CHANNEL, CALIFORNIA, COMPILED FROM SIDE-SCANNING SONAR RECORDS

Side-scanning sonar surveys of parts of the floor of the Santa Barbara Channel, California, carried out in March 1969 in connection with the U.S. Geological Survey's study of the oil-spill area, provide the basis for an acoustic-geologic map of the area. Navigation during the field work was controlled closely and continuously by means of aircraft-tracking radar onshore that communicated with the ship by 2-way radio.

The side-scanning-sonar equipment consisted of a towed transducer housing a dual array of piezoelectric-crystal hydrophones, each 4 ft long, one operating at 27.5 khz and the other at 30 khz. These were triggered alternately with 0.5-m sec pulses at 1-sec intervals and scanned the bottom to ranges of 375 m on both sides of the track or in a single-channel mode to ranges of 750 m on one side or the other. The shipboard equipment included the electronic systems, power supply, and recorder, which displayed returns on linear sweeps of an intensity-modulated Alden helix recorder, 45 cm wide, printing 45 lines/cm of length on wet paper.

Features mapped include smooth bottom, rippled sand bottom, ledges of folded bedrock, drilling towers, pipelines, and features of unknown origin. Sonar records delineate changes in strike of the north-dipping strata on the flanks of the east-west-trending Rincon anticline, and identify a structural depression along the anticlinal crest at long. 119°40′W.

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SEDIMENTOLOGY AND SHALLOW STRATIGRAPHY OF MID-ATLANTIC RIDGE MOUNTAIN TOPS

Bottom photographs and drilled rock cores, obtained from several mountain tops along the crest of the Mid-Atlantic Ridge near 45°N, show a patchy distribution of basic igneous rock outcrops and localized mixed deposits of basaltic boulders, cobbles and pebbles, ahermatypic-coral skeletal fragments, and calcareous mud. Coralline limestones repeatedly have been observed underlying unconsolidated pebble and mud deposits.

Between 900 and 1,200 m water depth on the south slope of Confederation Peak (45°23′N, 28°10′W), outcrops of fractured igneous rock are surrounded by deposits of angular cobbles and pebbles in a calcareous-mud matrix. Downslope, exposed, igneous rock outcrops are surrounded by pebble deposits with about a 60% calcareous-mud matrix. A basalt conglomerate core drilled near the top of this mountain (914 m) is composed of manganese-coated pebble and cobble-sized basaltic fragments cemented by a calcareous matrix that may have lithified, in part, during subsequent vertical uplift of this deposit to its present elevation. At 1,042 m water depth, porous coralline limestone was encountered by the drill after 143 cm of penetration through unconsolidated sediments. The surface of the north side of Bald Mountain (45°13′N, 28°56′W) between 1,555 and 2,380 m is composed of outcrops of basic igneous rock alternating with angular cobble and gravel deposits, probably of similar composition. An intermittent cover of calcareous mud is evident starting at about 1,900 m water depth. Slightly porous and friable, coralline limestone, covered by 81 and 155 cm of coral skeletal material, basaltic pebbles, and calcareous mud has been drilled at 1,426 and 1,682, respectively. Generally, limestones covered by a relatively thin layer of unconsolidated sediment and those situated at relatively shallow water depths show a greater degree of induration. Five whole-sample radiocarbon dates determined for the upper parts of several limestone cores range approximately between 31,000 and 39,000 years, suggesting that deposition and (or) lithification may have been associated with a moderately warm interval following the early Wisconsin glaciation (Emiliani's Stage 3).

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DEPOSITION OF COCCOLITHS IN CALCIUM CARBONATE COMPENSATION REALM OF ATLANTIC OCEAN

Recent coccoliths deposited in the Atlantic Ocean undergo selective dissolution in the calcium carbonate compensation realm, resulting in an increase in the relative proportion of solution-resistant placoliths in the assemblage. Solution of the coccoliths proceeds through gradual selective removal of ultrastructural elements in a sequence characteristic for each taxonomic group.

