Brooks Range, which is the main site of outcrops of Jurassic and Lower Cretaceous orogenic deposits and marks the boundary between distal and nearshore facies in exposed Permian and Triassic rocks, and (4) the Brooks Range overthrust and metamorphic belt, which contains most of the known Devonian and Lower Mississippian molasse deposits, as well as the Devonian carbonates that bordered these deposits on the south, and the upper Paleozoic carbonates that succeeded the molasse deposits.

The stratigraphy records Devonian uplift of the northern high, and downwarp of a deep molasse basin on the south; a series of late Paleozoic through earliest Cretaceous marine transgressions onto the northern high from shallow basins on the sites of the present Brooks Range and Colville geosyncline; Late Jurassic to earliest Cretaceous orogeny in the Brooks Range, coupled with downwarp of successive foredeeps that migrated northward with time; the filling of the Colville geosyncline beginning in late Early Cretaceous time; and because the molasse basin was filled from the south and west and was warped in Late Cretaceous time, migration of depocenters through early Tertiary time was northward and northeastward.

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Mineral Economy of Canada—Viewpoint of Government

During the last 20 years, the value of mineral production has grown from 5.8 to 7.1% of the gross national product and now amounts to almost $5 billion annually, of which 50% originates in the metallic sector, 29% in the fuels sector, and 21% in the industrial minerals sector of the industry. Minerals and mineral products account for about 33½% of the country's total export trade, 43% of all revenue freight traffic, and more than 12% of total annual capital investment. It has been largely responsible for the development of that vast part of Canada which lies above the populated area just north of the Canada-United States border.

The role of government in Canada has been to provide the legislative and taxation environment necessary to attract capital from domestic and foreign sources, and for the attainment of orderly and continuous mineral-industry growth. The role of private industry in Canada has been to supply the knowledge and capital for exploration, development, and exploitation of the nation's mineral deposits, and to market the resultant products in Canadian and world markets. The harmonious blending of these roles has made Canada one of the world's foremost producers and exporters of mineral products. A reappraisal of national objectives reaffirms the continuing important position of the Canadian mineral industry in the attainment of economic growth, expanded export markets, and regional development. The tax incentives which have in the past recognized both the importance of minerals to the national economy and the unique aspect of risk in mineral exploration and development will be continued, albeit in a somewhat modified form.

The future will call for an even greater interplay between government and industry in the solution of greater and more complex problems than have confronted the nation and the industry in the past—trade problems such as tariffs, quotas, and nontariff barriers: the location of processing facilities and degree of processing; the environmental effects of mineral operations; the supply of trained manpower; problems arising from both the growth and the decline of mineral producing areas; changing technology; and foreign ownership and control. Solutions to these and other problems must be in harmony not only with national, economic, and social aspirations, but also with external conditions and influences. On the assumption that the nation will devise generally enlightened solutions or, at least, sensible compromises to the problems of the future, the value of the Canadian mineral industry will probably rise to $12 billion in 1980 and about $17.5 billion in 1985.

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Deep-Sea Drilling in Northern Pacific: Paleontology and Biostratigraphy[1]

Cores of rocks ranging in age from Pleistocene to latest Jurassic from 17 sites in the northwest Pacific Ocean have yielded new information on the biostratigraphic relations of foraminifers, radiolarians, and nannoplankton. Areas sampled by the *Glomar Challenger* on leg 6 of the Deep Sea Drilling Project were the Horizon Ridge (Guyot), the Shatsky Plateau and surrounding abyssal floor, the Philippine Sea, and the Caroline Ridge.

Calcareous nannofossils are present in most of the recovered cores, including cores of abyssal brown clay, and are the most commonly preserved of the 3 groups. Diverse foraminiferal assemblages are associated with calcareous rocks of all ages whereas radiolarians are commonly poorly preserved or absent in highly calcareous strata. Radiolarians are more markedly affected by biogeographic variability than are the calcareous microfossils; biostratigraphy developed in equatorial regions cannot be applied in the Shatsky Plateau region (north of 30°). However, volcanic ash-rich areas of the Philippine Sea produce unusual Miocene nannoplankton similar to those in ash-rich sediments from the Caribbean, and foraminifers are sparse or absent and commonly small in size.

Biostratigraphic boundaries determined by the 3 microfossil groups are generally in accord. Stage and epoch boundaries based on nannoplankton may occur higher in cores than determinations based on Foraminifera and Radiolaria. The various effects of ecology, preservation, and drilling techniques on the development of zonal scheme based on the 3 major groups of microfossils require careful evaluation.

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Mineral Economy, Industry, and the Geologist

Mineral production accounts for 3% of the United States gross national product and for about 7% of the Canadian gross national product. In the United States, the value of mineral production is now approximately $30 billion annually, of which 70% is derived from fuels and 10% from metals. In Canada, metals account for more than half and fuels account for only one third of the total value of about $4½ billion.

[1] Publication authorized by the Director, U.S. Geol. Survey.

Mineral production is a declining component of the gross national product. Even so the total value of production will probably exceed $40 billion in 1980. The supply and demand for different minerals will grow at different rates, but the total amount of mineral product during the next decade will be almost ⅔ as much as cumulative consumption during the past 35 years. Finding the mineral reserves to supply expanding economy will be an enormous challenge to industry and to the geologist.

