decreases northward from the mountain front. Twenty anticlines have been tested, and favorable reservoirs in the Cretaceous seem to be limited to narrow nearshore facies.

Pre-geosynclinal rocks are at drillable depths near the edge of the Brooks Range and on the basement rise. Folding and overthrusting make the Mississippian to Triassic rocks along the mountains difficult to evaluate without intensive subsurface exploration. In the north, geophysical data suggest that the basement rise trends southeast from Barrow and may even be an arch with northward regional dips offshore. Recent private exploration resulted in test wells on two presumably separate structures along the trend of the rise. Reservoir rocks between the Upper Triassic and basement were penetrated by the Colville well, and produce oil and gas in the wells at Prudhoe Bay. These Triassic terrigenous clastic and Mississippian carbonate rocks are part of a sequence of deposits that seem to transgress regionally northward across an unconformity and regress southward away from the source. Additional reservoirs on the rise may be present if Devonian(?) carbonate rocks, that discordantly underlie the Mississippian at the front of the northeastern Brooks Range, are preserved below the unconformity.

Transportation facilities necessary for the development of large petroleum resources in northern Alaska will make the development of the extensive coal deposits there more likely and will improve the potential of known phosphate and rich but limited oil-shale deposits.

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Recognition of Alluvial-Fan Environments in Stratigraphic Record

Alluvial fans are orogenic deposits whose geometry is influenced by the rate and duration of uplift of the adjacent mountains and by climatic changes.

Three longitudinal shapes are common. A fan may be a wedge that is thickest (or thinnest) near the mountains, or it may be lenticular.

An alluvial fan may consist of water-laid sediments, debris-flow deposits, or both. Water-laid sediments occur as channel, sheetflood, or sieve deposits. Main stream channels commonly are backfilled with coarse-grained sediments. Sheets of finer grained sediments are deposited downslope from the channel. The fine-grained sediments may be cross-bedded, massive, or thin bedded; the coarse-grained sediments may be imbricated, massive, or thick bedded. Sieve deposits consist of intertonguing lobes of very permeable gravel.

Debris flows are poorly sorted and may have graded bedding or preferred particle orientation. Boulders weighing many tons may be present in an unsorted matrix. Mudflows are fine-grained debris flows. Platy fragments are oriented parallel with the bedding in low-viscosity flows. In high-viscosity flows, fragments are oriented vertically, and normal to the direction of flow.

Individual beds may be traced for long distances along radial sections, and channel deposits are scarce. Cross-fan sections reveal beds of limited extent that are interrupted by cut-and-fill structures, which are most common near the fan apex.

Logarithmic plots of the coarsest 1-percentile and median-particle size make patterns which are distinctive of fan environments. Sinuous patterns indicate tractive-current environments. Rectilinear patterns indicate mudflow environments.

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Deep-Water Drilling—Sigsbee Salt Diapirs

(No abstract submitted)

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Foraminiferal Densities and Environmental Variables: Use of Statistical Models to Examine Estuarine Environment

Many environmental variables have been suggested to explain species distributions. However, species distributions generally cannot be evaluated statistically because of inadequate sampling procedures. The purpose of the present study is to outline a method of analysis using statistical models.

A pilot study in the Choptank River, Maryland, indicated that *Elphidium clavatum* density decreases progressively upstream, whereas *Ammobaculites exiguus* and *Ammonia beccarii* densities change very little. From this pilot study, three stations were selected for detailed analysis.

Four foraminiferal samples were taken monthly at each station for a year. Temperature, salinity, oxygen, and chlorophyll *a*, *b*, and *c* were measured each month at every station. A general multiple regression-analysis of variance model was constructed containing 21 parameters for environmental variables, station differences, overall periodic differences, and interaction of station and periodic differences. This model was compared with several containing fewer parameters. Restricted models containing 15 parameters sufficiently accounted for observed species densities in each example.

The set of environmental variables is significant at the 95% level for all species, but none is significant individually. However, relatively large values of regression coefficients for chlorophylls, especially *b*, suggest that food (amount and kind) is important in determining species densities. Each species exhibits periodicity, and for each, periodicity differs at the three stations.

Results indicate that the use of statistical models permits greater understanding of relations between foraminiferal species and environments. Such understanding will be of great value in paleoecology.

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Delineation of some Outer Deltaic Plain Subenvironments Based on Sedimentary Properties in Vertical Section

A small wedge of detrital sedimentary rocks (deposits of the outer part of a deltaic plain) was investigated to delineate subenvironments. The rock unit (Middle Pennsylvanian age) is as thick as 40 ft and occupies an area of about 300 sq mi in western Pennsylvania, where intense strip mining provides excellent continuity of outcrop. Criteria for defining rock subfacies are vertical sequences of bed-thickness properties of sandstone and siltstone, together with minor sedimentary structures and fossil content—in brief, those properties observable in smaller exposures or subsurface records.

Lateral relations of the vertically defined rock subfacies, exposed in continuous cut faces, delineate