Searches for new and innovative ways to explore for hydrocarbons have included consideration of various thermal techniques possessing the possibility of making significant contributions to exploration technology. The recognition of hydrocarbon maturation as basically a thermal process has made the relatively accurate determination of sedimentary-basin temperature history important. Whereas many thousands of bottom-hole temperature measurements have been made in hydrocarbon exploration holes in sedimentary basin, the necessarily marginal quality of these data has limited the application of heat flow, geothermal-gradient, and temperature techniques to hydrocarbon exploration and to the investigation of thermal properties of sedimentary basins.

There is no substitute for detailed and accurate temperature-depth logs made in holes that have reached thermal equilibrium. From these measurements, a large amount of thermal information can be determined, such as the effective in-situ thermal conductivity of the units encountered by the drill and evaluation of active migration phenomenon in the vicinity of the drill hole. Correlation of thermal conductivity with log properties can be used to extend throughout a sedimentary basin the detailed information from the few holes suitable for equilibrium temperature measurements. Actual logging experience and comparison of relative in-situ thermal-conductivity values with values in equivalent units measured in the laboratory demonstrate major discrepancies and emphasize the need for, and importance of, in-situ data.

BLOCH, JOHN D., Washington Univ., St. Louis, MO

Fluid Inclusion Analyses of Detrital Quartz Grains—New Provenance Tool

Preliminary analyses by microthermometry of fluid inclusions in detrital quartz of the Upper Cambrian Lamotte Sandstone revealed the occurrence of 2 distinct groups of aqueous fluid inclusions. Specific salinity signatures and homogenization temperatures may be used to distinguish specific granite types of the source rock terrain. The inclusions chosen for analysis occur in isolated clusters or are randomly distributed within a grain, commonly in association with mineral inclusions of zircon, sphene, rutile, and/or tourmaline. Secondary inclusions are present in the Lamotte but are not included in this study.

The first group of inclusions is characterized by low salinities (< 1.0-8.0 wt. % eq. NaCl), the second by high salinities (12.1-29.6 wt. % eq. NaCl). Final melting temperatures as low as −30.6°C indicate the presence of divalent ions in these inclusions. Both groups yield homogenization temperatures of between 150°C and 220°C. The low-salinity inclusions occur predominantly in subrounded to well-rounded sand less than 1.0 mm in size that is derived from a distal source. The brine inclusions occur exclusively in subangular to angular gravel 2.0-3.0 mm in size, implying a more proximal source area.

A comparison of these inclusions with inclusions found in the granites of the apparent source terrain indicates that a medium-silica amphibole-orthoclase granite (Slabtown type) or a low-silica amphibole-plagioclase granite (Sivermines type) or both are the primary source rocks for this quartz. These granite types have limited areal distribution in the present-day St. Francois mountains and the identification of these granite types as the source rock for the locally derived quartz has broad implications for reconstructing Cambrian depositional environments and paleostructure of the ancient St. Francois mountains.

BLODGETT, ROBERT H., Ohio State Univ., Columbus, OH

Paleovertisols as Indicators of Climate

Clay-rich paleosols are common in the rock record in upper deltaplain, fluvial floodplain, marginal lacustrine, and playa deposits. In environments characterized by a marked seasonality of precipitation, these soils are generally Vertisols. Modern Vertisols contain over 35% clay, predominantly smectite, have a distinctive slickensided ped structure, and locally develop surface microrelief and carbonate nodules.

The optimum development of Vertisols is in subtropical to tropical monsoonal climates. Surface microrelief (gilgai) is common in subhumid and semiarid, but not arid, climatic regimes. Carbonate nodules are common in both drab and pigmented Vertisols in semiarid climates. In the transition to subhumid regimes, carbonate nodules are likely to be either absent or restricted to drab Vertisols. Vertisol pigmentation appears to be a function of inherited color or the development of organic complexes, and thus only indirectly controlled by climate.

Changing precipitation patterns can cause the production or destruction of evaporites or carbonates in a Vertisol profile. In contrast, the slickensided ped structure has a high preservation potential and is probably modified little during changes in climate and subsequent burial. Unlike marine and profundal lacustrine clays, Vertisols have a high bulk density and appear to be affected little by burial compaction. Syndepositional cementation, in the form of veins and nodules of low-Mg calcite (i.e., calcrete), is common. However, major changes in the clay mineralogy of these paleosols may occur during diagenesis, including the transformation of smectite into mixed-layer clays, illite, or kaolinite.

BOLLER, KIMBERLY ANN, Texas Tech Univ., Lubbock, TX

Ostracode Distribution in Late Pennsylvanian Finis Shale Cyclothem

Four successive intergrading ostracode biofacies characterize the Finis Shale cyclothem (Cisco Group, Virgilian) near Jackboro, Texas. Composition of the ostracode biofacies parallels the distinct megafaunal assemblages ascribed by Boardman et al (1983) to changing oxygen concentrations, water depths, and salinity.

