Bed-parallel disc fractures started at bit level, within the core, at bedding irregularities. Hackle plumes indicate that spreading velocity of disc fractures was greatest toward core centers and decreased toward core margins in response to changes in tensile stress intensity.

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Radiolarian Preservation in Present and Past Oceans

Three methods were used to collect living and recently dead radiolarians and fecal pellets containing radiolarians—plankton tows for those in the water column, and gravity cores and box cores for recovery from surficial sediments. Deep Sea Drilling Project cores were used to study radiolarians from fossil sediments. Our techniques differ from previous studies by the investigation of individual skeletons and suggest that radiolarian skeletons are removed from the water column primarily by dissolution and, secondarily, by settling as individuals or via fecal pellets. Laboratory experiments suggest that metallic coatings help to protect the skeletons from dissolution in the water column and in sediments. Other factors of extreme importance are differential rates of settling, thickness of the "radiolarian dissolution zone," productivity of overlying waters, amounts and ratios of terrigenous and authigenic sediment, presence of different water masses in the water column and at the sediment-water interface, degree of bioturbation, and chemical conditions at and below the sediment-water interface.

Paleobiologic developments such as the evolution of diatoms appear to be related to radiolarian conservation. The use of silica by diatoms may be partly responsible for the preferential dissolution of some Neogene radiolarians. Major changes in oceanic circulation appear to be related to such changes as the cessation of radiolarian preservation in the middle and tropical Atlantic during the middle Miocene.

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Sedimentologic Facies in Modern Glacial-Marine Environment

Studies of recent Antarctic glacial-marine sediments have enabled us to delineate facies associations that reflect the influence of fundamental glaciologic and glacio-isostatic processes on continental-margin deposition. Glacial-marine deposits can be broadly categorized as representing three sedimentary provinces. These are (1) the grounded shelf province—that portion of the continental shelf where sediments have been deposited by grounded ice at some time during glaciation; (2) the nongrounded shelf–upper-slope province; and (3) the middle to lower slope–rise province.

Sediments in the grounded shelf province consist predominantly of orthotills deposited by grounded ice, related till-flow deposits, and paratills deposited from floating ice. Glacial erosion and deposition by subglacial streams are also important processes. Seaward of the maximum grounding line, on the nongrounded shelf and upper slope, deposition is primarily by floating ice. However, substantial sediment reworking occurs, forming coarse residual deposits and sediments enriched in fine-grained material. From a sedimentologic standpoint, distinction between the outer shelf and upper slope is problematic. The middle to lower slope and continental rise may be dissected by submarine canyons or may be nonchannelized. Gravity-flow deposits are commonplace. Laminated muds, perhaps deposited by contour currents, are also widespread. The boundary separating the two slope provinces is related to a zone of glacio-isostatically induced slumping where sediment gravity flows are generated, and perhaps to the shallowest depth at which contour currents occur.

These facies associations are useful in characterizing older sequences; they have been used to interpret several ancient glacial-marine sequences.

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Organic Geochemistry of Sediments Recovered by DSDP/IPOD

Since the beginning of the Deep Sea Drilling Project more than 10 years ago, organic geochemical studies have been undertaken on almost 2,000 sediment samples from beneath the ocean floor. These studies have provided fundamental information regarding the distribution of carbon in oceanic sediments and have yielded a better understanding of the processes that alter and transform organic matter in the marine environment. Of particular practical importance have been those investigations directed toward the occurrence of liquid and gaseous hydrocarbons in sediment of the continental margins and ocean basins; however, work has not been specifically directed to finding oil and gas. Instead, such discoveries have been purposely avoided, and information about possible occurrences of petroleum has been extrapolated from studies of anoxic basins, such as the Carioca Trench and the Black Sea, and from continental-margin sediments such as those off Norway, northern Africa, and southwest Africa. It is evident that significant concentrations of organic matter are sequestered in certain marine sediments, and it appears that much of this organic matter has come initially from the continents. Studies of the continental rise off Morocco show that organic material is undergoing diagenetic processes leading to petroleum. The organic geochemical conditions for petroleum formation, therefore, are present in the outer continental margins, but it remains to be determined if the geologic settings there are favorable for petroleum accumulations.

