loose sand below, thereby creating shallow erosional depressions on the landscape. Heavy trampling in wet interbeds of sand and mud homogenizes the previously distinct layers into a thicker, more massive unit, typically without any obvious tracks preserved. Although we have identified individual prints of hippo and antelope—and a four-print trackway of *Homo erectus*—exact taxonomic assignments are not yet easily made.

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Late Mesozoic Plate Tectonics

Most of this world's oil was generated in the late Mesozoic, and most of these deposits consist of middle Cretaceous oil. A study of Deep Sea Drilling Project results combined with marine geophysical data has yielded a large-scale, plate-tectonic history for this period. The most significant events in this history are (1) the opening of the north-central Atlantic between North America and Africa about 180 m.y. ago; and (2) the fragmentation of Gondwanaland 130 m.y. ago, a worldwide phenomenon when Africa separated from South America, Australia-Antarctica separated from greater India, and spreading patterns in the Pacific were greatly altered in response to the large-scale continental breakup. The middle Cretaceous is not characterized by continental breakup, but has unusual, and probably highly significant, characteristics. An apparent increase in worldwide spreading rates occurred from 110 to 80 m.y.B.P., coincident with a period that lacked magnetic-field reversals. Subduction rates increased, sea levels rose, and batholiths formed behind subduction zones as results of these spreading-rate increases. Mid-plate volcanism created most of the seamounts and guyots present today in the western Pacific, as well as voluminous sills that are chemically similar to midocean ridge tholeiite. These events probably controlled the generation and subsequent preservation of late Mesozoic oil deposits in a yet unknown way.

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Uranium In-Situ Leach Mining—A Third Alternative

Uranium in-situ leach mining, when used as a single commercial mining method, represents a technologic breakthrough with which many people are not familiar. In the last 5 years, plant-installed capacities for uranium in-situ leach mining have increased approximately 12-fold. There are now at least seven western states which have activities of some type regarding uranium in-situ leaching.

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Chocolay Group—Early Proterozoic Cratonic Sequence

The Chocolay Group of the southern Lake Superior region (upper Michigan, Wisconsin, and Minnesota), a stable-shelf assemblage bounded by unconformities, resembles Phanerozoic cratonic sequences. The Chocolay Group consists of a lenticular basal conglomerate overlain successively by quartzite (0 to 700 m), dolomite (30 to 800 m), and locally slate; it is capped by a regional unconformity. This sequence, although generally thicker, is similar to cratonic sequences (e.g., Sauk) in that both become finer upward, contain texturally mature sediments, are areally extensive, and are contained by unconformities.

New data on the Chocolay Group show interesting divergences from a quiescent stable-shelf model. Paleocurrents from cross-beds in quartzites show strong unimodality (s = 20 to 60°) atypical of stable platforms. Current directions from ripple marks and cross-beds crudely parallel later Precambrian troughs. Locally there are apparent reversals in the fining-upward trend of the Chocolay Group. Granite and basalt pebbles and abundant feldspars are present locally in dolomitic formations, but are absent in the underlying quartzites. The presence of irregular topography and the occurrence of uplifting locally are suggested by data which include thinning of quartzite members, variations in modal percent of detrital feldspar, and intraformational unconformities in the dolomites.

Based on large stratigraphic thickness, variations in sedimentary texture and mineralogy, and unimodality of paleocurrents, analogy to a simplistic stable craton interior is rejected. Rather, the influence of pericratonic tectonic conditions, including fault-bounded troughs, is suggested.

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Interaction Between Overwash and Eolian Processes on Migrating Barrier Islands

Landward barrier-island migration is accomplished by three processes: (1) inlet dynamics, (2) overwash, and (3) eolian transport. Although these processes are well understood conceptually, few studies have been designed to define their relative roles and thus determine the actual mechanics of barrier-island migration in recent times.

From field surveys of sites on Nauset Spit, Cape Cod, Massachusetts, and Assateague Island, Maryland, an interaction between the two subaerial sediment transport processes can be recognized. Overwash surges during storm conditions deliver fairly large quantities of sand each year (often exceeding 10 cu m of overwash deposition per meter of dune breach). A large part of this material is then redistributed by the wind, eolian transport being largely governed by the winter northwest (offshore) winds.

The net result at Assateague Island is the transport of most of the sand back to the beach face. A small part (less than 10%) of the overwash sand is deposited on the backside of the primary barrier dunes. Although this amount of accretion may seem quantitatively insignificant, this sand may serve as the major source of material to the dunes for their landward translocation concurrent with the migration of the island. This same general model can be applied to the Cape Cod barrier beaches except that drift-line deposits can initiate dune development on the washover fans. These studies can be applied to barrier-island management as well as im-

proving our basic understanding of barrier-island dynamics.

