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TERTIARY OF GREENLAND

Voluminous occurrences of plateau basalts in both East and West Greenland are not believed to have been continuous across the shield area of central Greenland. Whereas the volcanic rocks are almost exclusively basaltic, intrusive rocks also are present, particularly in East Greenland; these show a wide spectrum of rock types, including granites and nepheline syenites.

Because of the difficulty of access to these areas, knowledge of them is still rather limited, although by compiling information from the literature, tentative conclusions regarding the types of magmas involved and their evolution can be gained. The basalts are mainly tholeiitic, commonly with rather primitive features. Small amounts of both normal alkali basalts and greatly undersaturated basalts are also known. Production of such large quantities of tholeiitic basalt commonly has been correlated with continental breakup in this area. Comparisons of the petrology with other areas in the North Atlantic can be made. The highly alkaline rocks are not represented outside of Greenland, except for the peralkaline granite of Rockall. These present special problems, although late trends towards alkaline compositions are well known from other magmatic provinces.

Sedimentary rocks are present in both areas. The stratigraphy in West Greenland is particularly well documented and this, in combination with radiometric ages, shows that magmatic activity was limited almost entirely to the Paleocene. This, as previously noted, is in accordance with the distance of East Greenland from the present mid-ocean ridge and known ocean-floor spreading rates. The areas discussed are bounded on the seaward sides by block faults and large-scale crustal warps, a situation which is broadly similar to what is observed in other regions of crustal extension.

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PALEOZOIC OF NORTHERN AND CENTRAL ALASKA

Cambrian through Middle Devonian fossiliferous rocks define 3 depositional elements in Alaska: a carbonate platform near the craton in the Porcupine Plateau and north of the northeast Brooks Range; a shale-chert-volcanic basin south and west of this platform in the Ogilvie Mountains, Yukon-Tanana Upland, northeast Brooks Range, and probably along the Arctic Coast; and two linear segments of an outer carbonate platform—one trending westward from the southern Brooks Range to Seward Peninsula and St. Lawrence Island, the other southwestward from the Yukon-Tanana Upland to the lower Kuskokwim River. Early Paleozoic orogeny in the northeast Brooks Range is indicated by Silurian (430 m.y.) granite and a post-Cambrian unconformity within pre-Mississippian rocks.

A thick wedge of Upper Devonian terrigenous clastic strata in the Brooks Range north and east of Upper Devonian carbonates indicates a Late Devonian orogeny farther north. Regional angular unconformity beneath Mississippian rocks, and a Late Devonian-Early Mississippian granite mark the position of the orogenic belt along the Arctic Coast, northeast Brooks Range, and northern Porcupine Plateau. Upper Devonian turbidite conglomerates also indicate uplift south of the Porcupine Plateau and in the Yukon-Tanana Upland.

Mississippian and Pennsylvanian carbonates lap northward and eastward from the Brooks Range across a platform of folded Precambrian (?) to Devonian rocks on the Arctic Coast and northern Porcupine Plateau. Permian uplift along the Arctic Coast is indicated by the fact that coarse Permian clastic sediments were shed southward into the Brooks Range. A regional unconformity beneath Permian quartzose clastics indicates other uplifts in the Porcupine Plateau and on part of the former carbonate platform on the upper Kuskokwim River. The Permian uplift on the Kuskokwim is bordered on the southeast by thick Mississippian and Permian volcanic rocks of the Alaska Range, and on the northwest by Permian volcanic rocks and chert along the Yukon and lower Kuskokwim Rivers. Permian eugeosynclinal rocks may extend farther north, because Permian terrigenous clastics in the Brooks Range grade southward into chert and argillite, and Permian(?) mafic intrusives occur on St. Lawrence Island.

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PERMAFROST AND ENGINEERING PROBLEMS ASSOCIATED WITH PETROLEUM DEVELOPMENT IN SEDIMENTARY BASINS OF NORTHERN CANADA

Intensive exploration for petroleum deposits is taking place in the sedimentary basins of northern Canada which are in the physiographic regions comprising the Interior Plains on the mainland, the Arctic Archipelago, the Arctic Lowlands and Plateau, and the Innuitian region. The distribution of permafrost ranges from scattered islands less than 50 ft thick in the southern fringe of the discontinuous zone in northern Alberta and British Columbia to continuous—perhaps 300–1,000 ft thick—in the Mackenzie Delta. The sedimentary basins in the Arctic Islands lie entirely within the continuous zone with permafrost ranging in thickness from about 1,000 to 2,000 ft or more. Ground ice, a commonly occurring and vital component of permafrost is found in a variety of earth materials comprising various types of landforms, and also in bedrock. Ice forms include segregated ice, pore fillings, intrusive or injected ice, vein or wedge ice, and buried ice. Although the existence of ground ice may be inferred in places from certain features of the terrain, *e.g.*, pingoes and ice wedge polygons, the distribution and type of ice are not readily determined in many cases.

The effect that construction and other activities have on the ground thermal regime in permafrost areas is a prime consideration. Most engineering problems are caused by thawing of perennially frozen ground containing large quantities of ice. Disturbance of the surface cover and heat loss from structures causing degradation of permafrost in areas underlain by ice-rich materials will result in large-scale ground subsidence and drastic differential settlements. It is most important, therefore, that site investigations be carried out to provide information on the distribution of permafrost, the conditions under which it exists, and its properties and characteristics so that unsuitable or potentially troublesome areas or routes can be delineated.

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MIDDLE AND UPPER DEVONIAN BIOSTRATIGRAPHY IN CANADIAN NORTHWEST TERRITORIES

Middle and early Late Devonian rocks are well ex-