metric constrictions increase flow speeds to about 50 to 200 cm/sec causing the strongest currents on the eastern side of the straits. Geoprobe and current mooring stations show that tidal flows and storm-driven currents, including storm surge runoff, can significantly increase bottom current speeds in certain areas.

Topographic expression of the strong current regime occurs as ridges and swales in straits and scour depressions on shoal flanks. Large leeside shoals as much as 100 km long are constructed on the north side of islands and westward-projecting landmasses. These presently developing sand bodies are supplied with sand eroded from upcurrent beach and delta deposits. Strong currents presently remold the crests of the leeside and other relict offshore sand ridges into a complex series of small- and large-scale mobile bed-form fields.

Strong northward flow influences sediment composition and facies distribution over much of the region as well as the patterns of storm sand layers, ice scour marks, and large (25 to 150 m) scour depressions in modern sandy silt. The modern sedimentary facies on the western Yukon delta have been truncated by strong currents in eastern Shpanberg Strait. A substantial part of Yukon Holocene sediment has been displaced from Norton Sound by storm surge currents and the mean northward flow, bypassing Chirikov Basin, to be deposited 1,000 km to the north in Chukchi Sea. The increasing current speeds toward Bering Strait also control the offshore gradation of Holocene transgressive sand facies. The gradation to stronger currents in eastern strait areas results in coarser grain size and also increased concentrations of shell fragments and heavy minerals.

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Paleocene Time Scale for Rocky Mountain Region

A time scale for Paleocene rocks of the Rocky Mountain region has been constructed from provincial palynomorph biozones and vertebrate ages compared to worldwide planktonic foram ages and K-Ar boundary age estimates. As presently interpreted, the major elements of this time scale, from older to younger, are as follows. (a) Top of Cretaceous Maestrichtian foram age = top of *Triceratops* dinosaur age = top of concurrent-range zone of palynomorphs *Proteacidites*, most *Aquilapollenites*, *Cranwellia*, *Balmeisporites*, and several others: about 65 m.y. (b) Early Paleocene, early Danian foram age = Puercan and earliest Torrejonian mammal ages = assemblage zone of palynomorphs *Momipites coryloides* and *Ulmoidipites tricostatus*: about 65 to 62 m.y. (c) Early Paleocene, late Danian foram age = early and middle Torrejonian mammal age = concurrent-range zone of palynomorphs *Maceopolipollenites leboensis* and *M. amplus*: about 62 to 60 m.y. (d) Late Paleocene, early Thanetian foram age = late Torrejonian and early Tiffanian mammal ages = concurrent-range zone of palynomorphs *Maceopolipollenites amplus* and *Tiliaepollenites* sp.: about 60 to 57.5 m.y. (e) Late Paleocene, late Thanetian foram age = late Tiffanian and Clarkforkian mammal ages = assemblage zone of palynomorphs *Pistillipollenites* and *Caryapollenites*: about 57.5 to 53.5 m.y. (f) Base of Eocene Ypresian foram age = base of Wasatchian mammal age = base of concurrent-range zone of palynomorphs *Platycarya*, *Tilia*, and *Eucommia*: about 53.5 m.y.

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Distribution, Diagenesis, and Depositional History of Porous Dolomitized Grainstones at Top of Madison Group, Disturbed Belt, Montana

Dolomitized crinoidal grainstones locally form the upper part of the Mississippian Madison Group that unconformably underlies Jurassic strata in the Disturbed belt, northwestern Montana. Surface exposures of these grainstones exhibit a significant vuggy and intercrystalline porosity (4 to 12%) and are permeable (6 to 12 md). Many of the pores are filled with dead oil.

The porous crinoidal grainstone unit at the top of the Madison has undergone eogenetic secondary dolomitization, probably in Late Mississippian time, and hence prior to any significant erosional events. Porosity most likely resulted from solution effects during erosion and was fully developed before deposition of the Jurassic strata. Phreatic calcite cement partly occludes some of the pore space and developed after migration of liquid hydrocarbons into the grainstone unit.

Variations in thickness of the grainstone unit are mainly the result of pre-Jurassic erosion. In places the grainstones are completely eroded beneath the Jurassic rocks but, where present, they thicken to more than 100 m as observed in a north-south direction along the strike of imbricate thrust slices of the pre-Tertiary section. These thickness changes resulted either from broad warping of the Mississippian strata followed by planar erosional truncation, from erosional relief on the Jurassic erosion surface carved into unfolded Mississippian strata, or from some combination of these two effects which may have different geographic trends. Location of thickness maxima of the grainstone unit in each of several thrust plates enables correlation of the thickness patterns in an east-west direction from thrust sheet to thrust sheet. Projections of such patterns into the subsurface will be a valuable guide for exploration in the Disturbed belt.

