

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.

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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.

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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.

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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.

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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

penetration of hard formations in order to recover the oldest rocks in the eastern Caribbean Sea; (2) Curaçao to Kingston, dedicated primarily to geochemical studies of the interstitial waters and to organic geochemical analysis of anaerobic sediments from the Cariaco trench; (3) Kingston to Balboa, where attempts were made to reach the oldest rocks in the western Caribbean adjacent to Panama and to establish biostratigraphic standard sections. Paleontologists were looking for deep-sea evidence for the final closing of the Isthmus of Panama through the isolation of the Caribbean fauna from the Pacific fauna.

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SEDIMENTOLOGY OF RESERVOIR SANDSTONES IN EL-MORGAN FIELD, GULF OF SUEZ, U.A.R.

Well cuttings and core samples from 17 wells in El-Morgan field were studied for grain-size distribution, degree of roundness, and feldspar content. The sandstones are Miocene and generally are arkose or subarkose. Mechanical analysis indicates that the sand mode achieved good sorting in a high-energy beach environment, and then was transported en masse by strong waves and currents to a neritic environment where it became mixed with finer sand and clay. The sandstones are leptokurtic and positive skewed indicating a nearby source area. Study of roundness of the sand grains reveals a mixed source, mainly plutonic, with minor contributions from a preexisting sedimentary source, presumably a Cretaceous or Nubian sandstone.

Maps showing the variation in average grain size, feldspar content, and percent of sand in the formation, clearly indicate a source area south and southwest of the field. It is believed to be the nearby Zeit Range. The lack of feldspar alteration is attributed to rapid erosion as a result of the high relief attained by large-scale block faulting in pre-Miocene and early Miocene times and to conditions of extreme aridity.

The sands were deposited from traction currents. The bottom topography of the Miocene sea controlled the amount of turbulence and determined the size, shape, and distribution of the sands.

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ORDOVICIAN GRAPTOLITE FACIES AND NORTH ATLANTIC CONTINENTAL DRIFT

Pre-Caradoc graptolite faunas of North America and Europe are believed to indicate a significant divergence into 2 major facies associations: a "Pacific" fauna which is characteristic for Australia and most of North America, and an "Atlantic-Baltic" fauna which is documented in British and Scandinavian sequences, and which has been reported recently from Newfoundland.

Pelagic graptolites have not received much attention for their potential as facies indicators, but studies of Appalachian and European graptolite occurrences have demonstrated that two contrasting faunal developments existed during the Early Ordovician with both facies occurring on both sides of the Atlantic.

North American circumcratonic pelagic seas apparently provided a prevalent west-to-east current pattern which is indicated by periodic waves of immigrant Pacific graptolites in the northern Appalachians of Quebec and western Newfoundland, as well as in western Ireland and the Atlantic Norwegian Caledonides. This facies is in contrast with penecontemporaneous grap-

tolite congregations of epicratonic black shales in the Oslo region, southern Sweden, Wales, eastern Ireland, and northernmost Newfoundland.

The juxtaposition of both facies in both North America and Europe suggests the existence of a continuous physical barrier during part of the Early Ordovician. The axis of this barrier extended from Newfoundland to central Norway. Only a pre-drift continental plate margin association of North America and Europe makes this assumption tenable.

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FORAMINIFERAL STUDIES: WILKINSON BASIN, GULF OF MAINE

Sediment samples from a 280-m core taken in the Wilkinson basin, Gulf of Maine, have been studied for foraminiferal content. The sediments are dusky yellowish-brown silty clay and presumably represent particles carried by glacial meltwater into the Atlantic Ocean during the latest period of continental deglaciation.

Several features set the foraminiferal fauna apart from the normal open-shelf fauna. There is a distinct lack of arenaceous species in these sediments. *Eggerella advena*, customarily abundant, is lacking, and only *Hyperammina elongata* and *Trochammina inflata* are present in trace quantities.

Bolivina fragilis and *B. pseudoplicata* dominate the calcareous fauna, with fewer *Glandulina laevigata*, *Guttulina glacialis*, and *Nonionella labradorica* present. The species abundance and diversity are large and compare favorably with other northern areas.

The faunal list from the basin does not compare with species found at comparable depths on normal shelves. The fauna appears mixed with shallow-water elements derived from relict sediments on the shelf and bordering the basin. By far the majority of species found are from depths of 60-75 m. A few ubiquitous species, *Bulimina marginata* and *Cassidulina norcrossi* are found at greater depths.

Planktonic/benthonic ratios increase upward attesting to an influx of planktonic forms associated with rising sea level.

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LATE PLEISTOCENE-HOLOCENE SEDIMENTATION HISTORY OF CAPE KENNEDY INNER CONTINENTAL SHELF

Lithologic analyses of 91 cores averaging 10 ft in length, radiocarbon dates of *in situ* peat deposits from the shelf, and interpretation of 360 mi of high-resolution continuous seismic profiling indicate a complex sedimentation history for the Cape Kennedy inner continental shelf.

Two prominent and continuous acoustical horizons in the upper subbottom can be traced throughout the 200 sq mi grid studied. The lower reflector lies at -60 to -110 ft MLW and is characterized by an irregular surface probably resulting from erosive processes during long-term subaerial exposure. The upper horizon lies at depth of -40 to -90 ft MLW and generally 2-15 ft below the existing bottom. This horizon is relatively smooth and dips seaward at a low angle. Internal reflectors between the upper and lower horizons suggest prograding beds. Cores penetrating the upper reflector contain subaerially cemented sands and recrystallized shell.