TRESSLAR, R. C., and C. W. POAG, Dept. Oceanography, Texas A&M University, College Station, Tex.

LIVING FORAMINIFERA OF WEST FLOWER GARDEN BANK

The West Flower Garden Bank is a calcareous prominence on the outer edge of the Texas-Louisiana continental shelf, rising to within 20 m of the sea surface. An actively growing fauna of West Indian scleractinian corals caps the top 30 m of the bank, and represents the northernmost known flourishing coral reef in the Gulf of Mexico.

The bank supports a foraminiferal fauna related to that present on the West Indian and Florida-Bahamian reefs. Within the sediments most species and individuals are attached to coarse sedimentary particles, rather than being free tests. The largest populations are attached to large scleractinian colonies in the upper part of the bank and to algal nodules that occur at a depth of 46-82 m.

TYRRELL, W. W., Jr., Amoco Production Co., New Orleans, La.

DENKMAN SANDSTONE MEMBER—IMPORTANT JURASSIC RESERVOIR IN MISSISSIPPI, ALABAMA, AND FLORIDA

A clean, generally well-sorted, commonly porous, Jurassic sandstone separates marine lower Smackover carbonate mudstone from nonmarine redbeds of the Norphlet Formation in parts of southern Mississippi, southwestern Alabama, and northwestern Florida. Various workers have considered this sandstone unit to be marine, nonmarine, or a combination, and have called it basal Smackover, Norphlet, or Denkman. "Denkman sandstone" was proposed for this unit by Murray, who designated the Lion No. 2 Denkman, Sec. 22, T17N, R4E, Rankin County, Mississippi, as the type section. The Denkman locally exceeds 1,000 ft in thickness and is a lithologically distinct, mappable unit. Nevertheless, it is included in the Norphlet Formation by the industry and in this paper it is called the Denkman Sandstone Member of the Norphlet Formation.

The Denkman is overlain generally without gradation by nonsandy basal Smackover carbonates, but is gradational downward into redbeds, the more characteristic lithology of the Norphlet. Regionally, the Denkman grades updip into conglomeratic redbeds interpreted to be alluvial fan and fluvial deposits. The Denkman sand typically consists of well-sorted, fine- to medium-grained, rounded and commonly frosted, quartz grains with some feldspar, chert, and rock fragments. The section is commonly crossbedded and does not contain fossils or carbonate beds. The Denkman usually has good permeability and intergranular porosity ranges up to 25%. Unlike sandstone beds in the Smackover, the Denkman rarely contains carbonate cement. The Denkman sandstone is reddish in its lower part and may contain some thin shaly beds. Regional distribution of the Denkman suggests a sand source on the north and east. Stratigraphic relations, lithology, and sedimentary structures suggest a nonmarine fluvial to eolian origin for most of the Denkman sandstone. Locally the uppermost part has been reworked during Smackover transgression. The Denkman Sandstone Member marks the top of the Werner Anhydrite-Louann Salt-Norphlet Formation deposition cycle.

The Denkman sandstone commonly has excellent reservoir properties and has been found productive at the Pelahatchee, Prairie Branch, Archusa Springs, East Nancy, South State Line, Big Escambia Creek, Flomaton, Little Escambia Creek, Jay, and Blackjack Creek fields. It is and will continue to be an important exploration objective along the southeast part of the Jurassic trend.

VAN MORKHOVEN, F. P. C. M., Shell Oil Co., New Orleans, La.

BATHYMETRY OF RECENT MARINE OSTRACODA IN NORTHWEST GULF OF MEXICO

Holocene bottom samples from the northwest Gulf of Mexico, examined for their Ostracoda faunas, yielded a total of 171 species. A large majority of them have never been described. The number of species per sample varied from 2 to 40; the richest and most diversified faunas occur in middle to outer shelf environments. Numerous species exhibit rather restricted depth ranges, and distinctly different faunal assemblages characterize the various bathymetric environments from shallow freshwater lakes and bayous down to the abyssal depths of the Sigsbee Deep. A bathymetric chart illustrates that at the generic level there exists a marked diversity of faunal composition at different depths.

A pronounced relation has been noted between the size of 2 common species of *Echinocythereis* and the depth at which they were collected. A similar connection was observed in 12 species of the genus *Krithe*.

The results of this study will be of considerable use in evaluating the paleoecologic significance of the rich, ostracod assemblages commonly found in the clastic Tertiary and Upper Cretaceous deposits of the Gulf Coast area.

