

near Dinosaur National Monument includes: (1) large-scale tabular-planar cross-stratified units with many low-relief, asymmetric ripples oriented up and down slip-face deposits; (2) raindrop imprints on slip-face deposits; (3) contorted stratification, lamination style, and burrowing in the Weber match those of modern eolian deposits; (4) well-sorted quartz sandstones interbedded with poorly sorted, micaceous siltstones and conglomerates at Rangely oil field; interpreted to be interbedded eolian dune and fluvial sediments respectively; (5) consistent southward transport directions in the Weber Sandstone considered more compatible with a wind-driven depositional system than a marine depositional system; (6) the general lack of appreciable clay or chert in the study in contrast to the occurrence of these minerals in marine rocks of the Weber farther west; (7) thin lenticular carbonate rocks (commonly only 0.30 to 0.60 m thick) restricted to extensive diastems indicating deposition in nonmarine ponds associated with interdune areas; and (8) striking differences between the lenticular, brecciated, nonfossiliferous dolomites in the Weber Sandstone here and the thick, fossiliferous cherty limestones of equivalent age in marine deposits within the Weber and the older, underlying Morgan Formation elsewhere.

Shortly after deposition, the eolian deposits of the Weber Sandstone became saturated with water and were then subjected to penecontemporaneous deformation, which produced complex folding and breaking of laminations.

FUNKHOUSER, L. W., Standard Oil of California, San Francisco, CA, and F. X. BLAND and C. C. HUMPHRIS, JR., Chevron U.S.A., Inc., New Orleans, LA

Deep Tuscaloosa Gas Trend of South Louisiana

The deep Tuscaloosa gas trend of south Louisiana is one of the most significant exploration plays in the United States in recent years. This trend, productive from an expanded Tuscaloosa sand-shale sequence of Late Cretaceous age, covers a band approximately 30 mi (48 km) wide and 200 mi (322 km) long, from the Texas line on the west and extending past Lake Pontchartrain on the east.

Regional studies initiated by Chevron in 1964 demonstrated the probability of an unexplored sedimentary section lying just to the south of the Lower Cretaceous carbonate bank edge which crosses south Louisiana. Improved regional seismic data later verified the presence of such a unit, located between reflectors identified as Upper Cretaceous chalk and Lower Cretaceous carbonate rocks.

The discovery well of the Tuscaloosa wedge was drilled at False River area in May 1975, where Chevron tested 20 MMcf of gas per day from a sand at 19,800 ft (6,035 m) in the No. 1 Alma Plantation, 15 mi (24 km) northwest of Baton Rouge. Chevron confirmed the trend in December 1975, by discovering Rigolets field, 125 mi (201 km) to the southeast.

The productive section of the Tuscaloosa is interpreted to be a shallow-water deposit that has been built by progradation southward across the Lower Cretaceous

carbonate bank edge. Down-to-the-south faulting in this expanded section, along with deep-salt movement, has produced most of the structural features that are now productive from the Tuscaloosa.

Fifty-two exploratory wells have been completed to the present along the Tuscaloosa trend, resulting in the discovery of 14 fields. Proved plus potential reserves discovered through September 1979 are estimated to be approximately 4 Tcf of gas.

GAGOSIAN, ROBERT B., Woods Hole Oceanog. Inst., Woods Hole, MA

Early Transformation Reaction of Steroids in Marine Environment

Several processes control the distribution of organic compounds in recent sediments, including biologic production and consumption, geochemical and biologic transport processes, and chemically and biochemically controlled transformation reactions. In transformation reactions of specific biogenic organic compounds, steroids illustrate the reactivity and organic compounds which contain "biologic markers."

Steroid alcohols (sterols) can degrade through several possible chemical or microbiologic pathways in sediments to produce steroid ketones (stanones), reduced alcohols (stanols), and hydrocarbons (sterenes and steranes). Two marine sedimentary environments describe some of the potential mechanisms of the transformation pathways involved: (1) the highly productive upwelling areas of Walvis Bay, South Africa, and (2) the strongly reducing conditions of the Black Sea.

GALLAGHER, J. J., Cities Service International, Houston, TX, and MARTHA O. WITHJACK, Cities Service Research, Tulsa, OK

Basement Tectonics of China—Continental-Scale Cataclastic Flow

The basement rock of China deforms by cataclastic flow because at the continental scale (10^3 km) China maintains the continuity during deformation necessary for flow. Moreover China's constituent basement elements undergo cataclasis because they rearrange by brittle mechanisms in response to compression in the west and extension in the east. Structures, sedimentologic patterns, and earthquakes suggest brittle basement elements at two scales which are distinguished by their mechanical behavior. Larger elements have characteristic dimensions of 10^2 km and behave as rigid blocks. Smaller brittle elements, 10 km and smaller, occur in zones with flow characteristics at the scale of 10^2 km. Clay models support the interpretation of flow for China as a whole and for ductile zones in particular. The geology of China is used as a guide to prepare clay models and pieces of wood to simulate rigid basement elements. The space between the pieces is filled with clay which simulates zones of ductile basement and both the wood and the clay are covered with a layer of clay which simulates sedimentary rock cover. Wood blocks are moved in a sequence, in directions, and for distances suggested by the tectonic history of China. The resulting location, trend, type, and relative degree

of development of clay structures bear remarkable similarities to the structures of China. A few examples are intensely deformed clay analogous to the central China foldbelt, undeformed clay analogous to the Tarim, Ala Shan, Ordos, and other stable areas, and intensely deformed and elevated clay analogous to the upthrusts surrounding the stable areas of China.

