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ZOOGEOGRAPHIC PROVINCES OF HOLOCENE PLANKTONIC FORAMINIFERIDA

Faunal provinces of planktonic Foraminiferida are delineated by oceanic water masses and available food supply. Species diversity decreases generally from tropical to polar waters, as well as from fertile to infertile areas. Productivity is probably higher and more continuous in tropical current systems than in subpolar regions. Test size and porosity decrease from low to high latitudes. These factors combine to yield higher accumulation rates of foraminiferal carbonate in tropical-subtropical than in subpolar-polar ocean basins (at depths above the $CaCO_3$ compensation depth).

The bipolar nature of the species distributions is evident from the reciprocal faunal zones in the northern and southern hemispheres. The Indo-Pacific fauna is richer than the Atlantic fauna. Most species (23) live in the warm-water region between approximately 40°N and 40°S lat. Tropical species, such as *Globigerinoides sacculifer* and *Globorotalia menardii,* inhabit the relatively eutrophic equatorial current systems and are transported to mid-latitudes by western boundary currents. Some subtropical species (*Globorotalia hirsuta, G. truncatulinoides, etc.*) live in the central oligotrophic areas of the oceans. Other species (*Globigerinoides ruber, Globoquadrina dutertrei, etc.*) are abundant in both tropical and subtropical latitudes, especially off continental margins. Salinity influences the distribution patterns of the 2 most successful species, *G. ruber* and *G. sacculifer.*

The northern and southern cold-water regions are inhabited by a total of only 8 species. The subpolar fauna is characterized by *Globigerina bulloides,* and left-coiling *G. pachyderma* is the sole representative of the polar provinces. Mixed assemblages of subpolar and subtropical species appear in convergence regions and areas of upwelling along eastern boundary currents.

Apparent species compositions and distribution patterns can be modified artificially by the mesh sizes of plankton net samplers.

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LATE NEOGENE STRATIGRAPHY (FORAMINIFERAL, COCCOLITH, AND PALEOMAGNETIC), UPPER COASTAL GROUP, JAMAICA, WEST INDIES

Late Neogene planktonic foraminiferal and calcareous nannofossil biostratigraphy of the Upper Coastal Group on the island of Jamaica is compared with the planktonic succession in the Gulf of Mexico and with the standard European stages and reference sections in Italy. Correlation of epoch boundaries and other paleontologic data from the Italian to the Caribbean and Gulf of Mexico regions utilizes restricted occurrences of planktonic foraminiferal and calcareous nannofossil species common to both regions. Species important for this intercontinental correlation and dating include: *Globorotalia acostaensis, Sphaeroidinellopsis sphaeroides, Discoaster challengeri,* and *D. extensus* in late Miocene; early Pliocene *Globorotalia margaritae* and *Discoaster quinqueramus;* middle and late Pliocene species of the *Globorotalia crassaformis* lineage, *Sphenolithus abies,* and *Reticulofenestra pseudoumbilica;* and appearance of *Globorotalia truncatulinoides, Helicopontosphaera* sp., and *Gephyrocapsa oceanica,* and faunal evidence for onset of climatic deterioration in early Pleistocene.

Climatic criteria obtained by analyses of the planktonic fauna provide a basis for recognition of the Pliocene-Pleistocene boundary within the most continuous and fossiliferous exposures of late Neogene marine sediments in the Gulf of Mexico and Caribbean region. On the basis of these data a sequence of planktonic foraminiferal zones and subzones is compared with the polarity reversal stratigraphy within the Gilbert, Gauss, and Matuyama geomagnetic epochs.

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CARBONATE POROSITY RELATED TO DEPOSITIONAL FABRIC —ZELTEN FIELD, LIBYA

Production from the Zelten field, Libya, is from the highly porous shelf carbonates of the Zelten Member (main pay) of the Paleocene and lower Eocene Ruaga Limestone. Fifteen facies are easily recognized, mapped, and predicted. In the Zelten field, primary and secondary porosities, recorded as high as 40%, are related to the original depositional fabric of the sediment and are, therefore, facies controlled. Porosity is best developed in the coralgal wackestone and packstone and *Discocyclina*-foraminiferal packstone and grainstone, which together form a northwest-southeast trend across the northern part of the field. Porosity is lowest in the miliolid-foraminiferal-wackestone and argillaceous bryozoan/echinoid-wackestone facies, both of which are blanketlike in distribution over the top of the field and form the cap for the reservoir. Porosity is also low in the argillaceous molluscan-wackestone facies south of and equivalent to the coralgal and *Discocyclina*-foraminiferal facies.

It is concluded that early compaction of the soft carbonate sediments determined the amount of porosity preserved in the reservoir today. The grain-supported facies were not compacted and much of the original primary porosity is presumed to have been enlarged later by leaching. However, the mud-supported facies were compacted; the original porosity was lost early and consequently, later leaching was inhibited.

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HILIGHT MUDDY FIELD—LOWER CRETACEOUS CHENIER PLAIN DEPOSITS IN POWDER RIVER BASIN, WYOMING

Thin sandstones and shales of the Muddy Formation produce large amounts of oil at Hilight field. The Muddy section is generally tight, and the best reservoir sandstones have effective porosity of 17% and average permeability of only 115 md. High production rates are caused primarily by extensive fractures, and the reservoir will yield an ultimate recovery of more than 80 million bbl of oil.

Sedimentary structures and petrographic analyses show that Muddy sands were deposited in littoral marine, lagoonal, and fluvial environments. Porous sandstones average 10 ft and rarely attain 20 ft in thickness. Lower Muddy sandstones are fluvial, whereas upper Muddy sandstones are mostly littoral or lagoonal in origin. Fluvial sandstones are associated with shales and siltstones that are highly carbonaceous and were deposited in poorly drained marshes. Lagoonal sand-