semblages in middle Miocene through Holocene sediments exposed along the Pacific Coast north of Lat. 28°N. Therefore, the sequence of tropical planktonic species commonly used to zone Tertiary sediments is difficult to utilize at the leading edge of the northern East Pacific. Nevertheless, variations in percentages and coiling directions of temperate and cool-water species, together with restricted occurrences of tropical species, allow paleo-oceanographic definition of that part of the stratigraphic record currently accepted as the Pliocene-Miocene boundary, specifically the interval from $13\text{–}10 \times 10^6$ yrs. ago.

Bathyal upper Miocene sediments exposed north of Lat. 30°N. are characterized by a subarctic to cool-temperate planktonic fauna marked by a zone of sinistral-coiling specimens of *Globigerina pachyderma*. A warm-temperate to subtropical fauna characterized by *Globigerina eggeri, G. conglomerata, Globorotalia inflata, G. menardi tumida, G. crassaformis, G. hirsuta, Globigerinoides ruber, G. triloba, G. conglobatus,* and *Sphaeroidinella dehiscens* occurs in sediments deposited at Lat. 34°N. (Repetto Formation of southern California) approximately $10\text{–}9 \times 10^6$ yrs. ago. This tropical to warm-temperate facies can be traced within a wedge of bathyal marine sediments extending north from Lat. 8°N. (Charco Azul Formation of Panama) to Lat. 47°N. (Quinault Formation of Washington). North from the equator the number of subtropical and tropical species characterizing the biofacies decreases; *Pulleniatina obliquiloculata* is absent within the biofacies north of Lat. 25°N.; *Sphaeroidinella dehiscens, Globigerina conglomerata, Globigerinoides triloba, G. conglobatus,* and *Globorotalia menardi tumida* are not present north of Lat. 35°N. At Lat. 47°N. the biofacies is marked only by dextral-coiling specimens of *Globigerina pachyderma* and rare occurrences of *Globorotalia crassaformis* and *G. hirsuta.*

The initial appearances of *Globorotalia crassaformis, G. inflata,* and *Sphaeroidinella dehiscens* are currently used to mark the Pliocene-Miocene boundary in tropical latitudes. Consequently, their first appearance possibly can be used as a correlative Pliocene-Miocene boundary in the temperate eastern Pacific. However, expansion of warm isotherms from the equatorial region during the early Pliocene can not be considered instantaneous. Indices of the tropical to warm-temperate biofacies appeared later at progressively higher latitudes. A choice must be made between utilization of a time-transgressive biologic datum or a radiometric datum for an epoch boundary. Given a framework of absolute dates, appearance and oscillation of planktonic foraminiferal faunas can be evaluated in terms of paleo-oceanographic parameters rather than emphasized as criteria for establishing highly controversial epoch boundaries.

JODRY, RICHARD L., Sun Oil Company, Richardson, Texas

PORE GEOMETRY OF CARBONATE ROCKS

In most clastic rocks a relatively simple relation exists among producibility, porosity, and permeability, depending on the degree to which size and shape of framework particles influence these factors.

Carbonate rocks do not exhibit such a simple relation. In addition to porosity between framework particles, the particles themselves may be porous. Carbonate rocks are subject to leaching, replacement, and recrystallization to a vastly greater degree than are clastic rocks. During the course of diagenesis of carbonate rocks, type and degree of porosity and permeability may be so altered that they no longer offer a satisfactory measure of the producibility of the rock. Two carbonate rocks may have identical porosities and permeabilities, with one forming a good reservoir rock whereas the other is incapable of storing or producing oil or gas. A study of the pore geometry of a carbonate rock commonly is necessary to determine whether it is capable of producing hydrocarbons.

By relating previously devised systems of classification of carbonate-rock particles, grain-size, porosity, and texture to mercury capillary-pressure measurements, a petrophysical classification has been devised which classifies carbonate rocks by producibility. Families of capillary-pressure curves are related to families of carbonate-rock types. Once such a classification has been made for a carbonate rock in a given area, it is possible to predict the shape and amplitude of its capillary-pressure curve from a visual examination of the rock.

By relating rock characteristics to depositional environments, maps may be made that predict what the producibility of rocks in an area may be. Such maps can help reduce the number of dry holes drilled in areas where anticipated closure is less than that dictated by the pore geometry required for the rocks to produce hydrocarbons.

The pore geometry of dolomitized rocks differs greatly from that of limestone. Work done in the past has led to the conclusion that dolomitization creates and then destroys porosity and permeability. In the field, rocks commonly are found which appear to invalidate this conclusion. Pore-geometry studies indicate that the time during diagenesis at which dolomitization occurs and the original petrographic characteristics are the critical factors that determine whether dolomites will develop into reservoir rocks capable of hydrocarbon production.

JONES, JAMES I., Institute of Marine Science, University of Miami, Miami, Florida

SIGNIFICANCE OF DISTRIBUTION OF PLANKTONIC FORAMINIFERA IN EQUATORIAL ATLANTIC UNDERCURRENT

The relation between distribution of living planktonic Foraminifera species and selected elements of the equatorial Atlantic current system has been investigated through the use of depth-controlled, opening-closing net, quasi-synoptic plankton samples, as well as hydro-casts, S-T-D lowerings, and direct current measurements. Physico-chemical data collected with the biologic samples were used to define major biotopes within the current system. They showed salinity variation to be one of the most important factors affecting foraminiferal distribution and temperature variation to be of lesser importance; variations in salinity as small as 0.5 ppt. appear to exert strong influence on population variation within the planktonic Foraminifera. Because of such sensitivity, planktonic Foraminifera may be very useful as water-mass indicators in studies of oceanic-current and circulation patterns.

JONES, H. LLEWELLYN, Saskatchewan Department of Mineral Resources, Regina, Saskatchewan, Canada

SOME ASPECTS OF SEDIMENTATION AND PALEOECOLOGY OF MIDDLE DEVONIAN WINNIPEGOSIS FORMATION OF SASKATCHEWAN, CANADA

The Middle Devonian Winnipegosis Formation of Saskatchewan is divisible into upper and lower mem-