ity of oil or gas fields contain significant quantities of saturated hydrocarbons ranging from methane through the pentanes.

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EXAMINATION OF GEORGIA COASTAL SEDIMENTS WITH N.E.L. SPADE CORER

For 2 years samples have been obtained with an N.E.L. spade corer from the nearshore waters of the Georgia coast. During the past year, work has been concentrated on sampling in the coastal rivers, sounds, and estuaries of the Sea Island section of Georgia. Approximately 300 spade cores have been collected at 150 stations in 12 rivers and estuaries.

A tremendous variety of sediments and substrates are indicated by the sampling results. Sediment textures in the estuaries and rivers range from clay to gravel. Rivers such as the Satilla, Altamaha, and Ogeechee, which have their sources far inland, are characterized by clean, well-sorted sand, whereas closed sounds such as Doboy and Sapelo Sounds appear to be the sites of silt and mud accumulation. Exposures of Miocene bedrock, indicating the absence of any Holocene sediment accumulation, are found at several locations in the St. Marys and Turtle Rivers. All the samples reflect the mixing, to some extent, of Pleistocene and Holocene sediments. Mixed assemblages of Miocene, Pleistocene, and Holocene macroinvertebrate fossils have been found.

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OCCURRENCE AND SIGNIFICANCE OF RIBBING VARIATIONS IN LATE ORDOVICIAN BRACHIOPODS

Brachiopods are among the most common elements of marine Paleozoic faunas. Many species are suitable for study of widely separated basins.

Costate specimens representing 11 species were obtained from Upper Ordovician (Richmondian) strata in the Ohio Valley, Illinois, Iowa, Minnesota, Missouri, Oklahoma, Tennessee, and Texas in order to examine geographic patterns in costation and to determine whether observed variations were uniform within each sedimentary province. Regardless of wide variations in costae between different species, most species showed some tendency toward geographic variation in costation. In the Ohio Valley, the variations generally followed a trend toward lower costation. Specimens of *Lepidocyclus capax* (Conrad), *Austinella sooyellei* (Miller), *Plaesiomys subquadrata* Hall, *Zygospira kentuckiensis* James, and *Z. modesta* (Hall) are typically less costate than related members in adjacent basins. These relations support earlier observations of provincialism in the type Richmond fauna. Exceptions to this general pattern were noted in *Glyptorthis insculpta* (Hall) and *Rhynchotrema dentatum* (Hall), both of which exhibited little geographic variation in their costation. Observations for the widespread species, *Lepidocyclus capax*, are somewhat contradictory. Representatives from the Ohio Valley generally are less costate than those observed in Tennessee, Iowa, and Minnesota, but are somewhat more costate than the "Fernvale" variant in Oklahoma. The latter may be an older form.

Preliminary results suggest that ecologic factors, operating within a sedimentary basin, did affect costation but not uniformly for all species. Studies are continuing to determine more precisely the degree of uniformity of costation patterns and whether such patterns are related to variations in lithology.

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SOLITARY CORAL GROWTH FORMS AND DISTRIBUTION PATTERNS AS INDEX OF SEDIMENT-ACCUMULATION RATES

The characteristic feature of a 300-m-thick shelf sequence of alternating limestone and shale (lower Carboniferous, Northwest Ireland) is the presence of extensive solitary coral-strewn bedding planes. These shale-overlain, prone, coral death assemblages from particle-supported beds 5–15 cm thick alternating with 6–75-cm beds of skeletal carbonaceous silt, sand, or mud. The death assemblages consist of randomly oriented adult corals averaging 50–100 cm in length in concentrations of 4–11/sq m; they are laterally extensive (>30 m) with rare discontinuities. Locally upward-facing surfaces of prone individuals are breached and infested with boring bryozoans and sponges, or encrusted with auloporid corals. Coral growth forms and internal structures in the death assemblage commonly are aberrant; the cylindrical form is irregularly coiled and constricted; the intertabular space is highly variable (0.50–4.0 mm); the tabulae are thin in places and accompanied by a suppressed dissepimentarium. In the malformed parts of the corals the intertabular space commonly is infilled completely with silty biomicrite, whereas normally developed axial structures are spar filled. A few free-living upward-growing corals are present in life position in intervening units.

The coincidence of silty biomicrite axial infill and aberration in growth form and internal structures suggests that rapid local accumulation of fine sediment about the calyx forced upward growth and concomitant skeletal reduction. The coral death assemblages are lag deposits probably produced by unusually intense storm wave action which alternated with prolonged periods of quiet-water accumulation. The thickness of the quiet-water deposits (>75 cm) implies a long duration between storms, *e.g.*, "once-in-a-hundred-years."

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GEOCHEMICAL PROSPECTING AT SEA

An underwater seep-detector system was placed in operation in November 1967 as one of the research and development programs on the M/V *Gulfrex*. From thousands of miles of traverse, the results of the hydrocarbon analyses of seawater have shown the tremendous potential of this system for locating petroleum and natural gas seepages in offshore areas. The seepages, in turn, indicate prospective areas of buried hydrocarbon deposits.

The *Gulfrex* seep detector is capable of analyzing seawater for saturated and unsaturated hydrocarbons up to butane. The analyses have yielded surprisingly consistent data on the background hydrocarbon assemblage in the seas. From this knowledge, we now can recognize true petroleum and natural gas seepages, even in areas where prolific life activity may give abnormally high hydrocarbon backgrounds. The specific signature of hydrocarbon distributions in the sea also has the potential of distinguishing the types of hydro-

carbon accumulations giving rise to a seepage. Data are available for typical hydrocarbon backgrounds, abnormal hydrocarbon backgrounds, suspected gas seeps, and suspected petroleum seeps.

