probably were controlled by paleoenvironmental factors. Northeast-trending belts of thin, low-sulfur, low-ash coal coincide with structurally high areas; and a belt of thicker, higher sulfur, higher ash coal coincides with the trough of a major syncline. The thickness relations suggest that folding was contemporaneous with peat accumulation, and that the folds produced linear northeast-trending paleotopography which was covered by the ancient peat-producing swamps. The slight local relief would have affected water depths and associated anaerobic conditions. Sandstone-filled stream channels in the rocks below and above the Pittsburgh coal trended northwest across the old topographic grain. Compositional variations in the coal are independent of variations in type of overlying rock.

Northeast of Pittsburgh, Pennsylvania, the upper Freeport coal has no partings on depositional and structural highs; it has one parting on the flanks of the highs; and it has two partings in lows. Between Pittsburgh, and Brookville, Pennsylvania, northeast-trending areas of high sulfur in the upper Freeport and lower Kittanning coals coincide with each other and with areas that were topographically and structurally low when the coals were deposited.

Penecontemporaneous structural control of coal thickness and composition is evident within and east of a northeast-trending zone on the east side of the Appalachian basin, across which 300-ft fold amplitudes increase abruptly to 600 ft. The control was not effective in areas west of the zone. Folds on the west probably are younger than those on the east, and they did not affect deposition of Upper Pennsylvanian coal.

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PATTERNS OF COASTAL SEDIMENTATION: CARBONATE MUDS OF FLORIDA BAY

Muddy carbonate sediments of Florida Bay have accumulated in response to hydraulic processes characteristic of coastal environments. These processes are reflected in faunal distribution as well as physiography of the accumulations. The frequently encountered coastal sedimentary pattern of "banks," "lakes," and mainland veneer is expanded laterally in Florida Bay because of topography of the underlying Pleistocene rock surface.

In Florida Bay the dominant physiographic pattern consists of circular "lakes" of deeper water surrounded by curvilinear banks and islands. The banks, composed predominantly of mud sediment, reach within a foot or so of mean sea level and are largest in the western bay nearest the open Gulf of Mexico. The northeastern ("interior") segment of the bay is characterized by narrower banks, in many places exposed subaerially as islands.

Spitlike accretion is apparent from growth lines on islands and some banks. This indicates locally directed currents; however, overall randomness of orientation and circular patterns of sediment distribution suggest that significant currents develop in all directions. The larger submerged banks of the "outer" bay display prominent accretion lines and are in addition elaborately channeled. The channeling follows a distinctive cycle of establishment and decline that seems closely related to bank growth.

Current control of deposition of muddy sediments is reflected also in the ancient sedimentary record, notably the Pennsylvanian Virgil "mounds" near Alamogordo, New Mexico, and Pennsylvanian Lansing "mounds" in southeastern Kansas. Sediment-baffle processes previously proposed for the construction of mound-topography appear unneeded inasmuch as current processes may achieve similar results.

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CHANNEL SEQUENCE DEVELOPMENT IN AGGRADATIONAL STREAMS WITH EXAMPLE FROM SOUTH CANADIAN RIVER, TEXAS

At least 8 channel sequences of varying relative age have been observed in the floodplain of the South Canadian River. These sequences initially identified by vegetational differences on aerial photographs probably represent deposition during major flood events. Surface features on the most recent channel sequences include longitudinal bars, elongate scour marks, and extensive ripple-marked areas near bars. Within an individual sequence the only sedimentary structure types observed are plane bed, trough cross-stratification, and ripple cross-stratification. Channel sequences, or small divisions within them, are punctuated by mud or silt-mud layers. These layers or clay drapes are deposited as the result of the settling out of fine sediment during waning flood conditions.

Channel sequences older than the most recent 2 or 3 flood events are heavily vegetated and commonly discontinuous downstream. Moving correlation coefficient (r) analysis indicates that the sinuosity and position within the floodplain of channel sequences or remnants of all ages are controlled by the confinement of the South Canadian River valley and location within the valley of earlier sequences. This shows that major floods with a strong aggradational effect are probably a valley-wide phenomenon within this depositional system.

Daily discharge data show that floods, with a discharge of greater than 10,000 cu ft/sec, occur less than 1% of the time in the South Canadian River. These floods are catastrophic events which cause major changes in the configuration of the river floodplain.

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NONSKELETAL CARBONATES FROM BAFFIN BAY, TEXAS

Twenty-five piston cores were taken from Baffin Bay, Texas, and 1 piston core was taken from an adjacent blue-green algal mat lagoon. The cores ranged in length from 85 to 670 cm. X-ray diffraction analyses and scanning electron microscope examination of the carbonate-rich layers in the sediment show that aragonite, calcite, Mg-calcite, and dolomite are all present as nonskeletal carbonates. Each varies from 0 to 100% in the individual samples studied.

