As with all oceanic sea floor, the process of axial accretion along the crest of an active mid-oceanic ridge is of paramount tectonic importance to the geologic fabric of the northern Atlantic Ocean floor.

The chronologic evolution of the Norwegian-Greenland Sea region has been derived from the analysis of Raff-Mason magnetic anomaly patterns by several investigators. These studies indicate that Norway and Greenland were severed when rifting commenced 60–70 m.y. ago, approximately along what are now the edges of their continental shelves. A half rate of 1.2 cm/year has been measured as the rate for this earliest sea-floor spreading. A second episode of spreading lasted from 40 to 18 m.y. ago, and was accompanied by a westward axial shift of the mid-oceanic ridge in the Norwegian Sea. At present, the axis of activity is along the Iceland-Jan Mayen and Mohns Ridges. Mohns Ridge apparently has been stable throughout the evolution of the region whereas the Iceland-Jan Mayen Ridge appears to be a very recent feature. In the Greenland Sea the Knipovich Ridge is apparently now acting as a trench which connects the mid-oceanic ridge branches in the Arctic and Norwegian Seas.

Baffin Bay is enigmatic as to whether it is downfaulted continental or oceanic crust. The writers prefer the hypothesis that Baffin Bay was formed at the same time as the Labrador Sea (prior to 60 m.y. ago) in a proto-North Atlantic by the process of sea-floor spreading. The now-extinct Mid-Labrador Sea ridge would have extended via transform faults through Baffin Bay and perhaps even to the Alpha Ridge in the Arctic. This system then slowed down and became extinct in the Tertiary.

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Geology, Petroleum Potential, and Exploration of Hudson Bay Basin, Canada

The Hudson Bay basin is a major sub-Arctic sedimentary province of Canada. Situated south of the Arctic Circle the basin underlies much of Hudson Bay, an extensive but shallow inland sea.

The basin covers approximately 270,000 sq mi and has a Phanerozoic stratigraphic thickness variously estimated between 6,000 and 10,000 ft. It is dominated by Devonian, Silurian, and Ordovician carbonate rocks with local Cretaceous clastics.

The geology of the basin is considered as a present northern exploration frontier. Estimates of hydrocarbon potential have been made.

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Speculations on Late Mesozoic Tectonic History of Part of Southern Alaska

Late Mesozoic sedimentary and volcanic rocks in southern Alaska form 2 crudely parallel, arcuate belts that are concave on the south. The northern belt consists of the southern Wrangell Mountains and their ill-defined mergence with part of the St. Elias Mountains on the east. The southern belt consists of the eastern part of the Chugach Mountains and part of the St. Elias Mountains. Both belts include large tracts of geologically unmapped terrane; knowledge of their geology is based mainly on reconnaissance investigations and a few local detailed studies.

The northern belt is the less structurally complicated of the two. It contains a sequence of Late Triassic, Jurassic, and Cretaceous shelf deposits that overlies widespread Triassic subaerial basalt. Mesozoic rocks of the northern belt clearly have continental affinities and probably were deposited on a late Paleozoic oceanic terrane that collapsed against the continental margin during the early Mesozoic.

Geologic details of the structurally complex southern belt are less well known. Late Mesozoic rocks of this belt, which attain great thickness, include argillite, slate, graywacke, submarine lavas, and small bodies of ultramafic rock. These rocks are cut by numerous granitic plutons of Mesozoic and early Tertiary ages and locally have been metamorphosed. The Mesozoic rocks are interpreted to have been deposited at least in part on the oceanic crust and later underthrust against the continental margin.

The rocks of the region have been affected by at least 2 major orogenies; the older from the Late Jurassic to Early Cretaceous and the younger from Late Cretaceous to earliest Tertiary. Each of the orogenies involved significant crustal shortening by folding and imbricate faulting in the southern belt and similar but less severe coeval deformation in the northern belt. Details of the Mesozoic tectonic history of the southern belt have been partly obscured by Cenozoic tectonic events.

Both the northern and southern belts appear to be truncated on the east by a system of major dextral transform faults. Late Mesozoic rocks similar to those of the northern belt occur about 500 mi southeast on the Queen Charlotte Islands near the present continental margin. Rocks similar to those of the southern belt are absent there, suggesting that they may have been thrust beneath the continent.

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Stratigraphic Scheme of Ordovician of Northeastern USSR and Its Correlation

Ordovician deposits occur in marginal uplifts of the Kolyma medial massif (different facies zones of the Omulevka Mountains, Selennyakh Ridge, Tas-Khayakhtakh Ridge), middle part of the Kolyma River, in the Verkhoyansk fold-mountains region (Sette-Daban Ridge), in the Chukotsk Peninsula. Recent data indicate the presence of Ordovician in the Omolon and Okhotsk medial massifs. A correlation chart was prepared, and it shows the correlation of Ordovician deposits of all principal regions of the northeastern part of USSR by ostracod, brachiopod, trilobite, and graptolite associations. The biostratigraphic zones corresponding to the Upper Ordovician of the international stratigraphic standard are accepted as principal units of regional stratigraphic importance. However, the stratigraphic positions of some biostratigraphic suites have been revised. This resulted in the revision of the contents and names of some zones.

