for his exploratory talents; (3) a realization that pricing policies must recognize and accept the changes in cost accounting brought about by increasing concern for the environment and preventing its pollution; and (4) stability of employment prospects, so that he not only obtains a position upon graduation from college, but has assurance in middle life, if he proves competent. It is not only necessary to be a well-trained geologist initially, but he must have continuing curiosity, self discipline, and enthusiasm. He must continue to assert the difference between being a professional and a hired hand.

DAPPLES, E. C., Northwestern Univ., Evanston, IL 60201

SOME CONCEPTS ON CEMENTATION OF SANDSTONES

(No abstract submitted)

DAVIES, DAVID K., Dept. Geol., Univ. Missouri, Columbia, MO 65201, and ROBERT R. BERG, Dept. Geol., Texas A&M Univ., College Station, TX 77843

PETROGRAPHIC ANALYSIS OF SANDSTONES IN STRATIGRAPHIC EXPLORATION

All the fundamental rock properties (composition, texture, and sedimentary structure) are required to determine the depositional environments of sandstone bodies. Once depositional environments have been established, however, petrography alone can be a significant factor in identifying environments. Petrography is particularly useful if only small samples are available, such as core chips or side-wall cores. Thin-section analysis of such samples yields compositional and textural data which can be environmentally sensitive.

This is confirmed by a study of the Muddy Sandstone in the subsurface of the eastern Powder River basin. In this area, barrier bars are characterized by high quartz content (>90%) and low matrix (<10%); delta destructional bars by moderately high quartz (60–90%) and matrix (10–40%); and fluvio-deltaic sediments by low quartz (45%) and relatively high matrix (35%) and rock fragments (20%). The vertical sequence of mean grain-size change in each environment is significant, but maximum grain size is also a key value and is generally a grade coarser in fluvio-deltaic than barrier or delta-destructional sandstones. Plots of quartz mean size versus quartz content are environmentally sensitive, and from only a few thin sections an estimate may be made of depositional environment when other data are not available.

Indirect tools, such as electric logs, appear unreliable for identification of environment, unless the environment is established first on the basis of fundamental rock properties.

DAVIS, JAMES R., Phillips Petroleum Co., Bartlesville, OK 74003

SEDIMENTATION OF PLIOCENE SANDSTONES IN SANTA BARBARA CHANNEL, CALIFORNIA

Pliocene rocks in the Ventura basin, including the part under the Santa Barbara Channel, provide an excellent area to study a strongly deformed but essentially intact turbidite basin. Conglomeratic beds, containing typical turbidites, are present along the northern margin of the basin.

Isopach, sand-isolith, and sand-percentage maps of the Pliocene Repetto and Pico Formations in the east-west Central basin show thick deposits bounded on both sides by thinner deposits in the Rincon trend on the north and the Montalvo trend on the south. Deposition was controlled by partly effective fault barriers on the north and south margins of the Central basin. Sand-isolith and sand-percentage maps indicate local increases in sand in the north on the Rincon trend suggesting the presence of ancient subsea fans in the Repetto and lower Pico. The overall decrease in sand on the west denotes a major influx of sand from the east down the Central basin axis. The first influx of sand from the southern margin of the basin is found on the sand-percentage map of the middle Pico "A." Deposition of sand was also affected by topographic highs associated with growing faults and anticlines.

Distribution, textural properties, primary structures, and microfauna of sandstones in the Ventura basin are comparable to the modern deposits in the nearby Santa Monica basin. Stratigraphic maps reveal Pliocene subsea fans, and observations of outcrops and cores show the same type of beds as described in the Santa Monica basin. Hence, sedimentation was controlled by sand deposition in and at the foot of submarine canyons in the form of subsea fans.

DAVIS, RICHARD A., JR., Dept. Geol., Western Michigan Univ., Kalamazoo, MI 49001, and WILLIAM T. FOX, Dept. Geol., Williams College, Williamstown, MA 01267

BEACH AND NEARSHORE PROCESSES AND MORPHOLOGY IN NONTIDAL ENVIRONMENT

Recent detailed studies of the beach and nearshore environments of eastern Lake Michigan have revealed almost no significant differences compared with similar marine environments, except for the absence of marine tidal fluctuations. The morphology and the processes operating in both areas are remarkably similar; however, the rates at which these processes operate appear to be more rapid in Lake Michigan.

Beach profiles reflect environmental conditions which may or may not be associated with seasonal cycles. Storm conditions yield nearly identical flat profiles in both areas with characteristic lag deposits of heavy minerals in the back-beach zone. Quiescent conditions produce accretionary beaches except when lake levels rise gradually for prolonged periods.

The inner nearshore profile in both Lake Michigan and marine areas is commonly characterized by an ephemeral bar which migrates shoreward and is welded to the beach. The bar forms during the waning phase of a storm and migrates shoreward during low-energy conditions. Migration of the bar generally proceeds more rapidly in Lake Michigan than in tidal areas. The crest of the bar is not exposed in Lake Michigan until welding occurs, whereas, it is exposed during low tide in comparable marine environment.

Farther from shore are relatively stable bars whose number and position are controlled largely by the slope of the nearshore bottom. These features also show generally comparable morphology in both areas, although they seem somewhat less stable in the marine environment.

DICKEY, PARKE A., Univ. Tulsa, Tulsa, OK 74104, and JOHN M. HUNT, Woods Hole Oceanographic Inst., Woods Hole, MA 02543

GEOCHEMICAL AND HYDROGEOLOGIC METHODS OF PROSPECTING FOR STRATIGRAPHIC TRAPS

A trap is of no value unless it has oil or gas in it. Prospecting, therefore, should include efforts to determine if petroleum was generated by the enclosing rocks, and if it was likely to have collected behind the barriers that constitute the trap.

