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DOLLAR BAY FORMATION OF EARLY CRETACEOUS (FREDERICKSBURG) AGE IN SOUTH FLORIDA

The slowly subsiding, low-dip, South Florida basin centered on Florida Bay was an area of carbonate and evaporite deposition. Several structural features mapped in the basin during the study include the Charlotte high (Charlotte County), the Martin high on the northeast, the Largo high in the southeast, and the Pine Key arch in the south. The Broward trough and the center of the basin are the only persistent negative features. Neither the Lee-Collier swell, a very low and ephemeral feature extending offshore from the southwest part of the peninsula, nor the Forty Mile Bend high in the lower part of the peninsula, are persistent.

The common types of limestone, dolomite, and anhydrite textures occur in a series of cycles within the so-far nonproductive Dollar Bay Formation. A cycle typically culminates in porous calcarenite between anhydrite end members. Environments from shallow shelf to euxinic are present. Light carbonates usually occur over highs and dark carbonates in the structurally low areas.

The Dollar Bay Formation is 450 ft thick and consists of 4 units. All contacts above, below, and within the formation are conformable. The formation contains many zones of porosity; numerous oil shows have been reported.

Unit D at the base of the Dollar Bay consists of a single cycle about 55 ft thick. The favorable facies usually is a dark-brown, finely crystalline dolomite with intercrystalline porosity. Five poor shows of oil have been recorded in this unit.

The overlying unit C is a single sedimentary cycle averaging 325 ft thick, consisting characteristically of chalky dolomite and limestone. Interspersed are beds of fine-grained calcarenite with effective porosity. Fifteen oil shows have been reported from this unit, one of which consisted of a recovery of 15 ft of oil on a drill-stem test. In Hendry County, unit C thins and becomes a dark, petroliferous micrite, undoubtedly the source for the oil shows within this unit.

Units B and A consist of multiple thin cycles. They have few favorable characteristics and shows of oil are scarce. The Dollar Bay Formation, particularly unit C, has the best potential for oil production of any nonproductive section in the South Florida basin. Although structure will control local oil accumulation, stratigraphy will determine the favorable areas in which to search. Unfortunately, the Dollar Bay favorable areas do not coincide with the Sunniland Limestone favorable trend.

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INFERRED DIAGENETIC HISTORY OF WEAKLY SILICIFIED DEEP-SEA CHALK

At various times during the Oligocene, profuse blooms of the planktonic calcareous algae, *Braarudosphaera rosa*, contributed large numbers of braarudosphaerid pentaliths to deep ocean sediments of the South Atlantic Ocean basin. During such intervals the carbonate compensation level for *B. rosa* was considerably depressed; nevertheless, many of the pentaliths were disaggregated into wedge-shaped segments as a result of solution. Following deposition, skeletal calcite liberated by dissolution was reprecipitated as low magnesium calcite overgrowths on discoasters, coccoliths, pentalith segments, and minute particles of skeletal debris. As shown by scanning electron micrographs, extensive development of the secondary overgrowths led to the formation of low magnesium chalk laminae within the otherwise unconsolidated Oligocene ooze sequence. Paleo-oceanographic conditions rather than absolute sediment age or depth of burial were responsible for the submarine lithification of the chalk laminae.

At one locality (Rio Grande Rise, SDSP Site 22, Sample 22/4/1), calcite cementation was followed by the deposition of silica derived from the dissolution of siliceous microfossils and volcanic glass. The silica was reprecipitated as spherules (3-5 microns in diameter) of alpha-cristobalite which partly filled the interstices of the rock and are responsible for the weakly silicified condition of part of the chalk. Clinoptilolite, a second authigenic silicate in the chalk, is readily distinguished in scanning electron micrographs from the detrital quartz and mica also present in insoluble residues of the chalk.

Abundant cristobalite spherules are also present in weakly silicified chalk lenses sampled within the Eocene "Horizon A" radiolarian chert sequence at DSDP Site 29B. These results indicate that cristobalite spherules represent the initial stage of silicification of carbonate rock in the deep-sea environment.

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DIGITAL WELL LOGS PLUS DIGITAL COMPUTER EQUALS NEW PRACTICAL EXPLORATION TOOL

Petrophysical analysis utilizing digital-log information has recently become a recognized tool in the search for oil and gas. Until now, this method has not been widely used in exploration programs, due to the unavailability of a mass of accurate, inexpensive digital-well-log data and adequate computer software to completely analyze the data.

