

versity, matures through increase in interdependence, and wanes to extinction under changing environment. Different styles of diversity are used to distinguish degree of provincial maturity.

In Pennsylvanian and Lower Permian rocks, several terrestrial biomes, based on insect-faunal and on floral ranges, are present across North America and Europe. One boundary is correlated with paleolatitude, another boundary is meridional. These biotically leaky boundaries are not associated with physiographic barriers.

Zonation of terrestrial biomes shows promise for fine-correlation of coal areas remote from standard and type stratigraphic sections.

ECHOLS, R. J., Dept. Oceanog., Univ. Washington, Seattle, Wash., and G. A. FOWLER, Dept. Oceanog., Oregon State Univ., Corvallis, Ore.

TINTINNIDS IN SHELF SEDIMENTS FROM ALASKA, OREGON, AND CALIFORNIA

The distribution of neritic, agglutinated tintinnids on the sea floor has been examined using approximately 530 samples from the Arctic Ocean between 115°E and 165°W long., the northern Bering Sea, and the eastern North Pacific between 37°N and 46°N lat. *Tintinopsis fimbriata* dominates the observed fauna in the Arctic Ocean and Bering Sea, whereas *Stenosemella ventricosa* is dominant in the sublittoral region off northern California and Oregon. Species <63 μ in diameter and without firmly agglutinated loricas are not likely to have been recovered with sample processing techniques used in this study.

Tintinopsis fimbriata occurs in low frequencies in nearly all samples from the Arctic Ocean and Bering Sea. It is most common, however, in samples from off the mouths of the largest rivers, particularly the Lena River. It may be a diagnostic brackish-water species. An unidentified *Tintinopsis* appears to have a similar relation to the Columbia River and the Yaquina River of the Oregon-Washington area. Other distributional patterns appear to be the result of dispersal by either surface currents or bottom currents. This pattern is particularly noticeable in the southeastern Chukchi Sea and off the coast of Oregon and Washington.

A sharp decrease in the number of tintinnid loricas with depth in a core from the southeastern Chukchi Sea suggests that they are less likely to be preserved in the fossil record than are the remains of other common marine microorganisms.

EDGAR, N. T., Scripps Inst. of Oceanography, Univ. of California at San Diego, La Jolla, Calif.

MARINE GEOLOGY OF CARIBBEAN SEA COMPARED WITH MEDITERRANEAN SEA

The Caribbean basins, surrounded by lands and islands marked by a history of tectonic and volcanic activity, have remained remarkably stable throughout the Cenozoic. Sedimentation has been characterized by pelagic biogenic material and volcanic ash typical of a deep marine environment. Acoustic basement, reached at 5 sites by the Deep Sea Drilling Project, is composed of Late Cretaceous dolerites and basalts considerably younger than the surrounding lands.

The Mediterranean Sea may be divided into eastern and western basins. The eastern basin is dominated by the Hellenic arc, an island-arc structure, and the Mediterranean Ridge, a low ridge characterized by thick folded and faulted sediments. The western basin has more features in common with the Gulf of Mexico,

such as thick terrigenous sediments and salt diapirs. Drilling has revealed buried evaporites in association with shallow water sediment and fossil indicators that led the scientific team to the conclusion that the Mediterranean desiccated during the late Miocene.

EDWARDS, J. M., and R. W. FREY, Dept. Geol., Univ. Georgia, Athens, Ga.

RADIOGRAPHIC AND SEDIMENTOLOGIC EXAMINATION OF HOLOCENE SALT MARSH, GEORGIA

Seven subenvironments of a coastal Georgia Holocene salt marsh vary conspicuously in grass types and topography. However, preliminary examination has revealed few basic differences in sedimentary structures and grain-size distribution of the sediments, from these various parts of the marsh. Samples from these subenvironments are classed as either clays or silty clays, and any primary sedimentary structures in these habitats have been reworked biogenically by burrowing organisms and/or disturbed by plant activity. Noticeable variations do occur in subenvironments in which silt and sand predominate over clay-size materials. Tidal creek banks show laminations, crossbedding, slump structures, and filled-in burrows. Levees bordering major drainage tributaries and barrens adjacent to the Pleistocene barrier island show no distinct structures but have a distinctive grain-size distribution in the silty sand to fine-grained sand range. Minerals present include quartz, feldspar, montmorillonite, kaolinite, chlorite, and illite at all sampled stations, with only slight variation in relative proportions.