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Seismic, Stratigraphic, and Economic Analysis of Potential Gas Accumulation, Gulf of Mexico

Study of selective seismic and geologic data in a portion of the offshore Gulf of Mexico indicates that with proper application of new geoseismic techniques, the hydrocarbon (gas) potential of an area may be assessed and a specific reservoir quantified. Various techniques, such as wavelet processing of seismic data, petrophysical analysis of well log data, and calibration methodology are essential to establishing the technical framework for further analysis of a stratigraphic trap. Enhancement and special treatment of these data by various new proprietary techniques, used with sound geologic concepts, permit a more reliable qualitative as well as quantitative interpretation of a potential reservoir.

The geologic meaning of seismic amplitudes and their measurements are important not only to explorationists, but to exploitation geologists and reservoir engineers as well. Experience gained in areas (fields) of known production can lead to expansion of confidence limits into wildcat areas where there is little or no control.

Although the example demonstrated is in the Tertiary clastic section of the Gulf of Mexico, concepts and techniques employed are applicable in any geologic environment, so long as physical principals permit.

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Controls of Sedimentation of Lower Mississippian Waulsortian-Type Mounds of Fort Payne Formation, Northern Tennessee

The Fort Payne Formation (Osagian), which extends from the type section in Alabama to Indiana, has a wide range of carbonate and clastic lithologies. In the subsurface of Scott County, Tennessee, where the Fort Payne currently produces oil and gas, it consists of a carbonate platform and associated Waulsortian mound sequence. This sequence may be divided into two lithologic units: (1) a cherty dolostone with remnant evaporites, and (2) a fossiliferous limestone. Each of the units is divisible into several microfacies.

At the beginning of Fort Payne deposition, an erosional surface existed on the underlying Chattanooga Shale. A transgression brought about intertidal to shallow subtidal conditions. Lithologic unit 1, deposited in sabkhalike condition, was draped over the Chattanooga, thus preserving its topography. Further transgression brought about more nearly normal-marine conditions and colonization of the area by crinoids and bryozoans. They served to baffle and trap fine-grained carbonate material into mud lenses. Multiple lenses coalesced into the Waulsortian-type mounds of lithologic unit 2, up to several kilometers long and 25 m high. Subsequent subaerial exposure resulted in solution and development of secondary porosity in favorable grainstone types. Other early diagenetic effects included partial collapse of the mounds to form fractures during dewatering. Later diagenetic effects included emplacement of petroleum in reservoirs now producing oil and gas.

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Beatrice Field, Moray Firth, North Sea

Beatrice field is located in Block 11/30 in the United Kingdom sector of the North Sea. The field lies just 14 mi (22.4 km) from the Scottish coast. The water depth is 160 ft (49 m). In August 1976, well 11/30-1, the seventh wildcat in the subbasin, discovered oil at about 6,000 ft (1,800 m) in an 831-ft (253 m) gross column, at a time when most companies had written off the inner Moray Firth as a major oil province. The well produced an aggregate of 6,060 BOPD (38° API) with a low GOR. The crude, though light and sweet, has a high wax content (17%) and high pour point (65°F; 18.3°C).

An additional four wells, three productive and one dry, have delineated the 4,271-acre (1,728 ha.) field, in which there are an estimated 476 million bbl of oil in place (162 million bbl recoverable).

The field reservoir is an alluvial to marine Jurassic (Sinemurian-Callovian) sandstone and shale sequence. Stratigraphic markers within the sequence can be related to outcrops fringing the Moray Firth. The oil accumulation is in an elongate, fault-bounded anticlinal trap.

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Seismic Stratigraphy and Geologic History of Campeche Escarpment, Gulf of Mexico

Interpretation of multifold seismic data from the Campeche Escarpment northwest of the Yucatan Peninsula shows geologic features that suggest the sequence of events in the evolution of the Gulf of Mexico. Profiles of the "basement" surface resemble topography typical of subaerial erosion, that is, a pediment surface. An inferred Jurassic salt layer that covers sediments in a downthrown basement block pinches out against the pediment surface. Updip of the salt pinchout and topographically higher are possible Late Jurassic carbonate banks or reefs which onlap the basement erosional surface. A major unconformity separating the carbonate seismic unit from the overlying slope-front-fill unit probably corresponds to a worldwide middle Cretaceous unconformity. Since Late Cretaceous, deep-water turbidites emanating from the east coast of Mexico and northern Gulf Coast have dominated the study area.

The scenario revealed at Campeche Escarpment suggests that an early Mesozoic mantle event (plume?) uplifted this once continental area and caused thinning of the crust to near oceanic thickness. Whether and how much of the Gulf of Mexico is underlain by thinned Paleozoic or Mesozoic continental crust, or true oceanic