COMPARISON OF QUARTZ AND CARBONATE SHALLOW-MARINE SANDSTONES, CRETACEOUS FREDERICKSBURG, CENTRAL TEXAS[1]

The lower Fredericksburg Cretaceous of central Texas contains two shallow-marine sandstone deposits of similar shape but of contrasting lithology, genesis, and porosity trend.

The lower sandstone (Paluxy) is part of the initial clastic phase of the lower Fredericksburg depositional cycle and is composed predominantly of quartz sand and clay. It occurs as a tongue which projects southward from the main body of the Paluxy Formation. The tongue was deposited by longshore currents, modified shoreward by wave swash and tidal action, in a coastal near-shore marine environment. The trend of the tongue is controlled by the position of the shoreline and by the configuration of the sea floor.

The upper sandstone (Whitestone Member of the Walnut Formation) is the terminal phase of the lower Fredericksburg cycle and is composed entirely of carbonate grains. The Whitestone is an elongate, mound-shaped body of calcarenite trending northwest. It was deposited in an agitated, offshore, shallow-marine environment by northwest-southwest-trending marine currents which were modified locally by surge channels normal to this trend. The trend of the mound is controlled by linear shoal areas.

14. LEE A. SMITH, Esso Production Research Company, Houston, Texas

PALEOENVIRONMENTAL VARIATION CURVES AND PALEOEUSTATICS

In Tertiary and Quaternary marine environments, temperature, salinity, temperature stability, and substrate probably were the most important natural forces influencing the distribution of benthonic organisms. The notable sensitivity of organisms to the interaction of a multiplicity of environmental controls results in distribution patterns which generally may be related to water depth. Temperature and "water depth" are, at present, the most important factors which lend themselves to objective statistical procedures for use in stratigraphic paleoecology and for interpretation of paleoeustatic changes.

Environmental changes occurring during deposition can be recognized and used for constructing one or more curves that diagrammatically represent local variation in the several controlling factors in the ancient environments. Detected cyclical phenomena are useful as aids to correlation. Separate relative paleo-water-depth and paleotemperature curves may be derived similarly from analyses of sequential assemblages collected from a single section.

Relative paleo-water-depth curves reflect the local balance between sedimentation and subsidence rates and any eustatically controlled variation in sea-level. Such curves are useful in correlating separate sections within a "basin" of deposition, however complex the distribution of facies.

Relative paleotemperature curves mainly reflect current shifts, changes in landmass configuration, and major alterations of world climates. Paleotemperature curves are useful aids to correlation within a "basin" of deposition and probably are useful between adjacent basins.

If eustatic control is known to dominate, the cyclical phenomena can be used in correlating for relatively great distances. The major control, however, can not be determined accurately from either paleo-water-depth or paleotemperature curves alone. The degree of coincidence between the paleo-water-depth and paleotemperature curves for the marine Pleistocene section suggests the derivation of a third curve (paleoeustatic-change curve) that more nearly reflects relative paleoeustatic changes. The proper use of paleoeustatic-change curves will improve interbasinal correlations and should aid in intercontinental correlations.

The application of these proposed procedures to subsurface sections in southern Louisiana suggests several generalizations concerning the marine Pleistocene. The lowest temperatures were recorded for Nebraskan and late Wisconsin (Woodfordian) glacial phases, whereas the highest temperatures for the Quaternary occurred during Yarmouth interglacial time. Higher temperatures than exist at present are indicated for the Aftonian, Yarmouth, and Sangamon stages and during late Wisconsin (Twocreekan) time. Marine faunal evidence, although limited, suggests that the "late Wisconsin-early Recent" section, as commonly defined, has definite characteristics of a fifth interglacial stage.

Seemingly, evidence from marine sections confirms the importance of the interglacial Twocreekan Stage, as recently defined, and suggests that the effects of this stage may have been more widespread than those of the Farmdalian or "Bradyan" of authors.

