Asphaltite Deposits of Southeastern Oklahoma

Three Oklahoma oils and six associated asphaltites were studied and found to have a common source, based on geologic and geochemical criteria. Bulk analyses reveal the following: (1) vanadium and nickel are enriched in the asphaltite relative to the oil by an average factor of 41, although the V/Ni ratio only ranges from 0.5 to 3.5 in most of these samples; (2) the average H/C atomic ratio decreases and the average O/C, N/C, and S/C atomic ratios increase significantly from oil to asphaltite; and (3) stable carbon isotope ratio values show that the ratio of ^{13}C to ^{12}C in the asphaltites is essentially the same as that in the oils, being approximately -29.8 ppt (relative to PDB) in almost all cases. These bulk analyses and analysis of isolated chemical fractions of these materials indicate that the asphaltites and oils are of common origin and have a similar temperature history. These data further indicate that asphaltite is a secondary product after oil and that biodegradation, accompanied by other near-surface effects, is the causal mechanism for asphaltite formation. This conclusion is supported by the geology of the region, insomuch as local listric faults could have served as conduits of migration, bringing deeper oil into the zone of near-surface alteration.

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Mineralogy and Petrology of Texaco's Hobson Uranium Deposit, Karnes County, Texas

Texaco's Hobson uranium deposit is located in Karnes County, Texas, along the prominent south Texas uranium trend. The uranium mineralization occurs in the Deweesville Sandstone of the Whitsett Formation of the Eocene Jackson Group. The host rock is a friable, fine-grained, well-sorted, highly porous and permeable sand interpreted to be a beach deposit. The sand contains significant volcanic constituents and ranges in composition from arkosic to tuffaceous. Locally, the host sand contains hard, dense opal-cemented sandstone beds. Bentonitic shales underlie and overlie the minerlized sand unit.

Geometrically, the Hobson uranium-bearing zone resembles an elongated roll-front type deposit. Chemical uranium values compared with gamma ray equivalent uranium values indicate that the uranium has been dissolved from the updip side and precipitated on the downdip side of the roll-front.

Details of the uranium mineralization were studied using thin section microscopy, autoradiography, X-ray diffraction, scanning electron microscopy, and energy dispersive spectroscopy techniques. The uranium mineralization occurs in the pores of the sand, as sand-grain coatings and as replacements of sand-size and smaller grains. The uranium mineralization is commonly associated with pyrite and other opaque grains. Favored hosts for uranium, other than pore openings, appear to be clay aggregates, altered rock and glass fragments, and carbonaceous plant debris. Aggregates of coffinite were identified by XRD and SEM-EDS analyses. Some uranium mineralization also appears to be dispersed, and is postulated to be adsorbed on the clay and carbonaceous matter.

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Domestic Uranium Exploration—Another Perspective

Inherent in a decision to spend money in exploration is an explicit or intuitive judgment that the orebodies found will be rich enough and the market strong enough to support profitable production reasonably soon after discovery. For uranium, these judgments are based upon general principles that derive from historical behavior patterns in other cyclically priced resource commodities, and upon extrapolation of recognized trends that pertain to uranium's unique characteristics. Some of these factors are discussed in an examination of strategies which could be pursued in uranium exploration and development for the 1980s.

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Toward a General Theory of Vertical Migration

Between 1951 and 1954, the Southwest Research Institute of San Antonio evaluated over a hundred little known exploration methods and found only geochemical, radiometric, and electrical methods to be worthy of careful scientific study. Critical examination of the now extensive literature of all three generic methods seems to indicate a mechanism which may relate each method to the other: the physical-chemical phenomenon of vertical migration. A selective review of the theoretical and empirical literature of these methods, together with a similar review of applicable geologic and hydrogeologic studies, was undertaken. Indications that vertical migration is not an implausible common mechanism reinforces the potential validity of each of the methods and suggests the need for additional research directed toward a conclusive condemnation or validation of these methods.

Considering the total of pre-drilling exploration efforts, the current limited use of surface geochemical, radiometric, and electrical methods seems only to preserve them in limbo. Ambiguities will undoubtedly continue to exist, as in all other exploration methods, even if subsequent research should demonstrate increased operational validity of the three methods. The opportunity-cost of not properly using these methods would be tremendous should they be determined to be more reliable than is generally conceded. This consideration, together with the indications of plausibility which this paper describes, justifies serious and concentrated research and demonstration efforts of an order not hitherto performed.

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Mesozoic and Tertiary Carbonate Buildups and Factors Which Control Their Distribution

With the development of global paleogeographic reconstructions, it is possible to examine the original distribution of carbonate buildups at various times in the earth's history. Through an extensive search using published geologic literature, carbonate buildups have been classified based on their association with shelf-edge, shallow-shelf, and basinal sediments. By plotting the data on well-constrained Mesozoic and Tertiary paleogeographic continental reconstructions, it is observed that carbonate buildups are generally restricted to low latitudes. However, the maximum excursion of buildups from the paleoequator varies significantly through geologic time.

