Predicting Future Oil Using Three-Dimensional Discovery-Process Model

A three-dimensional discovery-process model has been developed to predict the size distribution of future discoveries in partially explored regions. Such a forecast was made for the Midland basin in west Texas by using pre-1975 historical drilling and discovery data from this basin. The parameters of the model are the effective basin size and the efficiency of discovery. The effective basin size is defined as that part of the basin where exploration companies will actually drill exploratory wells. The efficiency of discovery parameter is a measure of the rate at which deposits will be discovered in this region. In the Midland basin both of these parameters were estimated directly from historical data. Approaching the forecasting problem in this manner removes the necessity for using analogies or subjective judgment to estimate these parameters. As the historical data base is quite large, a series of integrated computer algorithms have been developed to estimate parameters and predict future oil.

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Gwna Melange, Upper Precambrian Olistostromal Sequence, North Wales, United Kingdom

The Gwna melange of north Wales is a sequence of pebbly mudstones and broken formations interstratified with undisturbed volcaniclastic units. The individual clasts, generally lying in a matrix of arenaceous mudstone, locally range up to a kilometer in outcrop. The clasts include graywackes, arenites, quartzites, limestones, basalts, cherts, and volcaniclastics.

The melange has been frequently cited as the "type" melange indicative of a tectonic origin. Recent mapping, petrography, and sedimentologic analysis have produced evidence for a sedimentary (olistostromal) origin for most of the melange. Sedimentary structures present include clastic dikes, resedimentation and soft-sediment injection features, and dewatering "cleavages" in various stages of development. The upper contact of the melange is at least partly a sedimentary-erosional contact with overlying undisturbed beds of composition similar to that of the melange. Certain larger clasts (up to 50 m) of graywacke exhibit oriented tectonic kink folds. These large clasts are in sedimentary contact with the melange, and may be explained best as undisturbed sedimentary-slide units (olistoliths) that were folded by later regional tectonic deformation. Smaller clasts within the melange responded to these regional forces mainly by continued movement, or shearing, within their ductile matrices.

This olistostromal sequence possibly represents an unstable continental margin associated with a previously postulated late Precambrian subduction zone.

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Impact of Coal Properties on Combustion Characteristics

The combustion performance of fuels is important in determining fuel applicability to a given combustion process. Establishment of well-defined combustion-related parameters is of particular importance in dealing with low-rank fuels such as the western subbituminous coals and lignites in both conventional pulverized and novel applications. The characterization of these fuels takes two forms: (1) the evaluation of operational performance in terms of slagging and fouling potential, carbon burnout, flame characteristics; and (2) an assessment of environmentally related parameters such as emissions of nitrogen oxides, sulfur dioxide, particulates, and trace elements. In an attempt to address these problem areas, experimental and paper studies have been conducted. Attention is focused on (1) indicating the basic features of pulverized coal fired unit design, (2) ranking of coal types, and (3) the identification of the coal-quality parameters which significantly impact power plant design and operation. In this way, the exploration geologist will be able to develop an overview of the considerations associated with the coal selection and utilization.

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Resource Appraisal Predictions and Exploration Performance in Offshore United States

Geologic estimates of undiscovered oil and gas resources in the United States were published in 1975 in the U.S. Geological Survey Circular 725, and the ranges for offshore United States were 10 to 49 billion bbl of oil, and 42 to 181 Tcf of gas. The offshore area included 28 separate provinces within the regions of Alaska, Pacific coastal states, Gulf of Mexico, and Atlantic coastal states.

Assessments were limited to the shelf areas in water depths of 0 to 200 m. Important exploration wells have been drilled in five of the 28 provinces since the publication of Circular 725, and a comparison of the results of these exploratory efforts with the resource appraisals is the object of this study.

Resource assessments for the Gulf of Alaska were 0 to 4.4 billion bbl of oil and 0 to 13 Tcf of gas. Industry leased 76 tracts (409,057 acres; 163,623 ha.) for $560 million in April 1976, and has drilled 11 tests on nine structures without success. There has been no activity in the area since July 1978.

The Southern California Borderland includes two provinces: (1) inner basins and (2) outer basins and ridges. Resource assessments for the inner basins were 0.4 to 2.0 billion bbl of oil and 0.4 to 2.0 Tcf of gas. Outer province assessments were 0 to 0.2 billion bbl of oil, and 0 to 0.2 Tcf of gas.

A federal lease sale that was held in December 1975 included 56 tracts (310,049 acres; 124,000 ha.) in both the inner and outer areas. Subsequent drilling has resulted in at least one oil discovery in the inner area, and activity continues. Six tests in the outer area have been negative, and there is no activity in this area at present.