Observations can be made to see if the rocks and fluids contain traces of hydrocarbon which suggests that they are source rocks. Oil seeps from breached traps around the margin of a basin commonly suggest that similar traps may contain oil downdip.

The key to stratigraphically trapped oil is the presence of barriers to fluid flow. Such barriers can be located by discontinuities in the patterns of fluid pressures. In mountainous areas, meteoric water commonly has gained access to strata which have regional continuity of permeability. Abrupt changes in water composition in these areas indicate barriers where stratigraphic factors may have preserved the petroleum.

DRAKE, CHARLES L., Earth Sci. Dept., Dartmouth College, Hanover, NH 03755

FUTURE CONSIDERATIONS CONCERNING GEODYNAMICS

The past decade has seen remarkable advances in ideas about the earth and the origin of its surface features. Among the most significant results of efforts during this decade is the realization that the tectonically active belts may be considered as the edges of large lithospheric plates moving relative to each other. In addition, there is evidence of lateral inhomogeneities in the mantle which may be related to the driving mechanism for these motions. It is difficult to overstate the importance of these ideas in drawing together the different disciplines which make up the earth sciences.

It is time for a second look at these ideas. The short term movements in the seismically active belts appear to be related to the long term movements preserved in the geologic record, hence, it is possible to study process as well as result. It also is apparent that there have been major movements, primarily vertical, within the lithospheric plates that are apparently unrelated to the relative horizontal movements of the plates.

The International Council of Scientific Unions has established a new Commission, the *Inter-Union Commission on Geodynamics,* to encourage research in these areas and to provide international coordination of efforts.

DUBAR, JULES R., RICHARD A. WALLS, and SUSAN S. DUBAR, Geoscience Dept., Morehead State Univ., Morehead, KY 40351

NEOGENE ECHINOID ASSEMBLAGES OF CAROLINAS—THEIR PALEOECOLOGY, MORPHOLOGIC ADAPTATIONS, AND STRATIGRAPHIC RELATIONS

Echinoids have considerable potential as stratigraphic and paleoecologic guides for Neogene marine deposits. Entire individuals and fragments are present in most marine units of the Atlantic coastal plain; their calcitic exoskeletons persist where leaching has removed more abundant aragonitic mollusks, and their complexity affords potential for generic and possibly specific classification of disassociated skeletal components.

Exoskeletal size, shape, and thickness; modifications of skeletal plate systems; and the nature of internal structures of skeletal components are environmentally induced morphologic adaptations among individuals of the same species which are potential paleoecologic indicators. The present study indicates that where sedimentation rates are low and the substrate stable, relatively immobile forms are most common, and normally small, active species become large, heavily constructed, and inactive.

Echinoid assemblages studied in detail are from the Waccamaw Formation (Aftonian?) of North and South Carolina, and the Canepatch Formation (Yarmouthian?) of Horry County, South Carolina. Studies of associated biota and sediment characteristics serve as paleoecologic control.

All Waccamaw assemblages are comprised of cassiduloids, clypeasteroids, and arbacoids, whereas only the latter two groups occur in the Canepatch Formation. Populations of the clypeasteroid genera *Mellita* and *Encope* are mutually exclusive within the Canepatch Formation.

EARGLE, D. HOYE, U.S. Geol. Survey, Austin, TX 78701, and ALICE M. D. WEEKS, Dept. Geol., Temple Univ., Philadelphia, PA 19122

URANIUM GEOLOGY OF COASTAL PLAIN OF SOUTH TEXAS

The principal economic deposits of uranium discovered in Texas are in the southern half of the coastal plain, close to oil-bearing structures. Host rocks are tuffaceous sandstones that range in age from late Eocene to Pliocene. Those of Eocene age are shallow-marine sandstones, overlain unconformably by Miocene continental tuffs; those younger than Eocene are fluvial tuffaceous sandstones interbedded with siltstone and clay.

The earliest exploited deposits contained shallow oxidized ores, generally spotty and out of radiometric equilibrium. The minerals were chiefly uranyl phosphates and silicates, with vanadates minor to absent. Deposits worked today are farther downdip, generally below the water table and the oxidation level, and are either rolls or irregular bodies near fault lines from which hydrogen sulfide-bearing hydrocarbons seep. Minerals are sooty pitchblende and coffinite; molybdenum and selenium are present. The ores are in near radiometric equilibrium, and the uranium is easily recovered from them. At least one deposit is in the sedimentary rock overlying sulfur-bearing salt-dome caprock.

Chief factors in the occurrence of the deposits are: (1) a source of uranium in tuffs that originated in northern Mexico or western Texas; (2) mobilization of uranium by a "built-in" solvent, alkaline carbonate pore water developed by diagenetic alteration of chemically reactive volcanic debris; (3) concentration of fluids by evaporation in an arid climate; (4) movement of fluids to reducing environments; (5) precipitation of uranium by reductants such as organic matter and/or hydrogen sulfide; and (6) preservation in a favorable structural or stratigraphic trap not susceptible to leaching.

EDGAR, N. TERENCE, Deep Sea Drilling Project, Scripps Inst. Oceanog., La Jolla, CA 92037

CARIBBEAN SEA DEEP-SEA DRILLING RESULTS

Leg XV of the *Glomar Challenger* departed December 3, 1970, from San Juan and arrived in Panama on January 26, 1971. The cruise was divided into 3 parts: (1) San Juan to Curaçao, where a hole reentry system was utilized operationally for the first time to facilitate