abundant at the B-2 location, is absent at GE-1. Given the otherwise similar stratigraphic sections, these differences are believed mainly climatic in origin. Porosity in GE-1 Lower Cretaceous sands shows only slight decrease with depth.

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Environmental Studies at NOAA's Atlantic Oceanographic and Meteorological Laboratories

Two major current projects are focusing on processes and rates of marine sediment transport on the inner shelf, at the shelf edge, and on the continental slope. They are the Inner Shelf Sediment Transport Experiment (INSTEP) and the Marine Geotechnical Rational Use of the Sea Floor (RUSEF).

INSTEP is designed to investigate the rates and directions of sediment transport and the process by which sediments are resuspended from the bottom. Initial studies are on the inner Long Island, New York, shelf, a typical barrier-island coast. Suspended-sediment flux, bottom erosion versus deposition, and bottom characterization are integrated work units. The nucleus of the project is data collected from three "state of the art," bottom-boundary-layer sensing platforms which measure (1) suspended-sediment concentration and current 1 m off the bottom; (2) current-velocity and sediment-concentration profiles in the bottom 1 m of the water column, and (3) the current-velocity profile in the bottom 2 m and the suspended-sediment concentration 1 m above the bottom. The study is designed to measure, for the first time, the threshold of sediment transport with increasing current in the marine environment owing to the combination of unidirectional and wave-generated currents.

Marine Geotechnical RUSEF programs include seafloor-stability studies on the continental slope off the northeastern United States and on the shelf off the Mississippi delta, and a sediment-transport study along the northeastern United States shelf edge. Most of the northeastern continental slope north of Cape Hatteras has been mapped with shallow-penetration seismic reflection profiling and narrow-beam echo soundings. Extensive piston and hydroplastic gravity coring was done in both regional and site-specific areas. For the first time, several large slump blocks have been identified, one of which has been mapped in detail. A major effort is underway to identify by geotechnical methods the conditions (processes and mechanisms) leading to mass slumping and other types of seafloor instabilities.

The Mississippi delta research is a cooperative NOAA-Lehigh University seafloor-engineering study using in-situ instrumentation to determine and assess critical soil properties important in stability analyses.

Two other studies of interest to the petroleum industry are a geochemical study of hydrocarbon concentrations in the water column and in bottom sediments, and an extensive current-meter program, both in the New York Bight from the shelf edge to the inner shelf.

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Subaqueous Gravity-Displacement Products

All sediments deposited on subaqueous slopes are affected by the tangential component of the earth's gravity. Among the kinds of gravity-displacement processes are subaqueous rock falls, slumps, and debris flows. Turbidity currents are likewise processes affected by the slope, but are not a subject of discussion here.

Individual blocks of rock move down a slope from reefs and coastal cliffs; they result from bioerosion, the effects of storm, or ordinary gravity. Incoherent slumps generate a body of sediment so thoroughly mixed and churned that nearly all traces of stratification are obliterated. Debris-flow deposits containing large blocks are known as olistostromes. In places, such olistostromes have been mistaken for melanges, a mixture of huge blocks of diverse kind and provenance dispersed in pervasively sheared and fine-grained matrix which forms a special kind of tectonic breccia. Deep-water rubble of shallow-water carbonate rocks, usually angular, interstratified with dark deep-water marine shale is known as brecciola. Brecciolas accumulate at the toe of the slope. On the upper part of the slope accumulate sediments resulting from coherent slumps which have moved down a slope with their strata still preserved. Deposits of slope-influenced sediments may also result from contour-following currents (contourites) which travel along the lower parts of slopes.

Many examples of ancient gravity-displacement products have been reported from the rock record, among them the so-called melanges (in fact, olistostromes) of Turkey, slope-fan-basin-plain deposits of the Appalachians, and basinal deposits in the Delaware basin of west Texas. In the Taconic sequence of the Appalachians, as in many other hinge-line deposits, only the lower slope and base-of-slope portion of the early Paleozoic continental margin has been preserved.

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Dolomite is Evaporite Mineral—Evidence from Rock Record and from Sea-Marginal Pools of Red Sea

Despite recent pleas to consider dolomite a product involving fresh water, especially the reaction between fresh water and seawater, more recent work in the rock record and in sea-marginal pools of the Red Sea commands a return to the earlier hypothesis that most dolostones owe their origin to hypersaline brines and that dolomite is an evaporite mineral. Schizohaline dolostones, as well as other examples, commonly lack evaporites; yet these dolostones probably accumulated under hypersaline evaporitic conditions although the evaporite minerals have since vanished. However, the imprint of evaporite minerals and other evidence for hypersalinity have been preserved. Evidence includes (1) abundant authigenic feldspar; (2) calcitized anhydrite nodules; (3) euhedral quartz crystals; (4) solution-collapse breccias; (5) ghosts and pseudomorphs of former crystals of gypsum or anhydrite, now preserved as molds, calcite, or pyrite, in some places preserving the outlines of the former sulfate crystals; (6) relict inclusions of anhydrite, barite, or celestite; (7) enterolithic folds; (8) various kinds of chert, including length-slow chalcedony; (9) saddle-shaped dolomite crystals; (10) dedolomite; and (11) fluorite. The Dorag model was developed from study of the classical mid-Ordovician authigenic feldspar-bearing strata, where hypersalinity must have prevailed.