Selective dissolution of coccoliths permits recognition of 3 zones. (1) A basal dissolution zone about 500 m thick immediately overlies the calcium carbonate compensation depth. Sediments in this zone lack planktonic Foraminifera, have a low $CaCO_3$ content, and contain a coccolith assemblage of low diversity composed of solution resistant species, chiefly placoliths. In the southern and equatorial Atlantic, these sediments are bathed by Antarctic bottom waters. (2) A middle zone in the region from 500 to 1,500 m above the calcium carbonate-compensation depth contains corroded and fragmental tests of planktonic Foraminifera and a coccolith assemblage, with abundant resistant species and some corroded, less resistant forms. (3) An upper dissolution zone extends from about 1,500 m above the calcium carbonate compensation depth to the calcium carbonate saturation depth. Sediments contain normal planktonic foraminiferal assemblages and diverse, well- to moderately well-preserved coccoliths, with only a few species showing obvious signs of corrosion.

Selective dissolution with depth removes tropical species, so that assemblages deposited at greater depths resemble living assemblages from higher latitudes.

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ABYSSAL BENTHONIC FORAMINIFERA AS INDICATORS OF PRESENT AND PAST DEEP-SEA CIRCULATION IN NORTH ATLANTIC OCEAN

Analysis of surface-sediment samples from 5 transects across the western North Atlantic Ocean shows the existence of 2 distinct populations of benthonic Foraminifera. The distribution of these populations correlates well with the distribution of the cold North Atlantic deep water (*Epistominella exigua* assemblage) and the very cold Arctic/Antarctic bottom-water masses (*Epistominella umbonifera* assemblage). Slight, but detectable, faunal differentiation is associated with the Arctic and Antarctic deep-water masses respectively. Abyssal, benthonic Foraminifera thus can be utilized to trace the thermohaline circulation of the deep ocean.

Analyses of core samples, dating from the last full-glacial period, indicate a shifting of faunal boundaries. First information points to an areal diminution of the fauna associated with the very cold bottom water, indicating a general warming of the bottom water during the last ice age, that possibly was due to the pack-ice cover over ocean areas that now provides the very cold bottom waters.

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DIAGENESIS OF UPPER CRETACEOUS CHALKS FROM NORTH SEA, ENGLAND AND NORTHERN IRELAND

Cores of chalks from the Ekofisk field in the North Sea have been compared with outcrop samples of the "Upper Chalk" in southern England, Yorkshire, and Northern Ireland. Techniques used included petrography, scanning electron microscopy, and isotope and trace-element geochemistry. Although all of the chalks appear to have shared a similar initial composition,

subsequent variation in degree and type of diagensis have yielded a remarkable range of ultimate lithologies. The Chalk of Northern Ireland is extremely hard (porosities of 1-10%), has oxygen isotopic values averaging −5.60°/oo, has low Sr concentrations and shows equant, blocky calcite micrite. Samples from Yorkshire have porosities of 18%, oxygen isotopes of about −4.00°/oo, and moderately extensive blocky calcite. Chalks from southern England (Dover, Thanet, Brighton) are very soft (porosities of about 43%), yield oxygen isotope values around −2.88°/oo, and show relatively slight recrystallization to blocky calcite. The Ekofisk chalk has an average porosity of 30% with oxygen isotope values averaging −0.42°/oo, high Sr concentration, traces of dolomitization, and common rounded crystal shapes.

These diagenetic variations appear related to the extent of freshwater diagenesis. Areas of continuing subsidence (North Sea basin) were not exposed to fresh water; cementation there was a function of burial depth and associated pressure solution-reprecipitation of calcite in marine or brine waters. In areas of increasing uplift (generally greatest near basin margins), progressively greater freshwater input brought about increasing diagenetic alteration of lithologic and petrophysical characteristics. These diagenetic facies are petrographically, as well as geochemically, recognizable.

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COMPARISON OF SLOPE AND BASINAL SEDIMENTS OF MARGINAL CRATONIC BASIN AND GEOSYNCLINE

The transition from slope to basinal facies generally is not so well exposed or understood as it is in the Pennsylvanian of New Mexico's Pedregosa basin and in the Liassic of Switzerland's Piemontais geosyncline.

