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HYDROCARBONS CORED FROM KNOLLS IN SOUTHWESTERN GULF OF MEXICO

Some of the piston cores from knolls in the southwestern part of the Gulf of Mexico contain either layers of solid hydrocarbons or scattered inclusions of this material.

Geochemical analyses indicate that the hydrocarbons contain about 50% asphaltenes. Samples from within a 58-m thick tar layer, from the tar layers, and from the inclusions were compared.

Paleontologic investigations on coccoliths and Foraminifera show that mixing of fossil assemblages is common suggesting upward movement of sediment with the hydrocarbons.

These findings demonstrate that hydrocarbons can originate in deep-sea sediments and that their upward movement results in "oil seeps," which may account for some of the hydrocarbons found on modern beaches.

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REVIEW OF RECENT STUDIES ON MARINE PLEISTOCENE OF ATLANTIC COASTAL PLAIN—NEW JERSEY TO GEORGIA

A review of recent work on the marine Pleistocene of the Atlantic coastal plain shows that more than 50 formation and physiographic names have been used. An attempt is made to correlate some of these. There is good physiographic and paleontologic evidence of a Sangamon high sea level at about 28 and possibly 42 ft. No higher Pleistocene shorelines have been demonstrated conclusively in Maryland, Delaware, or New Jersey; the higher Pleistocene deposits probably are of alluvial origin. There is physiographic evidence of a 100-ft shoreline in Virginia (Windsor=Elberon Formation), and there is physiographic and paleontologic evidence of such a shoreline in South Carolina and Georgia. This shoreline has been referred to the Wicomico Formation and is tentatively regarded as of Yarmouth age. The terraces above the 100-ft contour are probably nonmarine, and may be of Tertiary age.

The old idea that the Atlantic coastal plain has been very stable during Pleistocene time and that the shorelines reflect eustatic changes in sea level is questioned. Warping and Holocene submergence have been indicated for New Jersey, and the work of various geologists suggests that along the southeastern coast, the eustatic fluctuations of the sea may have been superimposed on a tectonically rising coast. There is evidence of a mid-Wisconsin high stand of the sea, but whether the presence of the Silver Bluff and Princess Anne shorelines above sea level has been caused by a mid-Wisconsin sea level higher than the present, or whether tectonic movement has taken place, is not determined. There is no evidence of a Holocene stand of the sea higher than that of today.

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COILING DIRECTIONS IN PLANKTONIC FORAMINIFERA FROM COASTAL GROUP OF JAMAICA

Dominant coiling directions were noted in the *G. menardii, G. acostaensis-G. dutertrei* and *G. crassaformis-G. truncatulinoides* groups in the middle Miocene to Pleistocene Coastal Group of Jamaica. Several reversals of coiling direction in the *G. menardii* lineage occur at the top of the Miocene (Buff Bay Formation) before dextral coiling dominates Pliocene assemblages. A period of dextral coiling in the *G. crassaformis* group is seen in the Pliocene (lower part of the Bowden Formation), coinciding with increasingly abundant *G. miocenica* and *G. fistulosus*. *Globoquadrina altispira* disappears from the sequence just before reversal to sinistral coiling in *G. crassaformis*. Sinistrally coiled *G. menardii* reappears in the impoverished planktonic faunas at the top of the Bowden Formation. The direction of coiling in the *G. tosaensis-G. truncatulinoides* group is variable near the base of the Manchioneal Formation, but becomes dextral with the near-disappearance of *G. tosaensis*. At least some of the coiling changes appear to have regional correlative value in the Caribbean and Gulf of Mexico.

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PERMEABILITY ANISOTROPY IN MICROSUCROSIC DOLOMITES

It is generally agreed that there is no preferred relation between porosity and permeability unless additional parameters, such as grain size, and shape, or pore-size distribution, are used as a basis of initial selection. Most mechanically deposited sediments obviously retain directional properties such as preferred orientation of elongated grains, imbrication, *etc.*, unless substantially modified by diagenesis. This anisotropy is also reflected in their respective permeability properties. Somewhat less obvious is the occurrence of permeability anisotropy in fine-grained carbonate deposits referred to an intertidal and supratidal origin. This is surprisingly true of the uniform microsucrosic dolomites.

Silurian dolomites from the Montana subsurface demonstrate a vertically consistent dielectric and permeability anisotropy. This is based on the simultaneous solution of three equations of the form $y - h = a \sin (kx-b)$, where three permeability plugs of 120° apart are analyzed for each foot of core. Use of the sine function, calculated in the expansion identity form

$$\sin (kx-b) = \sin kx \cos b - \cos kx \sin b,$$

assumes the existence of one maximum value and one minimum value lying within 180° horizontal rotation, because permeability is a two-directional feature. The resulting calculations yield an ellipse whose major and minor axes provide a ratio equivalent to the permeability contrast based on azimuthal orientation.

Assuming that the concepts of shoreward distribution of common matrix carbonate particles in a tidal-flat complex, and local source dolomitization are valid, both primary deposition and secondary dolomitization habits would provide a condition of final permeability anisotropy. Based on remnant magnetic orientation of the described core samples, the anisotropy is shown to be concordant with presumed directions of regressive facies progression and normal to regional structural axes and small scale fracturing.

