large diurnal inequality of the tides has a striking effect on beach morphology, because wave energy is concentrated at 4 different levels during a 24-hour period.

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PLANKTONIC FORAMINIFERAL ASSEMBLAGES AND PLEISTOCENE TEMPERATURES

The faunistic compositions of recent planktonic foraminiferal assemblages from the Atlantic Ocean between 0–46°N lat. correlate with average ocean temperatures at 50-m depth. The correlation between temperature and faunistic assemblages provides the basis for an independent method of reconstructing paleotemperatures during the Pleistocene. In this model, Parks' distance coefficient is used to construct a similarity matrix comparing every recent sample station with every other station based on the abundance of species and phenotypes. Relative to the station(s) of highest diversity there is a linear relation between the similarity of all stations and average ocean temperatures at 50-m depth.

Pleistocene assemblages contain the same species and phenotypes as found in recent sediments. Comparison of the similarity of Pleistocene assemblages with recent assemblages in the manner suggested allows an estimate of the ocean temperatures at 50-m depth during deposition of the assemblages. The model, tested in an equatorial core suggests faunistic paleotemperatures which are ± 1° from isotopic paleotemperatures of *G. sacculifer* from the same core. The temperature range between glacial and interglacial periods in the equatorial Atlantic is 5–6°C. In the Caribbean, during the last 100,000 years, the faunistic paleotemperature ranged between 20 and 27.5°C, a somewhat larger variation than that found in the equatorial Atlantic.

The results of this study provide an independent estimate of paleotemperatures during the Pleistocene Epoch. Comparison of faunistic and isotopic paleotemperatures for the cores examined are consistent with Emiliani's estimate of paleotemperature variations, whereby 70% of the isotopic variation is directly related to changes in ocean temperature.

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COMPOSITE BEDDING IN LOWER ORDOVICIAN RESEDIMENTED CONGLOMERATES OF QUEBEC

Lower Ordovician conglomerates and sandstones of the Cap des Rosiers Formation occur in a sequence of fine-grained sandstone and siltstone turbidites near Grosses Roches in Quebec. The conglomerates lie on eroded turbidites, and the presence of rip-up structures, channeling of underlying sediments, grading, poor sorting, very large blocks, and some chaotic fabric in the conglomerates suggests that they were formed by deposition from gravity-controlled slides or flows.

There are 3 lithologies in the conglomeratic facies: (1) polymict conglomerate, (2) medium- to coarse-grained quartzose sandstone, and (3) fine- to medium-grained dark-gray sandstone with slump balls. Most of the conglomerate beds and many of the coarse-grained sandstones show extensive internal layering. The layering is defined by thin sandstone lenses in the conglomerates and by pebbles in the sandstone. Detailed logging of a 100-m thick section shows that layers are traceable for distances of up to 80 m along strike; but most layers are of extremely limited lateral extent. Field evidence suggests that their extent is an original depositional feature rather than the result of erosion by succeeding layers. Erosive structures such as those at the bases of conglomerate beds are not common between layers within beds. Thin turbidite beds and thick sandstone beds are present between conglomerate beds but not between layers within beds. This pattern suggests that deposition of each conglomerate bed occurred as a series of events which were closely related in time and space, and the beds therefore can be considered composite. An origin by some type of progressive failure at source is suggested.

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DEPOSITIONAL ANTICLINES OF CONTINENTAL MARGINS AND THEIR OIL-PRODUCING COUNTERPARTS

Oceanic wind-driven currents such as the Gulf Stream have shaped immense depositional anticlines at the distal edges of detrital source areas along the present and past continental margins. These currents generally parallel the continents with high velocities, commonly sweeping to the base of the slopes. In contrast, the deeper geostrophic currents shape the continental rises as they move slowly along topographic strike. Occasionally, both systems are intersected by turbidity currents flowing down the margins at extremely high velocities.

A striking example of wind-driven current deposition occurs in the Florida Strait where calcareous sands from the Florida reef vicinity are swept along a trough by the Gulf Stream and then onto a broad anticlinal rise. A similar slope-trough-rise profile is observed at the Anton Dohrn Seamount where the North Atlantic Current has shaped another rise from the available sediments as it veers around this buttress.

A wind-driven current origin can plausibly explain the Poza Rica trend in Mexico. As the Golden Lane reef contributed its Tamabra talus downslope into swift currents of the Chicontepec foredeep, anticlines were shaped at the base of the slope, simulating the Anton Dohrn Seamount.

Significant reserves in anticlines formed by wind-driven currents will be found beyond the reefs and laterally away from the deltas in the "poor" environment where the subtle slope-trough-rise has been unrecognized. Reservoirs such as Poza Rica attest to the excellent structural, reservoir, and source qualities which can be realized in an inspired search for such targets.

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PETROLEUM GEOLOGY, SWEETGRASS ARCH, ALBERTA

The Sweetgrass arch is a positive structural feature extending from central Montana into southern Alberta. Rock units ranging in age from Precambrian Belt to Late Cretaceous Montanan are exposed along the 350 mi axis. The 3 major features are the South arch, culminating in the Beltian exposures on the south end; the Kevin-Sunburst dome and Sweetgrass volcanic uplifts in the center; and a broad, northward-plunging nose in southern Alberta.

