9. S. L. Troitskiy: Paleozoological division of Pleistocene marine basins on Arctic coast of Eurasia 4:35

Engineering Geology in Arctic Environment, Part 2
Continental Ballroom
Presiding: O. J. Ferrians, Jr., J. Brown

1. O. J. Ferrians, Jr.: Synopsis 1:30
2. R. A. Hemstock: Engineering geology and petroleum exploration in Arctic 1:40
3. J. L. Nelson: Application of acoustics to determination of permafrost distribution 2:05
4. F. C. Frischknecht, W. D. Stanley: Airborne and ground electrical resistivity studies along proposed Trans-Alaska Pipeline System (TAPS) route 2:30
5. R. W. McGaw, D. M. Anderson, J. Brown, R. K. Haugen, A. R. Tice: Bentonitic debris flows near Umiat, Alaska 2:55
6. J. T. Gilchrist: Inuvik test loop—an Arctic prototype investigation 3:20
7. R. R. Migliaccio, J. W. Rooney: Engineering geologic and subsurface soil investigations for Trans-Alaska Pipeline System 3:45

Evolution of Arctic Ocean Basin
Imperial Ballroom
Presiding: M. Churkin, Jr., N. A. Ostenso

1. J. K. Hall: Geophysical evidence for ancient sea-floor spreading from Alpha Cordillera and Mendeleyev Ridge 1:30
2. W. Hamilton: Continental drift in Arctic 1:50
3. Yu. E. Pogrebitskiy, V. A. Vinogradov, V. V. Zakharov, E. N. Zatzepin: Fold systems and platform covers of middle Siberian Arctic shelf 2:10
4. A. E. Malloy, M. A. Beal: New bathymetric chart of Arctic Ocean 2:30
5. Y. H. Kulakov, A. P. Puminov, V. D. Dibner: Neotectonics of Arctic 2:50
6. J. W. Kerr: North Canada rift system 3:10
7. P. R. Vogt, N. A. Ostenso: Geophysical studies in Barents and Kara Seas 3:30
8. A. A. Meyerhoff: High-latitude evaporite deposits and geologic history of Arctic and North Atlantic Oceans 3:50
9. K. B. Mokshantsev, G. S. Gusev: Tectonics of Arctic region of Yakut ASSR 4:10
10. W. B. Harland: Tectonic evolution of Barents shelf and related plates 4:30
11. M. Churkin, Jr.: Summary 4:50

Pacific Section SEG
Continental Parlor South
Presiding: J. B. Hughes
(Program to be announced)

ABSTRACTS OF PAPERS

ANDERSON, R. ERNEST, U.S. Geol. Survey, Denver, Colo.

Tectonic Overview of Bering Sea-Aleutian Ridge Region

Known and inferred surficial structural features of the Aleutian Ridge, Terrace, and Trench in the central and western Aleutian arc, Alaska, appear to reflect predominantly tensional strain of diverse orientations. Features on the ridge are inferred to have formed from igneous activity-related tectonism including distension of the surficial skin over rising and spreading epizonal plutons, volcanotectonic subsidence, and rifting; features on the terrace and landward trench wall may have formed from distension of a decoupled surficial skin above a prolongated zone of imbrication and uplift; and those in the trench and on the seaward wall from dynamic loading of the Pacific lithospheric plate by overthrusting and southward migration of the Aleutian tectogene. The plutonism, imbrication, and dynamic loading are interpreted as resulting from a first-order process of crustal foreshortening normal to the arc. This interpretation is consistent with evidence from natural seismicity which indicates predominantly compressional strain across the central and eastern Aleutian arc. Surficial structural features in the eastern Aleutian arc between the continental margin and the volcanic arc appear to reflect directly the first-order compressional strain, whereas the features in the bordering Aleutian Trench are predominantly of tensional origin.

Movement vectors for the Pacific plate based on a pole of rotation at lat. 53°N, long. 47°W., indicate normal convergence against the continental margin near Kodiak Island, movement tangential to the arc trend in the vicinity of the Near Islands, and tension oblique to the arc trend in the vicinity of the Commander Islands. If the Aleutian Trench has resulted from crustal foreshortening its presence along the entire arc suggests movement of the Bering Sea plate independent of the Pacific plate. Structural features such as Bowers Ridge in the western Aleutian arc may reflect foreshortening parallel with the arc. Such features may be related to Pacific plate movement, whereas the arc itself there may have resulted from movement of the Bering Sea plate. The eastern Aleutian arc could have resulted from south-to-southeast drift of the Alaskan continental mass hinged to the Canadian mainland along the axis of the Alaska orocline combined with Pacific plate normal convergence.

Body forces such as those that might be derived from perturbations of rotational parameters (angular momentum and moments of inertia) of the core-mantle system seem better suited to explain the suggested plate movements than are forces derived from mantle convection.

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Sediment Distribution in Kara Sea

The distribution of sediment in the Kara Sea is controlled by the discharge of Western Siberia's two largest rivers, the Yenisey and the Ob'. These two rivers have a combined annual fluid discharge of 942 cu km, ranking them fourth behind the Amazon, Congo, and Ganges-Brahmaputra rivers in total annual discharge. This discharge represents almost 1% of the total volume of the Kara Sea. The combined delta of the 2 rivers covers approximately 230,000 sq km at the 50-m isobath.

During the winter months, the rivers freeze and discharge approaches zero. A saltwater wedge must move far upstream. During spring breakup and flooding, the salt water is flushed out, and the major part of the annual discharge and sediment load flows into the Kara Sea. The finer sediments continue flowing seaward, toward the Arctic basin.