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Silica Dissolution from Montmorillonite; Effect of Solution Chemistry

The rate of silica removal from two montmorillonites (Chambers and Polkville) has been measured as a function of time, temperature, solution composition, and exchange ion on the clay. Solution compositions ranged from 400 to 4,000 ppm potassium in all samples. Sodium concentration ranged from 0 to 9,400 ppm, calcium from 0 to 380 and magnesium from 0 to 10 ppm. Silica removal rate increased as the temperature increased from 200 to 350°C, decreased with time, and could be approximated initially by a parabolic rate law. Within the time range (from 1 to 10 days) approximated by the parabolic-rate law, comparison of rate constants allows quantitative evaluation of the effects of solution chemistry and exchange ion. Calcium-saturation of the clay reduced the value of the rate constant, relative to sodium-saturation, by about 50%. In all analyses, increasing solution concentration of an ion decreased the rate of silica removal. On an equimolar basis, magnesium was most effective at inhibiting dissolution, followed by calcium, sodium, and potassium. Reductions of the rate constant by 50 to 75% were observed for a Na-clay with 9,400 ppm sodium and for Ca-clay with 380 ppm calcium, relative to the sodium and calcium-free solutions. Activation energies for silica removal range from 3 to 12 kcal/mole. The highest values are associated with the largest concentrations of ions in solution, thus suggesting dissolution-inhibition by an ion adsorption mechanism. These results demonstrate that silica dissolution rate depends dramatically on solution composition. This relation should be incorporated into models constructed to describe sandstone cementation or porosity enhancement by dissolution and transport of dissolved silica from clays in sandstones or interbedded shales and sandstone sequences.

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Painter Reservoir Field—Giant in Wyoming Thrust Belt

Painter reservoir field is the largest of several recent Nugget Sandstone hydrocarbon discoveries in the Wyoming thrust belt province. The field is located in Uinta County, Wyoming, 5 mi (8 km) northeast of the town of Evanston. It lies on trend with the Clear Creek and Ryckman Creek accumulations, 5 and 10 mi (8 and 16 km), respectively, northeast. These features are also productive from the Nugget Sandstone.

The field discovery, Chevron-Federal 22-6A, was drilled in mid-1977 on a seismic anticlinal structure. The Nugget Sandstone was entered at 9,728 ft (2,918 m) and 1,355 ft (407 m) were penetrated to the total depth of 11,083 ft (3,325 m). After extensive testing, on October 22, 1977, potential of the well was 410 BOPD and 859 MCFGD, on 15/64-in. choke, FTP 1,275. Flow rates as high as 1,500 BOPD were recorded on larger chokes. Gravity of the oil is 48.4° API. Active development began immediately and is still in progress.

Field limits and structural configuration are not yet fully decided, but seismic and drilling data indicate an overturned fold associated with the hanging wall of the Absaroka thrust. Present drilling has established an oil and gas column of over 1,000 ft (300 m). The producing Nugget formation is a cross-bedded, quartz sandstone over 850 ft (255 m) thick with an average porosity of 12% and permeability ranging from 0 to 1,000 md. Analysis of the oil suggests a Cretaceous source.

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Detailed Temperature Logging as Useful Tool for Lithologic Interpretation

Data from an extensive drilling program conducted on the Atlantic coastal plain by the Department of Energy suggest that detailed temperature logs may be useful for interpretation of subsurface lithology and stratigraphy. Temperature was measured to ±0.01°C and was sampled every 0.5 m. Thermal gradients were computed, and compared to lithologic sequences as derived from drill cuttings collected every 3.0 m.

Examination of a vertical thermal-gradient curve reveals that breaks in the curve correspond to major grain-size changes. Many of these breaks correspond to stratigraphic boundaries that are associated with a grain-size change. However, stratigraphic boundaries that are not defined by a grain-size change are more difficult to recognize.

Preliminary results from the first hole at Fort Monmouth, New Jersey, suggest that the correspondence between thermal gradient and grain size is due to a direct correlation between local thermal gradient and the amount of sediment at that depth that is finer than 4.0 psi. This relation allows detailed interpretation of lithologic sequences. Trends within a stratigraphic unit, such as fining-upward sequences, can be readily identified. Also, thin lithologic units (1 to 2 m thick) that were recovered within sediment cores are recognizable on a thermal-gradient curve. These results suggest that detailed temperature logs can provide valuable, detailed information about subsurface stratigraphy and lithology.

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Deep-Sea Drilling: New Dimension in Our Approach to Oceanic Sediments

Over a century ago, when sedimentologists began studying deep-sea sediments, they could grab only small samples of mud from the seafloor. To study the evolution of sedimentation with time, it became imperative to add a vertical dimension and the first long-piston cores opened an entirely new field. When the seafloor-spreading and plate-tectonic hypotheses were developed, it was clear that the best test was to add the time dimension to the models. This combination of interests made the Deep Sea Drilling Project a logical step.

At first, the project aimed at verification and time-calibration of plate tectonics, but it soon became clear that oceanic sediments contain a wealth of information regarding the paleo-oceanographic evolution of the world ocean. One striking result of drilling is that, although the evolution of the oceanic crust appears rather continuous, oceanographic conditions have undergone abrupt changes that may reflect variations in the geometry of the ocean basins. Thus, the sediment record of the past 200 m.y. is both more diversified and more discontinuous than anticipated. For the first time, vertical sequences of cores allow a study of diagenesis of