the unconformity plane and the duration of subaerial exposure periods associated with meteoric flushing and karst development is of prime importance for petroleum exploration. The Late Jurassic–Early Cretaceous angular unconformity brings into juxtaposition a deep Paleozoic aquifer and an overlying Mesozoic aquifer. Problems of salinity, reserves estimate, and exploitation arise. Karstic phenomena that developed during the Late Cretaceous exposure time contribute to the excellent storage capacity of the Cenomanian-Turonian aquifer. (3) Alumina-rich lateritic soils, formed under subaerial tropic conditions at the Triassic-Jurassic boundary, are used by the ceramic industry.

FLORES, RICHARD L., Exxon Co., U.S.A., Houston, TX

Computer-Generated Graphic Displays of Commercial Production History and Reservoir Data

Many types of digital information are available commercially for use by the petroleum industry. Two particularly useful types of data are production history and reservoir information. Computer files of production history information typically contain monthly production figures and periodic test results where they are available. Computer files of reservoir information commonly include such data as producing formation, discovery date, average depth, net pay, porosity, permeability, lithology, trap type, fluid contacts, drive type, and chemical analyses of crude oil, gas, and formation-water samples.

It is often difficult to assimilate these large volumes of information by merely listing the data. Computer-generated production decline curves, P/Z gas plots, maps, bar graphs, and other such graphic displays allow one to analyze these data with less time and effort.

FLOWERS, BILLY S., Shell Offshore Inc., New Orleans, LA

Corsair Trend—Exploring for Deep Geopressured Gas, Middle Miocene, Offshore Texas

(No abstract)

FLY, STERLING H., III, Cities Service Oil & Gas Corp., Midland, TX

Siliciclastic-Carbonate Interactions in Laborcita Formation, Sacramento Mountains, New Mexico

Outcrop exposures of the Laborcita Formation (Wolfcampian) reveal an active depositional environment with abrupt lateral and vertical changes between fan-deltaic and carbonate sediments. The siliciclastic source area was to the east, in the Pedernal uplift. Fan-delta lobe shifting was important in producing the cyclic nature of deposition.

Away from the area affected by the fan-deltas, deposits are increasingly calcareous. Shales are the predominant lithology in the Laborcita Formation, due to the abundance of carbonate-inhibiting terrigenous matter, especially in restricted areas. A few digitate stromatolites and *Archeolithophyllum* sp. mounds indicate subaerial exposure. Toward the edge of the narrow shelf, large phylloid-algal buildups (20 m or 65 ft thick) occur. An exposure in Coyote Canyon, near the northern end of the Laborcita exposure, shows an onlapping sequence of several mounds. This mound zone was terminated when muds and fine to medium-grained terrigenous sands migrated in and inhibited growth of the carbonate-producing organisms. The terrigenous sediments were in turn overlain by grainstones exhibiting long, low-angle (15°) cross-bedding, which dips landward (southeast). Individual grainstone beds are thin (0.5-1.5 m or 1.6-5 ft), extend along strike laterally for about 2.5 mi (4 km), and are composed largely of bioclastic carbonate grains (not ooliticaly coated) with 5% quartz grains. Direction of migration was southwest to northeast.

Gradual emergence is recorded by the Laborcita Formation. With continual progradation of terrigenous deposits, interrupted by marine incursions resulting in deposition of shallow-water carbonated deposits, the transitional Laborcita Formation was ultimately overlain by the terrigenous Abo Formation.

FOLK, ROBERT L., Univ. Texas at Austin, and PAMELA A. TIEZZI, Exxon, New Orleans, LA

Diagenesis and Dolomitization in Triassic (Rhaetian) "Portoro" Limestone, Portovenere, Liguria, Italy

The Portoro Limestone is jet black with white veinlets and gold stylolites, and is much used as ornamental stone. Vague, pale-gray nodules represent precocious lithification at shallow depths below the sediment surface, probably the result of bacterial colonies consuming organic matter and mobilizing carbonate. Gnocchi (now turned upside down) are partly filled with geopetal, fine dolomite sediment; original tops are filled with sparry calcite and baroque dolomite. These probably represent dissolved evaporite nodules. Despite the black color, the rock contains very little organic matter. The rock is made of 10-20 μm metamicrite as the result of thermal metamorphism; crystals are so clear that the minute amount of organic matter is readily visible. There are many generations of dolomite; most abundant is postmetamorphic, post-fracturing dolomite that contains inclusions of metamicrite and has ragged crystal form. Earlier dolomite behaved as a mechanical sediment, accumulating as geopetal filling within cavities, on top of clasts, and within tectonic fractures.

FORSTHOFF, G. M., Gulf Oil Exploration and Production Co., Casper, WY, and T. L. HOLCOMBE, National Geophysical Data Center, Boulder, CO

Controls of Bioclastic Turbidite Deposition in Eastern Muertos Trough–Northeast Caribbean Sea

A study of seismic-reflection profiles and sediment cores establishes regional bathymetric and source area control over the composition, transport, and distribution of turbidites in the eastern Muertos Trough. Bioclastic (carbonate) turbidites dominate the eastern portion of the trough. Analyses of carbonate content and sand-sized components suggest that the bioclastic turbidites (characterized by planktonic foraminifera, pteropods, and sponge spicules) are reworked pelagic oozes originally deposited on the outer-shelf and upper-slope areas south of St. Croix and eastern Puerto Rico. The presence of several intrashelf and upper-slope basins prohibits shallow-water carbonate sediments from entering the Muertos Trough.

