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.

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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.

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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.

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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.

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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.

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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