Aragonite is the most common carbonate constituent, and occurs as needles less than 4μ in length. However, it also occurs as clusters of radiating needles, whose delicacy seems to indicate that the aragonite formed *in situ* and is not of a detrital origin. Aragonite also occurs as friable, partly lithified material and in 1-mm thick flakes. Calcite and Mg-calcite are found in unlithified muds in the form of anhedral to euhedral crystals 1–10μ in size. One sample composed of 100% Mg-calcite was semilithified. Dolomite has been reported from the subsurface where it occurs as lithified,

laterally traceable beds composed of 1–5μ anhedral and a few euhedral stacked crystals. Two newly discovered occurrences of dolomite are as a minor constituent disseminated in unlithified carbonates and in a carbonate crust in the uppermost layer of a blue-green algal mat. The mat is growing today in a hypersaline lagoon adjacent to Baffin Bay, and the dolomite seems to be penecontemporaneous. The dolomite occurs with other carbonates which are forming as lithified grains embedded in the organic mat material.

With the exception of the lithified aragonite flakes and the lithified carbonate grains in the algal mat, all the lithified carbonates are found at core depths greater than 350 cm.

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CHARACTERISTICS OF BASINS WITH GIANT FIELDS

Approximately 270 giant fields located in 60 basins account for the principal world energy sources. To compare the geologic and historical development characteristics of giant fields, one of several possible basin classifications has been proposed. Three general basin types based on the different crustal thicknesses in *cratons, oceans,* and zones *intermediate* between the two are the basis of a classification of 8 types of basins. There appears to be a relation between the classified basin types and both their hydrocarbon characteristics and, to some extent, their historical development patterns.

Cratonic basins are typified by taphrogenetic, block structures out to the mobile zone where the intermediate crustal zone basins are developed. In general, cratonic basins have high-gravity, low sulfur crude and contain over three fourths of the world's gas and the great majority of known Paleozoic hydrocarbons. They have moderate oil recovery per cubic mile of sediments and are relatively predictable in hydrocarbon character. Intermediate basins are more or less directly related to "sea-floor spreading" and commonly display structural trends at angles to cratonic trends. Depending on the tectonics of the various leading edges of worldwide plates these basins are either intensely or relatively moderately deformed. They are commonly subject to high heat flow, at some time during their development. As a result of their tectonic history they are less predictable and their hydrocarbon characteristics are much more variable than those of cratonic basins. Ocean basins are little known and in water too deep for commercial prospect at present.

Normally accepted geologic conditions for the formation of hydrocarbons are enhanced by several special factors including the presence of evaporites, unconformities, regional arches, and suitable geothermal gradients resulting in giant and supergiant accumulations. The lack of significant reserves in Paleozoic rocks may be related to the advent of post-Permian "sea-floor spreading."

When the history of the world's oil basin development patterns over the last 100 years is analyzed it is noted that: (1) more producing basins are being found, but the industry is experiencing a lower success rate in its search; (2) although half of the producing basins contain giant fields, the odds are that only 1 of 5 or 6 basins have prospects of major reserves; (3) the time required to discover oil and develop it in a basin appears to be related to when it was explored, its size, and its geologic character. These factors are modified by terrain and market relations; (4) there has been a tendency to develop basins more rapidly in recent years.

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NEW LIGHT ON PETROLEUM POSSIBILITIES OF THE BASIN AND RANGE PROVINCE, ARIZONA

In 1947, in his presidential address, Earl Noble cited 6 masks that hamper explorationists in their search for oil: water, overthrust blocks, multiple unconformities, high-velocity limestones, younger volcanics, and thick deposits of relatively young clastics. Improved technology, courage, and success have removed some of these masks in many areas of worldwide exploration, but these masks continue to hinder the search in other areas.

Relatively thick sections of valley fill and volcanic cover have been the chief deterrents to exploration in the basins of southern Arizona. Meager geologic information, poor maps, and the public land situation have added to the negative attitude of companies and individuals. But new data are changing the picture.

Although Edwin McKee pointed out 25 years ago that Paleozoic seaways covered most of southern Arizona and that petroliferous rocks may be present in the intermontane valleys, only in recent years has field work by the U.S. Geological Survey confirmed the presence of Paleozoic rocks in some of the upfaulted mountain blocks. Oil and gas shows in thick Paleozoic sections in southwestern New Mexico and northern Mexico have added to the attractiveness of southeastern Arizona.

Other Survey geologists have developed information indicating a marine embayment of Pliocene age, extending into southwestern Arizona and southeastern California and covering about 15,000 sq mi. It may be larger. More surprising has been the discovery that salt domes exist in Arizona and that salt deposits may extend nearly 350 mi along the northern edge of the Basin-Range province. North of Kingman the salt is more than 4,100 ft thick. Near Phoenix several wells have proved the existence of a dome underlying a gravity minimum. Salt thickness is well over 3,600 ft. Near Florence, palynologists date a caprock core overlying salt as Pliocene(?).

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EFFECTS OF DEPOSITIONAL ENVIRONMENT AND POST-DEPOSITIONAL HISTORY ON CHEMICAL COMPOSITION OF LOWER TUSCALOOSA OILS

The crude oils in lower Tuscaloosa Cretaceous reservoirs in Mississippi and Alabama can be divided into groups on the basis of their chemical compositions. One of these groups appears indigenous to the lower Tuscaloosa interval. The oils in this group, all in unfaulted structural and stratigraphic traps, are located in south-central and southwestern Mississippi, where the lower Tuscaloosa has been subjected to the deepest burial and greatest diagenetic influence. The remaining group of oils in the lower Tuscaloosa are commonly contained by faulted structures. They are situated