Volcanic rock fragments derived from Puerto Rico are transported to the trough via the Guayanilla Canyon system. Mixing of the volcanic fragments with outer-shelf and upper-slope lutites results in mixed bioclastic-terrigenous turbidites south of central and western Puerto Rico. The paucity of shallow-water carbonate sediments in the trough suggests that the submarine canyons are effective conduits for the "rapid" transport of volcaniclastic sands across the shelf and thereby prevent extensive mixing with inner- and middle-shelf carbonate sediments.

Sediment transport within the trough is primarily axial in an east-west direction. Outer trench-wall fault scarps, south of Guayanilla Canyon, limit the southerly progradation of the trench-wedge facies and deflect incoming gravity flows in a down-axis (westward) direction. Where no faults exist, the trench wedge progrades southward and interfingers with the pelagic sediments of the northern Venezuelan basin.

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Quantitative Sedimentologic Application for Dipmeter Data

Traditionally, interpretation of dipmeter computations has required considerable expertise. Although dip angles and directions were computed precisely, relationships between successive correlations were left to qualitative visual inspection.

Now, with new software, 4- or 8-button data can be output in a form that allows routine quantitative analysis. This new program computes curves that provide measures of the thickness between dip correlations, planarity of correlations, parallelism of successive bedding planes, and grain-size trends from resistivity curve shapes.

Uses for this information are varied. To the extent that dipmeter correlations reflect bedding planes, the thickness between correlations can be used to study vertical changes in bed thickness. Combining grain-size trends with bedding characteristics and thickness, one obtains a sedimentologic description of the formation that can be displayed with easy-to-understand graphics. An appropriate depth scale allows a macroscopic view of several hundred to several thousand feet of log data or a microscopic examination of a short interval in great detail.

The dipmeter data can also be incorporated into computerized analysis of other wireline log data. Laminated formations can be identified, and the direction and dip of the laminations can be indicated on a lithofacies

section. With different depositional units readily distinguishable in such a display, a clearer understanding can be obtained of the represented depositional environment. Further, well-to-well correlation is easier to make.

GARDNER, JAMES V., DAVID S. MCCULLOCH, and STEPHEN L. EITTREIM, U.S. Geol. Survey, Menlo Park, CA, and DOUGLAS G. MASSON, Inst. Oceanographic Sciences, Wormley, United Kingdom

Morphology of Central California Continental Margin, Revealed by Long-Range Side-Scan Sonar (GLORIA)

Leg 2 of the 4-leg USGS EEZ-SCAN 84 program used GLORIA long-range side-scan sonar to survey the region from Pt. Conception to just south of Pt. Arena, from the shelf break to the 200-nmi coverage. The overlapping digital sonographs were slant-range and anamorphically corrected, and a photomosaic of the sonographs was constructed at a scale of 1:375,000 (1 in. = 11.1 km).

The underlying bed rock appears to be an important control in shaping the morphology of this margin. Several faults have sea-floor expression and lie subparallel to the margin. The density of canyons and gullies on the slope varies from south to north, probably because of variations in the characteristics of the bed rock. The slope west of San Francisco is the most dissected segment of the central California slope.

Monterey Fan is covered by large-scale bed forms (5-15 m amplitude and 1.5-2.0 km wavelength) over much of its surface. Monterey channel crosses southwestward across the fan, but abruptly turns south along a 40-km long surface fault that coincides with a well-mapped meander loop. The channel loops to the north then turns southward crossing the entire Monterey Fan and, at its distal reach, changes to a broad, braided pattern. Major slumps on the margin have long (> 30 km) scarps, some have slump folds, and one has a debris-flow deposit that can be acoustically traced for more than 75 km.

Seventeen new seamounts were mapped. Taney Seamounts are large, rimmed, calderas with diameters of about 15 km each; these appear to be very large explosive or summit-collapse features.

GLYNN, WILLIAM G., Wisenbaker Production Co., Tyler, TX, and THOMAS E. COVINGTON, ROBIN G. LIGHTY, and WAYNE M. AHR, Texas A&M Univ., College Station, TX

Prolific Overton Field Gas Reservoirs Within Large Transverse Oolite Shoals, Upper Jurassic Haynesville, Eastern Margin East Texas Basin

Late Triassic rifting along a northeast-southwest spreading center in east Texas resulted in basement highs along the eastern margin of the East Texas basin that became sites of extensive ooid shoal deposition during Late Jurassic time. Reservoirs within oolite facies at Overton field contain over 1 tcf of natural gas. These large shoals, each approximately 15 mi (24 km) long and 3 mi (4.8 km) wide, trend north-south as a group and northeast-southwest individually. They are oblique to the basin margin but parallel with Jurassic diffracted tidal currents within the East Texas embayment. Modern Bahamian ooid shoals of similar size, trend, and depositional setting occur at the terminus of the deep Tongue-Of-The-Ocean platform reentrant. Overton field reservoirs are in ooid grainstone shoal facies and in transitional shoal margins of skeletal-oolitic-peloidal grainstones and packstones. Adjacent nonreservoir facies are peloidal-skeletal-siliciclastic wackestones and mudstones.

