leases, and invoices; (3) professional and scientific applications in contouring, mapping, well posting, geologic and geophysical modeling, reservoir analysis, spreadsheet evaluations, and investment analysis; and (4) custom programming, that is, the program that provides a specific edge on the competition. Each category has its advantages and limitations, depending on the type of micro and the quality of the software. Additional categories will surface as the micro is accepted within the profession.

The microcomputer will undoubtedly become an integral part of our profession. The professional and personal adjustment to the micro will most certainly be bittersweet. As with all innovations, there are dangers of misconceptions and subsequent misuse of the micro. These dangers are not always apparent, and can deter its useful application. It is important to identify and understand the microcomputer, its uses, its strong points, and its limitations.

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Chemical Characteristics of Some Major Uranium Deposits in Western USA

Multi-element chemical analyses of several thousand samples were retrieved from the U.S. Geological Survey's computerized Rock Analysis Storage System and used to estimate the average abundances of various elements in each of several types of uranium deposits, in altered rocks associated with some of these deposits, and in unmineralized parts of the various host rocks. Deposits for which results are presented include the tabular deposits in the Morrison Formation, Ambrosia Lake district, New Mexico; secondary deposits in the Ambrosia Lake district; tabular deposits in the Morrison Formation of the Henry Mountains, Utah; tabular deposits in the Chinle Formation in Utah and Colorado; roll-type deposits in Tertiary rocks from the Texas Gulf district; roll-type deposits in the Tertiary basins of Wyoming; tabular deposits in the Entrada Sandstone in Colorado; and a vein-type deposit in crystalline rocks of the Front Range of Colorado. Statistical treatment of the data identified elements that were notably more or less abundant in the deposits and altered rocks than in the unmineralized parts of the host rocks. Comparisons of the mean abundances of elements in the deposits show that the chemical composition of roll-type deposits varies greatly even among deposits in the same district. By contrast, the chemical characteristics of tabular deposits display little variation; the Ambrosia Lake tabular deposits and those of the Henry Mountains district are particularly similar. The data place some constraints on the geochemical aspects of genetic models and suggest certain elements as potential prospecting guides.

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A Channelized, Sand-Rich, Deep-Sea Fan Deposit, Lower Atoka Formation (Pennsylvanian), Ouachita Mountains, Oklahoma and Arkansas

The lower member of the Pennsylvanian Atoka Formation exposed in the Ouachita Mountains of Oklahoma and Arkansas is part of a thick (more than 10,000 m or 32,800 ft) turbidite sequence deposited in a remnant ocean basin (the Ouachita geosyncline) during the Carboniferous. Paleocurrent data indicate a predominantly longitudinal sediment dispersal pattern westward down the basin axis.

Nine lithofacies are recognized: massive, amalgamated sandstones (A1), graded, matrix-supported sandy mudstones (A2), six different types of classic turbidites (C1, C2, C3, D1, D2, and D3), and chaotic deposits (F) including debris flows. These occur in two principal lithofacies associations, both representing deposition in an areally extensive, sand-rich, channelized deep-sea fan environment. Lithofacies association 1 consists of packages of lithofacies A1 (and to a lesser extent A2 and C3) 1-30 m (3-98 ft) thick, interbedded with intervals comprised of lithofacies A2, C1, C2, C3, D1, D2, and D3, in which the sandstone:shale ratio is generally high (amalgamated to 1:5). Thickening- and thinning-upward sequences are arranged symmetrically about the lithofacies A1 packages, producing stacked symmetrical sequences 1 to 20 m thick. Lithofacies association 2 consists of lithofacies C3, D1, D3, and minor amount of D2, arranged in symmetrical as well as individual thickening- and thinning-upward sequences 1-40 m (3-130 ft) thick. The sandstone:shale ratio is highly variable (amalgamated to 1:50). Although thickness trends in this lithofacies association can be highly complex, thinning-upward sequences (10-40 m or 33-130 ft thick) are prominent. Slumped chaotic deposits (lithofacies F) are intercalated throughout both lithofacies associations. Common crevasse splays that develop into new channel segments, and filling of distributary channels are the inferred processes involved in the development of the two lithofacies associations.

The absence of deposits of major depositional lobes and the extensive development (both vertically and laterally) of a channelized (distributary channel) fan environment suggest that current submarine-fan models are not generally applicable to this deposit.