Although structural traps would be expected to be the dominant controlling factors in hydrocarbon accumulation on so large a positive feature, the fact is that stratigraphic traps predominate on this arch. Structural closure on the large Kevin-Sunburst dome does not by itself cause the entrapment of oil and gas there; rather, irregular porosity development in the Mississippian carbonate rocks and lensing and pinchout of Cretaceous sandstones is primarily responsible for those accumulations.

The largest oil and gas reserves on the arch are found in channel sandstones of the Lower Cretaceous basal Mannville Group, extending from Cutbank field, Montana, northward through the Taber, Hayes, and Bantry fields of Alberta. The middle Mannville glauconitic Moulton zone produces from a series of north-trending sandbars in the Darling area of Montana, in the Taber area, and in scattered trends in the Jenner, Countess, and Hussar fields of Alberta.

Large gas reserves are found in thin blanket sandstones of Late Cretaceous age, principally in the Medicine Hat and Second White Specks zones. A thick deposit of sandy shale in the Milk River Formation probably contains several trillion cubic feet of gas, but the low productivity of early wells kept these reserves off the market until 1970. A small drilling boom is now under way to develop and exploit what will be possibly the largest single gas field in areal extent in Canada.

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BIOSTRATIGRAPHY OF GRAPTOLITE-BEARING BEDS OF UPPER ORDOVICIAN MAQUOKETA FORMATION OF NORTHEASTERN IOWA

A graptolite fauna comprised of 3 species is present in the lower Elgin Member of the Maquoketa Formation. Although this fauna has been reported previously, revision and reevaluation of the taxonomy are proposed. The following taxa merit discussion and revision: "*Diplograptus peosta*" (Hall) belongs to the species group *Orthograptus truncatus* Lapworth. Its geographically and chronologically restricted occurrence dictates a subspecific designation. *Climacograptus putillus* (Hall) is a species which is very similar to *C. mississippiensis* Ruedemann. The 2 species differ with regard to the origin of the median septum; however, other strong affinities should be considered in a revision of both species. An unnamed subspecies of *Orthograptus quadrimucronatus* exhibits affinities with 2 subspecies from eastern North America. Its small size and restricted occurrence separate it as a distinct subspecies.

The stratigraphic and geographic distribution of graptoloid species within the Maquoketa Formation suggests that 2 graptolite zones exist and the graptoloid species are provincial within both zones.

Individually the graptoloid species of the Maquoketa Formation are similar to species reported to be late Caradocian, early Ashgillian, Edenian, Maysvillian, and Richmondian in age. Comparison of the Maquoketa graptolites with faunas of eastern and western North America suggests a discrepancy in previous correlations between the Richmond Stage and the *Dicellograptus complanatus* zone of western Texas.

The graptolite fauna as a whole is correlated with the faunas of the Haymeadow Creek Member of northern Michigan as well as the upper Utica Formation of New York and Canada.

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SELECTIVE SILICIFICATION OF OOIDS IN GRAYWACKES OF GAULT FORMATION, EARLY CRETACEOUS, EAST ALPS

Flysch-type graywacke beds of the Gault Formation of 3 Alpine nappes (Falknis, Tasna, and Flysch Nappe of the East Alps) usually contain less than 5% (maximum 19%) of ooids whose aragonite concentric rims are mostly silicified. Other unstable carbonate components, such as echinoderm and bryozoan fragments (high-Mg calcite), are also preferentially silicified. Most of the other carbonate grains are little altered.

The ooids generally consist of a large nucleus (of quartz, feldspar, glauconite, or other grains) covered by a relatively thin oolithic coating. Silicification has nicely preserved the internal structure of the coatings—tiny inclusions of clay particles and iron-stained minerals delineate the original concentric structure.

This kind of selective silicification is a diagenetic process which probably took place after final redeposition of the sediment (in an assumed trenchlike environment). It is less likely to have occurred at an early stage of diagenesis immediately after formation of the ooids in a high-energy, near sea-level environment, or during transport on the shelf.

Epigenesis at a transitional stage to very low-grade metamorphism has enlarged the crystal size within the siliceous rims. In the unmetamorphosed Flysch Nappe, the rims are cryptocrystalline. In the Falknis and Tasna Nappes (lower chlorite-schist and stilpnomelane facies), many of the silicified coatings display distinct small quartz crystals.

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INDUSTRY'S EXPECTATIONS AS TO NATIONAL MINERALS AND MINING POLICY

The recognition by the government of the need for a long term secure source of minerals is subtle acknowledgment that shortages in hard minerals may soon become as prominent as the mineral fuel shortages of today.

The Mining and Minerals Act of 1970 discloses that industry will be encouraged to provide the mineral needs within the constraints of giving appropriate protection to the environment and conserving and reclaiming those resources which otherwise might have been wasted. If industry is to accomplish this goal there are certain things that will be expected from government:

1. Administration and implementation of policy to avoid over regulation and multidepartment regulations which will unduly burden the operator.
2. Implementation of policy and regulations with thorough recognition of long-range supply-demand picture on an international basis and in a manner which will be fair and consistent regarding imports, stockpiling, and mineral development.
3. Design of tax-legislation regulations and incentives to encourage mineral exploration, development, and reclamation.
4. Encouragement of research and educational facilities which will provide the manpower and technology for the wise and efficient use of our mineral resources.
5. Administration of public lands to insure multiple use and to make prospective areas available for minerals exploration.
6. Serving the public's best interest.

The need for cooperation is recognized and the goals of the Act can be achieved if industry and the consumer can depend on a long period of stable government commitment and policy