lateral distance of 1,000 ft indicate that 80% of the Type A sandstone is continuous for this distance, whereas only 10% of the Type B sandstone is continuous. Factors for lateral continuity with distance multiplied by kh (millidarcy-feet) give a measure of the kh which may be expected to be in connection between wells various distances apart. At a distance of 500 ft from an injection well, only 60–80% of the total kh of the injection well may be in connection with a producing well, in the direction of depositional strike (north-south). In the depositional dip direction (east-west) this value may be 80–100%.

THORSTENSON, DONALD C., Dept. Geol. Sci., Southern Methodist Univ., Dallas, TX 75222, and FRED T. MACKENZIE and BYRON RISTVET, Dept. Geol. Sci., Northwestern Univ., Evanston, IL 60201

EXPERIMENTAL CEMENTATION OF CARBONATE SANDS

The processes of vadose and phreatic diagenesis in carbonate rocks have been simulated in the laboratory by using CO_2 charged water to leach a "source bed" of carbonate sand. Precipitation of carbonate cement in a second sand body, above and below an artificial water table, was induced by CO_2 evasion. Aragonite and high-Mg calcite (predominantly the latter) were leached from the source bed, and low-Mg calcite was precipitated as cement in the second sand unit. More cement was produced in the "vadose" zone than in the "phreatic" zone.

The petrography of the cement is similar to that observed in cemented eolianites in Bermuda. Petrographic evidence suggests that cementation proceeds in 3 stages: (1) intragranular calcite cement forms drusy cavity fillings in the original voids of skeletal fragments; (2) rim cementation, consisting of fine-grained spar calcite; and (3) intergranular fine-grained calcite spar filling the original pore space in the skeletal sediment.

Mass transfer calculations show that the laboratory cementation process is consistent with soil P_{CO_2}, rainfall, and cementation rates on Bermuda.

TODD, DONALD F., Independent Indonesian American Petroleum Co., Denver, CO 80203, and A. PULUNGGONO, P. N. Pertamina, Djakarta, Indonesia

SUNDA BASIN—IMPORTANT NEW INDONESIAN OIL PROVINCE

The Sunda basin is one of the Tertiary ideogeosynclines bordering the stable Sundaland. Twenty-one prospects have been drilled since offshore exploration started in late 1968 with oil and/or gas being discovered in 52% of these ventures.

A north-south horst and graben framework on a rugged Late Cretaceous surface governed erosion, deposition, and tectonic growth throughout the Tertiary in all but the northeastern extremities of the basin.

Volcanic and fluvial rocks constitute initial sedimentary deposits. Quantity of sediment influx was primarily responsible for differential sinking of graben blocks during early basin development and resulted in thick deltaic deposits during early Miocene. Downwarp of the backdeep continued with sea invasion through island passages in the geanticline on the south. High tectonic blocks prevented segments of the basin from being invaded during early basin development. With continued denudation and downwarp, Miocene transgression expanded over the Sunda basin. Local high areas persisted, but trangression continued dominant.

As basin segments filled, a nearby flat depositional surface developed. Slight lowering of sea level resulted in regional regression, followed by major transgression in post mid-Miocene time. Late in this second transgressive period, most disconnected ideogeosynclines became one regional geosyncline surrounding the Sundaland. Final regional regression occurred in late Miocene, culminating in complete emergence during Pleistocene. Worldwide melting of Pleistocene ice caused a resubmergence of the basin to present marine conditions.

Production has been established in principal intervals producing in Sumatra. Major new pays have been established in Oligocene volcanic tuffs and in Oligocene (?)-Miocene sandstones of the Talang Akar. Possible commercial shows have been found in Miocene Batu Radja transgressive limestone and in weathered basement rocks. Major oil production is indicated from Air Benakat sandstone bodies. Gas production has been established in the Parigi Limestone.

UNDERWOOD, JAMES R., JR., Dept. Geol., West Texas State Univ., Canyon TX 79015, Y. Y. YOUASH, Dept. Geol., Univ. Libya, Tripoli, Libya, and GEORGE PHILIP, Dept. Geol., Univ. Cairo, Cairo, U.A.R.

UNIQUELY ROUNDED DESICCATION COLUMNS NEAR EUPHRATES RIVER, NORTHWESTERN IRAQ—PRODUCED BY PROLONGED EROSION IN ARID CLIMATE

During a reconnaissance in northwestern Iraq distinctive, much eroded, polygonal mudstone desiccation columns averaging 2 ft in diameter and ranging in height from 2 to 4 ft were seen in the bed of a wadi 200 yd upstream from its intersection with the Euphrates River between the villages of Haditha and Ana. These columns were unique because of their well-rounded upper terminations and because of their discreteness, emphasized by enlarged bounding fractures which ranged in width from 3 to 6 in. The key to the origin of such columns must lie in prolonged preservation and exposure—perhaps over a period of several years—to erosion, largely by weathering (including spheroidal weathering) and by wind and perhaps to a lesser extent by water.

At this locality the blanket of sediment in which the desiccation columns developed was deposited during floodstage of the Euphrates. If this same height of flood was not reached again for several years and if the columns were not destroyed by local rainfall or wadi flow, prolonged erosion would result. Regionally, rainfall averages only about 4 in. per year, but local areas may receive little or no rainfall for extended periods.

Thus if preserved in ancient rock such extremely eroded and rounded columns, or the casts produced by filling of their bounding fractures, would be suggestive of a more arid environment than is indicated by many occurrences of "ordinary" mudcracks or mudcrack casts and associated columns with noneroded planar or only slightly curvilinear upper surfaces.

VAIL, PETER R., and JOHN B. SANGREE, Esso Production Research Co., Houston, TX 77001

TIME STRATIGRAPHY FROM SEISMIC DATA

The seismic reflection process expresses the interbedding of sediments as a pattern of seismic cycles which

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.

VALENTINE, JAMES W., Dept. Geol., Univ. California, Davis, CA 95616

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.

WARD, WILLIAM C., Dept. Earth Sci., Louisiana State Univ., New Orleans, LA 70122

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.

WARME, JOHN E., Dept. Geol., Rice Univ., Houston, TX 77001

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