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Using Magnetotellurics in Regional Hydrocarbon Exploration of Parana Basin, Brazil

The magnetotelluric (MT) geophysical method has been used effectively as a hydrocarbon exploration tool in the intracratonic Parana basin of South America. The Parana basin, an area of about 1,200,000 km^2 (463,322 mi^2), extends over portions of Brazil, Paraguay, Uruguay, Argentina, and Bolivia. It has been only sparsely explored by drilling, and only a few of the 100 or so complete wells have penetrated basement rocks. The basin is covered by the world's most extensive flood basalt complex, making geophysical exploration of the underlying Paleozoic sediments extremely difficult, although modern seismic techniques have begun to achieve good results. The thick surface basalts and buried diabase sills pose no problem for the MT method, because the natural electromagnetic fields utilized as the energy source pass easily through the basalt and underlying sediments to provide scattered signals containing critical information on thicknesses and resistivities of the geologic units.

The MT method has been utilized in a multidisciplinary exploration program recently completed in the Parana basin by the State of Sao Paulo. In the deeper portions of the Parana basin, MT interpretations show that basalts have thicknesses of up to 2 km (6,500 ft) and that basement may be as much as 6 km (19,700 ft) below the surface. In most of the basin, the basalts are covered by thin units of Upper Cretaceous to Holocene continental sediments and are underlain by 2-4 km (6,500-13,000 ft) of prospective Paleozoic sediments. In addition, interpretation of the MT sounding data with layered and fault-dike models outlines a linear uplift known as the Ponta Grossa arch.

Permian Irati sediments are an important source unit classified as mostly in the "oil window." Good electrical contrasts occur between the Permian sediments and older units, so that MT measurements can indicate the regional thickness of the Permian and younger sediments for use in interpretation of migration patterns and possible traps. In addition to providing this stratigraphic information, MT and aeromagnetic surveys have delineated the influence of the Sao Francisco craton in truncating uplift and tensional features of the Ponta Grossa arch.

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Laramide Sedimentation and Tectonic Development Along Southern Margin of Wind River Range, Wyoming

Surface observations along the southern margin of the Wind River Range indicate that motion on the Wind River and Continental faults controlled depositional patterns and lithologic character of early Eocene syntectonic sediments. The stratigraphic sequence consists of alluvial plain, lake margin, deltaic, and alluvial fan units. Subsequent movement on the Wind River fault warped this sequence into a monocline 2 mi (3.2 km) long. This structure dies out to the northwest and southeast along the Wind River fault and is overlain by undeformed middle Eocene sediments. Clast composition and paleocurrent studies of post-early Eocene conglomerates indicate that there were additional sources for coarse clastics formed by subsequent uplift in the Precambrian core of the range.

Tectonic implications of these interpretations are: (1) early motion on the Wind River fault controlled the margin of Eocene Lake Gosiute and generated a distal sediment source to the east; (2) last motion on the Wind River–Continental fault system was episodic and principally over by the end of early Eocene; (3) the Continental fault, now a post-Miocene collapse feature, was a tear fault with a vertical component up on the north; (4) the Wind River fault is a zone consisting of segments that moved separately; and (5) there are at least two unmapped fault zones along which the core of the Wind River Range was uplifted.

These interpretations suggest that compression in the Wyoming foreland continued significantly later than early Eocene. An imbricate thrust model is proposed to accommodate these observations and interpretations.

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Sedimentological Cross Section of Cambro-Ordovician Carbonate Shelf (Knox Group, Conasauga Formation) in Central Alabama: Facies, Diagenesis, Potential Reservoirs

Cambro-Ordovician thrust-imbricated carbonates in central Alabama are the focus of renewed exploration interest. Samples from east-west-trending core holes within the surface-most thrust plates reconstruct the carbonate shelf and shelf-edge facies before deformation. The Upper Cambrian shelf margin now is in the subsurface of Talledega County; coeval dolostones in the western part of the state represent the former shelf interior. Rock analogs to former environments include the following. (1) Barrier shoals (Conasauga Formation)—dark colored, partially dolomitized ooid and skeletal grainstones. (2) Submerged back-barrier and offshelf dolomitized sediments (lower Knox Group)—western belt: finely crystalline algal thrombolites, fenestral dolopelmicrites, rippled beds; eastern belt: finely laminated dolostones, slope-derived pebbles and graded beds. (3) Tidal flats (upper Knox Group)—light-colored, crystalline dolostones, dolomitized pellet grainstones, algal laminites, pseudomorphs after sulfates and early diagenetic chertification. (4) Former emergent shelf-(Knox unconformity)—pelmicrite, skeletal wackestones, erosional chert pebble conglomerate.

Multiple possibilities for hydrocarbon reservoirs appear throughout the sequence. Vuggy and intercrystalline dolostone porosity is primarily in the lower Knox formations. Primary interparticle pores are retained in lower Knox algal buildups. Breccia porosity occurs in the strata below the Knox unconformity through solution of the underlying Knox Group. Fractures in the subsurface are believed to enhance permeability in all porosity types.

