upwelling zones, knowing the past areas of upwelling and abundant phytoplankton productivity is vital for assessing the potential richness and extent of possible oil source beds.

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Facies, Environments, and Development of Tuxpan-Tecolutla Carbonate Platform, Gulf Coast, Mexico

In the Cretaceous Tuxpan-Tecolutla carbonate platform in the subsurface of the Gulf of Mexico, sedimentologic and stratigraphic data were obtained from the study of 35 wells drilled in the El Abra Formation both onshore (Golden Lane and central platform) and offshore.

Three main depositional complexes are recognized: lagoon, reefal environment, and oolitic banks. Each complex includes several microenvironments.

Dolomitization proceeded episodically in the lagoon. The last phase, showing a northern displacement of the central depression, was associated with the formation of evaporites. Several bentonitic beds are interlayered with the generally massive limestone of the El Abra Formation; some could be traced laterally and are used as marker beds for El Abra deposition.

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Ichnology of Labrador Group (Lower Cambrian) in Southern Labrador

Rocks assigned to the Labrador Group record deposition during initial phases of the lower Paleozoic transgression onto the eastern continental margin of North America during late Early Cambrian time. In Labrador the group comprises two formations; the lower one, the Bradore Formation, is a series of conglomerates, sandstones, and minor siltstones; the upper one, the Forteau Formation, is a series of siltstones, shales, fossiliferous limestones, and reefs.

The Bradore Formation, interpreted on the basis of physical sedimentary structures to be a series of tidal-dominated, nearshore, sand shoals, is almost devoid of body fossils. The presence of an abundant soft-bodied infauna is, however, demonstrated by prolific *Skolithos* as well as numerous *Monocraterion* and *Dolopichnus* and minor forms such as *Lingulichnus, Stipsellus*, and *Cruziana*.

The Forteau Formation comprises a series of patch reefs rich in archaeocyathids surrounded and buried by interreef skeletal limestones, siltstones, and shales. In contrast to the underlying Bradore, these rocks are extremely rich in body fossils. Correspondingly, the interreef beds are replete with ichnofossils including *Chondrites, Cylindrichnus, Monocraterion, Monomorphichnus, Paleophycus, Planolites, Rusophycus, Skolithos*, and *Teichichnus*. These forms suggest that the environment of deposition was relatively shallow and that sedimentation was slow and continuous.

We have also discovered numerous traces in the fine-grained sediments which floor growth cavities within the reefs, suggesting that mobile organisms either inhabited the cavities or at least were transient through them.

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Sediment Dispersal at Fort George Inlet, Florida

Fort George Inlet is located in northeastern Florida, 0.9 km north of the St. Johns River. The geomorphic history of Fort George Inlet is characterized by migration.

The pattern and rate of sediment dispersal were established through fluorescent sand tracing, tidal-current measurement, and bed-form mapping. Morphologic changes were determined utilizing nearshore and beach profiles established in 1923 and 1974, as well as air photos, hydrographic surveys, historical maps, and coastal climate data.

Fort George Inlet partially intercepts the southerly littoral drift (estimate of 190,000 m^3/year based on SSMO data) and deposits sediment along Little Talbot Island and Wards Bank, altering the hydrodynamic system in the study area. In the past, accretion at Little Talbot Island (average rate of 142,880 m^3/year) forced Fort George Inlet south at an average rate of 36 m/year. However, in 1961 the direction of inlet migration was reversed and is now northward at a rate of 21 m/year. Sediment intercepted by Fort George Inlet is producing a recurved spit extending north from Wards Bank. The expansion and encroachment of this spit into the inlet throat are believed to have initiated the reversal in migration direction. Analysis of aerial photographs indicates that inlet migration occurs sporadically during severe storms.

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Genesis, Occurrence, and Causes of Sediment Distribution in Inner Reefs of Mombasa, Kenya

Though quantitative statistical analysis of skeletal carbonate sediments is under a cloud of uncertainty, the results thereof, in conjunction with copious field observations, elucidate the causes of sediment distribution in and adjacent to the Mombasa, Kenya, reef/platform complex and aid definition of hydrodynamic and ecologic environments. The recent surface sediments have been analyzed to determine their textural and genetic composition. They are made up of two components: biogenic carbonate material (molluscan debris, coralgal, *Halimeda* and Foraminifera) and fluvio-terrigenous quartz (from the pre-Quaternary of the immediate hinterland).

The fringing reef is divisible into a northern and southern sector by the Ras Iwa Tine promontory. Four sediment populations are present which are distinct in skeletal origin, textural composition, and position on the reef. Sediment samples close to the berm abound in *Halimeda* fragments, whereas the carbonate fraction on the outer platform (1 km away) and the channel are dominated by molluscan fragments.

