental factors. The environment also controls the amount and type of the organic matter present and its potential to yield hydrocarbons.

A conceptual model for predicting organic richness in time and space is based on predictions of the geographic location of high marine organic productivity by upwelling systems during intervals of optimal preservational potential within transgressive cycles. Whether or not the marine organic matter is in fact preserved in the rock record depends on the spatial relationship of the upwelling system to potential environments of preservation. The problem of preservation is addressed at two levels. The first is whether or not a depositional basin was in the proper geographic position to receive the organic matter during a sediment accumulation cycle, and second, whether or not that organic enriched interval is preserved in the stratigraphic sequence of the basin.

Prediction of basin location is derived from plate tectonic reconstructions. Prediction of productivity is based on paleogeographic and paleoclimatic models. Presence or absence of potentially organic-enriched rock units is evaluated by examination of the stratigraphic record of the basin being studied. Measuring actual levels of organic content of the rocks must be done with sample analysis.

The conceptual model for predicting the temporal and spatial distribution of organic richness derived from marine upwelling systems is simplistic by necessity. It focuses on primary parameters and addresses only a few secondary parameters. Success or failure in making predictions with this model in basins already understood can test the validity of the model and which parameters are most important.

ASPLER, LAWRENCE B., and J. A. DONALDSON, Ottawa-Carleton Centre for Geoscience Studies, Ottawa, Ontario, Canada

Oblique-Slip Sedimentation and Deformation in Nonacho Basin (Early Proterozoic), Northwest Territories, Canada

The Nonacho basin shares several traits with molassoid basins formed in oblique-slip settings: (1) great thicknesses (about 9 km, 6 mi) of siliciclastic sediments deposited in alluvial fan, fan-delta, braided stream, beach, deltaic, and lacustrine environments; (2) synsedimentary faults which activated nearby sources; (3) rapid sedimentation and subsidence; (4) telescoped facies transitions, particularly adjacent to active faults; (5) extremely variable thicknesses of lithostratigraphic units; (6) diachronous sedimentation resulting from the migration of source areas and sites of sedimentation along deformation fronts; (7) mobility of deposition and deformation such that early sediments were uplifted, cannibalized, and redeposited; (8) paleocurrents directed basinward near basin margins, and longitudinally in axial regions; (9) lower greenschist facies metamorphism; (10) paucity of volcanic rocks; and (11) complicated structural geometries. However, these features alone are not diagnostic of oblique-slip origin; all are compatible with rift, aulacogen, impactogen, retroarc, peripheral, intramontane, and broken foreland settings. More reliable indicators of an oblique-slip tectonic setting for the Nonacho basin are: (1) anastomosing pattern of near-vertical, en echelon faults which delineate rhomb-, wedge-, and rectangular-shaped semi-independent subbasins and basement uplifts; (2) stretching lineations of shallow to moderate plunge along shear zones; (3) folds and near-vertical penetrative fabrics, related to shear zones, but at angles of 20°-30° to these zones. The Nonacho basin fill is interpreted as a foreland molasse of the Trans-Hudson orogene. Deposition and deformation probably occurred in response to convergence accommodated by oblique slip, analogous to the Tarim and Tsaidam basins of China, which developed in the late stages of India-Eurasia collision, north of the Tibetan Plateau.

ATALIK, ERKAN, and CHARLES F. MANSFIELD, Univ. Tulsa, Tulsa, OK

Dakota Sandstone Facies, Western Oklahoma Panhandle

The Cretaceous Dakota Sandstone in Cimarron County comprises three sandstone units and intervening mudrocks; it overlies the Kiowa