VISHER, G. S., Univ. of Tulsa, Tulsa, Okla.

ENVIRONMENTAL CRITERIA—THEIR USE AND MISUSE

Recent advances in sedimentology have made it possible to reconstruct and identify closely associated environments. Tables of environmental criteria for deltaic, shoreline, and marine environments are based upon modern analogues. Preliminary log and sample data generally only suggest environmental interpretations. Characteristics of channeling, marine wave and current patterns, and shoreline processes are identifiable only with a range of data from logging programs, cores, and core slices.

Stratigraphic study of genetic depositional units provides the basis for stratigraphic exploration. The areal and vertical patterns of sedimentary units are closely related and consequently patterns of reservoirs, source beds, and trapping lithologies can be determined. These are related to local structure, and oil and gas trend plays can be recognized and developed on the basis of this type of information.

Exploration for stratigraphic traps requires an understanding of the genesis of the target reservoir unit. Environmental interpretations utilizing incorrect depositional models, incomplete studies of modern examples, or the absence of a multiple approach will lead to incorrect interpretations.

WALPER, J. L., and C. L. ROWETT, Dept. Geology, Texas Christian Univ., Fort Worth, Tex.

PLATE TECTONICS AND ORIGIN OF CARIBBEAN SEA AND GULF OF MEXICO

Previously published reconstructions of the late Paleozoic "fit" of crustal plates and continents fail to explain many geologic features present in the southwestern U. S., Mexico, Central America, and northern South America. In particular, they fail to consider major geologic and tectonic continuities of Paleozoic age observable in the Southern Appalachians, the Ouachita and Marathon fold belts, the fold belts of southern Mexico and Central America, and the eastern Andean mountain belt of northern South America, as well as the significance of many major transcurrent fault systems or megashears that cross these regions.

With the well-documented joining of Africa-North America as a control for the positioning of South America relative to North America, this report suggests a somewhat different "fit" than any heretofore proposed. Instead of truncating North America in northern Mexico and filling in the Gulf of Mexico with fragments as is most commonly done, this reconstruction wraps Mexico and Central America around the western margin of South America, thus placing in juxtaposition the major tectonic belts of both continents. There is evidence that indicates that the Late Ordovician Taconic orogeny was an arc-continent collision rather than a continent-continent collision as has been suggested previously. Similar evidence indicates that the late Paleozoic Ouachita and Marathon orogenies were arc-continent collisions. Correlative periods of deformation for both of these orogenies have been documented from many places in northern and northwestern South America.

The early Paleozoic history of the Cordilleran mobile belt appears to have been independent from that of the eastern mobile belt. In the late Paleozoic, however, these mobile belts seem to have become coupled tectonically to produce regional stresses that were released along several major megashears. In southern and southwestern North America these include the Wichita and Texas megashears; a third megashear is probably present in northern Mexico. Late Paleozoic movement on these fault zones produced numerous basins and uplifts throughout these regions.

Modifications of the model proposed by Malfait and Dinkleman for the origin of the Caribbean region include the opening of a sphenochasm in the Gulf of Honduras, and regional tensional and compressional stresses resulting from the clockwise rotation of North America. The Gulf of Mexico and the present dislocated positions of the Ouachita and Marathon fold belts are the result of an opening sphenochasm under the present Mississippi embayment and the westward displacement of the Ouachita and Marathon fold belts by left lateral movement on the Wichita and Texas megashears.

WEAVER, F. M., and S. W. WISE, Florida State Univ., Tallahassee, Fla.

Chertification Phenomena in Antarctic and Pacific Deep-Sea Sediments—A Scanning Electron Microscope and X-Ray Diffraction Study

Diagenetic sequences leading to the formation of deep-sea chert have been studied in drill and piston core samples taken in the Antarctic and Pacific Oceans. A pure white chert cored at the base of a Neogene diatom-radiolarian ooze sequence on the Kergulean Plateau (Southern Ocean) contains no volcanic alteration products and was derived solely from the solution and reprecipitation of biogenous opaline silica. The chert consists entirely of alpha-cristobalite spherules (5-10 microns in diameter) with some strongly etched fragments of siliceous microfossils.