The oldest Ordovician deposits (Inaya horizon) are correlated conditionally with the Tremadocian of England, the Gasconadian Stage of North America, and the Ust'kut Stage of the Siberian platform. The correlation is based on brachiopod and trilobite associations and stratigraphic position. The Khita horizon is compared with Beekmantown Stage of North America and the Chunya Stage of the Siberian platform on the basis of trilobite and brachiopod associations. The Elgenchak horizon is comparable with the Llanvirnian on the basis of graptolite associations, and is comparable with the Whiterock Stage and probably a part of the Marmor Stage of North America on the basis of the brachiopods. The Lachug horizon corresponds to the Llandeilian; it definitely is comparable with the Krivoluk Stage of the Siberian platform and is conditionally compared with Ashby Stage of North America. The Lachug horizon is characterized by rich graptolite, brachiopod, ostracod, and trilobite associations. The Kharkindzha horizon unites heterofacies deposits and corresponds to the lower and middle Caradocian of England, the Mangaseya Stage of the Siberian platform, and conditionally to the Porterfield Stage of North America. The base of this zone is the most distinctive faunal boundary in the Ordovician of northeastern Asia and is characterized by the appearance of rich graptolite faunas of the *Nemagraptus gracilis* zone and by numerous ostracod, brachiopod, and trilobite associations. The Omuka horizon correlates with the deposits corresponding to upper Caradocian and Ashgillian. The upper part of the Omuka horizon definitely is comparable with the Ashgillian on the basis of graptolite associations, and with horizon 5b of Norway on the basis of corals and brachiopods.

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Two Stochastic Models Useful in Petroleum Exploration

What probability law characterizes the *spatial* distribution of oil and gas fields in a petroleum province?

How does the probability that a wildcat well will find a reservoir change (if at all) as the history of a basin unfolds?

The answers to these questions are important inputs to any model of the process of exploring for oil and gas. Some attention has been devoted to the latter question by Arps and Roberts and Kaufman. Bradley and Uhler and Griffiths have touched on aspects of the former. There are deficiencies in each of these treatments.

Our objective here is two-fold: first to posit a reasonable model of the spatial distribution of petroleum reservoirs that conforms to a number of empirically observed facts about such distributions; second, to examine a simple first-order model of the exploration process that allows one to test empirically the hypothesis that at an early stage in the exploration of a basin the process behaves like sampling without replacement.

We have examined some Canadian data as examples of applications. The techniques of inference are useful in predicting properties of an unexplored region.

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North Canada Rift System

The North Canada rift system, 3,000 mi long, is a dormant incipient branch of the Mid-Atlantic Ridge. It penetrates northwestward into the North American continent, splits into 2 branches at the head of Baffin Bay, and then fades out into the Canadian Arctic Islands.

This system was the locus of continental drift, as Greenland and Canada rotated apart to form intervening seaways. The location of the system resulted from the interplay of subcrustal forces and the anisotropy of the Precambrian and younger crust.

The adjacent continents were deformed passively in the drifting process, by faults and joints occurring in upper levels merging to flow at greater depths. Two phenomena thereby resulted from and facilitated drift. *Continental stretching* occurred where the crust was extended or stretched more or less equally in all directions. *Continental bending,* observed only on a large scale, occurred when the coast was stretched very much more than nearby inland regions, mainly by faulting.

The North Canada rift system illustrates in an arrested state, the first 4 stages of rift ocean development. They are (a) extension failure (many examples), (b) rift valley (Nares Strait), (c) proto ocean (Baffin Bay), and (d) incipient ocean (Labrador Sea). Each stage contains in its sedimentary record the remains of the earlier stages.

The system probably began to form in latest Triassic or Early Jurassic, with the initiation of a rift valley along the site of the present Labrador Sea. Important movements were still occurring as late as Oligocene. It is now essentially dormant, having weak seismicity that indicates only minor adjustments.

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Stratigraphic and Tectonic Development of Cook Inlet Petroleum Province

The Cook Inlet basin in south-central Alaska is an intermontane half-graben about 200 mi (323 km) long and 60 mi (95 km) wide. The basin contains roughly 20,000 cu mi (82,000 cu km) of Tertiary sediments estimated to have at least 1.5 billion bbl of recoverable reserves by present production techniques; and 5 Tcf of proved gas reserves in place, possibly 70% recoverable.

This paper discusses the more extensively explored northern part of the basin.

The stratigraphic and tectonic development of the basin includes 3 Mesozoic cycles of marine sedimentation and 2 Tertiary cycles of estuarine to nonmarine sedimentation. Each cycle is closed by an orogenic episode accompanied by a major geographic shift in the depocenter for the succeeding cycle and generally by some increase in the relative land area to produce progressively more extensive land areas and a more restricted basin of deposition. The stratigraphic succession in the basin includes a cumulative total of over 40,000 ft of Mesozoic rocks and up to 30,000 ft of Tertiary strata.

The structural trend of the basin approximates N30°E between its confining mountain borders. The enclosed Tertiary sediments are deformed into *en echelon* anticlines with more northerly trends diverging from the basin margin about 15°. The folds are concentric and contain Mesozoic sedimentary and volcanic rocks in their cores. They have essentially a universal westward asymmetry, except along the northwest margin of the basin where the structural development is influenced by the basin-bounding Castle Mountain fault system which has good evidence for a strong right-lateral component of movement. Northwest-directed continental underthrusting along the Aleutian trench could be an adequate mechanism to account for the structural shortening evident in the basin.