which there is no known stratigraphic or structural break.

At least 300 holes have penetrated basement beneath the Mesozoic and Cenozoic sediments of the Atlantic Coastal Plain between New York and Georgia. Approximately 90 per cent of them penetrated basement at elevations above −1,000 feet M.S.L. The 10,054-foot Esso #1 Hatteras Light well, which encountered the top of basement at −9,954 feet M.S.L., is deepest.

Drill hole plus meager geophysical data support the following tentative conclusions.

Precambrian and Paleozoic metamorphic and igneous (including volcanic) rocks, similar to those exposed on the Piedmont to the west, constitute basement. Many of these rocks have been highly fractured and sheared.

Part of the rocks accumulated in a pre-Mesozoic eugeosyncline.

From at least late Mesozoic time the basement surface has played the role of a differentially warping platform.

At least four periods of diastrophism are known to have occurred in this area.

The regional structural (and topographical) trend is northeast-southwest.

The surface of the basement may be characterized as an old age erosion surface—commonly referred to as the Fall Zone peneplain—with sporadic fault troughs, ridges, valleys, and "arches."

Locally some of the rocks have been weathered to depths exceeding 150 feet.

The basement surface dips generally seawardly from 15–40 feet per mile (with about 35 feet per mile typical) to approximately the −2,250-foot M.S.L. contour; seaward from this contour it steepens to about 100–125 feet per mile.

Oil may occur in commercial quantities in weathered zones on or fractured zones in the basement or in sedimentary rocks that lens out against topographic highs on the basement surface.

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Isotopic Evidence on Mechanism of Dolomitization

Dolomite found in nature is generally thought to be either "primary" in origin, or to be the result of diagenesis of pre-existing calcium carbonate sediments, or else to have been formed under different conditions by both mechanisms. In an effort to elucidate the mechanism of formation of dolomite, attention has been given to the evidence which might be given by the isotopic compositions of dolomite, partially dolomitized limestones, and limestones.

Theoretical studies indicate that there should be little, if any, difference in the carbon isotopic composition of dolomite regardless of whether it is of primary or secondary origin. Measurements of carbon isotope abundance in limestone and continuous dolomitized limestone show no significant differences. Consideration of the circumstances and processes which might affect oxygen isotopic composition indicates that these isotopes are of little help in revealing the mechanism of formation of dolomite.

In theory, study of the magnesium isotopic composition of dolomite and partially dolomitized limestone should indicate whether dolomitization has resulted, in particular cases, from diffusion of magnesium salts in solution into pre-existing calcium carbonates. Measurements have been made of magnesium isotope abundances in carbonate rocks from several different geologic situations, and attempts have been made to interpret the data in terms of the probable mechanism of dolomitization.

H. G. Doll, Schlumberger Well Surveying Corporation, Ridgefield, Connecticut

Possibilities of Wire-Line Well-Logging Methods in Mohole

Wire-line well-logging refers to the measurement of some physical characteristics of the underground formations traversed by a borehole. The corresponding equipment involves a bottom-hole sensing device which generates signals that are directly a function of the measured parameters, an insulated electric cable whereby these signals are transmitted to the surface, and an apparatus for the continuous recording of the measurements.

The parameters commonly recorded in oil wells are the following:

(1) Electrical resistivities, which can be obtained with the greatest accuracy and detail by means of induction log, laterolog, micrologand microlaterolog, depending on the cases. From the knowledge of electrical resistivity an estimation of porosity can be made.

(2) Spontaneous potentials, for the definition of permeable formations, and the estimation of interstitial water salinity.

(3) Natural radioactivity.

(4) Density (by gamma ray scattering).

(5) Porosity by means of neutron logging.

(6) Compressed sound wave velocity, either by steps over large intervals (several hundred feet), or continuously over short intervals (1–3 feet).

(7) Temperatures.

(8) Formation dips.

Other operations can be performed by means of equipment attached to the electrical cable: for example, sampling of formation and of the impregnating fluids from the wall of the hole. It seems offhand that all these operations could usefully be performed in the Mohole, at the level of the sedimentary rocks. In the igneous rocks and in the mantle, some of them could be omitted, because of unfavorable conditions. However, the recording of natural radioactivity, density, porosity, and sonic velocity would be highly desirable. It is also possible that the electric cable will be used to transmit the signal of other non-standard bottom-hole devices, which may be especially developed for the Mohole, such as a gravity meter, or an NMR magnetometer.

Bryson C. Donnan, Clarkson, Ontario, Canada

Offshore Exploration in Great Lakes Region

All of the Great Lakes with the exception of Lake Superior are underlain by Paleozoic sediments and can be considered drillable with the various types of equipment illustrated. However, Lake Ontario being underlain by a veneer of essentially Ordovician and Cambrian rocks only, is less attractive explorationwise.

An arbitrary 108-foot maximum (18 fathoms) is set as the practicable depth of water which could be handled by the types of equipment presently in use, beyond which companies would have to resort to floating drilling vessels or to more elaborate and expensive drilling towers.

