available owing to economic, environmental, or political reasons. Also it is a useful technique for a realistic assessment of hydrocarbon potential in a drilled area for two reasons. First, the proposed method is applicable to the evaluation of hydrocarbon potential in an off-structure area where most of the hydrocarbon generation occurred but where the conventional geochemical methods are useless because of lack of samples. Second, the technique incorporates subtle lateral changes in geothermal gradients—hence maturation level—due to variation in thickness and lithology of sediments.

The proposed method involves three major steps. (1) The thermal conductivity of a formation in a basin is determined from the seismic interval velocity. Then the subsurface temperature is calculated from heat flow (measured or estimated) and the thermal conductivity. (2) The calculated temperature is combined with geologic age derived from seismic stratigraphic or related data to calculate maturation level in terms of vitrinite reflectance (R_o) using our modified Lopatin's method. (3) The calculated R_o value is incorporated with burial history curve to reconstruct organic maturation history diagram. This diagram forms the basis for determining the timing of oil generation and depth interval of the oil window.

We have tested the modeling technique in several sedimentary basins using measured vitrinite reflectance value, DST temperature, and fluid inclusion as checks.

HO, THOMAS T. Y., HARRY DEMBICKI, JR.,* and BRIAN HORSFIELD, Conoco Inc., Ponco City, OK

Pyrolysis-Gas Chromatography as an Exploration Tool for Geochemical Evaluation of Source-Rock Potential

A pyrolysis system was developed to identify the possible production type (oil, condensate, and gas) and the presence of contamination (by migrated oil or drilling additives) in rock samples. This is accomplished by incorporating gas chromatography (GC) in the pyrolysis system so that a direct analysis can be made of the hydrocarbons in the pyrolysis products from sediments samples. This analytical capability of making a positive identification of pyrolysis products is one of the important advantages of this system. Because of this additional feature, this pyrolysis system can overcome problems related to the interpretation of indirect production type indicators such as the oxygen and hydrogen indices used by the commercially available ROCK-EVAL system.

The productive type is recognized either qualitatively by GC fingerprint traces or quantitatively by hydrocarbon composition (C_1-C_4, C_5-C_{14}, and C_{15+}) from the kerogen (Peak II) pyrolysate. Oil-prone sediments are recognized by GC traces with a full spectrum of C_1 to C_{28} hydrocarbons, or by high amounts of C_{15+} hydrocarbons. In contrast, gas-prone sediments are characterized by the predominance of light hydrocarbons from C_1 to C_7 in the GC trace, or by low amounts of C_5-C_{14} and C_{15+} hydrocarbons. Condensate or mixed type production is intermediate in character between the two.

Migrated oil or liquid contaminants are detected by a stepwise heating of the rock samples and GC analysis or Peak I (solvent extractables) and Peak II (kerogen decomposition) products.

The application of this pyrolysis system over the past four years as a rapid method for evaluation of organic richness, maturation, and production type using well or outcrop samples along with the limitations of the techniques will also be discussed.

HOBBS, CARL H., III, and ROBERT J. BYRNE, Virginia Inst. of Marine Science, College of William and Mary, Gloucester Point, VA, and MICHAEL J. CARRON, Navoceano, Bay St. Louis, MS

Surficial Sediments, Chesapeake Bay, Virginia

Surficial sediments, Chesapeake Bay, Virginia, are significantly sandier than previously reported. Sixty-five percent of the area as determined from 2,000 grab samples are sands when plotted on the ternary sand:silt:clay diagram. The mean graphic-mean is 3.17ϕ. Distribution of sediments is, in large part, a function of geomorphology with an apparently good correlation between depth and sediment type. Finer grained sediments are usually confined to the deeper channels. The exceptions to the depth-size relationship are the presence of fines in the shallow, marginal embayments such as Mobjack Bay and the absence of fines in the deep channel in the southeastern section of the bay. The occurrence of sands here is a function of infilling with sands from the area of the bay mouth and, perhaps, of scour into older (Pliocene?) materials. Sediment distribution also reflects the local source with the shallow-water marginal sands derived from erosion of the banks and relict features.

