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**BIOSTRATIGRAPHY OF "OLIGOCENE" STRATA, SOUTHERN OLYMPIC PENINSULA, WASHINGTON**

Just south of the Olympic Mountains of western Washington, the Refugian stage of Schenck and Kleinpell and the Zemorrian stage of Kleinpell comprise a continuous sequence about 9,000 feet thick. These strata locally constitute the Lincoln Creek Formation, known throughout the Grays Harbor basin of western Washington. Rocks of the Refugian stage are divided into the *Sigmomorphina schencki* zone and *Cassidulina galviniensis* zone, which are also known throughout the basin, although the latter originally was named the *Eponides kleinpelli* zone. Because the foraminiferal composition of the Zemorrian strata is so nearly similar throughout, they are subdivided locally in only a general way and are informally termed the upper and lower zones of the stage.

Foraminifera from both the Refugian and Zemorrian strata suggest that the environment of deposition was reasonably uniform in a cool to cold open sea at upper bathyal to possible lower neritic depths.

REEDY, ROBERT D., Signal Oil and Gas Co.

**DUTCH SLOUGH GAS FIELD, CONTRA COSTA COUNTY, CALIFORNIA**

Dutch Slough gas field, discovered in October, 1963, by Signal Oil and Gas Company, is conveniently located 40 miles east of San Francisco and adjacent to one of the leading energy markets in the State of California.

A reserve of approximately 300 billion cubic feet of natural gas has been established in former "dry hole" country. A full spectrum of anomalous structural and stratigraphic occurrences has provided for an accumulation of quality natural gas and condensate. Present production is obtained from the Paleocene Meganos and Martinez Formations, but deeper Cretaceous objectives offer considerable future potential.

REESE, R. J., International Business Machines Corp.

**RECENT APPLICATIONS OF DIGITAL COMPUTERS TO GEOPHYSICAL PROBLEMS**

The oil-finder of the near future will carry out interpretation with the aid of recently developed computer techniques in which the functions of geology and geophysics are intimately interrelated and are guided by a highly skilled interpreter who operates in a man-computer feed-back loop.

Geologic in-put data will be derived from computer well data files, similar to those now being developed in several cities. Geophysical data in digital form will be entered from mass storage devices capable of storing thousands of seismic records. The professional interpreter will select and control the sequence and type of operations carried out by the computer system. Such operations might typically include network adjustment of survey data, stacking and digital filtering of seismic data, creation of contour maps, derivation of trend surfaces of geologic and geophysical data, computations of continuations and derivatives of potential field data, detailed well log analysis, and other methods.

Computed out-put will be displayed almost instantaneously on a cathode ray tube. The interpreter can communicate with the computer by means of a light-pen attached to the cathode ray tube. With the aid of the light-pen, the interpreter can cause the computer to

modify displayed out-put such as seismograms, logs, and maps. The interpreter also initiates interpretive routines to act on the modified data in subsequent analyses.

The advantages of such a man-machine system are: fast and effective retrieval of in-put data from mass storage, high-speed computation of complex and repetitive problems, almost instantaneous display of results, and feed-back from a highly skilled interpreter to direct the course of further analysis.

SANEM, ROBERT E., and ROBERT R. STODDARD, Standard Oil Co. of California, Western Operations, Inc.

**STRATI-STRUCTURAL TRAPS IN STEVENS SANDS**

Extensive drilling of the upper Miocene Stevens sandstones on the Bakersfield arch for almost 30 years has led to the classification of this area as one of mature exploration. Yet recent drilling, based on detailed structural-stratigraphic studies, has led to the discovery of a new field, English Colony, and new pools at Northwest Strand, Canal, and Ten Section.

In these studies, emphasis was placed on the diligent use of conventional geologic exploratory methods, including the detailed study of older fields, isochore and isolith mapping, stratigraphic sections, and detailed seismic mapping. In addition, specific geologic techniques have proved useful in particular areas. These techniques and their application to these recent discoveries on the arch are discussed.

A project of the type reviewed here is especially suited to a mature area of exploration where extensive subsurface control, production data, and adequate seismic coverage are present.

SAVIT, CARL, Western Geophysical Co., and M. N. MAYUGA, Long Beach Harbor Department

**LONG BEACH HARBOR GEOPHYSICAL AND GEOLOGICAL CASE HISTORY**

An offshore seismic survey in 1954 showed a continuous anticlinal structure extending from the presently developed area of the Wilmington oil field in Long Beach Harbor to an undetermined distance toward the southeast. Seventy miles of line were shot with "L" spreads during 9 operating days.

A number of normal faults transverse to the axis of the anticline were found in a pattern similar to that in the developed portion of the field. Information from 8 core holes drilled in 1962 verified the structural interpretation of the 1954 seismic survey. Only minor modifications of structural trend, depths and extent of productive zones, and location of major faults were required to make the seismic map conform with the core hole information. All stratigraphic units in the developed portion of the field are present in the undeveloped area under Long Beach Harbor. At least 5 zones (Ranger, Upper Terminal, Lower Terminal, Union Pacific, and Ford) are expected to yield commercial production. Based on current information, it is estimated that the undeveloped, easterly extensive of the Wilmington field will produce 1.1 to 1.5 billion barrels of oil during the next 40 years under a pressure maintenance operation.

SEIDEN, HY, consultant

**ASPHALTO FIELD**

The Asphaltto field is in Kern County on the western side of the San Joaquin Valley. It lies about 2 mi. east

of McKittrick, and approximately half-way between the old McKittrick field toward the west and the Elk Hills "24 Z" pool toward the east.

