the largest resources occur offshore in the Beaufort shelf and the Navarin basin shelf. Basins appearing to have a relatively low potential should not be ignored. Future geologic information could cause significant revisions. Cost and technical considerations detract significantly from the apparent exploration merit of some resource-bearing basins, particularly in the arctic marine areas.

Industry investment commitments since the study correspond with the study results.

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Oil Exploration in Nonmarine Rift Basins of Interior Sudan

In early 1975 Chevron Overseas Petroleum Inc. commenced a major petroleum exploration effort in previously unexplored interior Sudan. With the complete cooperation of the Sudanese Government, Chevron has acquired a vast amount of geologic and and geophysical data during the past 9 years. These data include extensive aeromagnetic and gravity surveys, 25,000 mi (40,200 km) of seismic data, and the results of 66 wells. This information has defined several large rift basins which are now recognized as a major part of the Central African rift system.

The sedimentary basins of interior Sudan are characterized by thick Cretaceous and Tertiary nonmarine clastic sequences. Over 35,000 ft (10,600 m) of sediment have been deposited in the deepest trough, and extensive basinal areas are underlain by more than 20,000 ft (6,100 m) of sediment. The depositional sequence includes thick lacustrine shales and claystones, flood plain claystones, and lacustrine, fluvial, and alluvial sandstones and conglomerates. Those lacustrine claystones which were deposited in an anoxic environment provide oil-prone source rocks. Reservoir sandstones have been found in a wide variety of nonmarine sandstone facies.

The extensional tectonism which formed these basins began in the Early Cretaceous. Movement along major fault trends continued intermittently into the Miocene. This deformation resulted in a complex structural history which led to the formation of several deep fault-bounded troughs, major interbasin high trends, and complex basin flanks. This tectonism has created a wide variety of structures, many of which have become effective hydrocarbon traps.

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Effect of Radiation on Particulate Organic Matter Associated with Roll-Front Deposits

When multiple maturation populations are observed in organic materials derived from core and/or outcrop samples, the common assumption is that the more mature organic constituents have been reworked from older sediments. Uranium roll-front deposits are exceptions to this rule. In core samples that pass through roll-front deposits, the extractable organic matter frequently exhibits various aspects of radiation damage (selective oxidation and/or thermal alteration). Core samples taken above the roll-front contain spores, pollen, and associated plant debris which have a uniform level of alteration (thermal maturity). However, once the roll-front deposit is penetrated, a dual mode of thermal maturity is observed. Lower levels of maturation gradually give way to much higher alteration values as one approaches the zone where the uranium ore is most concentrated. This process reverses itself once the core hole passes through the roll-front into nonmineralized rocks.

Because the alteration of the spores, pollen, plant tissue, and associated vitrinite particles is irreversible, the organic petrographer can use this data to assist the explorationist in regional mapping of uranium roll-front deposits, even when radioactivity in a given location has decreased below measurable levels.

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Paleodrainage-Unconformity Model as Guide to Uranium Deposits

This paper considers a uranium occurrence model that shows how early Eocene and Oligocene depositional patterns and paleogeography can be used to identify favorable host rocks and to suggest where uraniferous ground water passed through these rocks. The uranium in the ground water was derived mostly from volcanic ash of the Oligocene White River Group. This model accounts for most known uranium deposits and occurrences in eastern Wyoming, western South Dakota, and western Nebraska.

All major deposits in Eocene sandstones are in rocks of the fan-channel facies that were identified by sand grain size and shape studies, and most deposits are basinward of present-day major mountain valleys. Deposits occur only where rocks of this facies are less than 300 m (980 ft) below the reconstructed basal Oligocene surface—a distance calculated from roll-front migration and erosion rates.

Uranium deposits in other than Eocene rocks also are related to the configuration of the pre-Oligocene surface. White River channel sandstones have deposits and occurrences along a 200-km (125-mi) section of a major Oligocene river in eastern Wyoming and Nebraska. Oligocene trans-mountain drainages localized uranium occurrences in Precambrian granitic rocks in the Laramie Mountains. Deposits in Cretaceous rocks in northern Colorado and along the flanks of the Black Hills lie beneath the axes of Oligocene channels. The channels were the major conduits that localized the movement of the uranium-bearing solutions. Rocks underlying the divides between the channels are unfavorable for uranium deposits where the channels are parallel to the regional dip, because the divides have a thick impervious lateritic soil cover.