Several large geomorphic features are distinguishable on the maps of sediment characteristics. These features include the deep channels, a large sand shield near Tangier Island, relict spits, the zone of influence of the bay mouth, and the possible existence of an ancient channel extending from Mobjack Bay. The number of samples in this study is an order of magnitude greater (2,000 versus 200) than previous studies, allowing a significantly better delineation of sediment types.

900 samples, biased away from the coarser sands, were analyzed for total carbon, organic carbon, and sulfur contents. There are strong correlations between these characteristics and sediment type, especially weight percent clay. Additionally, there is a good relationship between the organic carbon and sulfur content. Total carbon content reached 10% in some samples, however, the average was 1.5%. Average organic carbon and sulfur contents were 1.0 and 0.34%, respectively.

HODGE, JOHN ADAMS, Univ. South Carolina, Columbia, SC

Three-Dimensional Study of a Modern Flood-Tidal Delta in South Carolina

A three-dimensional study of a modern flood-tidal delta in South Carolina was conducted using historical charts and photographs, geomorphic and sedimentologic process measurements, and shallow seismic profiling. Results suggest that the flood-tidal delta developed in response to shoreline erosion of the Santee River delta since the river was dammed and diverted in the first half of this century. The Santee flood-tidal delta complex consists of a transgressive sequence topped with tidal delta deposits 1 to 1.5 m thick. The clean, coarse to medium-grained sand of the flood-tidal delta is underlain by tidal flat, tidal channel fill, and bay-fill sediments. Beneath that lies estuarine-lower delta plain deposits.

The relationship of peak ebb and flood currents to the depth of flow and the degree of shielding by topographic highs exerts control over bed-form orientation and distribution. Ebb-oriented bed forms dominate the tidal delta surface, but preferential preservation favors flood-oriented bed forms owing to higher hydraulic energy on the ebb shield and flood ramp, and by protection from ebb currents provided in the lee of the ebb shield. Textural and mineralogic evidence indicates that littoral-derived sediments are being deposited in the North Santee channel. Seismic and stratigraphic data indicate the maximum volume of clean sand in the flood-tidal delta is between 387,000 and 500,000 m^3.

Surface mapping suggests that the North Santee flood-tidal delta will continue to transgress the adjacent tidal flat, weld onto nearby Cane Island, and be capped by salt marsh if undisturbed by rediversion of the Santee. The flood-tidal delta would apper in the stratigraphic column as a thin sheet sand with local variation in internal physical and biogenic sedimentary structures. Overall bed-form orientation would be slightly flood dominant, and the flood-tidal delta sands would be sealed on top and bottom with fine-grained, organic-rich sediments. Modern flood-tidal deltas are excellent sources for beach nourishment projects and, given sufficient burial, ancient flood-tidal deltas could make good petroleum reservoirs.

HOPKINS, J. C., Univ. Calgary, Calgary, Alberta, Canada

Sedimentology of Quartzose Sandstones of Lower Mannville and Associated Units, Medicine River Area, Central Alberta

Quartzose sandstones of the lower part of the Mannville Group in east-central Alberta are generally referred to as the Ellerslie Formation (Member). They are considered to be the deposits of a Lower Cretaceous fluvio-deltaic complex which overlies the "Pre-Cretaceous" unconformity in western Canada. In west-central Alberta, other quartzose sandstone units can be present beneath the Ellerslie. Some workers have included these units within the Mannville, others have attempted to map them separately. The result has been general confusion.

The trend and origin of different sandstone bodies can be compared in the Medicine River area. Here, two unconformity-bounded units—the UJ2 and UJ3 of Ter Berg (1966)—fill a deep valley cut into Lower Jurassic and Mississippian strata, and are overlain by the Ellerslie.

Ellerslie sediments blanket the area and are productive from quartzarenites in a number of isolated pools. Productive sandstone bodies encompass a variety of small estuarine, shoreline, and tidal ridge deposits, none of whose trends relate to the configuration of that old favorite, the eroded surface of underlying Mississippian strata.

Comparison of quartzose sandstone units in the Medicine River area with similar sandstone units elsewhere in Alberta, Saskatchewan, and Montana, indicates that the Ellerslie was deposited in a vast inland sea into which several large deltas prograded. UJ2 and UJ3 sandstones are similar to those of the Success and Morrison formations of Saskatchewan and Montana, respectively.