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Depositional Environmental Analysis of Kaibab and Toroweap Formations in Southwestern Utah

The Kaibab and Toroweap Formations of southwestern Utah contain six members which represent transgressive and regressive cycles. The lowest member of the Toroweap Formation is the Seligman, which contains gypsiferous siltstone in the south and sandstone in the north. It represents a transition from a sabkha in the south to a beach in the north and marks the beginning of a marine transgression. Above the Seligman is the Brady Canyon Member which is a fossiliferous limestone containing broken and rounded fossils deposited in a marine environment. Overlying the Brady Canyon is the Woods Ranch Member consisting of gypsiferous siltstone at the bottom with oolitic fossiliferous limestone near the middle and silty limestone at the top. Its depositional environmental interpretation is a sabkha near the bottom, an open marine in the middle, and shallow marine near the top representing a regression, transgression, and regression. The lowermost member of the Kaibab Formation, the Fossil Mountain, is a fossiliferous chert-bearing limestone with whole fossils and was deposited in a low-energy marine environment suggesting a transgression. Overlying the Fossil Mountain Member is the Harrisburg Member which consists of a series of alternating gypsiferous siltstones, dolomites, and limestones interpreted as having been deposited in an environment which fluctuated between a sabkha and shallow, open-marine seas.

Overlying the Harrisburg Member is the discontinuous Rock Canyon Conglomerate. It represents erosion and dissection of the Harrisburg Member and resulted from a major marine regression during Late Permian time.

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Sedimentology of Fluvial Upper Devonian Kanayut Conglomerate, Brooks Range, Alaska

The Kanayut Conglomerate, which extends across most of the Brooks Range in northern Alaska, is a widespread nonmarine clastic sequence as thick as 2,000 m. It records southwestward growth of a major fluvial-dominated coarse-grained delta. The Kanayut is underlain and overlain by fossiliferous marine strata of the Upper Devonian Hunt Fork Shale and Lower Mississippian Kayak Shale, respectively. It has been subdivided into four members, in ascending order: (1) a lower marine member, 560 m thick, consisting chiefly of sandstone; (2) a lower nonmarine member, 550 m thick, consisting chiefly of fining-upward cycles of sandstone to shale; (3) a middle nonmarine member, 450 m thick, consisting of massive interbedded conglomerate and sandstone; and (4) an upper nonmarine member, the Stuver Member, 400 m thick, consisting chiefly of fining-upward cycles of sandstone to shale. The distribution of maximum size of conglomerate clasts suggests a source area to the northeast, and paleocurrent measurements indicate sediment transport dominantly toward the southwest. The conglomerates are texturally and compositionally mature, containing primarily clasts of chert with lesser amounts of quartz, quartzite, and argillite. The sandstones are also compositionally and texturally mature, composed chiefly of subrounded grains of quartz, chert, and argillite, with negligible amounts of feldspar.

The Hunt Fork Shale, Kanayut Conglomerate, and Kayak Shale record a major progradational-retrogradational deltaic cycle. The lower marine member of the Kanayut and underlying and overlying marine units represent prodelta, delta-margin, and delta-front deposits, the lower nonmarine member and the Stuver Member of the Kanayut represents meandering fluvial delta-plain deposits, and the middle nonmarine member of the Kanayut represents braided fluvial delta-plain deposits.

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Geometry and Dispersal Patterns of Deep-Sea Fans From Various Tectonic Settings

Deep-sea fans range from small fan-shaped depositional bodies with relatively simple internal structure to large variably shaped depositional bodies with complex internal structure. Their shape depends on several important factors: (1) the topography of the basin floor and shape of the basin in which they are deposited; (2) the number and distribution of submarine canyons or sea gullies transporting sediment to the ocean floor; (3) the strength and direction of bottom currents; (4) the effects of the Coriolis force; (5) the grain-size distribution of the sediment being fed to the fan; (6) the rate of sediment supply; (7) the presence of syndepositional tectonism either along basin-margin slopes or on the sea floor; and (8) the position of the shoreline and effects of sea-level changes.

Fans in trenches can be extremely long and narrow, whereas those on flat ocean floors have more regular fan shapes. Fans fed by single submarine canyons are relatively simple, whereas those fed by sea gullies that extend outward from deltas are more complex. Bottom currents can redistribute fan deposits, and the Coriolis effect causes hooking of modern fan channels. Fans built primarily of sand from submarine canyons are highly channelized, whereas those containing a mixture of sediment sizes have well-developed non-channelized facies. The rate of sediment supply, strongly affected by sea-level changes and tectonism, provides overall constraints on the size and shape of fans.

Fans constructed along California-, Japan-, Andes-, and Atlantic-type margins have distinctive geometric, petrographic, and dispersal characteristics.

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Structural and Sedimentologic Study of Cerro Prieto Geothermal Field, Baja California, Mexico

Since 1977 the Comisión Federal Electricidad of Mexico and the Lawrence Berkeley Laboratory have cooperatively studied the Cerro Prieto geothermal field, located approximately 35 km south of the United States-Mexican border in the Mexicali-Salton trough.

As part of these studies, geophysical and lithologic well logs have been qualitatively and quantitatively studied using both manual and computer interpretation techniques. These logs were analyzed to make stratigraphic correlations throughout the Cerro Prieto field and to interpret the depositional environment of the field's lithologic units. Dipmeter and seismic data were of noted value in making stratigraphic interpretations and predictions. Cross sections were constructed to illustrate lithofacies variations throughout the geothermal field. These sections were used to construct a three dimensional model of the Cerro Prieto geothermal reservoir.

Petrographic, SEM, and X-ray diffraction analyses were made of the well bore cuttings to determine the degree and distribution of hydrothermal alteration, the origins of secondary porosity, and the relative degree of