Research in modern sea-marginal pools of the Red Sea shows that dolomite forms only where gypsum and/or anhydrite is likewise present. Among submerged algal mats where gypsum is absent, the carbonate minerals are aragonite or high-magnesian calcite; by contrast, where gypsum is abundant in deeper parts of pools, or among submerged algal mats, dolomite is present. Likewise, in a pool-marginal salina, not only halite, gypsum, and anhydrite, but also dolomite, form a cement between constituent particles. The high salinities at which gypsum precipitates (up to 330 × 10^3 mg/L in the summer) and the observation that dolomite prefers sulfate association suggest that both minerals owe their origin to hypersaline brines.

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Distribution of Carbonate Cements in Quarternary Alluvial-Fan Deposits, Birch Creek Valley, East-Central Idaho—Diagenetic Model

Quaternary alluvial-fan deposits in Birch Creek Valley are poorly sorted carbonate gravels that have undergone diagenesis in the meteoric realm through the dissolution and precipitation of calcium carbonate. Three diagenetic zones are documented on the basis of cement morphologies and paragenesis: (1) near-surface vadose, (2) vadose, and (3) "vadose-phreatic."

Cements formed in the near-surface vadose zone result from both pedogenic and nonpedogenic processes. Pedogenic processes predominate within the upper meter of fan surfaces, whereas nonpedogenic processes cause case-hardening on steep, unvegetated outcrops. Pedogenic cementation proceeds in a series of four morphologic stages and is characterized by clotted micrite and fibrous sparry calcite, commonly with gravitational morphologies and intricate banding. Nonpedogenic cements are primarily micritic to finely crystalline with homogeneous or clotted textures; microdigitate cements are common on the undersides of clasts.

Dissolution and incipient cementation are typical in the vadose zone; cements are best developed beneath large clasts. Thin, banded, gravitational cement, grain-contact cement, rare syntaxial overgrowths, and the lack of clotted micrite are indicative of vadose cementation.

Well-cemented fanglomerate reflects progressive cementation in the "vadose-phreatic" zone, or in a zone of water-table fluctuation. Two generations of cement are generally apparent. Early micrite cement forms discontinuous to continuous rims and is followed by an isopachous sparry cement. Syntaxial overgrowths are relatively common on monocrystalline grains. The degree of cementation is variable and appears to be related to grain size, sorting, and packing geometries.

The distribution and nature of the cements suggest that cementation is initiated soon after deposition and proceeds simultaneously in each diagenetic zone.

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Computer-Assisted Structural Analysis

The structural geologist's conceptual interpretations must be in accord with available data and in geometric balance. Traditionally, he has manually generated cross sections (two-dimensional) and maps (three-dimensional). From these models, iterative measurements of line lengths, areas, and volumes provide boundary conditions for a most logical solution. Projection and display from one domain to the other can involve tedious and error-prone work in the transformation of data elements.

Computer HELPWARE, defined as "the sum total of hardware, software, data management and, most important, peopleware," can assist the geologist in the search for a "most reasonable" interpretation.

Data management, with standardized definitions, is an essential element in automatic generation of maps from cross sections and vice versa. Three fundamental types should suffice; line, random, and grid formats each with linkage to a header record describing the subset attributes.

Input user-options include dynamically changing "L-Axis" projections of plunge and azimuth. The "L-Axis" interpretations may be determined from statistical curvature analysis techniques (SCAT) of dip-vector data.

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Land-Surface Subsidence in Houston-Galveston Region, Texas

The pumping of large amounts of groundwater in the Houston-Galveston region, Texas, has resulted in water-level declines between 1943 and 1973 of as much as 61 m in wells completed in the Chicot aquifer and as much as 99 m in wells completed in the Evangeline aquifer. The maximum average annual rates of decline for those years were 2.0 m in the Chicot aquifer and 3.3 m in the Evangeline aquifer. From 1964 to 1973, the maximum average annual rates of decline were 3.0 m in the Chicot and 5.4 m in the Evangeline. The declines in artesian pressures have resulted in pronounced regional subsidence of the land surface.

The center of subsidence in the Houston-Galveston region is at Pasadena, Texas, where as much as 2.3 m of subsidence occurred between 1943 and 1973. More than 0.3 m of subsidence occurred at Pasadena between 1906 and 1943. The maximum amount of subsidence during 1964-73 was about 1.1 m.

In the southern part of Harris County, about 55% of the subsidence is a result of compaction in the Chicot aquifer. The area in which subsidence is 0.3 m or more has increased from about 906 sq km in 1954 to about 6,475 sq km in 1973. The annual cost of damage attributed to subsidence for 1969-74 was estimated, in a study by Texas A&M University, to be about $32,000,000 in 2,448 sq km of the area most affected by subsidence.

The pumping rate has been almost stable since 1967,