and concepts, have been compiled. (1) A geologic tectonic map of the entire territory of Trinidad and Tobago, at a scale of 1:200,000. Apart from the surface geology of the land areas, this map shows the major faults and their displacements and locations, total depths and status of exploration wells, and the positions of major petroleum fields. (2) Five accompanying geologic sections at the same scale. (3) A new stratigraphic correlation chart.

These new compilations attempt to fill the gap in the published literature on the petroleum geology of Trinidad and Tobago.

PHILLIPS, F. JAY, Denver-Alaska Oil Co., Golden, CO

A Computerized Paleontological Work Station

A microcomputer efficiently replaces the pencil and notepad by the microscope. The same reports produced by hand are produced in less time at lower cost by computer. System components are the Checklist II program, a microcomputer, two disk drives, and a dot-matrix printer. Advantages over manual methods include multiple data use without reentry, automated drafting, more complex capabilities, and no transcription errors. Advantages over mainframe implementation include ease of use, same-day reports, work station mobility, and cost savings.

A computer system should be as easy to use as the manual system it replaces. This ease is achieved by using menus rather than memorized commands, and by duplicating manual procedures already in use. Data are stored by project; each file contains abundances for species in a related group of samples. This speeds program use by keeping all species information in active memory. Completed data files can be fed into a mainframe data base if desired. Various abundance formats are accepted, including specimen counts, relative abundance, presence/absence, and free form. Interpretive information can be entered as comments.

Data can be displayed as a variety of range of charts. Sample can be sorted. Species can be ordered alphabetically, by highest or lowest appearance, or manually. Abundances can be an entered, or converted to percent, presence/absence, total range, relative abundance, or graphic characters. Other analyses such as diversity calculations, cluster analysis, histograms, and graphic correlation can use the same data set.

PINERO, EDWIN, Mobil Oil Corp., Denver, CO

New Ulm Field: An Example of Cretaceous Shelf-Slope Instability in East Texas

The New Ulm field in Austin County, Texas, is an example of the structural and stratigraphic complexity above the Cretaceous Edwards shelf margin of east Texas. Deep wells and improved seismic data provide documentation of structural patterns and deepwater facies not previously considered in Gulf Coast reservoir play modeling.

Study of the data implies the Late Cretaceous to Eocene section was deposited along a shelf-slope break. Late Cretaceous, pre-Midway sedimentation was affected by structurally induced slope instability, and consequent gravity faulting and slumping resulted in an irregular sea-floor surface. Paleocene Midway sands were carried onto this surface by storm-generated density currents where the uneven topography caused deposition in constructional channels. Continued deposition of the fluvio-deltaic Wilcox on this surface caused faulting and folding by differential compaction. The folds are minor and the faults small and steep, not like the typical large growth faults of the Gulf Coast. Upper Wilcox sediments were progressively less disturbed as the region stabilized.

New Ulm field production includes gas from the Midway Formation and oil and gas from the Wilcox Group. Midway reservoirs are stratigraphic, consisting of turbidite channel sandstones; Wilcox reservoirs are structural, consisting of fluvio-deltaic sandstones within faulted anticlines.

This study adds evidence to data describing shelf-slope geology along the Edwards margin. The setting can be a new type of hydrocarbon play in the Gulf Coast.

PINGITORE, NICHOLAS E., Jr., and MICHAEL P. EASTMAN, Univ. Texas at El Paso, El Paso, TX

Barium Partitioning in Carbonates: Theory and Applications

The partition coefficient for Ba^{2+} into calcite has been established as 0.06 ± 0.01 at 25°C (77°F). The partition coefficient proved independent of rate of precipitation in a series of 19 runs of varying duration. This value is substantially lower than that reported by Kitano in 1971, reflecting our seeding technique, which focused the experiment on crystal growth rather than on spontaneous nucleation and growth. The 0.06 value is compatible with the values reported for Sr^{2+} (0.05 to 0.14), a cation of identical charge, but closer to Ca^{2+} in ionic radius.

The natural partitioning of Ba^{2+} was examined in fresh (aragonite) and altered (calcite) corals from the Pleistocene reef terraces exposed on Barbados, West Indies. The Ba^{2+} concentrations ranged from 8 to 15 ppm in the aragonites and decreased to typical values of 1 to 3 ppm in the calcites. The partitioning of Ba^{2+} in these samples was quantitatively similar to the attendant partitioning of Sr^{2+}. The partitioning of Ba^{2+} during the carbonate cycle offers new areas of investigation. The low concentrations of Ba^{2+} in sedimentary biograins (3 orders of magnitude less than Sr^{2+}) make Ba^{2+} a sensitive monitor of externally derived, barium-bearing solutions involved in diagenetic reactions. Likewise, the low concentrations ensure ideal partitioning behavior in diagenetic solutions of low ionic strength.