Similar sandstone deposits can be anticipated along the eastern margin of the Alberta trough, in south and central Alberta. Where quartzarenites are present, they will have resisted diagenetic porosity destruction, and will form attractive reservoirs.

HORNE, J. C., M. O. HAYES, and P. J. REINHART, Research Planning Institute, Inc./Colorado, Boulder, CO, and C. H. RUBY, Geoconsultants International, Inc., Kenner, LA

Niton Field: An Estuarine Sandstone Reservoir

The Niton field is a classic stratigraphic trap caused by the updip migration of hydrocarbons along a gentle southwesterly regional tilt (50 ft/mi, 9.5 m/km) into reservoir sandstones of the Basal Quartz Formation. These reservoir sandstones were deposited during the Late Jurassic to Early Cretaceous transgression over an unconformable surface on Jurassic sediments. As sea level rose, the topography on the unconformity gave rise to a number of tide-dominant estuarine valleys, 3 to 5 mi (5 to 8 km) wide at their mouths.

Two major factors related to this depositional setting exerted the greatest control on the distribution of Basal Quartz reservoir potential sandstones in the Niton field. (1) The topography of the unconformity governed the lateral extent of estuarine sand bodies deposited during the transgression. Maximum thickness of the sand bodies occurs either (a) along the long axes of paleovalleys, or (b) at entrances to the paleovalleys. (2) Diagenetic patterns of cementing were related to the original environments of deposition. The occurrence of swamps on the topographically high areas generated acidic ground waters which leached carbonate and silica from underlying sediments. This leached material was reprecipitated as silica cements in sediments overlying topographic highs and as calcite cements in tidal-flat sequences of the estuary fringes. These cements reduced porosities and permeabilities sufficiently to produce updip and capping seals to reservoir sandstones. Open marine sandstones deposited at the mouths of estuaries were only lightly cemented and, therefore, became the primary reservoir sandstones.

By comparing the depositional setting of the Niton area with modern analogs along Holocene transgressive coastlines, it is apparent that similar stratigraphically controlled sandstone bodies should exist along depositional strike in other drowned estuarine river valleys.

Thus, by comprehending the depositional and diagenetic setting of the Basal Quartz Formation, the energy explorationist has a predictive tool that can be used to discover new areas of reservoir potential sandstones.

HORVATH, PAUL S., Gulf Oil Corp., New Orleans, LA

How to Improve Your Exploration Success Ratio: A Case Study

This paper stresses the importance of integrated studies utilizing all available data and is intended to show how we can learn from experience. It can be demonstrated through studies of 51 producing fields in offshore Louisiana that in some places wildcat wells were not optimally located, thereby resulting in dry holes. By applying this experience, we can avoid unnecessary dry holes, extend our fields, and discover additional fields.

Field studies determined the type of traps present, the timing of the traps, and where seismic hydrocarbon indicators appear to work. Integrating these field studies with other studies and evaluations reveals that we must not only have detailed seismic control and use the latest technology, but also thoroughly evaluate and integrate the geologic and geophysical data if we expect to be successful in our drilling program. In this regard, we must use technology such as True Amplitude Recovery seismic data, waveform analysis, and modeling, as each could contribute to our exploration program. Examples, compiled to support this statement, reveal that in selected cases the locations of wildcat wells were not optimally located and so resulted in dry holes, although they could be considered near misses. In other cases, it was found further development of fields may be possible if the drilling of outpost or field extension wells would occur. To help avoid these dry holes, discover additional fields, and extend existing fields, a suggested exploration program is submitted.

HOUSEKNECHT, DAVID W., Univ. Missouri, Columbia, MO

Influence of Grain Size and Thermal Maturity on Intergranular Pressure Solution and Quartz Cementation in a Quartz-Rich Sandstone

Detailed cathodoluminescent petrography and scanning electron microscopy reveal that grain size and thermal maturity have significantly influenced intergranular pressure solution and quartz cementation in the quartz-rich Hartshorne Sandstone of the Arkoma basin. Mean grain size of Hartshorne sandstones ranges from very fine to medium-grained. In any stratigraphic section, a negative, linear relationship exists between grain size and volume of silica dissolved via intergranular pressure solution. In contrast, either a positive, linear relationship or no significant relationship