naissance area, delineating areas of clay- and silt-rich soils suitable for irrigation and crop yield, denoting locations free from encroaching sand seas, and providing transportation and accessibility estimates.

SCHLAEFER, JILL T., Amoco Production Co., Denver, Colo.

Subsurface Geology of Honor Rancho Area, Ventura County, California

Surface and subsurface data determine the San Gabriel fault geometry and history of faulting in the Honor Rancho area. The northwest-trending, east-dipping San Gabriel fault consists of two strands: an older, concave-upward strand, which becomes low angle at depth, and a younger, high-angle, planar strand. The two strands merge to form one high-angle fault southeast of the Wayside Honor Rancho oil field. West of the San Gabriel fault zone the Modelo Formation (lower and upper Mohnian) overlies granitic basement. West of the fault, the Modelo and Towsley (Delmontian) Formations are in fault contact with the Castaic Formation present only east of the older San Gabriel fault strand. The marine Castaic Formation (lower and upper Mohnian) unconformably overlies the nonmarine Mint Canyon Formation of middle to late Miocene age. The Pico Formation (Pliocene) unconformably overlies older strata on both sides of the fault. Despite lithologic similarities of the Pico on both sides of the fault, markers within the formation cannot be correlated across the fault. The Saugus Formation (Pleistocene) unconformably overlies the Pico Formation and correlates well across and within the fault zone. Ease of correlation suggests that most of the right slip along the San Gabriel fault occurred prior to late Pliocene time. There appears to have been no lateral offset during Pleistocene and Holocene times, but primarily vertical displacement has occurred since the deposition of the Saugus Formation. However, seismic studies infer that right-slip activity is still present at depth along the San Gabriel fault.

SCHOELL, MARTIN, Bundesanstalt Geowissenschaften und Rohstoffe, Hannover, Germany

Dual Origin of Natural Gases in Subalpine Tertiary Basins

Many young sedimentary basins produce a great variety of natural gases ranging from deep wet gases to shallow dry gases. It is of considerable interest to find evidence for the origin of these gases, especially with regard to deep exploration.

In the Tertiary subalpine Molasse basin of south Germany, dry gases occur in shallow Oligocene to Miocene reservoirs ($\delta^{13}C_1 \sim -70$ to -60 parts per thousand), low C_{2+} gases in upper Eocene reservoirs ($\delta^{13}C_1 \sim -60$ to -50 parts per thousand), and wet gases in other Eocene reservoirs ($\delta^{13}C_1 \sim -50$ to 62 parts per thousand; the wet gases being partly associated with crude oils). Two alternatives for the origin of the gases should be considered: (1) the dry gases may be migrated wet gases which have been stripped of their C_{2+} components and have been enriched in carbon 12 isotopes; and (2) the dry gases are of biogenic origin.

Carbon and hydrogen isotope analyses on gases in the Molasse basin have brought direct evidence for the dual origin of these gases. The shallow dry gases are of biogenic origin, as shown by the direct relation between the deuterium isotope ratios of the methane and their associated waters. The wet gases are of thermogenic origin. The scatter in the carbon isotopic composition and the C_{2+} concentration in this particular basin is due to downmixing of the bacterial gases to deeper strata owing to an underlying underpressured zone. C and H isotope analyses on gases from two other Tertiary subalpine basins (Austria and northern Italy) have shown the dual-origin concept to be generally applicable to these basins. In particular the D/H and $^{13}C/^{12}C$ patterns of the gases reflect mixing processes and thus give information on the general hydrodynamic situation of the basins.

SCHOLLE, PETER A., U.S. Geol. Survey, Denver, Colo.

Porosity Relations in Chalk Reservoirs

Oil and gas reservoirs in chalks of the Gulf Coast, Denver basin, and North Sea show similar porosity relations. Most of the storage capacity in the three areas comes from the preservation of primary porosity. Normally, the high initial porosity (60 to 75%) of chalks is progressively lost during burial owing to mechanical and chemical compaction effects. Thus, in many areas of the Gulf Coast and the Western Interior, paleoburial depths of about 1,000 to 1,500 m (3,300 to 5,000 ft) form an economic lower limit for exploration because primary porosity has been drastically reduced at greater depths.

Three factors can strongly influence this relation of porosity and burial depth. First, fracturing can greatly improve the effective permeabilities of chalk reservoirs. Fracturing related to gentle flexuring, salt-dome tectonics, or fault zones has a major influence on the reservoir characteristics of North Sea and Gulf Coast fields and may be involved in Western Interior fields as well. Second, abnormally high pore-fluid pressures (geopressures) reduce or completely halt mechanical and chemical compaction and thus aid in the preservation of primary porosity. In the North Sea and offshore Louisiana, geopressuring has allowed preservation of as much as 40% porosity at depths of greater than 3,000 m (10,000 ft). Finally, early formation of biogenic methane (from bacterial decomposition of organic matter contained within the chalks) or early introduction of migrated hydrocarbons to the point of virtual oil or gas saturation (as in some North Sea chalks) may also be instrumental in porosity preservation during burial.

The porosity relations in chalks, although fairly complex, are far simpler than those typically seen in shallow-water limestones. Thus, based on relatively sparse data, reservoir properties and petroleum potential of chalks can be reliably predicted throughout large areas.

SCHUENEMEYER, JOHN H., Univ. Delaware, Newark, Del., and L. J. DREW and W. BAWIEC, U.S. Geol. Survey, Reston, Va.

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.

SCHUSTER, DAVID C., Univ. Illinois, Urbana, Ill.

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.

SCHWARTZ, M. H., Shell Oil Co., Houston, Tex.

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.

SCOTT, EDWARD W., U.S. Geol. Survey, Laguna Niguel, Calif.

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