Early diagenesis of grainstone reservoir facies included meteoric dissolution and grain stabilization, resulting in abundant "chalky" intraparticle porosity and equant and bladed calcite cements filling interparticle porosity. Subsequent burial diagenesis resulted in intense solution compaction and coarse equant calcite and saddle crystal dolomite that occluded remaining interparticle porosity. Whole-rock trace element analysis indicates greatest diagenetic flushing (less magnesium, strontium) in porous zones. Stable isotopes for grains and cements show strong overprint of later burial diagenesis, with greater depletion of $\delta^{18}O$ in reservoir facies. However, hydrocarbons were emplaced prior to late cementation, and unlike other Jurassic Gulf Coast reservoirs, deep burial diagenesis provided no late-stage formation of porosity.

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Gas Monitoring During Drilling Substantiates Hydrogen Occurrence and Eliminates Corrosion as Source

Chromatograms from the simultaneous use of 2 gas "sniffers," one monitoring hydrocarbon gases and one monitoring H_2, while drilling 5 uncased exploratory bore holes in Paleozoic rocks in Kansas substantiates that H_2/N_2-rich gas emissions are from the sedimentary rocks above the Central North American rift system and are not the result of corrosion of casing pipe. The gases extend over an area of more than 100 mi^2, within which they appear to be migrating through formation waters along permeable zones at the silty to sandy base of pyritic shales. H_2 was detected in various zones from ± 500 ft depth in the Indian Cave Sandstone (Pennsylvanian) to depths of 2,100 ft in the Hunton Limestone (Silurian-Devonian). Negative peaks (noncombustible), which overlapped the H_2 positive peaks on the Wheatstone Bridge chromatograms, are thought to indicate N_2 gas. Possible N_2 gas occurs from about 1,300 to 2,100 ft, from the Heebner Shale Member (Pennsylvanian) to the Hunton Limestone. H_2/N_2 peaks on the chromatograms correlate well with the crossover peaks indicative of gas zones on open-hole wireline logs.

GOLD, PAUL B., Univ. Texas at Austin, Austin, TX

Diagenesis in Upper Miocene Sandstones, Louisiana Gulf Coast

Study of diagenesis in upper Miocene sandstones of coastal Louisiana documents depth-related cementation and geochemical changes of primary detrital mineralogy. Samples were collected from depths of 8,000-20,000 ft (2,600-6,500 m) in an area roughly corresponding to the upper Miocene depocenter in the Terrebonne trough of southeast Louisiana. Sandstones are primarily subarkoses and sublitharenites with minor amounts of feldspathic litharenites and lithic arkoses. Plagioclase feldspar (oligoclase/andesine composition) composes approximately 60% of the detrital feldspar. Dominant rock fragments are siltstone or mudstone, silicified volcanic rock, and chert.

Authigenic minerals and cements occur in the following order: dolomite, chlorite grain coats, albite overgrowths on plagioclase and K-feldspar, quartz, calcite, kaolinite, and ankerite. Calcite composition remains nearly constant with depth, but ankerite composition differs both with depth and within individual samples. In general, the mineralogy and order of cements resemble that of the lower Tertiary sandstones of the Texas Gulf Coast; however, in the upper Miocene, the volume of each cement is much less and the depth of first occurrence is greater.

Feldspars have reacted substantially with pore fluids. With increasing depth, feldspar becomes more sodic because of albitization and dissolution of calcic plagioclase. At approximately 20,000 ft, 75% of the plagioclase is nearly pure albite. Alteration of K-feldspar is not common above 17,000 ft; below 17,000 ft occurrences are rare because of dissolution.

GOLDHAMMER, ROBERT K., LAWRENCE A. HARDIE, and CHOU NGUYEN, Johns Hopkins Univ., Baltimore, MD

Compactional Features in Cambro-Ordovician Carbonates of Central Appalachians and Their Significance

Compactional features are well known from siliciclastic rocks, but it is generally believed that carbonates have undergone little burial compaction. However, in the 3.5-km thick Cambrian-Ordovician carbonates of the Central Appalachians, many small-scale compaction features have been recognized. Evidence for differential compaction is: (1) wrapping of thin beds around meter-scale early-cemented algal bioherms and (2) sedimentary boudinage and pinch-and-swell features in interlayered thin beds of carbonate grainstone and mudstone. The grainstone layers have deformed in a brittle manner (cracking or yielding boudins), whereas mudstone layers behave ductily (flowing and bending around boudins), indicating that at the time of burial, grainstone layers were lithified but mudstone layers were unlithified. Burrows and shells in sandy layers are preserved, but burrows are deformed and shells broken in muddy layers. Pervasive, rather than differential, compaction in muddy carbonates is evidenced by flattened burrows, rotation of platy allochems parallel with