The shape of the Pedrego basin is controlled by basement faulting; its trend is oblique to the Ouachita-Marathon geosyncline. During periods of stable sea-level stand, carbonate sedimentation prevailed in shelf areas, and bioherms built up at the shelf edge. Bioclastic foresets and huge slumps of brecciated material from these bioherms extended from the shelf edge into the basin, where deep-water carbonates were deposited. During periods of low sea-level stand, rivers cut through the shelf deposits and shelf-edge bioherms and eroded deep valleys on the slope. As sea level rose, the basin was filled mainly with shales, and valleys on the slope were filled with sand. The geometry of these sand bodies at the base of the slope is probably fan- or cone-shaped.

Normal faults in the Liassic slope sediments of the Piemontais geosyncline reflect the structural tension that persisted during early geosynclinal stages. Thick beds of structureless breccias accumulated on the downthrown side of these faults. In the downslope direction, the breccias grade into turbidite facies; farther downslope, thick wedges of turbidite thin at their distal edges. No evidence was found of channels or canyons that would serve as point sources for sediment dispersion down the slope. The turbidites grade upward into radiolarian chert.

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GEOLOGY AND DEVELOPMENT OF ATTAKA OIL FIELD, INDONESIA

Of particular significance in the Indonesia oil search was the discovery of the Attaka oil field, offshore East Kalimantan (Borneo), in late 1970. After confirmation drilling from September 1970 to February 1971, field development and facility installation began in early 1971. First production was achieved in November 1972.

This major field is in the Tertiary Balikpapan basin. Production occurs mainly from sublittoral to deltaic sands of the "Attaka Series," of Pliocene and Miocene ages. The age of the deepest bed penetrated in the field area is middle Miocene. Well logs and paleontologic data indicate a predominately regressive sequence of deposition. Highly permeable pay sands, 34 in number, occur at intervals from 2,000 to 7,800 ft measured depth.

The structure is a faulted anticline. Faults and stratigraphic variations in part control accumulation and affect fluid properties. The oil is very low in sulfur content, and has a range of gravity from 35 to 52°API. Both saturated and undersaturated reservoirs are present.

Development drilling was accomplished from 6 platforms with nearly all wells completed using dual tubing strings. After fluid processing at a production platform, further treating occurs at the onshore Santan terminal, where oil storage capacity is 2,000,000 bbl. Tankers are loaded at an SBM (buoy) anchored offshore. The maximum size of tanker that can be loaded is 125,000 DWT. With the completion of wells and facilities, it is anticipated that field production will exceed 100,000 BOPD during 1973.

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SEISMIC INTERPRETATION I AND II—RECENT ADVANCES IN SEISMIC EXPLORATION

This capsule review is a condensation of an SEG Continuing Education short course that is designed to present recent advances in seismic exploration from viewpoints based upon (1) a linear filter model and (2) a geometric model, with statistical communication theory unifying these two viewpoints.

Convolution of the source pulse with the earth reflectivity gives the seismic signal in the linear filter model. Absorption introduces the time variance. Horizontally traveling noise and random noise are additive processes that complete the filter model. Analysis of signal and noise in f-k (frequency-wavenumber) space leads to methods of noise suppression based upon spacial filters in the field and velocity filters in processing. Distortion of the source pulse by ghosts and reverberations is overcome by deconvolution, where the unknown and spacial varying source pulse is replaced by one that has constant and more desirable properties, such as zero phase.

The geometric model overcomes the one-dimensional shortcoming of the filter model, and allows for refractions and diffractions. Horizontal stacking to suppress multiples and increase signal-to-noise ratio requires accurate knowledge of the stacking velocity which is derived by analysis of normal movement.

Utilization of optimal aquisition and processing to preserve the amplitude and frequency characteristics of the underlying reflectivity, along with velocity estimates from strictly surface measurements, significantly improves interpretation in terms of lithology, stratigraphy, and fluid content, and demonstrates that the seismic method is more than a structural mapping tool.

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MULTISENSOR SYSTEMS REVEAL GAS SEEPS AND GAS-CHARGED SEDIMENTS

No abstract available.

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FACIES DISTRIBUTION OF TRACE FOSSILS IN JURASSIC-CRETACEOUS TRANSGRESSIVE SEQUENCE, NORTH-CENTRAL NEW MEXICO

In the southeastern part of the San Juan basin (north-central New Mexico), the upper Morrison, Dakota, and lower Mancos stratigraphic interval represents a transgressive nonmarine to marine, sedimentary sequence. Trace fossils, although quite