parallel time-stratigraphic bedding surfaces. Changes in rock stratigraphy, that is, lithology and facies, are expressed as changes in seismic parameters such as amplitude and interval velocity; these changes may occur within time-stratigraphic units, or may transgress the pattern of time-stratigraphic zones. Seismic stratigraphy is limited by the resolution of the seismic system and is somewhat complicated by the need to exclude unwanted signals, such as coherent noise patterns. Nevertheless, high-resolution seismic sections are the most powerful tool available to modern stratigraphers.

Two studies document the relation of bedding surfaces to seismic reflections. Well log correlations, seismic sections, a seismic model study, and a synthetic seismogram study document time-stratigraphic and rock-stratigraphic relations in Oligocene-Miocene strata in a South American basin. The second study involves a seismic line shot in the western United States across a series of wells spaced about 1 mi apart. Lateral facies changes within interfingering Cretaceous marine and nonmarine sediments demonstrate the continuity of time-stratigraphic surfaces and of reflections across major facies changes.

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ADAPTIVE STRATEGIES AND STRUCTURE AND STABILITY OF ECOSYSTEM

Ecosystem structures and stabilities are based upon the modal adaptive strategies employed by their component populations. These population strategies are, in turn, a reflection of natural selection of individuals for adaptation to particular environmental regimes. The selective pressures that are of primary significance are those related to the trophic resource regime. Fluctuating regimes require flexible responses, broad tolerances, and high reproductive potentials. Ecosystems in such regimes therefore contain few species but may have complex trophic webs; they vary temporally in composition and relative population proportions. Stable regimes permit specialized responses, narrow tolerances, and small populations. Ecosystems in such regimes may contain many species but may have simple trophic nets and vary but little through time.

At present the pattern of ecosystem structure correlates well with the pattern of trophic resource regimes; latitudinally the pattern is chiefly due to variation in solar radiation; longitudinally, to variation in nutrient supply. In the past, variations in resource regimes on a global scale accounted for fluctuations in both diversity and quality of the biota as ecosystem structures adjusted to the changes. To preserve our present marine diversity, nutrient effluents should be engineered so as to stabilize the trophic regimes.

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DIAGENESIS OF CALCAREOUS DUNE ROCKS, NORTHEASTERN YUCATÁN PENINSULA, MEXICO

Calcareous eolianites, of late Pleistocene and Holocene age, have accumulated along the northeastern coast of Yucatán. Consolidated Holocene dune rock on this coast provides a missing link in the study of progressive diagenesis from modern dune sand to Pleistocene eolianite. The Pleistocene dune rocks can be divided into 3 different limestones, and the Holocene eolianites, into 2 limestones. Each eolianite represents a separate diagenetic stage.

Youngest Holocene rocks have the same composition as dune and beach sands: 75–85% aragonite, 15–20% Mg calcite, and less than 5% low-Mg calcite. Older ridges of the younger Holocene eolianite contain up to 22% low-Mg calcite. The older Holocene eolianite has 69–84% aragonite and less than 5% Mg calcite (composition is low in Mg-calcite bioclasts). The youngest Pleistocene eolianite originally contained as much as 45% Mg calcite, and there is high retention of Mg calcite in some beds. Several samples have 20–32% Mg calcite (12–14 mol % $MgCO_3$); some samples have no Mg calcite. Aragonite ranges from 45–65%. The second youngest Pleistocene eolianite has 48–75% aragonite and less than 5% Mg calcite. The oldest eolianite contains 40–60% aragonite and less than 5% Mg calcite. Each eolianite has a different sequence and rate of progressive diagenesis toward calcitization.

The Holocene eolianites contain grain-contact cement, microstalactitic druse, and large syntaxial overgrowths on echinoderm fragments. Finer grained layers are preferentially cemented. "Micrite envelopes" may form around grains in the vadose zone, and microcrystalline inclusions are common in sparry cement of the eolianites. Much of the Pleistocene eolianite has grain-skin cement in pores which contain "root-hair sheaths" and blocky spar in pores where they are absent. This suggests that early cementation was influenced by transpiration of dune plants. "Needle-fiber" cement is present in Pleistocene eolianites near ancient weathered surfaces. The Pleistocene eolianites contain rhizocretions and "root-hair sheaths," which are absent in the Holocene eolianites.

Pleistocene eolianites now immersed in the intertidal-subtidal environment are enriched in Mg calcite as a result of precipitation of Mg calcite cement in the pores.

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COMMUNITIES OF BIOERODERS ON SUBMARINE OUTCROPS OF PACIFIC COAST

Investigation of marine invertebrates that bore, rasp, scrape, or otherwise erode intertidal and subtidal outcrops of sedimentary rocks of the Pacific Coast suggests that they are very significant in attrition of submarine outcrops and in shaping the configuration of the seabed. Localities ranging from the intertidal zone to depths of 160 ft in submarine canyons show that physical and chemical processes eroding the rocks are relatively unimportant compared with intensive "bioerosion."

Rock samples collected are studied by X-ray radiography to determine the internal distribution of borers; thin-section petrography and induction furnace analysis are used to learn the exact lithology and carbonate content. All borers and other occupants of each sample are recovered and identified.

Important initial excavators are bivalve mollusks and polychaete annelids. Upon death their borings provide protected habitats for other boring taxa, giving rise to a sequence of excavations with time. Over 50% of the volume of some rocks is excavated, containing extensive internal passageways and galleries.

