so well known as in the broad shelf area off the coast of southern California. Bedrock that underlies these sediments has been sampled only by a few dredgings, but is, of course, exposed in a few islands and along the shore. Although the offshore geology is very complex, the continental margin of northern and central California is unusually youthful, and thus is particularly suited for the study of basic problems of the development of continental shelves and slopes, and of the transition between continental and oceanic crustal rocks and structures.

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SANTA BARBARA CHANNEL FEDERAL SALE

(No abstract submitted.)

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OIL AND THE ASPHALT JUNGLE—PART 2

Oil in commercial quantities was first found in Los Angeles in the latter part of the 19th century. Today, several generations later and after most of the exploratory potential of California has been evaluated, the search for new accumulations of oil and gas in the heart of Los Angeles continues at a rapid pace. Indeed, the current tempo of drilling activity in the downtown parts of the city must be considered remarkable in view of the many decades which have passed since the date of initial oil discovery.

The City of Los Angeles in 1946 adopted its present Comprehensive Zoning Plan which, together with subsequent amendments, provides the regulatory framework for urban oil-well drilling and exploration. The first successful urbanized oil-drilling district was created in 1953. Since then, 150 of these supplemental-use districts have been established for the development of oil prospects throughout the city. Three years ago the city enacted a new ordinance permitting the drilling of deep geological core holes as a means of testing these oil prospects without the necessity of forming districts and drilling high-cost, exploratory wells. As a consequence, interest in the oil potential of the densely populated sections of Los Angeles has risen dramatically.

Currently, nine rigs are busy in central Los Angeles drilling either oil wells or core holes. Several more strings should be added in the near future. Production from approximately 185 downtown wells amounts to 22,000 bbls./day of oil and 55,000 Mcf./day of gas. Reserves in excess of 100 million barrels of oil already have been proved in the area extending from City Hall to Santa Monica Bay, and it is likely that 50 million barrels will be added to this estimate as a result of current drilling operations.

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MIDDLE GROUND SHOAL FIELD, ALASKA

Middle Ground Shoal oil field is in the Anchorage basin, Alaska, 21 miles west of Swanson River oil field, about 52 miles west-southwest of Anchorage, and is located centrally in Cook Inlet just north of the restriction formed by the East and West forelands. It was discovered by the Shell-Richfield-Standard group drilling from a floating vessel in the summer of 1963. This was about 4 years after the first marine reflection-seismic survey was conducted in Cook Inlet by an 11-company group, and almost 6 years after the discovery of Alaska's first major oil field, Swanson River.

Cook Inlet is probably one of the most difficult marine areas in the world in which to look for and develop oil reserves. Conditions, such as 25–35-foot tides, 6–8-knot tidal currents, strong winds, and pack ice make all phases of the operation extremely hazardous and tax the ingenuity of the men involved. A motion picture of the platform construction portrays this aspect.

First production was accomplished late in 1965 when the valve on the 7-mile pipeline to shore was opened. At the present time, operations are being conducted from two permanent platforms; a third will be constructed in 1966; and others may follow.

As the early phases of development are begun, the Middle Ground Shoal accumulation appears to be trapped by a very tightly folded north-south trending anticline. It is bounded along the west side by a major fault with a throw of 10,000 feet or more. In gross aspect, this anticline is near the western side of a long, narrow, non-marine Tertiary basin where vertical tectonics appear to be dominant.

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PROJECT MOHOLE

Project Mohole is this country's scientific effort to explore and sample all layers of the earth's crust and the underlying mantle.

The need for such a project is basic: the mantle comprises about 84 per cent of the earth's volume. When geologists and geophysicists know its composition and physical properties, they will be able to reason more intelligently about the earth.

There is also a possibility that knowledge of the mantle may be applicable to other planets in this solar system, for many scientists now believe that all of the planets were created at about the same time and may be similar in composition. Thus, exploration of *inner* space may contribute to exploration of *outer* space.

The most favorable sites for drilling to the mantle are in certain areas of the deep ocean basins where the crust is thinnest. At the site recently selected for Mohole drilling in the Hawaiian Islands, the mantle lies only 6–7 miles below sea-level. In contrast, the depth to the mantle beneath the continents averages about 20 miles.

The idea of drilling to the mantle from a floating vessel in deep water was first conceived in 1957 and, with National Science Foundation funds, Phase I of Project Mohole was completed in 1961 off the coast of lower California. The objective of this part of the Mohole program was to prove that the ultimate goals of the project were feasible by carrying out a shallow drilling (coring) program in deep water from a floating vessel.

In this respect, Phase I was successful; in 1962, the National Science Foundation initiated Phase II of Project Mohole. The purpose of Phase II is to achieve the original objectives of the project—making the penetration of the crust and mantle as meaningful as possible through collection and study of rock samples and scientific measurements to be made in the hole both during and after completion of drilling.