15. DON R. ANDERSON, Union Oil Company of California, Houston, Texas

BIOSTRATIGRAPHY OF VICKSBURGIAN EQUIVALENT AT TOLEDO BEND DAM SITE, LOUISIANA AND TEXAS[1]

This is a study of Foraminifera and, to a limited extent, Ostracoda recovered from cores from five stratigraphic test holes drilled along the proposed site of Toledo Bend Dam in Sabine Parish, Louisiana, and Newton County, Texas. The purpose of the study was to compare faunules from that portion of the sediments in the test holes considered to be Jacksonian (Eocene) and Vicksburgian (Oligocene) with faunules reported from type sections in Mississippi and western Alabama. The section studied is about 350 ft. in thickness.

On the basis of 113 species and subspecies of foraminifers and 14 species of ostracods recovered from 27 core samples, time-stratigraphic and biostratigraphic relations between the sediments in west-central Louisiana along the Sabine River and sediments from some classic outcrops of the Jacksonian and Vicksburgian in Mississippi and western Alabama are proposed: (1) the Danville Landing beds, Mosley Hill Formation, Sandel Formation, and Nash Creek Formation are considered to belong to the *Spondylus dumosus* zone introduced by Cheetham in 1957 for a series of beds in Florida and Alabama; (2) within the assemblage zone characterized by *Spondylus dumosus*, the Danville Landing beds are closely related or equivalent to the *Cribrohantkenina "danvillensis"* subzone as used by Deboo (1963, Ph.D. dissert., L.S.U.) and the Mosley Hill, Sandel, and Nash Creek Formations are related to the *"Cythereis" blanpiedi* subzone introduced by Deboo; and (3) the Jacksonian-Vicksburgian and Eocene-Oligocene boundaries are considered to coincide with the boundary between the Danville Landing beds and the Mosley Hill Formation; this boundary can be recognized only on the basis of paleontologic evidence.

A systematic treatment of the species identified is not

[1] Exploration and Production Research Division Publication No. 413.

[1] Master's thesis, Department of Geology, Louisiana State University, Baton Rouge, Louisiana.

presented because all of those recovered from the sediments examined are described and illustrated in the literature.

16. GENE ROSS KELLOUGH, University of Houston, Houston, Texas

PALEOECOLOGY OF FORAMINIFERA FROM THE WILLS POINT FORMATION (MIDWAY GROUP) IN NORTHEASTERN TEXAS

The last large-scale transgression of the Tertiary seas in northeastern Texas began with the deposition of marine clays of the Wills Point Formation (upper part of Midway Group) on the carbonate sediments of the Tehuacana Member of the Kincaid Formation (basal part of Midway Group).

The Wills Point Formation, divided into basal Mexia Member, Kerens Member, and upper Solomon Creek Member, has been studied from shallow-well and outcrop sections in an attempt to interpret the paleoecology of the Foraminifera and to delineate the boundaries of the members. Paleoecologic interpretations are based on: (1) the number of species of Foraminifera per sample; (2) the number of specimens per 1-gram sample; and (3) the characteristic dominance of the fauna, whether benthonic or planktonic.

By employing the criteria set forth by Walton (1964), that a decrease in number of species of Foraminifera indicates an approach toward marginal-marine conditions and an increase in numbers of species indicates a marine transgression, the writer postulates that at the beginning of deposition of Mexia sediments, sea-level increased gradually in depth with open-marine conditions prevailing. A maximum depth of no greater than 50 fm. is indicated for the section up to 150 ft. above the Tehuacana Member. Above this level, a gradual shallowing of water is indicated until, 330 ft. above the Tehuacana, the water was less than 10 fm. deep.

The decrease in number of species and the increase in dominance of the *Haplophragmoides-Ammobaculites* fauna suggests that marginal-marine conditions of an intertidal to 2-fm.-deep facies existed from 330–460 ft. above the Tehuacana.

A further regression with fluctuating brackish to nonmarine conditions caused the deposition of thin-bedded glauconitic sandstones between cross-bedded massive sandstones, and large flat-topped ferruginous concretionary layers 12–24 in. thick. At the top of the section studied, 687 ft. above the Tehuacana member, a thin section of gray clay containing an arenaceous fauna of five species was deposited in shallow brackish water.