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Strike-Slip Tectonics, Related Basin Formation, and Sedimentology in Zones of Continental Escape: Turkey as a Case Study

Strike-slip movement on various scales and in diverse orientations is one of the most prominent modes of deformation in zones of continental convergence. Extreme heterogeneity and low shear strength of continental rocks are responsible for creating "escape routes" of bewildering complexity into free faces from nodes of constriction along irregular collision fronts. Since the Tortonian (11 Ma), the tectonics of Turkey has been dominated by its escape westward from the east Anatolian collision zone onto the oceanic lithosphere of the eastern Mediterranean, mainly along the north and east Anatolian transform faults (NAT & EAT), and at least two other southeast-concave strike-slip faults that branch off the NAT near Erzincan and Resadiye. The Aegean graben system is a broad shear zone between the latter of these and the Grecian shear zone. At "triple junctions" involving the NAT/EAT and EAT/Dead Sea transform fault, space problems arise, giving rise to the Karliova and Adana/Cilicia basins, respectively. In Thrace, where the NAT takes a southwesterly bend, part of the resulting constraint is released by rifting in a northwest orientation that formed the Ergene basin. In addition, various pull-apart structures and "leaky" strike-slip faults contribute to the richness of strike-slip-related negative structures in Turkey. Some of these are of lithospheric dimensions and contain thousands of meters of sediment, whereas others formed within thinner crustal flakes above decollement horizons. Because escape tectonics necessarily involves subduction, arc-related strike-slip deformation may interfere with that indigenous to collision tectonics, as in south Turkey. Continental convergence eventually eliminates all subductable areas along the collision front and the structures generated by escape regimes may fall prey to compressional obliteration. In zones of complex and multiple continental collision such as Turkey, several episodes of escape tectonics may alternate with intracontinental compressional deformation, whereby the products of the older escape regimes would be very difficult to recognize. The present tectonics of Turkey constitutes an excellent guide to earlier episodes of escape tectonics in and around Turkey.

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Role of Diagenesis in Formation of Stratigraphic Traps in Aux Vases of Illinois Basin

The Aux Vases Sandstone, a prime exploration target in the Illinois basin, is a prolific but enigmatic reservoir that has produced nearly a billion bbl of oil. Detailed outcrop and subsurface study shows that much of this production is from diagenetically influenced stratigraphic traps in a complex tidal-sandbar system. The complexity of this system makes identification of traps difficult.

The sandbars are composed of fine to medium-grained, cross-bedded, clean, well-sorted quartz arenites. The Aux Vases typically possesses preserved, primary, interparticle porosities of 15-25%, and permeabilities of 40-250 md. Reduction of porosity and permeability in the tidal bars is caused by quartz overgrowths, pressure solution at quartz grain contacts, and authigenic chlorite cement.

The sandbars grade laterally and vertically into interbar and tidal flat sediments composed of fine-grained, bioturbated or ripple-bedded quartz wackes and arenites that typically have 15-20% porosity but are impermeable. The clay matrix of the interbar wacke sediments causes a reduction in permeability, as does the authigenic chlorite and illite cement in the fine-grained arenites associated with the wackes.

Exploration has been hampered because (1) bars of reservoir quality are not easily distinguished from interbar sediments on electric logs; (2) resistivity logs usually show excessively high water saturation; and (3) sandbar trends are difficult to predict. Study of electric logs has shown that a spontaneous potential (SP) of 75 mV or greater is a good indicator of relatively clean, well-sorted, sandbar sediments. An SP less than 75 is an indication of interbar sediments. SEM and x-ray analyses suggest that water adsorbed on mixed layer clays is interpreted on electric logs as free water, accounting for the high water saturation readings. Prediction of sandbar trends is difficult because there are two trend directions: the dominant trend is northwest-southeast, parallel to the shoreline; however, many bars trend east-west, or roughly normal to shoreline. The two trend directions are commonly juxtaposed, thereby adding to the complexity.

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Online Data Base Searching with Microcomputer

More than 500 geologic journals are currently published worldwide. Staying abreast of the outpour of professional information seems insurmountable for any one person. Online data base searching provides rapid access to most of this material; it has better precision and recall than manual searching and can be performed with a microcomputer.

Consumer guidelines exist for selection of microcomputer hardware and software to enable manipulation of search results. A suitable communications interface, appropriate software, and a telephone modem are necessary peripheral equipment; a printer and storage media are useful additions.

Data bases vary in subject coverage, file format, and document coverage. Bibliographic data bases specialize in scientific and technical information, and nonbibliographic data bases are strongest in the area of business, finance, and economics.