The distribution and abundance of carbonate buildups in the Mesozoic and Tertiary appear to be partly controlled by ancient ocean current systems. In a manner similar to the present, carbonate buildups extend further toward the poles along east-facing coastlines. Here, warm westward-flowing

equatorial currents are diverted poleward. The reverse situation is true along west-facing coastlines where cooler waters are brought into low latitudes by polar currents. Here, buildups are usually restricted to near the ancient equator. Another control on the distribution of carbonate buildups might be related to a decrease in light penetration poleward due to an increase in the angle of incidence of light striking the oceans. Work done by others suggests that significant seasonal reduction in light penetration occurs between 30° and 40° from the equator.

Maps showing the global distribution of carbonate buildups have been constructed for several intervals in the Mesozoic and Tertiary. These reconstructions illustrate the effects of ocean circulation, and continental placement and orientation on the distribution of carbonate buildups.

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Cretaceous Black-Shale Deposition Within an Oxidized Red Clay, Turbidite Environment, Southern Angola Basin, South Atlantic Ocean

Beds of black shale, intercalated with red and green claystone of Albian to Coniacian age, were recovered at DSDP site 530 in the southern Angola Basin. The 260 beds of black shale have an average thickness of 4.3 cm (range of 1 to 62 cm) and an average organic-carbon content of 5.7% (range of 1.4 to 16%). The green claystone beds resulted from reduction of iron in red claystone beds around black shale beds. A green-black-green reduced sequence may occur alone within predominant oxidized red claystone, or several, closely spaced reduced sequences may merge to form interbedding of black and green lithologies. The predominant red claystone beds were deposited as distal turbidites. Many of the black shale beds contain graded silt laminae, very low amplitude ripple cross-lamination, and fine, indistinct, discontinuous laminae, suggesting that the material in the black shale beds also may have been transported by turbidity currents. All lithologies are commonly bioturbated. The sequence, including the black shales, at Site 530 suggests that deposition of the distal turbidites, low in organic matter, in an oxidized bottom-water environment was interrupted periodically by the deposition of organic-carbon-rich clay. We conclude that the cyclic interbeds of more- and less-reduced strata, with frequencies and durations measured in thousands or even hundreds of years, resulted from variable supply of organic matter, most of which is of marine origin, and not from bottom-water stagnation. We favor periodic regional increases in organic productivity that resulted in increases in production of organic matter, and an expanded and intensified mid-water oxygen minimum that impinged on the continental margin, as a cause of periodic increases in accumulation of organic matter. These conditions would produce variations in the amount of organic matter in both time and space, and result in interbedding of organic-carbon-rich, reduced sediments and organic-carbon-poor, oxidized sediments, a characteristic of all so-called anoxic sequences in the Atlantic Ocean.

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Marmul Field, South Oman: Appraisal and Development of Structural and Stratigraphic Trap Oil Field with Reservoirs in Glacial/Periglacial Clastics

The Marmul field lies in the Dhofar province of the Sultanate of Oman. The heavy oil accumulation was discovered in 1956 by Dhofar Cities Services who drilled five wells, but the field was not considered commercial and operations were abandoned. Petroleum Development Oman acquired the concession in 1969. Producible oils occur in Paleozoic clastics overlain unconformably by a Cretaceous sealing shale. Initial appraisal showed the complex nature of the reservoir distribution to be due to its glacial/periglacial environment of deposition, and a simple geologic model was conceived. Seismic impedance contrast at the seal's unconformity surface was then used as a predictive tool to differentiate glacial waste zones (tillites) from periglacial reservoirs and as support to the continuing appraisal and development drilling. The glacial/periglacial geologic model was progressively refined by further development drilling. The appraisal effort based on geologic and seismic impedance models was then deliberately pursued toward possible additional younger stacked reservoirs stratigraphically trapped at the periphery of the field. These reservoirs were proved by drilling to be separate from the main field and oil bearing. The unraveling of the field's complex trapping mechanisms, and the buildup of the geologic models needed for primary development and secondary recovery schemes, could only be achieved through an integrated and dedicated approach by geologists and geophysicists.

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What is Horizontal Resolution?

Horizontal resolution is the smallest interval measurable in the horizontal direction by the seismic method. Because both migrated and unmigrated sections are used for interpretation, the resolution of both must be evaluated. On unmigrated sections, the horizontal resolution is generally limited by Fresnel zone size for dominant frequency of the reflection being mapped. Features smaller than this seen on the section are probably noise or processing artifacts.

The horizontal resolution of a migrated section is much better than that of an unmigrated section and, theoretically, is directly related to the vertical resolution and angle of migration. In practice, the horizontal resolution is limited by uncertainties in velocity, inadequate spatial sampling, and presence of coherent noise, as well as shortcomings of, and approximations used in, the stacking and migration algorithms.

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Effect of Non-Hydrostatic Stress on Chemical Processes During Diagenesis

Non-hydrostatic stress facilitates porosity reduction in sandstones at elevated temperatures. Experimental results indicate that chemical equilibrium between fluids and solids in fluid-saturated, porous rocks will not be attained under conditions of directed stress. In rocks in which pore fluid pressures are less than lithostatic ($P_f < P_L$), downward directed stress at grain contacts can produce an inhomogeneous distribution of mineral solubilities. High strain at grain contacts causes higher solubilities of the solids and leads to dissolution (pressure solution), whereas growth may occur at solid/water interfaces with low surface strain. The driving free energy for coupled dissolution and growth reactions under non-hydrostatic loading is proportional to $P_L - P_f$. Consequently, the magnitude of the