GALLOWAY, WILLIAM E., CHRISTOPHER D. HENRY, and GARY E. SMITH, Bur. Econ. Geol., Univ. Texas, Austin, TX

Hydrostratigraphic Framework and Flow Dynamics of Uraniferous Aquifer—Oakville Sandstone of South Texas Coastal Plain

Synthesis of geologic, hydrochemical, and hydrologic data for the Oakville Sandstone provides a framework for effective hydrochemical exploration, leach mine planning, and evaluation of mining impact.

Quantitative lithofacies maps were combined with structural and well-pump test data to produce a regional Oakville transmissivity map. Interpreted groundwater flux patterns within the resultant three-dimensional transmissivity framework were mapped, and quantitatively illustrate several hydrodynamic principles.

(1) The complete groundwater system includes meteoric, elisian (compactional), and thermobaric connate zones. Boundaries separating zones are dynamic and evolve through time.

(2) Recharge of meteoric systems occurs directly at outcrop by seepage through overlying confining units, and by seepage from underlying aquifers.

(3) Flow occurs within a hierarchy of cells, ranging from unconfined local ($n \times 10$ sq mi) to intermediate confined ($n \times 10^3$ sq mi) to regional confined ($n \times 10^4$ sq mi) flow cells. Shallow groundwater may move in any direction with respect to dip.

(4) Discharge occurs by direct groundwater flow upward to the water table and by vertical seepage, commonly localized by fault zones, into adjacent aquifers.

(5) Topography and the three-dimensional permeability framework localize recharge and discharge zones and control flow direction. Recharge occurs in topographically high areas; discharge in lowest areas.

Groundwater flux in the Oakville is highly complex. Major uranium deposits occur within the realm of local (Ray Point district), intermediate (George West district), and regional (Duval County) flow cells. Extant flow direction commonly does not agree with geochemically-inferred mineralization-front polarity.

GARDNER, G. H. F., Gulf Research and Development Co., Pittsburgh, PA

New Dimensions in Seismic Exploration

The current price of crude oil makes it practical to explore for smaller reservoirs using more expensive techniques. Several techniques are discussed in this lecture which would not have been possible ten years ago for both economic and technical reasons.

Three-dimensional seismic methods add new dimensions to the amount of data collected, processed, and interpreted. Examples are given of 3-D field data and interpretations.

Signbit data recording adds a new dimension to the number of seismic traces that can be recorded, with a loss of amplitude information. Examples of field and model data are used to illustrate some of the advantages and disadvantages of this technique.

Color displays add a new dimension to the information content of a seismic cross section. Examples are shown of some conventional and unconventional displays.

Attributes other than amplitude and phase are shown to have promise in locating hydrocarbons.

GARDNER, J. V., U.S. Geol. Survey, Menlo Park, CA, et al

Hydraulic Piston Coring in Equatorial Pacific—Preliminary Results from DSDP Site 503 (Leg 68) Indicate Continuous Section of Undisturbed Late Neogene and Quaternary Sediment

Deep Sea Drilling Project Site 503 was cored, using the Hydraulic Piston Corer, at the location of Site 83 on the north flank of the Galapagos Rise. Two holes were cored to a total depth of 235 m and a section was recovered which represents approximately the past 8 m.y. The upper 100 m (Holocene through mid-early Pliocene) is virtually complete whereas below 100 m (to late Miocene) about 70% of the section was recovered. The sediment is a uniformly siliceous calcareous ooze with carbonate and color cycles throughout. These cycles have periodicities from 20,000 to 40,000 years per cycle. Clay content remains fairly constant at low percentages to 226 m but then abruptly increases to greater than 25%. This increase is thought to be the result of hydrothermal activity or weathering of the igneous basement or both. The section is highly undercompacted, which is thought to result from a significant percentage of diatoms.

Aboard ship we were able to identify most magnetostratigraphic boundaries above the Gauss-Gilbert. Sedimentation rates are about 4 cm/k.y. from lower Pliocene through mid-Pliocene but decrease to 1.5 to 2.5 cm/k.y. for the mid-Pliocene through Quaternary. Calculated bulk accumulation rates steadily decrease from late Miocene to late Quaternary with a distinct event of low accumulation rates in mid-Pliocene. This event may be a reflection of the emergence of the Isthmus of Panama.

The high accumulation rate and high quality of these cores provide the most detailed stratigraphic record of the past 8 m.y. available from the equatorial Pacific.

GAUTIER, DONALD L., U.S. Geol. Survey, Denver, CO

Physical Characteristics of Shallow Methane Reservoirs of Northern Great Plains

Sedimentary rocks deposited during the Upper Cretaceous Eagle-Telegraph Creek regression provide an excellent opportunity to examine shallow biogenic gas reservoirs in the northern Great Plains.

In central Montana, coastal sandstones of the Eagle Sandstone are highly porous (25%) and permeable (200 to 300 md) conventional reservoirs. Reservoir quality is adversely affected by the formation of authigenic min-