Size distribution and statistical analysis of the sediments indicate contrasting physical environments on either side of the Ras, even though geomorphologically they are similar. Sediments in the southern sector are generally better sorted (moderate to good), nearly symmetrically to slightly coarsely skewed, and unimodal, whereas the sediments in the northern sector are badly sorted, coarsely skewed, and bimodal in the shallower lagoonal area.

The distribution patterns reflect the physical oceanographic parameters within the reef, the areal coverage by vegetation, and the sediment source. Pure populations having the best sorting values are on the beach and within the southern lagoon. Sediments finer than 4ϕ are scarce within the reef.

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Small Computer Well-Data System

It would be desirable for offices in remote locations to be able to sort and select certain items of well data, but they usually lack on-site computer power. One system, an IBM System 32, is a small commercial computer used on a trial basis in this situation. Two files were input: (1) a general scout type containing drilling and production statistics and (2) data resulting from lithologic study containing test results and sand thickness. Programs executed against these files to generate reports based on the geologist's selection criteria are written in RPG 11 language, common to the System 32.

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Bed Forms and Processes on Estuarine Tidal-Current Ridge, Willapa Bay, Washington

Distinctive ebb and flood oriented bed-form fields are present on the opposite flanks of a tidal ridge within Willapa Bay, Washington. The ridge is approximately 3 km long, arcuate in shape, asymmetric in profile, and rises a maximum of 13 m above the channel floor. Repeated high-resolution profiling, diving observations, measurement of bed-form geometry, velocity profiles, and oriented cores define the formational processes and the depositional features of this migrating ridge.

Large-scale bed forms migrate along and up both ebb and flood flanks of the ridge during each respective tidal flow. Sinuous- to straight-crested sand waves occur on the steeper flood-dominated side; dunes and sand waves occur on the ebb flank. As the bed forms migrate up the ebb flank of the tidal ridge, they become lower and exhibit the following sequence in response to decreasing flow velocity: lunate dunes→catenary sand waves→sinuous- to straight-crested sand waves. The largest bed forms, 3 m high, occur between depths of 9 to 12 m within the lunate dune field.

Bed forms along the ridge crest change orientation with each tidal cycle. Bed forms on the ridge flanks reverse completely during spring tides, but during neap tides only the crests reverse. Oriented cores show unidirectional medium-scale cross-strata with reactivation surfaces on the flood and the ebb flanks of the ridge. Cores taken in troughs of some ebb-oriented dunes, however, show a veneer of ebb cross-strata overlying flood-oriented structures. Cores on the ridge crest have bimodal small-scale cross-strata.

The dominant ebb current transports sediment over the ridge crest where it is incorporated into flood bed forms on the reversing tide. Erosion on the ebb flank and deposition on the flood flank has moved the ridge 15 to 30 m/year for the last 20 years.

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Applied Biostratigraphy in Gulf Coast Tertiary

Concepts resulting from studies of microfaunal successions and paleoecology (biofacies) together with vertical and lateral sediment-distribution patterns (lithofacies) can be applied to exploration and development problems. Examples include correlation problems, predicting reservoir distribution, determining base of objective section, predicting geopressures, calibrating seismic events, and exploitation of salt-dome fields.

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Trace-Element Geochemistry and Diagenesis in Capitan Reef (Permian), West Texas

The lattice substitution of doubly charged cations into calcite during aqueous precipitation depends on solution composition and the appropriate partition coefficients. Thus, the trace-element geochemistry of a limestone encodes the chemical composition of the solution in which mineralogic stabilization occurred. Because different environments are characterized by specific solution chemistries, we can use the trace-element composition of a limestone to infer the diagenetic environment in which it stabilized.

A suite of calcite samples was collected in the reef core (massive) and upper fore-reef facies of the Permian reef complex (Guadalupian), from the cliffs above the entrance to McKittrick Canyon. These rocks averaged 375 ppm Sr^{2+}, 13,900 ppm Mg^{2+}, 9.4 ppm Zn^{2+}, and 40.1 ppm Mn^{2+} (AA analyses). Petrographic examination of these wackestones and packstones provided no conclusive evidence of the environment in which mineralogic stabilization occurred. However, the trace-element values, when compared to probable starting (sedimentary) compositions, indicate equilibration in an open chemical system with insignificant introduction of cations from an external source. Autodepletion of strontium and magnesium ($k^{Sr}_{cal} = 0.14$; $k^{Mg}_{cal} = 0.02$) accompanied autoenrichment of zinc and manganese ($k^{Zn}_{cal} = 5$; $k^{Mn}_{cal} = 15$). The degree of autoenrichment and autodepletion of these chemical species is characteristic of an open chemical system, that is, one in which fresh waters flush rapidly through the diagenetic site. This combination of fresh water and open system is diagnostic of a freshwater phreatic zone. We infer, then, that this part of the reef stabilized in a