Cristobalite spherules identical with those reported from the Antarctic, as well as the Atlantic and Caribbean Ocean basins, are present in Upper Cretaceous and Tertiary cherts and silicified limestones of the equatorial Pacific Ocean basin. Diagenetic sequences involving the replacement of carbonate microfossils and ooze matrix have been traced via scanning electron microscopy. A typical replacement sequence is: (1) cristobalite spherules are deposited within the interstices of coccolith oozes and chalks; (2) concomitantly, calcareous nannofossils begin to dissolve, thereby producing additional pore space (some calcite is lost to the rock, but some is reprecipitated within the interstices as euhedral crystals up to 10 microns in diameter); and (3) more cristobalite is precipitated while more calcite is dissolved. The process continues until the calcite matrix is completely replaced by cristobalite.

Foraminifera tests in the calcareous ooze apparently recrystallize or are dissolved outright. Cristobalite spherules are deposited within molds or within the recrystallized test. Finally, the recrystallized tests are dissolved leaving a cast of cristobalite.

In all samples studied, cristobalite was deposited as an authigenic mineral by means of inorganic chemical precipitation. In no place was a gel phase observed, and none is thought to exist in the formation of deep-sea chert.

WEIDIE, A. E., and J. A. WOLLEBEN, Dept. Earth Sci., Louisiana State Univ., New Orleans, La., and E. F. McBRIDE, Dept. Geol. Sci., Univ. of Texas at Austin, Austin, Tex.

Late Cretaceous Depositional Systems in Northeastern Mexico

The Parras and Sabinas basins in Coahuila and Nuevo León and the Ojinaga basin in northeastern Chihuahua were the principal sites of Late Cretaceous sedimentation in northeastern Mexico. Comparative study of these basins provides insight into the Late Cretaceous geologic history of the area. Interbasin similarities suggest first-order regional patterns; whereas, differences are the product of second-order local causes.

The three basins contain a similar sequence of deltaic deposits that show the same sense of progradation (west to east). The deltaic sequence is older (Campanian) in the Ojinaga basin and younger in the Parras and Sabinas basins (Campanian and Maestrichtian). Regional uplift, continuous sediment input, and shifting depositional sites from Campanian through Maestrichtian time produced these eastward shifting deposits.

The deltaic sequence differs from basin to basin. It is 1,000 ft thick in the Ojinaga basin, 3,000 ft thick in the Sabinas basin, and 10,000 ft thick in the Parras basin. Coal deposits are part of the sequence in the Ojinaga and Sabinas basins, but are absent in the Parras basin. Sediments in the Ojinaga and Sabinas basins were deposited during a single major progradational event; whereas the sediments in the Parras basin were deposited during multiple progradational and retrogradational cycles. These differences in the anatomy and thickness of the depositional sequences were produced by local tectonic events. The relatively thin, deltaic sequence with associated coal deposits of the Ojinaga and Sabinas basins suggests low subsidence rates together with low sediment input rate in these areas. The thick, cyclic, noncoal-bearing, progradational-retrogradational sequence of the Parras basin suggests a high rate of subsidence and sediment input concomitant with tectonic instability south and west of the depositional area.

WILSON, D. P., and J. E. MELTON, Mobil Oil Corp., Corpus Christi, Tex.

Paleostructural Analysis of Old Ocean Field

The petroleum geologists' search for energy sources leads him to prospective areas where he conceives structural or stratigraphic traps. This is only the beginning, however, for in order to understand and delineate the potential of an area one needs a clear and concise concept of the depth-burial-migration sequence of the prospect. In an effort to clarify and relate this concept to future prospects, the Old Ocean field has been analyzed.

Significant hydrocarbons are absent in pre-F-21 sands. The F-21 is local nomenclature for a producing sand body found approximately 300 ft below the top of the lower Frio.

One gas-condensate reservoir (F-21) and one oil reservoir (F-12) with a sizeable gas cap were analyzed by following their structural development from the time of earliest closure to the completion time of hydrocarbon migration.

In the F-21 reservoir, a small anticlinal trap was available to migrating hydrocarbons as early as the time of deposition of the F-19 sand. In the F-12 reservoir, closure was established by the time of deposition of the *Nodosaria blanpiedi* marker. Migration could have started this early, provided a supply of hydrocarbons was available.

On the basis of the size of the traps then available, the depth of burial at that time, and the associated pressure-volume-temperature relations, it was deduced that accumulation in both reservoirs could have been completed by the beginning of Miocene deposition, but not much earlier. This time coincides approximately with cessation of movement on the principal fault.

The structure was in an area of drainage large enough and sufficiently rich in hydrocarbon source rocks to provide the known reserves. It is further concluded that a trap existed at such time as physical and chemical conditions permitted release of oil and gas from the source material, and they became free to migrate.