The genetic interrelation of river, delta, submarine canyon, and abyssal fan does not hold strictly for the Yenisey-Ob' system. The northern Kara Sea contains 3 major physiographic provinces—the St. Ann and Voronin Troughs, separated by the Central Kara Plateau. Most of the sediment is carried to the Arctic basin along the eastern side of the longer, deeper St. Ann Trough, a sediment transport distance of approximately 600 km. The sediment may then go through a submarine canyon (no conclusive data available) to an abyssal fan (suggested on contour maps of the Arctic basin).

Sediment-distribution patterns in the St. Ann Trough reflect the transport of the distal deltaic sediments across the area. The sediment on the eastern side is fine silty clay, containing abundant illite, chlorite, and mica, with a high organic carbon and water content, and with a limited, dominantly arenaceous, foraminifer population. The sediments on the western side are much coarser, have smaller organic carbon and water contents, and contain an Arctic foraminifer population. In addition to some illite, the dominant clay mineral is locally derived kaolinite.

Abundance of the foraminifers appears to be directly proportional to bottom temperature and pH. The distribution is not a simple depth zonation. *Globigerina pachyderma* is the only planktonic species found.

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Bipolar Synchroneity of Late Cenozoic Paleoclimatic Cycles

There are now evidences that during the past 700,000 years, the Brunhes Normal Magnetic Epoch, temperatures were significantly cooler in both polar areas, in temperate regions, and even in tropical areas. In the Arctic there was a significant ice cover during the Brunhes; in the Antarctic, temperatures ranged between about 0 and 5°C in contrast to temperatures mostly above this during the Matuyama Reversed Magnetic Epoch.

Evidences of cooler temperatures in temperate areas during the Brunhes consist of invasions in both hemispheres of sinistrally coiled populations of *Globorotalia pachyderma* (Ehrenberg), a cold-water planktonic foraminifer. Some climatic cooling took place in tropical areas during the Brunhes as shown by the invasions of tropical areas by temperate species of planktonic foraminifers, the *Globorotalia inflata* and *G. puncticulata padana* groups, and the marked decline in the abundance of the tropical index *Sphaeroidinella dehiscens.* Bipolar synchroneity of paleoclimatic events is supported by independent isotope analyses of ice samples for the Wisconsin cold interval.

Earlier major bipolar cooling cycles occur in the Pliocene, Neogene Zone 21, and the late Miocene, with the maximum cooling in the Neogene Zone 17. Evidences consist of the major expansions of polar sinistrally coiled populations of *Globorotalia pachyderma* (Ehrenberg) into temperate areas during these cooling cycles, paleobotanical indications of cooling, and the association of marine glacial deposits with late Neogene polar faunas beginning in the late Miocene.

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Okhotsk-Chukotskiy Belt and Problem of Volcanic Arcs in Northeast Asia

1. The East Asian volcanic belt system is between the circum-Pacific zone of Cenozoic folding in the northeast and the interior, more ancient, mainly Mesozoic tectonic zones. The size of the East Asian system is comparable to that of recent volcanic arc systems.

2. The largest element of the East Asian system, the Okhotsk volcanic belt, is characteristic of marginal-volcanic belt structures. The basic features of the belt were formed during the Aptian-Albian and Cenomanian-Turonian Stages. Andesite volcanism prevailed during these stages. In addition, granitoid magmatism was widespread and accompanied by the formation of large-volume ignimbrite fields.

3. Comparative structural, petrologic, and historic-geologic analyses reveal a considerable difference between the Okhotsk-Chukotskiy belt, on the west, and the Kuriles-Kamchatka arc, on the east.

4. Subaerial, mainly andesitic volcanism formed a well-defined zone—now widely exposed—in the basement structures of the Okhotsk-Chukotskiy belt. The zone developed simultaneously with a system of deep faults, which during the Mesozoic separated the Verkhoyansk-Chukotskiy belt (west of the Okhotsk-Chukotskiy belt) and the Anadyr-Koryak-Kamchatka geosyncline (east of the Okhotsk-Chukotskiy belt). During the Late Jurassic and the first half of the Early Cretaceous, the Okhotsk-Chukotskiy volcanic belt (in relation to other belts mentioned) played the same role as does the Kuriles-Kamchatka volcanic arc today. The Kuriles-Kamchatka arc separates western Kamchatka, the Sea of Okhotsk, and Hokkaido on one side from the Kuriles-Kamchatka Trench on the other.

5. The Late Jurassic and Early Cretaceous Okhotsk-Chukotskiy volcanic arc was a peculiar bordering structure, which separated the Anadyr-Koryak-Kamchatka geosyncline system (a trench on the east), then at the early stage of its development, from the Verkhoyansk-Chukotskiy region of Mesozoides which was in a more advanced stage of development (stage of epigeosyncline orogenesis).

Development of the Okhotsk-Chukotskiy marginal volcanic belt began during the Aptian-Albian when the Anadyr-Koryak-Kamchatka system entered a stage when there was a large terrigeneous sedimentary accumulation, whereas the Verkhoyansk-Chukotskiy area was a consolidated continental block tending to rise. The volcanic belt developed on the site of the volcanic arc and extended far beyond the limits of the original arc—covering Mesozoides structures, even older massifs, and the peripheral zone of the Anadyr-Koryak-Kamchatka geosyncline system.

6. Gradual migration of volcanic arcs toward the Pacific did not occur in northeast Asia. Instead, the appearance and development of northeast Asian arcs were somewhat irregular in time and space.

The structure and tectonic development of these belts and structures are important in considerations of the general problem of andesite volcanism.

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Foraminiferal Biostratigraphy of Mesozoic of Northern Alaska

Benthonic Foraminifera have proved to be useful biostratigraphic indicators in the Mesozoic marine clas-