Resource assessments for the Florida Gulf platform (Gulf of Mexico), were 0 to 2.8 billion bbl of oil, and 0 to 2.8 Tcf of gas. The Mafla sale of December 1973, in which 87 tracts (485,397 acres; 354,159 ha.) were leased, preceded this estimate; some wells had been drilled in

these tracts at the time of the estimate, but the information from these wells was unavailable. Nearly $1.5 billion was spent for the leases, and since the sale 18 dry holes have been drilled. Almost half of the tracts leased have now been dropped.

The resource appraisal ranges for the Baltimore Canyon (Central Atlantic Shelf) were 0 to 4.6 billion bbl of oil and 0 to 14.2 Tcf of gas. A sale was held in August 1976, and more than $1 billion was spent for 93 leases (529,466 acres; 211,786 ha.). Several exploratory tests have been drilled with one reported gas discovery.

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Oil and Gas in People's Republic of China

China has recently become a focal point of interest of the world petroleum industry for several reasons.

1. Enormous reserves have been predicted for the country (on the order of Saudi Arabia) as well as a significant future potential as a world supplier of oil.
2. The Chinese political situation has improved markedly and American technology now is at the top of China's industrial shopping list.
3. United States and European oil companies have held discussions with China concerning future joint-interest offshore ventures in Chinese waters.
4. Some drilling contractors have had at least informal discussions concerning future operations in the country.
5. Many Chinese petroleum delegations have been visiting the United States in recent months, holding far-reaching technical discussions with United States oil companies and suppliers.

China considers information about its petroleum operations (reserves, drilling and production statistics, potential, etc) to be a state secret and little or no "hard" data have been made available for many years. However, on the basis of visits over the past year to China's two largest oil-producing areas and its most active offshore area, plus extensive discussions with several hundred engineers, geologists, and production supervisors, it has been possible to draw some basic conclusions about state-of-the-art of China's petroleum industry. These judgments, which stem from the collective observations of two technical petroleum delegations to the People's Republic of China, do not agree with some published U.S. government statements concerning China's potential, nor with some of the conclusions drawn by other outside observers.

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Legal and Political Status of Antarctica

Interest in the possible hydrocarbon and other mineral resource potential of Antarctica has emerged as forecasts of resource scarcity stimulate the search for new sources of supply. In addition to geologic, environmental, economic, and technologic factors, the political and legal status of Antarctica will have an important influence on determining if and when mineral-resource activities take place there. In 1959, the 12 nations then engaged in scientific research activities in Antarctica concluded the Antarctic Treaty. Seven of those nations claim territorial sovereignty over portions of Antarctica; five nations, including the United States, neither assert nor recognize such claims. The Antarctic Treaty establishes a basis for international cooperation in Antarctica. It sets aside Antarctica and the waters south of 60° S lat. for peaceful purposes only and guarantees the freedom of scientific research throughout Antarctica. The treaty provides for regular meetings of the parties enjoying consultative status (the original 12 plus 1) to recommend measures to their governments in furtherance of the principles and purposes of the treaty. For those matters it deals with, the treaty holds in abeyance the respective positions of claimants and nonclaimants to territorial sovereignty. However, it does not address the question of resource activities in Antarctica. The Antarctic Treaty Consultative Parties have been engaged in discussions of a possible regime to govern exploration and exploitation of Antarctic mineral resources. The parties have recommended that exploration and exploitation activities not take place while progress is being made toward the timely adoption of an agreed regime.

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Dolomitization of Northern Michigan Niagaran Reefs by Brine Refluxion and Mixing of Fresh Water and Seawater

Niagaran pinnacle reefs in northern Michigan are located in a band between a shelf-edge reef complex and deeper water facies in the Michigan basin. Pinnacles at the shelfward edge of this band are dolomite; pinnacles at the basinward edge are predominantly limestone.

Two types of dolomite have been observed in the pinnacles. The first type is composed of clear rhombs about 30μ in diameter which only partly replaced the preexisting limestone. Its origin is attributed to a freshwater/seawater mixing zone at the base of a freshwater lens which moved down through the pinnacles during their emergence at the end of Niagaran deposition. The source of the required magnesium was the stabilization of the original high-magnesian calcite in the reefs.

The second type of dolomite is associated with tidal-flat environments which existed over and adjacent to the reefs during deposition of upper Niagaran and/or upper Salina units. This dolomite occurs as brownish, irregular crystals which have usually completely replaced the preexisting limestone. The intensity of this dolomitization decreases away from the associated tidal-flat environments. Reflux of hypersaline brines is presumed to have been the magnesium source for this dolomite. Reef material unaffected by this brine reflux has $\delta^{13}C$ values of about +1.5 parts per thousand (versus PDB) and Sr^{2+} concentrations of about 200 ppm. Rock through which this brine passed has $\delta^{13}C$ values of about +4.5 parts per thousand and Sr^{2+} concentrations of about 100 ppm. Both of these geochemical differences have been attributed to diagenesis.