oping the West Siberian fields. The first pipeline of 40-in. diameter was completed to the Omsk refinery in 1967, and a second pipeline, of 48-in. diameter, is under construction. Siberia already has achieved self-sufficiency and the flow of crude oil in the Trans-Siberian pipeline was reversed west of Omsk in the summer of 1970 so that surplus West Siberian crude now moves westward to European Russia instead of the previous eastward flow of Volga-Urals crude to Siberia. In the Pechora basin, development of the largest potential producer, the Usa field, was underway in 1970 and construction of a pipeline to the Yaroslavl refinery in central Russia was started. The gas of the Vilyuy basin at present is used only locally, in the city of Yakutsk. No specific plans for long-distance transmission have been announced.

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ENGINEERING GEOLOGIC AND SUBSURFACE SOIL INVESTIGATIONS FOR TRANS-ALASKA PIPELINE SYSTEM

Since early 1968, the Trans-Alaska Pipeline System has been involved in surface and subsurface investigations for a pipeline originating at Prudhoe Bay and terminating at Valdez, Alaska. This route, which is slightly less than 800 mi long, crosses numerous geologic provinces, each with its own set of engineering and geologic problems.

Since work was begun, field studies have increased in scope and have advanced from preliminary route studies to more detailed surface and subsurface work. Presently, 12 drilling units are operating in the field and over 800 borings have been accomplished south of the Yukon River. Over 300 pipeline route borings have been put down north of the Yukon River and approximately 800 additional borings are planned. Drilling equipment being used is capable of being moved in rough terrain and of obtaining undisturbed frozen cores of different sizes to depths of 50 ft or more.

Many problems have been and are still being studied to further insure integrity and optimum security of the proposed pipeline. Some of the soil related problems receiving attention are (1) extent and character of permafrost; (2) solifluction; (3) landslides and avalanches; (4) stream and river scour; (5) erosion potential; (6) soil types and physical properties; and (7) seismicity.

Many techniques other than drilling have been, and are being, used or studied. Included are both infrared color and black and white aerial photography and other remote sensing techniques including thermal scanning and sidelooking radar. These techniques have been used to compile geologic maps of the entire route. In addition, seismic and acoustical sounding equipment is being evaluated.

As rapidly as information becomes available, it is utilized to finalize design parameters and determine construction requirements and controls. Because of the highly variable and complex soil and related conditions along the route, evaluation of all geologic and engineering data is a time consuming but extremely necessary process. It is anticipated that careful studies and the design now in progress will continue throughout the preconstruction and construction phases of the project. These studies, together with continued review of all data, will combine to insure a safe, pipeline system.

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PRELIMINARY CORRELATION OF MESOZOIC PLUTONIC ROCKS IN BERING SEA REGION

Most of the plutonic rocks of the Bering Sea region are of Cretaceous age and were emplaced in 3 main episodes dated by K/Ar methods at 98–108 m.y., about 90 m.y., and 75–82 m.y. The two younger suites consist of rather typical calc-alkaline granodiorite and quartz monzonite. In the 98–108 m.y.-old suite, quartz monzonite is closely associated with silica-saturated syenite and with strongly potassic subsilicic rocks. Plutons of this suite appear to be aligned along the boundary between the Paleozoic and Precambrian metamorphic and sedimentary rocks of the Seward Peninsula and the adjacent Mesozoic volcanogenic province. Rocks of the 90 m.y.-old suite also occur near this boundary; however, not enough data are available to indicate that rocks of this age are confined to this area. The 75–82 m.y.-old plutonic rocks are present throughout both geologic provinces and are not restricted to the boundary area.

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TECTONICS OF ARCTIC REGION OF YAKUT ASSR

The Arctic sector of Yakut ASSR includes the ancient Siberian platform, the late Hercynian Taimyr fold belt, the Mesozoic Verkhoyansk-Chukotsk fold ranges, and shelf seas that represent the recent Laptev-East Siberian Seas paraliageosynclinal region.

The Taimyr fold structures are cut off at the continental slope. Fold systems in the Verkhoyansk-Chukotsk region are divided by median masses, and are traced within the shelf seas. The Verkhoyansk-Kolyma system is divided by the Shelon, Kular, and Laptev buried massifs into 3 branches; one of these, in the northwest, abuts the Hercynides of Taimyr and the others extend northward toward the continental slope. The Novosibirsk-Chukotsk fold system, confined on the north by the Novosibirsk and De-Longa massifs, is traceable northwest to the continental slope; on the southeast it is subdivided into 2 branches. One branch terminates with Mesozoides of the Anyuy zone, and another extends toward Wrangel Island.

Outliers of fold structures of Mesozoides are exposed on islands of the shelf seas. Parts of median massifs represent uplifts of the basement of the recent paraliageosynclinal region. Within the latter there are northern and southern trough systems. The northern eugeosynclinal(?) system includes foreshelf and marginal-shelf troughs and uplifts, separated by systems of deep faults which probably have large associated intrusions of mafic magmatic rocks. The southern system consists of the miogeosynclinal sublatitudinal troughs that are separated by the Lyakhov uplift. Upper Mesozoic and Cenozoic strata of the troughs may reach thicknesses of 10–12 km.

The cut-off by shelf seas and the continental slope of the Mesozoides, Hercynides, and median massif structures; features associated with the building of the Arctic Ocean crust; the nearby presence of mid-ocean and other submarine ridges, which are nearly perpendicular to the continental margins and which commonly are extensions of the continental fold structures of different age; and the formation of a juvenile paraliageosynclinal region within marginal areas of the ocean are indicative of the extreme youth of large parts of the Arctic Ocean and of the formation of the ocean by oceanization of continental crust as a result of large vertical subsidence movements.