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APPLICATIONS OF DIGITIZED LOGS IN EXPLORATION

Present-day technology is supplying digitized wireline log records, either at the well site or at computing centers. Most of these records are used to calculate reservoir parameters of subsurface formations. Although porosity estimates have been vastly improved by these procedures, the techniques developed have dubious application in lithologic evaluation. Digitized logs do provide an excellent base for improved display of log information. Variable area, variable density, mixed mode, and filtered-curve displays accentuate similarities in deposition patterns between wells. Logs in wells with hole-deviation problems or steeply dipping beds may be normalized to match nearby wells. The human eye can be encouraged to act as an analogue computer by such changes in mode of presentation. Techniques developed to estimate formation fluid pressures from well-log data have been used to control drilling practices and may have a significant contribution in detecting patterns of fluid migration within deposition basins.

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KINZERS FORMATION—APPALACHIAN ANALOGUE OF BURGESS SHALE?

The Kinzers Formation of southeastern Pennsylvania contains a definite Middle Cambrian fauna near the top of what has been designated as Lower Cambrian rocks. Locally fossiliferous limestone, dolomite, and shale are highly deformed by folding and faulting, making physical tracing of individual units difficult or impossible. Ten faunules can be recognized within the Kinzers Formation, and range in age from Early Cambrian to middle Middle Cambrian. One unexplained time gap occurs in this interval.

The Middle Cambrian fauna, found in black organic shale, compares favorably with part of the Middle Cambrian Burgess Shale fauna. A lower assemblage, designated the "*Ogygopsis klotzi* fauna" contains *Ogygopsis klotzi* (Rominger), *Acrothele decipiens* (?), *Elrathina* sp., *Olenoides* sp., and *Peronopsis* sp., as well as unidentified agnostid trilobites, silicic sponge spicules, and segmented worms. The upper part of the black shale, less than 10 ft above the *Ogygopsis klotzi* faunule bed, contains an assemblage herein designated the "*Peronopsis* sp. faunule." This faunule includes *Peronopsis* sp., *Bathyuriscus* sp., *Elrathina* sp., and *Oryctocephalus* sp.

These beds may represent offbank ("outer detrital") deeper water deposits correlative in part with the Parker Formation of northwestern Vermont and the West Castleton Formation of the New York Taconics.

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TECTONIC CONTROL OF DEVONIAN REEF SEDIMENTATION, ALBERTA

Kaybob reef is one of a group of geologic reefs which underlie west-central Alberta and which comprise the Upper Devonian Swan Hills Formation of the Beaverhill Lake Group. Kaybob reef is a flat north-south elongate lens, 250 ft thick, 11 mi long, and 3 mi wide, built on the Slave Point Formation, a widespread platform carbonate.

Detailed core study of sedimentary structure, texture, and constituents reveals that the carbonate sediments composing the reef can be grouped into 3 environmentally controlled facies groups: reef-slope, reef-margin, and shelf-lagoon facies. The reef-slope facies is a stromatoporoid-crinoid-brachiopod grainstone. The reef marginal deposits consist of a groundmass of massive stromatoporoid grainstone containing varied concentrations of different stromatoporoid growth forms (ranging from slender branching to large massive heads).

The interior facies includes several rock types arranged in repeated vertical sequences. A basal unit of massive wackestone is overlain by combinations of massive, thin-bedded, and laminated mudstones, mudclast grainstones, and amphiporid carbonate conglomerate. Submarine and subaerial scoured surfaces are present within the upper units. The outer slope sediments intertongue with contemporaneous open-marine deposits seaward and with the reef-marginal facies on the inner side of the reef. This pattern changes laterally in vertical section, as the thickness of the reef changes from place to place. The upper half of the reef shows a marked westward displacement.

Position of the various facies within the geologic reef mass, and comparison with Holocene carbonate sediments from several Caribbean localities, together provide a paleoenvironmental interpretation. The interior facies includes most of the sediment types which have been described from recent shallow shelf-lagoon environments. Sequential arrangements are the same and result from similar processes. The marginal realm includes many facies comparable with those observed in Holocene "reef tracts," ranging from scattered coral growth on a sand bottom to coral constructed buttresses of ecologic reefs. Circumferential variations in geologic reef development, the westward displacement of the upper part, and a thick pile of open-marine deposits on the southwest are attributed to prevailing north winds during the Devonian.

Tectonic control is exhibited at 4 levels. 1. The interior shelf-lagoon sequences are initiated by small-scale pulses of subsidence, perhaps complicated by eustatic sea-level changes. 2. Larger scale subsidence variations account for the thickening and thinning of the geologic reef body as a whole. 3. An orthogonal pattern of sharp elongate folds trending NE-SW and NW-SE is expressed clearly at the base of the reef. The folds are confined to the area of reefing, where they controlled reef initiation by forming mud mounds during upper Slave Point deposition. The pattern may reflect Slave Point block faulting. 4. This reef and others in the region, together with their associated carbonate-shelf deposits, fit into a well-expressed orthogonal tectonic pattern controlled by larger scale basement features. The basement features include a "family" of NE-SW-trending, relatively stable arches revolving about a NW-SE-trending major arch, the West Alberta ridge. They form part of the system of stable arches that provides the tectonic framework of the continent.

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COMPUTER-BASED INFORMATION BANK FOR CRETACEOUS FORAMINIFERS FROM WESTERN INTERIOR REGION, UNITED STATES AND CANADA

Micropaleontologists and stratigraphers are overwhelmed by the vast accumulation of literature dealing