PIRIE, GORDON, and ROBERT EVERETT, Schlumberger-Doll Research, Ridgefield, CT

Depositional Environments and Invasion Profiling in Heavy Oil Sands, Eastern Venezuela: A Case Study

A comprehensive study of a single well for INTEVEP and Meneven in the Faja Petrolifera del Orinoco—an extensive (570 × 140 km, 350 × 90 mi) east-west trending heavying oil belt located immediately north of the Orinoco River, eastern Venezuela—resulted in an interpretation of an invasion profile dependent on depositional environments. The data base was derived from: (1) 400 ft (121 m) of whole core (67% recovery) and 124 sidewall cores taken from the 1,500-1,900 ft (457-579 m) interval of the upper Tertiary Oficina Formation, which, in this area, overlies the Precambrian metamorphosed igneous basement. (2) A logging suite of 22 conventional, experimental, and prototype wireline logs.

In this area, the Oficina Formation is a complex series of stacked, heavy oil-saturated, sand-dominant, fluvially-transported, unconsolidated sediments overlain by lignite- and mud-dominant backswamp and estuarine sediments. Bedding, mineralogy, lithology, and paleontology define fluvial-channel fills, channel-lag deposits, crevasse splays, overbank levees, swamps, estuarine lagoons, and estuarine-channel fills in a delta-plain environment.

Reservoir geometry and facies analyses suggest that several short, wide, deep-channeled, meandering rivers flowed generally northward across a tropical-subtropical plain of low relief carrying the bulk of the sediment in bedload traction (channel fills) and a smaller fraction in density suspension (crevasse splays).

A unique logging suite permitted the measurement of invasion in this heavy-oil environment. The invasion of the mud filtrate was measured at varying depths of investigation using, from shallowest to deepest depths: (1) gamma ray spectrometry log, (2) microspherically focused log, (3) nuclear magnetism free fluid index, and (4) deep Laterolog.

In addition, water trapped in the fine-grained sands was characterized by comparing the porosity from the electromagnetic propagation log to the free fluid index from the nuclear magnetism log. Identification of the depositional facies coupled with these log responses produced an innovative interpretation of the invasion profile. From an oil-bearing gross interval of 262 ft (80 m) 9 sand units were defined according to their primary and secondary (steam processing) production capability.

PLAYFORD, PHILLIP E., Geol. Survey Western Australia, Perth, Australia, CHARLES KERANS, Western Australian Mining and Petroleum Research Institute, Perth, Australia, and NEIL F. HURLEY, Univ. Michigan, Ann Arbor, MI

Platform-Margin and Marginal Slope Relationships and Sedimentation in Devonian Reef Complexes of Canning Basin, Western Australia

Devonian limestone platforms in the Canning basin were generally rimmed by reef-margin and reef-flat deposits, constructed by stromatoporoids, algae, and corals in the Givetian and Frasnian, and by algae in the Famennian. However, some platforms were low-relief banks with little or no reef development.

Reef rims were flanked by steeply dipping marginal-slope deposits that descended to depths up to several hundred meters. These deposits include debris flows, huge allochthonous reef blocks, scheck breccias, and reefal tongues and bioherms built primarily by sponges and algae.

Platform margins are classified as advancing, retreating, upright backstepping, and roll-over types. Advancing margins are typical of the Famennian reef complexes; the others occur principally in the Frasnian and Givetian, where they are often associated with platform-margin unconformities resulting from submarine erosion or margin collapse.

The reefs and slowly deposited parts of the marginal-slope facies were subject to pervasive early submarine cementation by fibrous high-magnesium calcite (now radiaxial spar). The strongly cemented reef limestones formed rigid wave-resistant rims to the platforms. Fracturing of these limestones, probably largely associated with earthquake shaking, gave rise to extensive networks of neptunian dikes and sills, and to the collapse of some sections of the margins. Such collapses in turn initiated debris flows and the deposition of allochthonous reef blocks on the adjoining marginal slopes.

The reef complexes are being explored extensively for lead-zinc deposits in outcrop and oil in the subsurface. A significant oil discovery was made in a Famennian platform margin (the Blina field) in 1981.

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Neptunian Dikes and Sills in Devonian Reef Complexes of Canning Basin, Western Australia

Neptunian dikes and sills are conspicuous features of early-cemented limestones in Devonian reef complexes of the Canning basin. They are sedimentary fillings of fissures formed by fracturing of the limestones soon after deposition, and are most abundant in the reef subfacies, but also occur in some back-reef and marginal-slope deposits.

The dikes and sills were filled with contemporary sediment (including oolite, peloid grainstone, biomicrite, and calcareous sandstone), encrusting organisms (*Renalcis* and stromatolites), and early radiaxial calcite cement. Some of the sediment is dolomitized or mineralized. Some dikes contain concentrically coated balls of radiaxial calcite up to 0.3 m (1 ft) across. Sediment in the dikes and sills was cemented rapidly, and repeated refracturing and infilling occurred during brief intervals. The largest dikes are up to 6 km (3.5 mi) long, 20 m (65 ft) wide, and originally extended more than 80 m (260 ft) below the surface. However, most are less than 100 m (330 ft) long and 5 cm (2 in.) wide. Neptunian sills are up to 0.8 m (2.5 ft) thick. The principal strike directions of major dikes approximately parallel the original reef fronts of underlying basement ridges. Lateral extension through the development of fissures amounted to as much as 6.5%, and averaged about 3% in measured reef sections. The fissures allowed circulation of large volumes of seawater to considerable depth within the reef complexes, and must have played a significant role in early diagenesis.