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MESOZOIC STRATIGRAPHY, SEDIMENTOLOGY, AND PALEOGEOGRAPHY OF NORTHERN YUKON, CANADA

Data derived from reconnaissance field work in 1962 and published data indicate that the Mesozoic succession is divided into 5 major cycles which reflect important events in the geologic history of the region: (1) Late Triassic transgression across a low shelf; (2) widespread Jurassic transgression and development of the Richardson trough; (3) earliest Cretaceous regression and basin filling that ended with local minor(?) uplift and erosion; (4) Albian transgression and development of the early Late Cretaceous regression; and (5) Late Cretaceous and early Tertiary nonmarine sedimentation in local tectonic basins. Within each of these major cycles several diastems and unconformities are present which increase in magnitude toward the basins' margins.

During Jurassic and earliest Cretaceous times, the Richardson basin was filled with marine shale and bordered on the east by a landmass (probably mountainous) which shed sand westward. The sands now form a series of Lower, Middle, and Upper Jurassic and Lower Cretaceous nearshore sandstone bodies. During the earliest Cretaceous some sand in the Babbage River region was derived from the underlying Mesozoic and upper Paleozoic clastic sediments in the western Brooks Range geanticline.

The earliest Cretaceous clastics filled the basin so that nonmarine conditions prevailed in the northernmost (Blow River) part. Moreover, slight uplift and erosion took place at that time. By the end of Aptian time, much of the eastern landmass had been peneplaned.

The tectonic and sedimentary patterns changed drastically during Albian to early Tertiary times. Sediments were derived from a rising cordillera which formed the western and southern margins of the new foreland basin and developed across the previous eastern Jurassic and Lower Cretaceous landmass. A thick succession of largely silty Albian shale was deposited in this basin. The thin Upper Cretaceous sedimentary sequence consists of nonmarine strata (Eagle Plain Formation) and marine shale. Much of the deformation and uplift of the Richardson Mountains took place during middle Late Cretaceous time. During the late stages of the cordillera deformation on the south and southwest, several small, partly fault-bounded basins developed in which thick sequences of coarse clastic materials were deposited.

A similar but thicker Mesozoic succession appears to extend beneath the Mackenzie delta. One of the best prospective hydrocarbon zones is the sequence of well-sorted sandstones near the base of the Lower Cretaceous, if these sandstones do not grade to shale on the north.

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SEDIMENTARY PROCESSES IN ARCTIC OCEAN

Two unusual Arctic Ocean sedimentary processes involve deposition of clay-size particles and deposition of glacial-marine erratics. The clay suite identified by X-ray diffraction in 50 cores from the Chukchi Rise and Alpha Cordillera consists mainly of illite with almost equal combined amounts of chlorite and kaolinite. Similar clays are present in atmospheric dust in permanent snow fields of northern Greenland. In addition, dust separated from snow samples of the Arctic ice pack contains these same clay minerals. This dust finds its way into leads during summer melting where it contributes an estimated 0.4 mm of sediment per 1,000 years. This is almost ½ of the total sedimentation rate for parts of the Arctic and up to 90% of the 2-μ size fraction sediment.

Pebbles have been found in 36 cores. Few striations have been noted but ice rafting is a believable mechanism to explain pebbles in the central Arctic Ocean. Twenty-three cores contain erratics at more than 1 level and as many as 7 are present in 300-cm cores: 38% are sandstone, 29% carbonate, 15% metamorphic, and 18% chert or unidentified clasts.

Distribution of the erratics shows no pattern that can be explained by known currents or events in time. Erratics are present in brown cores but no erratic has been found in gray cores. Turbidity structures characterized some of the gray cores. Probably, erratics were deposited randomly over most of the Arctic basin from melting glacial ice, but they appear to be less common in deeper parts of the ocean (Canada plain) where high sedimentation rates associated with turbidity flows mask their presence.

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TEXTURE, ORGANIC CARBON, AND CLAY MINERALOGY OF WESTERN BEAUFORT SEA SEDIMENTS

In the western Beaufort Sea the shelf sediments differ significantly from the slope and basin sediments in texture and in carbon and carbonate contents. The shelf is generally carpeted by positively skewed, platykurtic gravelly, sandy mud, whereas the slope and basin mostly have sandy or clean mud with symmetric and mesokurtic size-distribution curves. The predominance of muddy gravels on the shelf suggests that ice-rafting is important in transporting sediment to this region. Possibly the presence of the permanent pack ice across the slope and basin acts as an effective barrier for the movement of ice-rafted gravels to those regions. Probably the well-sorted and rounded sands associated with the slope and basin muds have been transported by turbidity currents from the shelf margin, where it is believed they were deposited originally under turbulent conditions during geologically recent lowered sea levels.

The shelf sediments have relatively lower organic carbon contents (average, 0.95%) than those of the slope and basin (average, 1.19%). However, the amount of carbonate in the shelf is higher (average, 4.8%) than in the slope and basin (average, 2.75%). The organic content is related to the clay percent whereas the carbonate content is related to the amount of calcareous shelly and lithogenous components.

Clay mineral composition of the less than 2- and 4-μ sediment sizes consists predominantly of illite with significant amounts of kaolinite and almost no chlorite. It is suggested that the use of clay minerals in the inference of paleoclimates must be made with great caution because the generally accepted view related to marine