These data and analysis capabilities are now available to the oil industry and can be readily used in modern petroleum exploration programs.

Results from computer analysis of digital logs from many wells can develop leads for exploration trends, locate possible bypassed hydrocarbon-bearing areas, and better indicate productive zones within a well.

AAPG DISTINGUISHED LECTURE TOUR ABSTRACTS

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UPPER PALEOZOIC FLUVIAL-DELTAIC, SHELF, AND SLOPE DEPOSITIONAL SYSTEMS IN A CRATONIC BASIN, WEST-CENTRAL TEXAS

Upper Pennsylvanian and Lower Permian rocks on the eastern flank of the West Texas basin were deposited within fluvial-deltaic, shelf-edge bank, and slope depositional systems. The Cisco fluvial-deltaic system consists of numerous 100- to 200-ft-thick packages of dip-fed facies flanked by strike-fed interdeltaic embayment facies. Fluvial deposits include tabular and belted sandstone bodies characterized by braided and coarse-grained, meander-belt sequences. Fine-grained multistory meander-belt facies exhibiting general fining upward point-bar sequences commonly occur high in the system, pointing to decreasing sediment supply from the Ouachita Mountains and Fort Worth Piedmont. Fluvial channels normally cut subjacent deltaic facies and may lie on rocks of previous depositional episodes.

Cisco deltaic facies are progradational, coarsening upward prodelta, delta-front, channel-mouth bar, and distributary channel units, and aggradational crevasse splays and delta-plain facies (coal, mudstones, or organic-rich clays); local destructional sandstone bars may fringe the delta. Interdeltaic embayment facies flank delta lobes and include mudstones, sheet sandstones, limestones, and impure detrital coals. Sheet sandstones may reflect strike-fed strandplain accretion or locally reworked delta-front sandstones.

The Sylvester shelf-edge bank system occupies a position along the shelf to basin break in paleoslope. The system is composed predominantly of carbonate units that intertongue updip with fluvial-deltaic facies and downdip with slope facies. Individual units range from 100 to 400 ft thick; carbonate facies thicken upward and basinward because terrigenous sediment supplied to the fluvial-deltaic system diminished.

The Sweetwater slope system, studied intensively by W. E. Galloway, is composed of numerous broad, coalescing to restricted wedges of mudstone and sandstone averaging 1,000 ft thick. Slope wedges are bounded by carbonate aprons and the wedges thin upward and basinward in response to decreasing terrigenous sediment supply. Sandstone distribution within slope wedges forms fan-shaped patterns that are elongate perpendicular to shelf edges. Principal slope units include shelf-margin, slope-trough, and distal-slope fan facies. Deposition was sporadic, probably by turbidity currents and associated traction carpets. The slope system was fed by major delta distributaries that prograded to the shelf edge, or by tidal or storm currents that transported sediment through local breaches in the bank system. Destructional processes such as slumping, sliding, and minor canyon development alternated with periods of active slope construction.

The eastern flank of the West Texas basin was, therefore, filled by simultaneous upbuilding (fluvial-deltaic and shelf-edge bank deposition) and outbuilding (slope deposition); some slope destructional activity followed episodes of outbuilding. Sites of deltaic and complementary slope deposition shifted widely in response to subtle variations in subsidence and normal avulsion of drainage systems. Fluvial, deltaic, and slope sandstones provide a variety of petroleum reservoirs and stratigraphic traps; early and late compactional and structural traps can be postulated from second-order compactional and structural mapping.

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ENVIRONMENTAL GEOLOGY AND GENETIC MAPPING

One of the most critical problems facing the world during the last decades of this century will be the effect of expanding population with its myriad needs for water, sanitation, recreation, and proper land use, coupled with complementary industrial expansion in developing magalopolis belts. A paradox exists between a concern about the ultimate supply of natural resources necessary to maintain the present western life style, and a growing concern about diminishing resources and the impact of accelerating exploitation on delicately balanced or endangered environments and ecosystems. Environmental management is the key to proper balance between exploitation and conservation.