The widespread uniformity of the normal marsh and the grain-size variation on and adjacent to tidal levees suggest that the topography and grass types delimiting subenvironments are controlled chiefly by the tidal and freshwater hydrography of the marsh.

EL-ASHRY, M. T., and U. R. NEJIB, Wilkes College, Wilkes-Barre, Pa.

MAGNETIC SUSCEPTIBILITY STUDIES OF SHALES FROM NORTHERN ANTHRACITE FIELD OF PENNSYLVANIA

Magnetic susceptibility measurements, using the Gouy method, were carried out on 70 pulverized shale samples from the Wyoming-Lackawanna Valley in northeastern Pennsylvania. The samples also were chemically analyzed for the elements Fe, Mn, Cr, Ni, and Co. The study showed that variations in the susceptibility values follow very closely variations in the concentration of the trace elements Cr, Ni, and Co. The susceptibility values varied from 1.682186 $\times 10^{-6}$ to 29.938439 $\times 10^{-6}$ per gram using a magnetic field of 2.25 Kilogauss. These values correspond to concentrations of Cr = 11 to 420, Ni = 30 to 160, and Co = 2 to 7.5 ppm respectively. The magnetic susceptibility was found to be field-dependent particularly in samples with high trace-element concentrations. The susceptibility also was measured using the Faraday method and similar results were obtained.

By both methods the variations in Fe concentration did not correlate with the susceptibility values measured, although Mn showed a minor degree of correlation. The contribution to the susceptibility values by free pyrite present in some samples was very small.

Trace-element concentrations were found to be low in the north and to increase southward. Black shales showed higher concentrations than greenish or grayish shales. Samples containing appreciable amounts of coal gave very low or negative susceptibility. Pure

anthracite coal gave negative values (-1.617697×10^{-6} per gram).

It is suggested that magnetic susceptibility measurements can give a first approximation as to the relative concentrations of trace elements in shales and similar rocks. Attempts are being made to establish magnetic susceptibility measurements as a simple and fast analytical method.

ELLIS, C. H., and W. H. LOHMAN, Marathon Oil Co., Littleton Colo.

NEOGENE CALCAREOUS NANNOPLANKTON, SIGSBEE ABYSSAL PLAIN, GULF OF MEXICO

A detailed study of calcareous nannoplankton from 11 upper Miocene to Holocene cores recovered by the D/V *Glomar Challenger* in the Sigsbee abyssal plain at Site 3, Leg 1 of the JOIDES Deep Sea Drilling Project, was conducted with the use of optical and scanning electron microscopes. Results show the presence of 8 of the 11 nannoplankton zones established for the late Neogene by Martini. The zones present, from youngest to oldest, are: *Emiliania huxleyi* zone, *Gephyrocapsa oceanica* zone, *Pseudoemiliania lacunosa* zone, *Discoaster surculus* zone, *Reticulofenestra pseudoumbilica* zone, *Discoaster asymmetricus* zone, *Ceratolithus tricorniculatus* zone, and *Discoaster quinqueramus* zone. Three of Martini's zones were not detected because there was no core coverage for the intervals where they most likely would be present. These include two late Pliocene zones, *Discoaster browneri* zone and *Discoaster pentaradiatus* zone, and the Late Miocene *Ceratolithus rugosus* zone.

A total of 84 species was recognized; however, a sizable part of the assemblages consists of reworked specimens. Nearly 70% of the species present in the Pleistocene assemblage are reworked; in pre-Pleistocene sediments, 25-50% are reworked. Relative abundances of individuals vary considerably throughout the 11 cores, but only 2 samples of the 88 examined were found to be entirely barren of nannofossils. Late Neogene calcareous nannoplankton from the Sigsbee abyssal plain occur in a succession of zones that agrees with the Neogene Standard Zonation sequence; they are also comparable to nannofossil assemblages known from continental shelf deposits in the Gulf Coast region.