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Predicting Pore Pressure and Porosity from VSP Data

Presently, VSP is being used to predict interval velocity and depth beneath the drill bit. The method is to exploit special properties of the VSP to produce a successful inversion to acoustic impedance. Depth and interval velocity are derived from the acoustic impedance prediction. This technique is often a valuable aid in making drilling decisions. Other rock properties may be computed from the same data.

Pore pressure is one such rock parameter that can be computed from interval transit times and depth. The product of interval transit times, depth, normal compaction ratios, and an area constant is pore pressure. Pore pressure prediction is as reliable as the predicted velocities and depths. In reservoir evaluation, and sometimes in the well completion program, porosity is the important rock property. The interval transit times predicted beneath the bit can be used to compute porosity. Unlike pore pressure, porosity computations require knowledge or assumptions about the rock matrix and shale percentages. For certain conditions these values are know. Further penetration of a reef in search of deeper porous zones is an example of a viable condition for porosity prediction.

For both these rock properties the same conventions employed by well log analysis in modifying and interpreting results are needed. Where the parameters assumed fit the actual conditions, the results should have merit. If not, further interpretation is required.

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Porosity Type and Distribution in Selected Richfield Oil Fields, Middle Devonian, Central Michigan Basin

The Richfield zone of the lower Middle Devonian Lucas Formation has been a source of significant quantities of hydrocarbons in the north-central and Saginaw Bay area of Michigan. Production through 1980 totaled 91,639,006 bbl of oil.

Prior work, which interpreted the Richfield's environment of deposition to be sabkha, neglected any detailed study of porosity type and distribution within the zone.

Integration of data from core analysis, contemporary geophysical well logs, and thin-section analysis provided a basis for delineating porosity types and porosity distribution within the fields. Porosity type and origin were determined by using the guidelines of Choquette and Pray. Patterns of porosity were mapped within producing fields and presented as "time-slice" contour maps and cross-sectional fence diagrams.

This approach will allow better understanding of the development of porosity in these sabkha carbonates and provides a more reliable method of predicting porosity trends.

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Mineral Oxidants and Porosity Enhancement

In many important hydrocarbon reservoirs, aluminosilicate framework grain dissolution constitutes an important part of the porosity (i.e., the Gulf Coast). Our experimental work has shown that difunctional carboxylic acids can increase aluminum solubility by three orders of magnitude. Oil field brines are observed to contain concentrations of monofunctional carboxylic acids up to 10,000 ppm, but only traces of difunctional acids. Oxidative degradation of kerogen is a commonly used technique in the study of kerogen structure, and results in extremely high concentrations of difunctional carboxylic acids (up to 40% of the carbon released from type 3 kerogen is in the form of oxalic acid).

The reduction of mineral oxidants and consequent oxidation of organic matter may be as effective in releasing peripheral difunctional carboxylic acid groups from kerogen as thermal degradation in the natural system. The coincidence in time, temperature, and space of smectite/illite ordering (release of Fe^{+3} from octahedral layers) and the peak concentrations of carboxylic acids suggests a possible mechanism for the generation of difunctional carboxylic acids. This mechanism would allow highly soluble difunctional carboxylic acids to be swept through adjacent sandstones just prior to hydrocarbon generation. Thus, an ideal mechanism is available for dissolving carbonates and/or aluminosilicates out of pores and pore throats, thereby enhancing porosity and permeability in hydrocarbon reservoirs.

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Nature and Significance of Austin-Taylor Unconformity on Western Margin of East Texas Basin

The Taylor Marl unconformably overlies the Austin Chalk on the western margin of the East Texas basin. Along this contact, up to 275 ft (84 m) of upper Austin is missing in the Waco area and up to 450 ft (137 m) in Bell County. However, the Austin Chalk appears to have been more-or-less uniformly deposited throughout the study area. Apparently regional uplift caused a regression that terminated Austin deposition and was related to the erosion of the upper Chalk. While the unconformity is areally extensive, slightly angular, and accounts for a relatively long period of time, the mechanism of erosion that caused the unconformity is still uncertain. Erosion was terminated by the deposition of the lower Taylor Marl. Taylor "A", the lowermost subdivision of the lower Taylor, was deposited in a near-shore environment that was highly variable.

Of particular interest is the relationship of this unconformity to structure and probably to oil occurrence in the Austin Chalk in McLennan and Falls Counties. Major Austin fracturing, which apparently does not extend into the Taylor in Falls County, clearly indicates that structure in the Chalk, at least in part, antedates Taylor deposition.

Oil occurrence in the Chalk is clearly related to fracturing and probably is localized by post-Austin-pre-Taylor fracture systems.

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Late Quaternary Shelf Margin Deltas, Northwest Gulf of Mexico

Deltaic deposition during a eustatic sea level fall occurs in two phases, each controlled primarily by the morphology of the sea floor and the rate