Fissuring probably resulted from earthquake shaking, differential compaction of underlying sediments, and slippage along bedding planes, especially in the steeply dipping marginal-slope deposits.

PLOTKIN, STEVEN E., Office of Technology Assessment, U.S. Congress, Washington, D.C.

Uncertain Future of Natural Gas Production in U.S. Lower 48 States

The Office of Technology Assessment (OTA), an analytic support agency of the United States Congress, has examined the process of forecasting future supplies of conventional, domestically produced natural gas in the U.S. lower 48 states to the year 2000. Its investigation focused particularly on the technical sources of uncertainty, including the incomplete geologic understanding of the remaining resources and the difficulties involved in properly interpreting and extrapolating past trends in natural gas discovery. The OTA examined the arguments developed by supply "optimists" and "pessimists" regarding both the size of the recoverable resource base and the speed with which new resources can be discovered and produced. As part of the investigation, resource-base estimates, ranging from those of H. King Hubbert and Richard Nehring to those of the U.S. Geological Survey and the Potential Gas Committee, were reviewed and compared.

The OTA concluded that the credible ranges of estimates for lower-48 resources and future production potential are very wide—400 to 900 tcf for the remaining recoverable resources of conventional gas at near-current prices and technology, and 9-19 tcf/yr for the year 2000 production under the same price and technology conditions.

PLUIM, SCOTT, Amerada Hess Corp., Tulsa, OK

Timing of Saddle Dolomite in Tuscaloosa Formation, Mississippi

Saddle (baroque) dolomites are characterized by curved crystal faces and sweeping extinction patterns. They are associated with hydrocarbons, sulfates, and base-metal mineralization, and occur as void-filling cements or replacement minerals. Most described saddle dolomites are from carbonates and are interpreted as a diagenetic product that formed under high temperatures during deep burial.

Saddle dolomites are present as nodular, poikilotopic cements in sandstones from a core of the Tuscaloosa Formation in southern Mississippi. The Tuscaloosa, a major oil producer in the area, consists of a series of fluvial/deltaic sands and shales. The sandstone is a fine to medium-grained lithic arenite whose grains are coated with isopachous layers of authigenic chlorite, which petrographic evidence indicates was precipitated at relatively shallow depths. The interrelationships of the chlorite rims and the saddle dolomite cements indicate that some of the dolomites were precipitated before the chlorite rims and that others formed shortly after the chlorite. This suggests that the saddle dolomites grew concurrently with the chlorite during a relatively early, shallow diagenetic event and not during deep burial.

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Sedimentation of an Upper Pennsylvanian Phylloid Algal Mound Complex, Hueco Mountains, El Paso County, Texas

A Late Pennsylvanian mixed carbonate-clastic sequence is exposed in the Hueco Mountains of west Texas. The sequence begins with deposition of a progradational fan-delta system and marine and tidal-flat carbonates. This unit is dominated by calclithite and shale with minor interbeds of shallow-water calcareous mudstone and wackestone. Shallow-water spiculites are commonly associated with these limestones. A thick carbonate unit composed predominantly of limestone overlies the clastics; it was deposited during or just after a major local transgression. The carbonate sediments were deposited on the submerged delta platform in the following sequence: (1) colonization of the shallow platform by rugose corals and early (or syndepositional) cementation of the zone; (2) establishment of shallow-water dasycladacean algal flats; (3) increasing domination of the environment by phylloid algae in response to increasing water depth; (4) accretion of phylloid algal sediments and formation of mounds (directly overlying the dasycladacean algal flats are a number of small mounds formed by accelerated sedimentation within phylloids algal "meadows." The high productivity of the phylloid algae and their sediment-trapping ability allowed sedimentation to keep up with sea level rise. Large bioherms resulted, but because of the difference in accretion rates of various mounds, some grew while others were buried by more successful neighbors); and (5) reestablishment of shallow-water dasycladacean algal flats as a result of shoaling of mound crests and subsequent increased sedimentation in deeper, quieter water on the lee side of the mound complex.

POORMAN, STEPHEN E., Baylor Univ., Waco, TX

Nature of Fort Chadbourne Fault System and its Relation to Petroleum Potential of Wilberns Formation (Upper Cambrian) of West-Central Texas

The Wilberns Formation (Upper Cambrian) in the subsurface of west-central Texas is composed predominantly of sandstone units. Subsurface mapping of the Wilberns shows the sandstones to be persistent through-