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POSSIBLE GROUNDWATER INFLUENCE ON HABITAT OF OIL IN GULF COAST

Within the geologic setting of the Gulf Coast the regional movement seaward of groundwater has a significant effect on some phases of oil and gas movement and concentration. Evidence indicates that the beginning of hydrocarbon formation comes fairly soon after deposition of the sediments.

The effects of groundwater on oil or gas accumulation may be separated into two categories: (1) accumulation in shallow, relatively unconsolidated sediments with a high water content, and (2) accumulation at greater depths where shale is at least moderately compacted and where fluid movement is mainly through sandstone, siltstone or permeable carbonate rocks. Evidence of the effects of groundwater in the first case must come mainly from studies of modern sediments and from groundwater hydrology and geochemistry. In the second case, the evidence rests on data from all phases of subsurface geology and from the history as well as the distribution of hydrocarbon reservoirs, both structural and stratigraphic.

An increased understanding of both of these categories of groundwater effects on oil or gas concentration should result in a concomitant increase in exploration efficiency and success.

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ORGANIC CARBON δ C^{13} VALUES FROM QUATERNARY MARINE SEQUENCES IN GULF OF MEXICO: A REFLECTION OF PALEOTEMPERATURE CHANGES

Variations in stable carbon isotope ratio values on combustible organic matter in Gulf of Mexico sediments correlate with Pleistocene warm and cold climates. Warm stages are characterized by C^{13}/C^{12} isotopic ratios of -20 to -22°/oo, compared with the PDB standard, whereas colder stages are characterized by -24 to -26°/oo.

Piston core samples from the present bottom show similar δ C^{13} values (-20 to -22°/oo) characterizing the warm post-glacial period regardless of bathymetric environment (shelf, slope, or abyss) except where relict Pleistocene sediments crop out (-24 to -26°/oo). Sedimentation patterns and paleontology confirm the relict nature of the latter. Samples from 1,000-ft cores on the present slope represent post-Pliocene sequences; δ C^{13} values alternate from more positive to more negative. These alternations from about -21°/oo to -25°/oo coincide with the glacial-inter-glacial stages which are independently identified by planktonic Foraminifera.

Interpretations of the data lead to the conclusion that the principal reason for the observed correlations is variation of water temperatures in the photosynthetic zone during warm interglacial climates and during cooler glacial climates. There are other alternative processes which could affect the data, one of which, the relative contribution of terrestrially-derived organic matter versus marine-derived organic matter, would change the δ C^{13} values in the same relative direction as the water-temperature variation. Thus, it is not possible to unequivocally interpret the contributions of different processes for individual samples.

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GEOCHEMISTRY OF URANIUM IN CARIACO TRENCH

The geochemistry of uranium and thorium isotopes and of protactinium was investigated in cores from the Cariaco Trench. Though the sediments could not be dated, they showed some features characteristic to anoxic basins. Uranium is a very valuable marker for geologic events.

Core P6603-2, taken at a depth of 940 m, at 10°25′N long., 64°38′W lat., spans the upper Pleistocene. At 356 cm there is a sharp break between the laminated sediments above and a homogeneous clay below. The uranium content shows a significant change at the 354–359 cm interval. The uranium present in this narrow band is only a third to a quarter of that found in the sediments above and below, whereas the thorium and protactinium contents remain constant.

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URANIUM GEOCHEMISTRY OF GULF OF MEXICO

The economic importance, the dissimilarity in chemical behavior of its two oxidation states, and the unique usefulness of its radioactive daughter products make uranium and its geochemistry extremely interesting to earth scientists. The Gulf of Mexico has the attractive feature of being a semi-closed system that offers the possibility of complete monitoring of all input and removal processes for trace elements such as uranium. Experimental values obtained in this study of the geochemical cycle of uranium in the Gulf of Mexico are as follows:

Ranges of Amounts and Isotopic Composition of Uranium

Type of Sample	*Uranium Concentration* $\times 10^{-6}$ g l	*Isotopic Composition* A_U^{235}/A_U^{238}
Gulf of Mexico profiles of surface to 3,600 m	3.4 → 3.6 ± 0.2	1.14 → 1.18 ± .03
Estuaries and bays along Gulf Coast	2.1 → 17.3 ± 0.2	1.12 → 1.54 ± .04
Midwest rivers	0.6 → 3.0 ± 0.2	1.01 → 1.44 ± .04

High uranium concentrations in midwest USA rivers relative to other rivers of the world can be explained by solubilization of the uranium in phosphate fertilizers applied to the land surface. Estimated pre-fertilizer uranium input to the Gulf of Mexico is nearly balanced by uranium co-deposition with carbonates on the Yucatan shelf.

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PLEISTOCENE DISCOASTERS FROM STRATOTYPE OF CALABRIAN STAGE (SANTA MARIA DI CATANZARO) AND SECTION AT LE CASTELLA, ITALY

Strata exposed near the town of Santa Maria di Catanzaro in southern Italy is the accepted stratotype for the Calabrian Stage (earliest Pleistocene). Although a Pliocene-Pleistocene boundary has been discussed as