Environmental geology is, above all else, the practical or functional application of the science to critical environmental problems; geologists have for years similarly applied the science to mineral exploration and investigations of earth history and processes. More and more traditionally trained geologists will begin filling an increasing number of positions involving environmental studies; these tasks will require the best in research and application that the science of geology has to offer.

A major geologic thrust is needed at this time to define and inventory natural environmental systems, their present status, and the impact of human modification. The principal geologic tool in the battle against pollution, diminishing resources, and indiscriminate land use will be properly conceived and innovative geologic maps. The United States is poorly covered by geologic maps of adequate scale and proper concept for solving impact problems. Maps should be composed principally of genetic units, even if they do not conform to traditional maps nor formally accepted nomenclature. For example, first-order environmental units may include substrate units or facies such as fluvial channel-fill sand or reef limestone; vegetational units such as salt marsh or grass-stabilized dunes; landforms such as tidal deltas or highly dissected badlands; process-defined units such as landslide areas or storm-washover channels; and man-made units. Maps of genetic units allow rapid derivation of special-use environmental maps for a broad spectrum of scientists and nonscientists. Delineation of genetic units allows three-dimensional extrapolation and interpolation of physical properties to predict the behavior of material under varied land use.

Results of environmental geologic investigations should be presented using innovative formats and techniques that encourage interdisciplinary communication, unite diverse specialists, and allow all experts to focus simultaneously on impact problems. Coupled with computer data storage, the environmental geologic map and derivative maps provide a current record of natural environments, processes and materials, as well as a permanent record of rates of erosion, deposition, and human modification and exploitation. Planners, economists, engineers, biologists, chemists, lawyers, legislative councils, and others can plot, plan, refer, and digest specific environmental data that are visually related to detailed inventory maps depicting the distribution and nature of fundamental natural systems.

Approximately 12 man-years of environmental geologic and derivative mapping and study in the 18,000-sq-mi Texas coastal zone by the Texas Bureau of Economic Geology have resulted in text and 64 full-color maps including Environmental Geology, Current Land Use, Physical Properties, Environments and Biologic Assemblages, Active Processes, Mineral and Energy Resources, Man-Made Features and Water Systems, Rainfall, Discharge and Surface Salinity, and Topography-Bathymetry. The "Environmental Geologic Atlas of the Texas Coastal Zone" provides a case history with which the philosophy, approaches, and results of an extensive environmental investigation can be evaluated.

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ORIGINAL AND SECONDARY PORES IN SEDIMENTARY RESERVOIR ROCKS: RELATION TO $CaCO_3$ CEMENTS

Retention of original pore space, development of secondary pores, and precipitation of $CaCO_3$ cement in pores of sedimentary reservoir rocks are the result of a delicate balance among organic processes, composition of water and migration of fluids, and the depositional and diagenetic history of calcium carbonate sediment particles and carbonate rocks.

In a high-energy marine environment, where waves and currents impinge on the sediment particles, original pore space may persist and thus may be available in subsurface reservoirs. However, in reefs, cements are precipitated early. Original pore space will be preserved only if hydrocarbons are introduced early, if shale seals off the reef from migrating fluids, or if the reef is invaded by meteoric waters undersaturated with respect to $CaCO_3$. Where reefs or ooid and skeletal accumulations are subject to leaching by meteoric water subaerially, in the subsurface, or on the sea bottom near leaks of meteoric water, leaching creates secondary (moldic) pore space while solutions are undersaturated with respect to $CaCO_3$. These new secondary pore spaces are added to the preserved original pores; they increase the total porosity. In corals leaching begins in sclerodermites. The newly created pores merge and form channels. In such leached corals porosity values may exceed the porosity values found in corals of unleached modern reefs. Hence conditions for developing maximum pore space include exposure of reefs or high-energy carbonate sands to meteoric waters. However, once meteoric waters become saturated with respect to calcite, calcite cement is precipitated in the pores. This cement progressively eliminates primary and secondary pores.

Under both surface and subsurface conditions, sulfate-reducing bacteria use sulfate from seawater, or from meteoric or formation waters as an oxidant for that part of organic matter which they oxidize for energy production. Calcite as a cement is formed when CO_2 produced in the bacterial oxidation of organic matter combines with calcium. CaS, an intermediate product in sulfate reduction, hydrolizes, because it is not stable in aqueous solution, and in this reaction the pH rises. At high