The upper boundary of the Mexia Member of the Wills Point Formation is placed approximately 180 ft. above the top of the Tehuacana Member where the abundance of planktonic Foraminifera decreases to 6% and, with one exception at 360 ft., stays at or below that figure.

The upper boundary of the Kerens Member is placed at the top of the continuous shallow- to brackish-water, wholly arenaceous fauna. The brackish to non-marine, non-foraminiferal section above is included in the Solomon Creek Member, whose upper boundary can not be determined. The massive sandstone and overlying bed of *Ostrea duvali*, which form the Caldwell Knob Member at the base of the Wilcox Group, are not present along the Trinity River in the Navarro-Henderson Counties area.

17. PAUL F. HUDDLESTON AND LYMAN D. TOULMIN, Florida State University, Tallahassee, Florida

UPPER EOCENE-LOWER OLIGOCENE STRATIGRAPHY AND PALEONTOLOGY IN ALABAMA[1]

Southeastern Alabama, where the clastic upper Eocene and lower Oligocene beds from the west grade into and interfinger with the equivalent limestone beds toward the east, is an area of deep weathering. Exposures are lacking except along the rivers and major streams, where complete unweathered geologic sections can be studied from a small boat. Study of these sections where the two lithosomes and their distinctive fossils mingle has resulted in a better understanding of the stratigraphic relations and correlation of upper Eocene and lower Oligocene strata between Mississippi and Florida.

The Moodys Branch Formation can be divided into a lower and an upper member in southeastern Alabama, the lower member being the *Periarchus lyelli* assemblage zone. The lower member is correlated with the Inglis Formation in Florida and the upper member with the Williston Formation. The members of the Yazoo Clay can be traced eastward into southern Alabama, where they merge into the Crystal River Formation, the "Ocala Limestone" of early reports. The upper member of the Yazoo (Shubuta Clay Member) is correlated with the upper part of the Crystal River (*Asterocyclina* assemblage zone) exposed in the vicinity of Marianna, Florida. The Red Bluff Clay is correlated with the Bumpnose Limestone that overlies the Crystal River Formation in the Marianna area. Like the Bumpnose, it contains the guide fossil *Lepidocyclina chaperi* Lemoine and Douvillé in exposures near Perdue Hill, Alabama.

18. JOHN. J. W. ROGERS AND JUDITH C. LONGSHORE, Rice University, Houston, Texas

LATE PLEISTOCENE AND RECENT HISTORY OF PORTION OF COLORADO RIVER VALLEY OF TEXAS

The modern valley of the Colorado River near Columbus and Eagle Lake is incised into terraces representing depositional surfaces of early Pleistocene sediments. The terraces which normally are cut landward from the deltaic shoreline areas have been accentuated by continued Pleistocene uplift along a down-to-the-basin fault crossing the river near Eagle Lake. Extensive deposition of coarse materials in the sag downstream from the fault has steepened stream and terrace gradients in comparison with gradients above the fault. The present river is progressively moving coarse materials downstream from earlier deposits.

19. KENNETH J. LOEP, Mobil Oil Company, Houston, Texas

STUDY OF ECOLOGY AND DISTRIBUTION OF RECENT FORAMINIFERA IN NORTHWESTERN GULF OF MEXICO[2]

Eight different stations in the Gulf of Mexico from 3–3,300 ft. in depth were studied in detail in an attempt to group the foraminiferal assemblages found at each station into useful ecologic indicators. It was found that four ecologic provinces are present from the shore to the lower edge of the continental slope: (1) beach and nearshore environment; (2) continental shelf; (3) continental slope; and (4) a shallow, clear, warm-water, calcareous environment (found on Stetson Bank). These environments are controlled by a combination of chemical

[1] Field expenses for the project were furnished by the Geological Survey of Alabama, and other financial assistance and a boat were provided by National Science Foundation grant G-13356. This assistance is gratefully acknowledged.

[2] Socony Mobil Oil Company, Inc., granted permission for publication of this work.