EREMENKO, N. A., G. P. OVANESOV, and L. N. MORDVIN, Inst. Geol. and Exploitation of Combustible Fuels, Moscow, USSR

REGIONAL EXPLORATIONS FOR OIL AND GAS IN USSR
No abstract available.

FAN, POW-FOONG, Inst. Geophysics and Planetary Physics, Univ. California, Riverside, Calif.

MINERALOGY OF SOME HAWAIIAN COASTAL AND MARINE CARBONATES

The Hawaiian beaches are predominantly calcareous sands of skeletal origin washed in across the reef flats. Calcareous deposits also are present in the island shelf and bank environments. The carbonate minerals listed in order of decreasing abundance are high-Mg calcite, aragonite, and low-Mg calcite. Relative abundance of these carbonate mineral assemblages was determined by X-ray diffraction analyses to correlate the mineralogy, the sources, and the depositional environments. Beaches of the island of Hawaii, the youngest of the Hawaiian Island chain, have a higher aragonite content (65%) than those of the other islands, and the older

the island, the lower is the aragonite content of its beach sands. This phenomenon is probably due to the maturity of the reefs. Coral and *Halimeda*, being the first to develop, formed the aragonitic framework which gradually was filled by high-Mg calcite skeletal sands, and, locally by low-Mg calcite skeletal sands.

Aragonite is most abundant in the upper part of the island shelf (50 m) and high-Mg calcite increases in abundance in the lower part of the island shelf. Low-Mg calcite makes up less than 20% of the island shelf and is uniformly distributed in it. Aragonite in the lower part of the island shelf is transported from the shallow part of the shelf. The abundance of high-Mg calcite and aragonite in Hawaiian marine sediments indicates the recentness of the calcareous deposits.

FERRIS, J. G., U.S. Geol. Survey, Washington, D.C.

HYDROLOGIC SYSTEMS

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FOWLER, G. A., Dept. Oceanog., Oregon State Univ., Corvallis, Ore.

TRENDS IN MODERN AGGLUTINATED FORAMINIFERIDA ACROSS CONTINENTAL MARGIN OF NORTHERN CALIFORNIA AND OREGON

Along the eastern margin of the North Pacific agglutinated forams generally increase in number from very few in the innermost sublittoral region to maxima in the middle sublittoral to upper bathyal regions. South of 30°N lat., the maxima range upward to approximately 20% of the total benthic fauna; north of 40°N lat. values range from 80 to 100%. The transition between these two realms occurs over only a few degrees of latitude. Off Oregon, the frequency of agglutinated forams decreases seaward of the maxima to values around 30% between 600 m and 1,800 m, then increases again into the abyssal region. Maxima in the latter region, however, do not reach values as high as those found in the sublittoral.

The sublittoral agglutinated populations between 37 and 43°N lat. are dominated by *Textularia earlandi* and *Spiroplectammina bifurcata*. These are replaced northward by *Recurvoides turbinatus* and *Eggerella advena*. There is an orderly progression of agglutinated species into the abyssal region off Oregon.

It is suggested that calcium carbonate availability may not be the only or even the principal factor controlling the ratio of agglutinated to calcareous benthic forams in the area under discussion. The amount and character of suspended detritus may be more important.

Trends of modern agglutinated forams may not be directly applicable to an interpretation of the geologic record. Many agglutinated tests are more easily destroyed than are calcareous tests. The frequency and quality of preservation of agglutinated tests drop off noticeably below the sediment surface.

FREEMAN, R. N., OKC Corp., Dallas, Tex.

PETROLEUM GEOLOGY OF SUBANDEAN BASIN OF ECUADOR, NORTHERN PERU AND SOUTHERN COLOMBIA

The Subandean basin is an arcuate structural depression aligned in a north-south direction between the Guyana shield and the Andes. Nevadan orogenic movements there were followed by miogeosynclinal conditions that characterized sedimentation throughout the Cretaceous Period. The initial deposits of an Aptian-