Black, organic-rich, noncalcareous, fissile shales occur near the base of the Finis. This lithofacies is barren of ostracodes and megafauna, and is interpreted to represent a "deeper" water, anoxic environment. The overlying dark-gray, phosphatic shales contain a diminutive pyritic molluscan fauna with abundant ammonoids and a low-diversity ostracode assemblage dominated by *Healdia*, indicating a dysaerobic environment. The overlying lithofacies is a medium-gray, clay-rich, calcareous shale.

The megafauna is dominated by a brachiopod-bryozoan assemblage, and a diverse *Amphissites-Kirkbya* ostracode association occurs. This fauna represents a "shallow" depth, aerobic environment. The *Amphissites-Kirkbya* biofacies is overlain by a dark-gray calcareous shale with abundant megafossils of the fusulind-bryozoan facies of Boardman et al. This interval is dominated by a *Bairdia-Amphissites-Kelletina* ostracode assemblage, indicating a shallower aerobic environment. The shale is interrupted by the Jacksboro Limestone Member, an algal limestone deposited at or near wave base, which is covered by a thin intertidal sandstone. The cyclothem is capped by noncalcareous, brown silty shale. It contains a low-diversity ostracode assemblage dominated by *Cavellina* and a megafaunal assemblage characterized by *Myalina*, which represents a shallow, brackish water environment.

BOSTROM, ROBERT C., Univ. Washington, Seattle, WA

New Vista of Crustal Architecture—High-Order Geoidal Images

Altimeter-bearing satellites produce images of the earth's gravity field in unprecedented detail. The images reveal crustal architecture in scale intermediate between lithosphere plates and local fault blocks. Geoidal images provide a preview of the architecture of remote regions prior to conducting ship or airborne operations, and provide interpretive background for regional exploration already in progress.

Altimetric satellites provide data primarily of water-covered areas. The geoidal images avoid assumptions inherent in the preparation of Bouguer, free-air, and isostatic gravity maps. Oceanic data combined with continental gravimetric data are displayed as contour maps.

The synoptic view provided by high-order geoidal images makes it possible to trace crustal features such as fracture zones to the margin of continents. The images are of sufficient detail as to cast doubt on many correlations deduced on the basis of the oceanic magnetic anomalies. Crustal stretching and intraplate deformation may be more common than supposed.

BOYD, RON, Dalhousie Univ., Halifax, Nova Scotia, Canada

Quaternary Stratigraphy of Sable Island Bank, Nova Scotia

Over 300 m of Quaternary sediments are preserved on the Sable Island Bank section of the Scotian Shelf off Atlantic Canada. Most of these are interpreted as Pleistocene glacial sediments. However, a Holocene sandbody over 50 km long, 4 km wide, and 50 m thick occupies the Sable

Island topographic high in the center of the bank. This Holocene sandbody is interpreted as having formed from reworking by marine transgression of the underlying Pleistocene glacial and glaciofluvial sediments. During transgression, a subaerial barrier system migrated northward across the bank, leaving behind an extensive set of shoreface-detached ridges. At the margin of the barrier system, longshore transport produced a submarine spit complex that migrated northward with the barrier system but did not produce significant ridge-type shelf sands. Sable Island Bank illustrates the importance of sea level transgression as a major mechanism for supplying sand-sized sediments to the shelf environment. In this case, the sediments have been transported over 100 km to the outer shelf by glacial and fluvial processes during low sea level stands. In addition, Sable Island Bank illustrates the importance of paleotopography in generating potential stratigraphic traps in shelf sandbodies. Topographic relief is likely to be generated on continental shelves exposed during low sea levels. During subsequent transgressions, sand-sized sediments are produced by reworking and are stranded on isolated topographic highs.

BRAKENRIDGE, G. ROBERT, and TAO VUONG*, Wright State Univ., Dayton, OH

Bagnold's Log Hyperbolic Approach to Sand Grain-Size Analysis as Adapted to a Large Sedimentation Tower

Recent criticism of sand grain-size analysis as a useful tool in sedimentary petrology is directed at popular techniques of data analysis that do not rest on a correct theoretical basis. Several decades ago, R. A. Bagnold pioneered a new approach that deserves attention before grain-size analysis is discarded for environmental discrimination. Bagnold wrote that transportational sorting and winnowing are independent processes involved in sediment deposition. As a result, grain-size distributions of sand deposits follow log-hyperbolic and not log-normal distributions, and the coarse and fine tails of grain distributions are independent. More recently, D. Love showed that grain-size studies assuming log normality are prone to specific errors, one of which is the false inference of two log-normal populations when a log hyperbolic-population is analyzed. A difficulty, up to now, in the practical application of Bagnold's approach has been the requirement that sieve-opening diameters be measured accurately. This problem can be eliminated by the use of sedimentation tower techniques. We are using a 2-m tall, 40-cm wide, water-filled sedimentation tower and a sensitive electronic balance coupled to a microprocessor to collect sediment-weight and settling-time data for sand samples. Bagnold's log differential plots can be plotted directly from such data by the computer and offer the potential to interpret sand grain-size distributions on a sound theoretical basis.