Lake Erie and Lake St. Clair have so far been the center of off-shore drilling activity in the Great Lakes region, with Lake Huron now on the verge of exploitation. Offshore development in Lake Erie has been concentrated in two main areas: in the east and underlake extensions of the Clinton-Medina gas fields are being proven; in the west end further biostromic Guelph gas-bearing reefs and extensions, as well as dolomitized Trenton oil and gas production are being sought.

Operating problems may be summarized as follows: relatively high costs of offshore contract drilling, short operating season (6–7 months), weather, disappointing results to-date of drilling based on geophysical surveys (seismic, gravity, magnetic, sparker), and attempts by the fishing industry and by champions of possible lake-pollution to prevent lake-drilling. Also the economics of offshore oil production are an unknown factor which will have to be determined by the type of production encountered.

The favorable marketing conditions in the heavily populated areas surrounding the Great Lakes provide ample incentive for offshore exploratory work. However, because of the problems mentioned, one of the main keys to a profitable natural gas operation has been to minimize drilling development and production costs. Some companies have accomplished this by operating their own offshore towers and by sub-contracting the actual drilling operations.

CHARLES L. DRAKE and MAURICE EWING, Lamont Geological Observatory, Palisades, New York

Structure of Continental Margin of Northeastern North America

During the last 20 years extensive geophysical investigations have been carried out on the emerged and submerged Atlantic coastal plain of the United States. These include over 300 seismic refraction profiles, numerous gravity measurements from both submarines and surface vessels and total intensity magnetic measurements from ships and aircraft.

The geological structure of the area between Newfoundland and Cape Hatteras has been determined in some detail by these measurements. The predominant features are two linear troughs paralleling the edge of the continental shelf and separated by a ridge in the basement. The shelf trough contains up to 18,000 feet of sedimentary material while the outer one contains in excess of 25,000 feet in places.

Comparisons of this structure with the Appalachian Mountain system taken as a whole reveal many interesting parallels. Prior to the Taconic orogeny the Appalachians must have resembled the present continental margin in general characteristics.

The picture south of Cape Hatteras is not as clear. The structure is more complicated and the refraction results are more difficult to interpret due to the presence of calcareous sediments. The Cape Fear arch appears to be the dividing line between the two structural types.

H. F. DUNLAP, J. S. BRADLEY, and T. F. MOORE, Atlantic Refining Company, Dallas, Texas

Marine Seep Detection—New Reconnaissance Exploration Method

Many major oil accumulations of the world are associated with oil or gas seeps. At the least, seeps prove the existence of mobile hydrocarbons in a basin. At the most, and when used with other geological and geophysical data, they can aid in locating exploratory wells.

An effective and inexpensive instrumental technique for locating gas seeps has been developed for use in water-covered areas. If a seep is present, some of the methane dissolves in the water as the gas bubbles rise to the surface. Currents spread this methane-enriched water into a long plume. A boat samples the water continuously, operating over a grid laid out at right angles to the current. The gas dissolved in the water is broken out of solution, and trace concentrations of methane detected using an infrared analyzer. This equipment has detected seeps at distances as great as six miles. A novel system of location using navigational radar is used in carrying out the survey.

Several surveys on marine seeps have been carried out using equipment mounted on various vessels ranging in size from a 14-foot outboard-powered skiff to a coastwise freighter. Under most conditions, the cost of the survey is a few cents per acre. In new basins, the method promises to be of considerable value in localizing areas of interest for more expensive exploration methods.

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Colloidal Nature of Petroleum

The distribution of nitrogen, sulphur, metals, saturates, and aromatics, among the various molecules and particles in petroleum, is of importance in geochemical speculations on the origin of crude oil. Investigations with the ultracentrifuge are believed to give a truer picture of this distribution, while previous studies have used distillation and precipitation that alter the property being studied. Centrifugation of whole crude oil in a preparative ultracentrifuge at about 80,000 times gravity for 2–5 days gives a gradient in concentration of some constituents in the liquid and a relatively small amount of solid sediment. Examination of the solid by x-ray diffraction permitted identification of kaolinite and sodium chloride among the inorganic constituents and high-molecular-weight waxes among the organic. Most of the asphaltenes remain in the liquid phase and are concentrated in the lower portions of the tube along with nitrogen, sulphur, nickel, and vanadium. Layer analysis of the centrifuged samples leads to a particle diameter distribution curve with a maximum at about 60 Angstroms. Viscosity is considerably affected by asphaltene content and can be used as a measure of separation.

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Dependence of Petroleum Source Materials on Rate of Burial

Organic matter, including parent materials of hydrocarbons and porphyrins, is produced by phytoplankton living in oceanic surface waters in quantities far greater than required for petroleum. Mostly, however, these materials are regenerated in the water and at the bottom, and thus are lost to petroleum. An understanding of petroleum genesis includes knowledge of how they can be preserved.

Radiocarbon age determinations at several depths in cores from basins off southern California show that the rate of deposition of total sediment varies from 8 to 125 $mg/cm^2/year$. Highest rates occur in basins close to shore where rates are similar to those for the now-filled Los Angeles and Ventura basins during the Pliocene epoch; the grain size, content of calcium carbonate, and interruption by turbidity currents also are similar. Most of the sediment is detrital silt and