Industry's attention is drawn daily to problems which divert it from its primary goal of supplying sufficient mineral production to promote the economic growth of the nation, such as problems of depletion, pollution, taxation, federal leasing regulations, and import quotas.

A major problem facing the industry and the explorationist is the creation of an environment to improve our mineral-finding ability. Past practices of the industry and explorationist merit change. The industry must stabilize its employment practices to retain and encourage an influx of high-caliber personnel into the industry. These scientists must be able to innovate and to use the rapidly increasing amount of data. This will require a stress on geologic teamwork in lieu of individual effort, which has been our trademark.

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Devonian Reefs in West-Central Alberta as Revealed by Structural Analysis of Shallow Cretaceous Horizon

Trend-surface analysis of structure on the Cretaceous Fish Scales marker horizon indicates the presence of underlying Leduc (Devonian) reef bodies in deeply-buried strata adjacent to the Foothills belt. Included are reef bodies associated with Windfall, Pine Creek, Bigstone, Simonette, and Sturgeon Lake fields. Results of this analysis have exploration significance because of sparse well control for deep Devonian strata and the availability of more widespread data from shallower drilling. Several anomalies shown by the analysis indicate the possible presence of undrilled Leduc reefs.

Success with this technique depends greatly on careful stratigraphic correlation of the higher beds as the anomalies are commonly very subtle. For example, the third-order residual map which best defines the Leduc reefs represents only 0.29% of the total map variability. The present study used data from 776 wells evenly distributed across about 33,000 sq mi; maximum well density was 3 wells per township (36 sq mi). Other geologic features revealed by the analysis include low-displacement normal faults and, apparently major depositional trends in the Beaverhill Lake and Woodbend (Devonian) intervals.

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Principles of Deltaic Prospecting

Deltas generally are formed at river mouths during stillstands of sea level under conditions of either cyclic transgression or regression. Consequently, they generally are not isolated phenomena, but rather occur in multiples in a predictable fashion. Reservoir facies consist of both continuous and discontinuous bifurcating channel sandstones, which thicken downward at the expense of the underlying prodelta clays.

All the lithologic components of a deltaic complex are related and are collectively referred to as a type of "genetic increment of strata" (G.I.S.). The G.I.S. is a sequence of strata in which each lithologic component is genetically related to all the others. It is defined at the top by a marker bed (such as a thin limestone or bentonite) and at the base by either a marker bed or an unconformity. It generally consists of the total of all marginal marine sediments deposited during a stage of either cyclic subsidence or emergence. An isopach map of a G.I.S. clearly shows the bifurcating trends of the individual distributaries and the shape of the delta, regardless of the varied lithology of the channel fills.

A "genetic sequence of strata" (G.S.S.) consists of 2 or more G.I.S. and, on an isopach map, the shelf, hinge line, and less-stable parts of a depositional basin are clearly defined. An isopach map of the McAlester Formation in the Arkoma basin is a good example of a G.S.S. The oil-productive Booch Sandstone is a good example of a deltaic complex occurring within a G.I.S. of this G.S.S. The upper Tonkawa, Endicott, and Red Fork Sandstones of the Anadarko basin are identified as deltaic accumulations within different G.I.S.'s.

A hypothetical model serves as a basis for establishing the criteria for (1) recognizing successive stillstand positions of a shoreline, (2) predicting paleodrainage courses, (3) predicting positions of a series of deltaic reservoirs, (4) locating isolated channel sandstone reservoirs, and (5) tracing related beach-sandstone reservoirs.

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Importance of Tidal-Inlet Sedimentation in Barrier-Island Systems

Barrier-island complexes, long thought to be composed largely of inlet-fill material deposited during migration, have been shown by recent work in geomorphology, stratigraphy, and petrology to contain only 10% tidal-inlet sediments.

Geomorphology of the North Carolina "Outer banks" barrier-island complex, as determined from recent aerial photographs, indicates that tidal inlets and their deposits comprise only 13 of the 120 mi between Beaufort and Nags Head. These 13 mi of inlets and inlet fill represent only 10.8% of the barrier-island system. Furthermore, geomorphic study of the earliest to most recent USCGS charts shows that tidal inlets and their deposits never have accounted for more than 10–11% of the barrier-island complex. Washover fans, tidal deltas, lagoon deposits, dunes, and beaches appear to be of far greater importance.

To confirm volumetric percentages of tidal-inlet deposits, 80 holes were drilled and 178 bottom samples collected from Pamlico Sound and the Atlantic shelf. Grain-size analyses made by settling-tube techniques indictate that tidal-inlet sediments are distinct. Standard deviation versus mean plots allows the best separation of fields. These subsurface studies clearly define the limits of tidal-inlet sedimentation and indicate that only 10% of the total sedimentary complex consists of such deposits.

We must conclude, therefore, that (1) inlet-fill sedimentation is minor in the depositional framework of these barrier systems, and (2) tidal-inlet systems do not migrate significantly in the formation of these barrier islands.