The discovery well, the E. A. Bender "Standard Oil Co." No. 18, in Sec. 23, T. 30 S., R. 22, E., M.D.B.&M., was spudded November 17, 1962, on an 80-acre farm-out from the Standard Oil Company of California and was completed for an initial production of 312 BD of 37° gravity oil from the interval 5,612–5,672 feet. Since then, over 60 wells have been completed in the field for average production in excess of 13,000 BOPD from about 600 acres. Cumulative production to December 31, 1964, is about 8,000,000 barrels of oil and 10,000,000 Mcf of gas. Peak production was over 17,000 BD in September, 1963.

The trap for the accumulation is formed by the shale-out of the upper Miocene Asphalt-Stevens Sands on the southeastern plunge of the McKittrick Front structure. Clues to the possible presence of the reservoir were given by the trend of the sandstones in the Elk Hills "24-Z" pool, and by the presence of thin laminae of oil-stained sandstones in the equivalent shale intervals of 3 wells straddling the area and about 1½ mi. apart.

Three sandstones are present and have been named respectively the Asphalt I, Asphalt II, and Asphalt III Sands. Only the uppermost Asphalt I Sand is productive in the discovery well, the lower sandstones being wet. However, subsequent wells have found all three sandstones productive at various locations, but toward the south and east, they merge into one thick sandstone body making their separation difficult.

Structurally, the field forms an elongated structural saddle at "N" point with some shallow closure of its own. Local unconformities and successive overlap immeasurably complicate attempts to unravel the structure and stratigraphy in any great detail. Generally, "N"-point structure is valid for the sandstones, but differs from lower horizons in detail. The Olig structure above is greatly different.

The discovery of the Asphalt field has given new impetus to exploration in the southern San Joaquin Valley and is certainly a classic example of a major discovery in a highly explored area.

SPAULDING, ARTHUR O., president, California Section, A.I.P.G.

PROGRESS REPORT ON CALIFORNIA SECTION OF AMERICAN INSTITUTE OF PROFESSIONAL GEOLOGISTS

(Abstract not submitted.)

THOMPSON, JACK D., San Diego State College

MIOCENE RADIOLARIA OF NEWPORT BAY, CALIFORNIA

The Newport Bay radiolaria occur within the Valmonte Diatomite Member of the Miocene Monterey Formation. Radical assemblage changes through the Newport Bay sections make it possible to distinguish 3 radiolarian faunules. The basal faunule occurs through 450 feet of strata exposed on the eastern side of the bay. It consists of a radiolarian assemblage limited to a few species of smaller, unornamented representatives of the suborders Spumellina and Nassellina. Nassellina are dominant. The second faunule, recognized through 550 feet of strata, contains a diverse and abundant assemblage of dominantly large, well-ornamented species of Spumellina. Progressively poorer radiolarian assemblages, comparable to those of the lowest faunule, occupy the upper 175 feet of strata of the Newport Bay sections.

The uniform lithology throughout this section shows that the terrigenous contribution to the area of deposi-

tion remained constant. Parts of the section representing thinly laminated sediments indicate a condition of low ambient oxygen concentration near the bottom at the time of deposition.

Deposition of this section began within a restricted, shallow, ocean basin. Streams flowing into this basin were small and few in number. The basin gradually deepened and free access to the open sea was attained. The top of the section indicates a return to the shallow, restricted conditions of the lower section.

THOMPSON, ROBERT W., Scripps Inst. of Oceanography, University of California, San Diego

TIDAL FLAT SEDIMENTATION ON COLORADO RIVER DELTA

Barren inter-tidal mud and salt flats comprise a low-lying coastal plain of 2,000 sq. km. extending southward from the Colorado River estuary to near the town of San Felipe, Baja California. The region is arid and characterized by maximum tides of 10 m. Examination of surface sediments in terms of sedimentary structures, texture, composition, and color reveals a repetitious sediment zonation across the plain related to varying exposure to subaerial drying, tidal inundation, and the activity of burrowing organisms. In a seaward direction or with decreasing elevation, the sedimentary sequence includes: (1) chaotic muds and evaporites; (2) medium brown, laminated clayey silts; (3) brown to gray, mottled silty clays; and (4) gray, laminated silty clays. Borings reveal a similar sequence stratigraphically disposed beneath the mud-flats, indicating their development through depositional regression.

Seaward growth was initiated during the late stages of post-Wisconsin sea level rise when accretion of tidally supplied muds from the Colorado River out-stripped the ability of small gulf waves to rework. Subsequent up-growth has resulted in onlap of tidal muds across the Pleistocene piedmont plain toward the west. Mud supply diminishes toward the south and wave effects are thus accentuated in the upper inter-tidal zones. Waves have truncated the piedmont plain. Coarse sands derived thereby are carried northward to form elongate beach ridges which finger out into the intertidal muds. Limited depositional regression by strand plain development has occurred in the southern area in response to mud-flat encroachment from the north.

Supply of river suspended load has been negligible for the past 50 to 60 years. As a consequence, waves have winnowed the former poorly segregated mud-flat deposits, piling coarse mollusk remains into beach ridges and spreading very fine sands as a sheet over the intertidal flats. Older beach ridges, now encased by intertidal muds, may represent earlier periods of low supply when the Colorado River was diverted into the Salton basin toward the north.

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DETECTION OF TECTONIC STRESSES BY NEW VELOCITY DEPTH RELATION

Although the existence of tectonic stresses is known, so far no practical method has been discovered to locate and determine the magnitude of these stresses. It has been demonstrated that velocity of elastic waves in a rock is a function of stress in the direction of propagation. If a block is subjected to active tectonic forces, then it is expected that the velocity of elastic waves within that block would be a function of time. This idea can be utilized to study the active tectonic regions.