Some taxa are confined to certain depth zones or rock types; others are present from the intertidal zones to the deepest localities investigated (160 ft). Rocks most susceptible to attack are generally fine grained

and soft, but durable calcareous lithologies are selected by chemical borers requiring a carbonate substrate. Places with relatively stable environmental conditions, such as the upper walls of submarine canyons, exhibit a diverse community of bioeroders. Their activities are responsible for a system of borings penetrating several decimeters into the rocks.

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STABLE CARBON ISOTOPE INVESTIGATION OF NATURAL GASES FROM SACRAMENTO AND DELAWARE-VAL VERDE BASINS—POSSIBLE IGNEOUS ORIGIN

Investigations of chemical and stable carbon isotopic character of gases from major fields in the Sacramento basin, California, and the Delaware–Val Verde basins of West Texas and New Mexico indicate a strong possibility of a high-temperature, igneous-type origin for some of these gases.

Geomagnetic surveys of the Sacramento basin indicate the occurrence of 2 types of volcanics. Thin, near surface flows and deep-seated basalt plugs are observed which appear to be related to the occurrence of gas in the basin.

Analysis of coproduced methane and carbon dioxide from a given well yields information concerning the thermal history of the gas. Isotopic equilibrium or quenching temperatures were determined and interpreted on a regional basis.

Gases from the Sacramento Valley are produced from sandstone lenses in alluvial fan-type deposits from Late Cretaceous to Eocene in age. In the south-central part of the basin, the Marysville Buttes constitute a topographic break which has a volcanic plug jutting about 2,000 ft above the surrounding country. Considerable amounts of gas have been produced from sandstone bordering this feature. Secondary folds and faults attending the intrusion exist at a radius of several miles from the core. Gases produced in wells surrounding this cylindrical shaft of igneous rock exhibit a temperature dependence as a function of the distance of production from the central core.

Delaware and Val Verde basin gases from the deep Ellenburger and Devonian formations are dry and composed almost entirely of methane and carbon dioxide. The basin gas data suggest a possible igneous origin, centered about the Marathon thrust zone of the Ouachita structural belt to the southwest.

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GEOCHEMISTRY OF CAYMAN TRENCH SEDIMENTS

The petrology of deep-sea sediments north of Jamaica and in the central Cayman Trench may be interpreted in terms of 2 basic sediment components, namely, the carbonate and terrigenous fractions.

On the basis of trace-metal concentrations, the carbonate fraction shows considerable variability both laterally and vertically. Evidence suggests that the carbonates were derived from shallow-water, benthic environments as well as pelagic organisms. Both geochemical and sedimentologic characteristics indicate that the carbonate fraction has undergone resedimentation. Foraminifera make up a significant percentage of many of the graded, turbidite sand layers.

The terrigenous component of the central Cayman Trench shows higher concentrations of cobalt, copper, chromium, lithium, manganese, nickel, and rubidium than those in the trench north of Jamaica. Lead concentrations, however, are higher in the terrigenous component of the latter area. This suggests that at least 2 sources of terrigenous sediment of distinctly different trace element chemistry supply the Cayman Trench in these different regions.

The overall chemistry is indicative of variable sources for both the carbonate and terrigenous fractions. This is supported by the general petrology and sedimentologic evidence of mixing and resedimentation.

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MICROBIOLOGIC ALTERATION OF CRUDE OIL IN MUDDY SANDSTONE AND OTHER RESERVOIRS

Loss of paraffin wax constituents from crude oil has been attributed by some investigators to microbiologic activity in the reservoir, but until now no significant evidence supporting this hypothesis has been reported. Gas chromatographic and mass spectral data now indicate that a highly selective loss of n-paraffins has occurred in some oils. A classic example of selective n-paraffin removal is found in the Cretaceous Muddy reservoir at Bell Creek field, Montana. Occurring within the same reservoir system are (1) oil showing no loss of n-paraffins, (2) oil with all n-paraffins missing up to about n-C_{17}, but unaffected above n-C_{17}, and (3) oil with the entire range of n-paraffins missing. A microbiologic process seems to be the only logical explanation for such high selectivity. Surface recharge waters apparently transport aerobic microorganisms along with the necessary oxygen to accessible reservoirs. Other evidence for microbial activity at Bell Creek includes increase in nitrogen content and optical rotation disproportionate to n-paraffin loss, suggestive of addition of microbially produced materials to an altered oil. Optical rotation, carbon isotope, and mass spectral data obtained on distillation fractions of Muddy oil from Whitetail field, near Bell Creek, provide direct evidence that components are being added to the oil by microbial activity. In East and West Hackberry fields, Louisiana, there is evidence that some branched as well as straight-chain hydrocarbons have been microbially destroyed. Examples of microbial alteration have been found in most oil-producing areas of the world.

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PLIO-PLEISTOCENE GEOLOGY, OUTER CONTINENTAL SHELF, LOUISIANA AND TEXAS

Pliocene and Pleistocene deposition on the outer continental shelf and upper continental slope offshore from Louisiana and Texas was a continuation of the process of prograding deltaic sedimentation with associated hydrocarbon accumulation that has been active in the northern Gulf of Mexico since the end of the Cretaceous. However, this more recent phase of the geologic history of the northern Gulf of Mexico basin differs from the earlier Tertiary history of the area in several significant aspects.