

Ridge. Previous geologic investigations of the terrestrial Tertiary basalts of the Davis Strait area have shown however, that the lavas are similar enough in chemical composition to be petrogenetically related.

The planned 1970 field work, consisting of sea magnetometer, gravity, bathymetry, seismic reflection profiling, seismic refraction measurements, and dredging, should enable the seaward extent and possible chemical evolution of the "aseismic ridge" of Davis Strait and the crustal type, structure, and sedimentary thickness of Baffin Bay to be determined. The analysis of these data may enable more substantial comment to be given on the pattern of sea-floor spreading between Greenland and Canada.

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BENTONITIC DEBRIS FLOWS NEAR UMIAT, ALASKA

Mudflows and bentonitic debris flows are found at numerous locations around the globe. Those that occur in arctic regions or at high elevations are unique in that the base material normally will remain frozen during periods of flow activity. The influence of a frozen base on flow morphology and frequency of activity was investigated for large-scale bentonitic debris flows along the Colville River near Umiat on the North Slope. These features originate in bentonitic detritus slumping from bluffs 150–200 m high. When the material becomes sufficiently hydrated it flows downslope leaving slickensided, fluted channels ranging in depth from 0.5 to 2 m and from 2 to 12 m wide. During July and August flow velocities up to 6 m/minute were observed.

Data were obtained that yielded relations among precipitation, water content, flow rate and frequency, thaw depth, and channel morphology. Flow was observed as initiating in the upper, steeper parts of the bluffs along an initial slip zone at the upper boundary of the permafrost. However, snow meltwater and thawing of the active layer were not sufficient to bring about the critical relationship between water content and slope angle required to initiate flow. As with mud- and debris-flows in warmer regions, frequency of flow was found to be closely related to the occurrence of precipitation.

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HIGH-LATITUDE EVAPORITE DEPOSITS AND GEOLOGIC HISTORY OF ARCTIC AND NORTH ATLANTIC OCEANS

High-latitude evaporites—late Proterozoic through Early Permian—are widespread in Canada, Siberia, and Europe. Their distribution patterns show that they precipitated from marine waters entering the continents from the Eurasian-Arctic basin, *not* from the Canadian-Arctic basin, which is separated from the former by the Proterozoic Lomonosov sill, and from the North Pacific by the 1,350-km-wide, Archean, Bering-Chukotsk shelf. Late Proterozoic through Devonian evaporites which precipitated from Arctic waters do not extend (except locally) west of the Rocky Mountains or east of the Chukotsk-Koryak Ranges. Marine connections between the high-latitude evaporite basins and those of the Tethys seas were minimal. After Devonian time, evaporite depocenters shifted systematically

Atlanticward with the progressive formation of the Franz Josef and Faeroes-Greenland sills. High-latitude evaporite deposits are scarce after formation of the Faeroes-Greenland sill.

Thus the requisite temperature and salinity for late Proterozoic-Paleozoic evaporite deposition in high latitudes during evaporite-maximum periods can be attributed only to the existence, and persistence, of the Gulf Stream-North Atlantic Drift system since middle Proterozoic time. No proposed mechanism of continental drift or polar wandering accounts for the high-latitude evaporite-deposition pattern, or for the consistent and progressive Atlanticward shift of evaporite depocenters through time. Continental drift and polar wandering in the Arctic and North Atlantic Ocean areas, if either ever took place, are pre-late Proterozoic events.

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RUSSIAN ARCTIC PETROLEUM PROVINCES

Major hydrocarbon reserves have been discovered and developed during the last 20 years in the Russian Arctic. Productive basins include the West Siberian, Pechora, and Vilyuy. Gas discoveries in the Anadyr basin are too new to be evaluated. Untested basins include the following: (1) *onshore*: Anabar, Lena delta, Indigirka, and Kolyma; and (2) *offshore*: Barents and Pechora Seas, Kara Sea, Laptev Sea, East Siberian Sea, Bering Sea, and Sea of Okhotsk.

In the West Siberian basin, as of January 1, 1970, more than 40 oil fields and 50 gas fields had been found. Production is from Cretaceous and Jurassic paralic to nonmarine strata. At least 9 oil fields had reserves greater than 500 million bbl; 20 gas fields had reserves greater than 3.5 Tcf. Samotlor is the largest oil field with 15.1 billion bbl; Urengoy, the world's largest gas field, had 210 Tcf. Deepest production was from about 10,500 ft, but most production was shallower than 8,150 ft.

The Pechora basin contained about 62 oil and gas fields productive from Devonian through Permian marine strata. Of these, 1 oil field contained more than 500 million bbl and 2 gas fields, more than 3.5 Tcf. Deepest production was from about 11,155 ft.

The Yenesei-Khatanga trough contained several fields, but is relatively undeveloped.

The Vilyuy basin contained about 41 gas fields, of which 2 gas fields contained more than 3.5 Tcf each in Triassic and Jurassic paralic strata. Deepest production was from about 9,840 ft.

More than 200 structures remain to be tested in the 4 basins. Although deformed basement has been penetrated in several areas, particularly near basin margins, the basin centers have not been explored thoroughly. In most of the West Siberian basin, for example, 2,000–8,000 ft of section below the deepest producing zones has not been tested.

In the West Siberian basin alone, proved plus probable oil reserves exceed 35 billion bbl, and proved plus potential gas reserves exceed 400 Tcf. If the results from the West Siberian, Vilyuy, and Pechora basins are indicative of Russian Arctic potential, a bright future could be in store for the Russian petroleum industry.

Despite the high costs and enormous logistics problems involved in development of these remote permafrost areas, the Russians are well on their way in devel-