The technical problems which confronted the Phase II Mohole staff, when it was organized in 1962, could be grouped in three general classifications. The first involved the design and construction of a stable and safe base for deep-ocean drilling operations to be carried out on a year-round basis. The second involved increasing drilling capability sufficiently to reach the 30,000–35,000-foot mantle depth. (This depth is 20–40 per cent greater than the deepest well ever drilled.) The third concerned the development of measurement and sampling techniques to insure maximum scientific productivity from the effort.

Phase II of Project Mohole is now well under way, and many problems have been solved. The basic design of a stabilized drilling platform with a dynamic positioning system is virtually complete, and some of the prototype models of new drilling tools developed by the project recently were tested in a well drilled in basaltic rock near Uvalde, Texas. Also, new logging and coring equipment has been tested successfully in the same hole.

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ELWOOD FIELD

The Elwood field is located along the coast line, 10 miles west of Santa Barbara, California. Less than 500,000 barrels of heavy oil has been recovered from the Rincon Shale, almost 100 million barrels of 28°–36° A.P.I. oil from the Vaqueros Sandstone (a shallow-water transgressive beach sandstone), and more than 3 million barrels of 33°–38° A.P.I. oil from four zones of the Sespe Formation (non-marine sandstone with siltstone interbeds). Productive area is slightly more than 690 acres. Early offshore wells were drilled from piers and later wells were directionally drilled from the adjacent sea cliffs.

Complex east-west-trending reverse and lateral-type faults parallel the Elwood anticlinal structure on the north and south. One minor cross-fault in the western productive area is not an effective barrier to oil movement. Naples offshore field, located 2 miles west on the Elwood trend, and La Goleta gas field, located 4 miles east on the Elwood trend, are characterized by geologic conditions similar to those in the Elwood field.

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BORON AS PALEOSALINITY INDICATOR NOT AFFECTED BY CARBON IN CLAY FRACTIONS

A recently reported inverse correlation between boron and organic carbon in rocks suggests that development of illite-organic complexes during deposition may inhibit boron absorption. The validity of boron as a paleosalinity indicator consequently has been questioned. Analogous studies of illitic clay fractions from the late Visean Lower Yoredale Formation of England revealed no significant correlation between organic carbon and boron. Thus, the validity of boron as a salinity indicator is not affected by organic matter associated with clay fractions. If the reported correlation between boron and organic carbon in rocks is valid, environments which favor organic accumulation could suppress illite authigenesis or inhibit boron absorption. The already-known association between boron and salinity suggests that the first interpretation is more probable.

Equivalent boron, previously regarded as the best index of paleosalinity, depends on the boron-K_2O ratio and K_2O concentration in pure illite. However, in previous investigations the K_2O concentration in clay fractions was assumed to be the concentration in pure illite. Such a procedure leads to increasing error with increasing organic contamination of clay fractions. Therefore, revised equivalent boron values were calculated for the Lower Yoredale Formation by estimating the organic fraction from carbon analyses and recalculating K_2O concentrations in terms of pure illite. These revised values correlate more closely with other geological information and improve discrimination between salinity environments.

Organic carbon associated with illite also may be a useful environmental indicator because it correlates closely with facies and distance from shore. It follows that studies of boron, carbon, and potassium in illitic clay fractions could aid environmental discrimination in exploration for offshore stratigraphic traps.

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ADVANCED DIVING SYSTEMS

(No abstract submitted.)

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SEDIMENTARY REGIME OF SAN MIGUEL GAP

San Miguel Gap is an offshore basin that intersects the continental margin at the extreme northwestern limit of the southern California borderland. The California current sweeps over the western portion of the gap, open to the deep sea through the Patton escarpment, whereas the eastern part lies close to the Channel Islands. Thus the bathymetry presents an enlargement of the continental slope, under both oceanic and terrestrial influences. A sedimentologic study of the basin and its surroundings was conducted.

Virtually all sediments of the gap region are sands. Foraminiferal tests, glauconite grains, and fine quartz-feldspar sand dominate the sand fraction. Locally, volcanic shards, terrestrial pebbles, tar, palagonite rubble, sponge spicules, and diatom tests are conspicuous. Cores show few obvious turbidity-current sands, but there is evidence of traction sediment movement. The clay fraction is significant only in the deepest part of the basin. Sub-bottom profiles suggest two generations of relatively undisturbed sediments overlying a "basement" of Miocene(?) volcanic and sedimentary rocks; the general characteristics of both sedimentary sequences are similar.

Biologic productivity, authigenesis of glauconite, and eolian introduction of terrestrial material, in that order, are the dominant sedimentary processes in the gap. These factors all can be directly related to climatic influences: productivity, to ocean currents and upwelling; glauconite, possibly to extreme weathering and low sedimentation rates; and the eolian sediments, to the occasional offshore windstorms. Because the ultimate control of sedimentation on the continental slope is climatologic, it is clear that valid paleoclimatic reconstruction in such areas may be based on the ancient sediments as well as on faunal data.

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OREGON AND WASHINGTON EUGEOSYNCLINE

(No abstract submitted.)