Two of the most powerful bibliographic exploration files are GeoRef (online version of the American Geological Institute's *Bibliography and Index of Geology*) and TULSA (online version of the University of Tulsa's *Petroleum Abstracts*). However, problems exist in searching these data bases: complex search protocol, a multiplicity of command languages, and expensive online time. Search expertise can be developed through several alternatives, including formal training, printed search guides, and local online user groups. A petroleum independent or consultant who will devote time to learn the systems will find the effort to be cost-effective. Such a geologist is rewarded with immediate access to a sophisticated research library.

SHIER, DANIEL E., Consulting Geologist, Golden, CO

Microcomputer-Assisted Subsurface Mapping

In subsurface mapping, the productivity of the geologist is a function of the time spent on geologic work and the time spent on purely clerical work such as sorting well logs, and plotting values on maps. In my one-man consulting office, the clerical part of subsurface mapping is largely handled by a microcomputer and peripheral equipment costing $1,900. This same system doubles as a word processor, eliminating the need for secretarial help. Overall productivity is enhanced by 20-30%, paying out the hardware in less than 2 months.

The BASIC software consists of 3 modules. One builds a file of subsurface data elevations, formation tops, net sandstone, etc. A second rearranges data or deletes it from the data base. The third, a mapping module, plots one township at a time, at either 1 in. = 4,000 ft (1:48,000) or 1 in. = 2,000 ft (1:24,000) on a dot-matrix printer. Township plots are taped together and roughly contoured to find errors and possible prospects. After editing, the data is replotted and these new maps are used by the drafter as an underlay for spotting data on a mylar base map.

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Fire and Limestone: Origin of Black Pebbles

The origin and meaning of blackened limestone grains and lithoclasts that occur throughout the geologic record have long been a mystery. The Pleistocene-Holocene unconformity and those within the Pleistocene throughout the Caribbean are often characterized by the presence of blackened limestone lithoclasts. Thoroughly blackened fragments may consist of laminated soilstone crusts (i.e., caliche or calcrete), coral, or oolitic, pelletal and skeletal grainstone derived from the underlying limestone. Blackened fragments occur sporadically or in pockets comingled with nonblackened but otherwise identical fragments. Simple cooking experiments with typical Pleistocene and Holocene limestone fragments showed that only laminated soilstone crusts, poorly cemented pelletal and oolitic grainstone, and aragonitic coral fragments are selectively blackened, whereas well-cemented, nonaragonitic fragments retained their light color. Blackening is caused by charring of organic matter within the rock. Heat from forest fires and smoldering humus accumulations is interpreted to cause the naturally occurring blackened lithoclasts.

Fire-blackened limestone lithoclasts differ from the more well-known salt-and-pepper sands, which typically result from selective blackening of individual Foraminifera, mollusk fragments and other fossils under subtidal conditions. Subtidal blackened grains are associated usually with unconformities and tidal channel deposits where they become mixed with unstained grains. Correct identification of the 2 differing types, when detected in ancient limestone, offers important environmental information, not only to distinguish marine and subaerial unconformities, but for clues to paleoclimate, vegetation, and soil development.

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Origin and Development of Northern Green River Basin: A Stratigraphic and Flexural Study

Two-dimensional profiling of the northern Green River basin using topographic, stratigraphic, and structural information shows that the basin can be modeled effectively as a flexural depression resulting from extrabasinal and intrabasinal loading on an elastically behaving lithosphere. Two distinct approaches were used: present basin geometry profiling and sediment thickness profiling. Present basin geometry profiling involves analysis of predicted present-day basin configuration compared with the observed configuration. Sediment thickness profiling, a procedure based on isostatic compensation for flexural responses to loading, relates stratigraphic thicknesses of basinal rocks to coeval tectonic loading. Results of both methods suggest the lower Tertiary and perhaps some uppermost Cretaceous sediments accumulated as a result of flexure due to loading by the Darby and Prospect thrusts to the west and the Wind River foreland thrust to the east. Moreover, results of the sediment thickness profiling are of predictive value resolving stratigraphic problems and timing structural events. Tentative results imply that (1) the northern Green River basin was essentially full by the end of the early Eocene and subsequent erosion has been negligible, and (2) the first movement on the Wind River thrust in the latest Cretaceous was significant in controlling basin configuration.

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Petroleum Geology and Exploration of Scotts Bluff Trend, Northeastern Denver Basin, Nebraska

Ten J Sandstone oil fields form a long, narrow, northeast-southwest trend in western Nebraska. Except for these fields, this area is nonpro-