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EMERGENCE MODEL FOR FORMATION OF ALEUTIAN ARC

It is generally believed that the Aleutian arc has been formed as a result of a North Pacific crustal plate being thrust into the Aleutian Trench and beneath the Aleutian Ridge. Several bathymetric and magnetic features along and south of the Aleutian arc conflict with that model of convergence between crustal plates.

A new model is proposed which calls for the development of the Aleutian arc by the emergence of material from the underlying mantle as the North Pacific plate is pulled away. The pattern of magnetic anomalies suggests that an ancestral Aleutian Ridge may have been the source for Late Cretaceous and early Tertiary southward sea-floor spreading. The present Aleutian Ridge was built during the Cenozoic by uplift and the accumulation of volcanogenic material. The Aleutian Terrace and Trench are half-grabens which have been collecting sediments since their probable late Tertiary formation. Tensional first motions of earthquakes beneath the trench may reflect its continuing formation, although there is no evidence of appreciable horizontal motion associated with its development. Basins at the bottoms of submarine canyons that cut into the Aleutian Ridge suggest that the Aleutian Terrace is still opening.

The Aleutian and Bowers basins have been collecting thick sedimentary deposits since the formation of the ancestral Aleutian Ridge. Bowers Ridge probably was pushed up from the Aleutian basin during late Tertiary deformation of the Aleutian Ridge.

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PERMAFROST AND ENVIRONMENTAL-ENGINEERING PROBLEMS IN ARCTIC

The existence of permafrost causes unique engineering geology problems for the development of Arctic regions. Permafrost is a naturally occurring material that retains a temperature colder than 0°C continuously for more than 2 years; this layer of frozen ground is designated exclusively on a basis of temperature. It is estimated to underlie 20%, or about 12 million sq mi, of the land surface of the world. It occurs in 80% of Alaska and 50% of Canada and the USSR. It is 5,000 ft thick in northern Siberia, 2,000 ft thick in northern Alaska, and thins progressively toward the south.

The ice content is probably the most important feature of permafrost affecting human life in the north. Ice exists as pore fillings, segregations, wedges, pingo ice, and buried ice. The segregations are the most extensive but least spectacular type of ground ice. Ice wedges are widespread and may occupy 10% by volume of the upper 10 ft of permafrost. Jerry Brown of CRREL estimates that 350 cu mi of ground ice exists in the permafrost of the Arctic coastal plain of Alaska.

The most dramatic, widespread, and economically important examples of the influence of permafrost on life in the north deal with construction and maintenance of roads, railroads, air fields, buildings, dams, sewers, pipelines, and communication lines. Engineering problems are of 4 fundamental types: (1) those involving thawing of ice-rich permafrost and subsequent subsidence of the surface under unheated structures such as roads and airfields; (2) those involving subsidence under heated structures; (3) those resulting from frost action, generally intensified by poor drainage caused by permafrost; and (4) those involved only with the temperature of permafrost causing buried sewer, water, and oil lines to freeze.

Normal building techniques commonly must be modified at additional costs because of permafrost, but despite special problems unique to the far north, development in permafrost regions will continue at an ever-increasing rate. Improvements in scientific and engineering approaches, plus careful geologic site selection and study of the permafrost problem, will allow successful expansion into polar areas.

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GEOLOGY OF SVERDRUP BASIN

(No abstract submitted)

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FOLD SYSTEMS AND PLATFORM COVERS OF MIDDLE SIBERIAN ARCTIC SHELF

Two separate and geologically and structurally different depositional basins (Kara and Laptev Seas) are distinguished in the middle Siberian Arctic shelf; both were formed by Neogene-Quaternary movements.

These neotectonic basins are superposed discordantly on a Mesozoic-Cenozoic platform sedimentary cover which overlies peneplaned fold structures of circum-Pacific affinity. Intense tectonic movements in vast areas beyond the limits of the Circum-Pacific geosynclinal belt extended as far northwest as Severnaya Zemlya–Novaya Zemlya–Pay-Khoy, thus modifying the ancient structure of the Riphean (Proterozoic) Northern Asia platform, and the Caledonian and Hercynian fold structures adjacent to it.

On recent rises, only fragments of intensely dislocated (by circum-Pacific tectogenesis) zones are exposed; they can be traced beneath the Mesozoic-Cenozoic cover by geophysical methods. Zones of intense dislocations are separated by relic blocks of the inner massif type. The age of the closing of the folding and orogenic processes within those zones becomes younger from west to east—from Late Permian to Early Cretaceous.

The age of the basalt layer of the Mesozoic-Cenozoic platform cover changes according to the age of the latest folding. The inner structure of the platform is described in terms of (1) isometric areas with evenly downwarped basement, and (2) elongated swells and associated depressions. The swells and depressions correspond to buried, intensely dislocated zones. The isometric areas correspond to underlying relic blocks where platform conditions had been unchanged since basement consolidation and where several structural complexes had developed in the platform cover.

In the upper beds of the Mesozoic-Cenozoic cover, the structural differences are less pronounced.

With the use of geophysical methods, 4 classes of middle Siberian shelf areas can be outlined: (1) epi-Karelian (Riphean + Paleozoic + Meso-Cenozoic complex); (2) epi-Baikalian (Paleozoic + Meso-Cenozoic complexes); (3) epi-Caledonian (middle-upper Paleozoic + Meso-Cenozoic complexes); and (4) epi-circum-Pacific (meso-Cenozoic complexes).

Type sections compiled from geologic and geophysical data for all classes indicate the thickness and composition of each complex