BRANDT VELBEL, DANITA, Yale Univ., New Haven, CT

Preservation of "Event Beds" Through Time

"Event beds"—strata attributed to rapid, episodic sedimentation—are recognizable throughout the geologic column. Although these beds range widely in age and depositional setting (deep-sea turbidites to shelf "tempestites"), a few diagnostic features are common to all event beds (erosional base grading up to a "pelagic" top). Few morphological features of these beds have changed through time; however, recent theories of increased infaunalization through time predict that fewer event beds would be preserved after the infaunal explosion of the Jurassic and suggest that the conditions under which post-Jurassic event beds are preserved must differ in some way from preservation of pre-Jurassic beds. A survey of recent literature on event beds, ranging in age from Precambrian to Holocene, reveals no shift in major patterns of preservation, although documentation of Tertiary to Holocene strata is sparse, probably because of artifact effects (e. g., relatively small volume of outcrop). Preservation of event beds is not so dependent on depositional setting as it is on the frequency and intensity of the event and the presence of infaunal burrowers.

BRECKON, CURTIS E., and CHARLES F. MANSFIELD, Univ. Tulsa, Tulsa, OK

Lateral Continuity of Turbidite Lithofacies Within Pennsylvanian Jackfork Group Near DeGray Lake, Clark County, Central Arkansas

A 23-km long, 2.5-km wide area with excellent exposures of the Jackfork Group occurs on and near the southern shore of DeGray Lake. This area, despite moderate to heavy vegetative cover, offers an opportunity to study the lateral extent of turbidite and associated submarine-fan lithofacies and to develop a model for estimating the extent of subsurface turbidite reservoirs using data from one or more wells. The extent of arenaceous lithofacies in the study area is also important to the local stone-quarrying industry.

Over 1,000 m of published and newly measured stratigraphic sections were studied to determine lithofacies present using the 1978 classification system of E. Mutti and F. Ricci-Lucchi. Lithofacies were then correlated along strike (which is generally within 20° of paleocurrent heading) using stratigraphic correlations, aerial photographs, field checking, and field tracing of nearly continuous outcrops.

Sandy sequences in which lithofacies B or C predominate, but which may contain lithofacies A, form ridges. These ridges are especially prominent where arenaceous intervals reach 10-30 m in thickness. Individual beds within these intervals are nearly all less than 1.2 m thick and are difficult to trace laterally. The arenaceous intervals, however, can be traced as units for up to 6 km and correlated for up to 8 km or more along strike. Shaly stratigraphic sequences of lithofacies G, D, E, and, rarely, F are poorly exposed, but can be correlated along strike for up to 6.5 km, with topographic expression and vertical lithofacies sequence being important guides.

BROOKS, GREGG R., Univ. South Florida, St. Petersburg, FL, and CHARLES W. HOLMES, Minerals Management Service USGS, Corpus Christi, TX

Offbank Transport of Carbonate Sands in Northern Straits of Florida—a Function of Sea Level

The southwest Florida continental slope, bordering the northern Straits of Florida, consists of a thick accumulation of carbonate sediments. High-resolution seismic data show oblique prograding clinoforms oriented offbank indicating large amounts of shelf-derived material are being transported off the shelf and deposited on the slope. No evidence of mass wasting was found, suggesting deposition occurred by a continuous influx from the adjacent shelf.

Sediment cores show an upward gradation from medium to coarse carbonate sands and granules to fine muds. The sand and granule fraction, dominated by coralline algae, mollusks, and benthic foraminifera, is typical of sediments found on the adjacent shelf. The fine fraction, however, is a foram or pteropod ooze containing only minor amounts of shelf-derived material.

The fining-upward sequence indicated the greatest input of shelf material occurred during lowered sea level. During these periods, large quantities of shelf sediments were funneled through breaks in the shallow banks to the north and deposited on the slope. As sea level continued to rise, less shelf sediment was transported offbank. Under current conditions of high sea level, very little shelf material is being contributed to the slope.

The slope therefore acts as a sink during sea level lowstands, for shelf-derived carbonate material produced during sea level highstands. The existence of at least 5 such sequences implies a cyclicity of similar depositional episodes that may be correlated with sea level fluctuations.

BROOKS, LAWRENCE L., Exxon Co., U.S.A., Houston, TX

Graphical Displays of Cross Sections Produced on the Computer

Much time is devoted to manually constructing cross sections and interpreting geologic data. Computer-generated displays can save manual effort and provide an interpretive aid for the geologist.

This poster session will display computer-generated cross sections containing full curve logs, lithology, oil and gas shows, geologic markers, interpreted dipmeters, and structural relationships. Contouring and the use of color will also be demonstrated as interpretive aids. Two of the methods used in preparing geologic data—the polynominal regression and the Markov process—will also be demonstrated. The poster session summarized the various ways in which the computer may display and aid in the interpretation of cross sections.