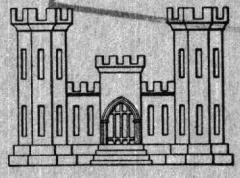
PRELIMINARY REPORT

STRATEGIC ENGINEERING STUDY

NO. 18

EASTERN SIBERIA
TERRAIN INTELLIGENCE

PREPARED BY
GEOLOGICAL SURVEY, U. S. DEPT. OF INTERIOR
UNDER DIRECTION OF
CHIEF OF ENGINEERS, U. S. ARMY



COPY 233

INTELLIGENCE BRANCH
OFFICE, CHIEF OF ENGINEERS
U. S. ARMY
OCTOBER 1942

ARMY MAP SERVICE, U.S.ARMY, WASHINGTON,D.C. 203586
9/45 NP 1945

PRELIMINARY REPORT

STRATEGIC ENGINEERING STUDY

NO. 18

* * * * * * * * * * * * * * *

TERRAIN INTELLIGENCE

* * * * * * * * * * * * * * *

Eastern Siberia

Prepared by:

Section of Military Geology
U. S. Geological Survey
Department of the Interior

Strategic Studies Section
Intelligence Branch
Office, Chief of Engineers
October, 1942

PRELIMINARY REPORT

STRATEGIC ENGINEERING STUDY NO. 18

TERRAIN INTELLIGENCE

Eastern Siberia

TABLE OF CONTENTS

	Page
Introduction	1
Reliability Chart	2
Topography - Map 1	
Map	3
Geology - Map 2	
Maps	4 - 5
Table	6
Construction Materials - Map 3	
Map	7
Tables (2 sections)	8 - 9
Mineral Fuels - Map 4	
Map	10
Table	11
Terrain - Map 5	
Map	12
Tables (3 sections)	13-15
Water Supply - Map 6	
Map	16
Table	17
Rivers - Map 7	
Map	18
Climate - Map 8	
Charts (3 sections)	19-21

INTRODUCTION

The following folio of terrain intelligence maps, charts and explanatory tables represent an attempt to bring together available data on natural physical conditions such as will affect military operations in Eastern Siberia. The area covered is the easternmost section of the U.S.S.R.; that is the area east of the Yenisei River. Each map and accompanying table is devoted to a specialized set of problems; together they cover such subjects as geology, construction materials, mineral fuels, terrain, water supply, rivers and climate. The data is somewhat generalized due to the scale of treatment as well as to the scarcity of basic data. Each of the maps are rated as to reliability according to the reliability scale on the following page. Considerable of the data shown is of an interpretative nature, although precise data from literature was used wherever possible. The maps and tables were compiled by a special group from the United States Geological Survey in cooperation with the Intelligence Branch of the Office, Chief of Engineers, War Department.

Method of compilation and reliability of data

These data have been assembled from published reports and maps of the geology of the area as listed on the geologic map of this set. The data presented necessarily involve more or less interpretation on the part of the compilers and the reliability depends very largely on the adequacy of the original reports and maps of the area. Each compilation is given a reliability rating as judged by the compilers. These ratings are:

Class A: Original data so complete that the compilation involves little or no interpretation by the compilers.

Class B: Original data seem accurate but incomplete for this purpose, and have required much interpretation.

Class C: Less accurate and less complete than B, better than D.

Class D: Original data very sketchy; inaccurate as well as incomplete.

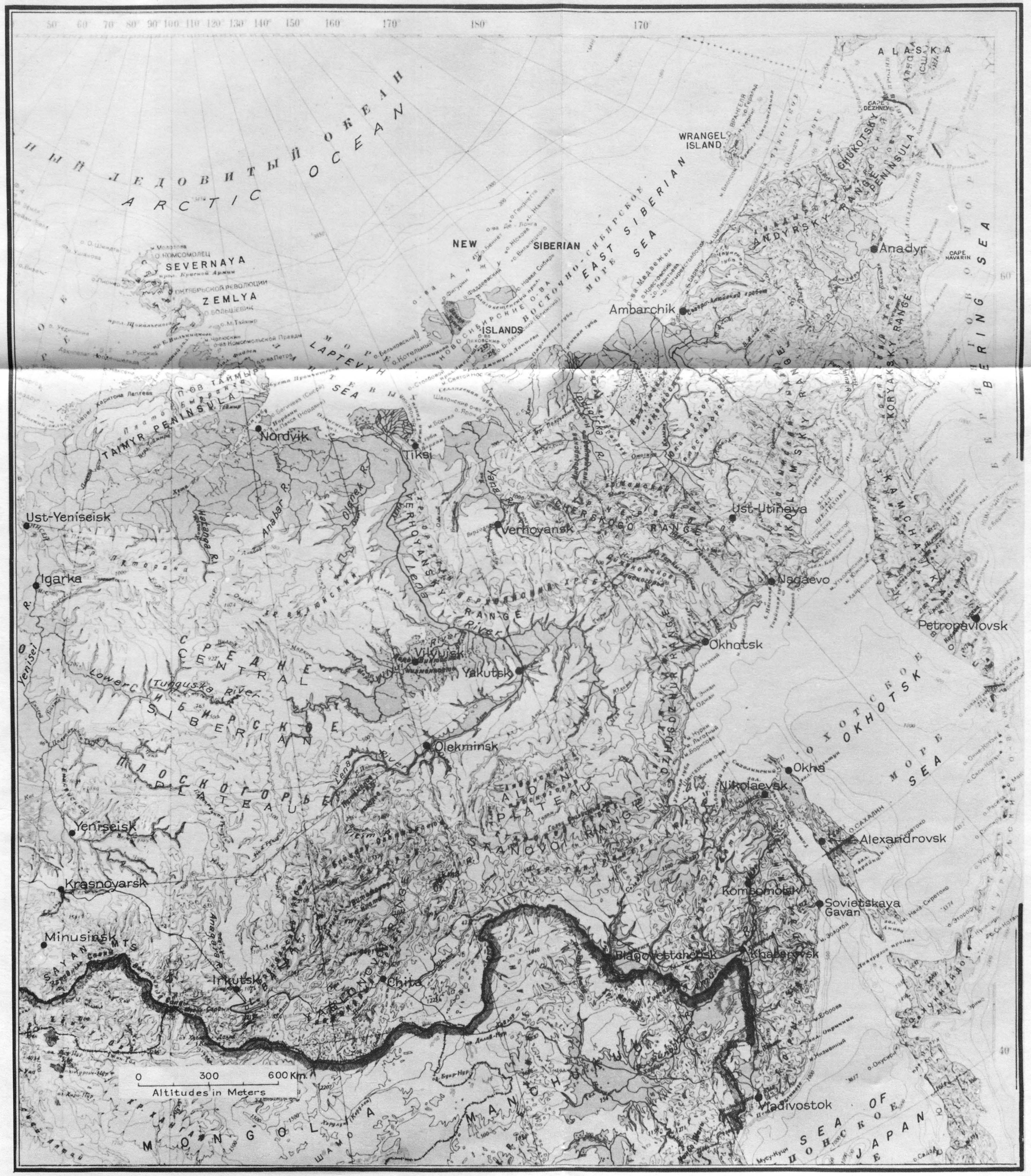
Original source maps are rated in three classes for each scale of map, as follows:

Surveyed map: The original map represents an actual instrumental survey and should be entirely reliable for the scale.

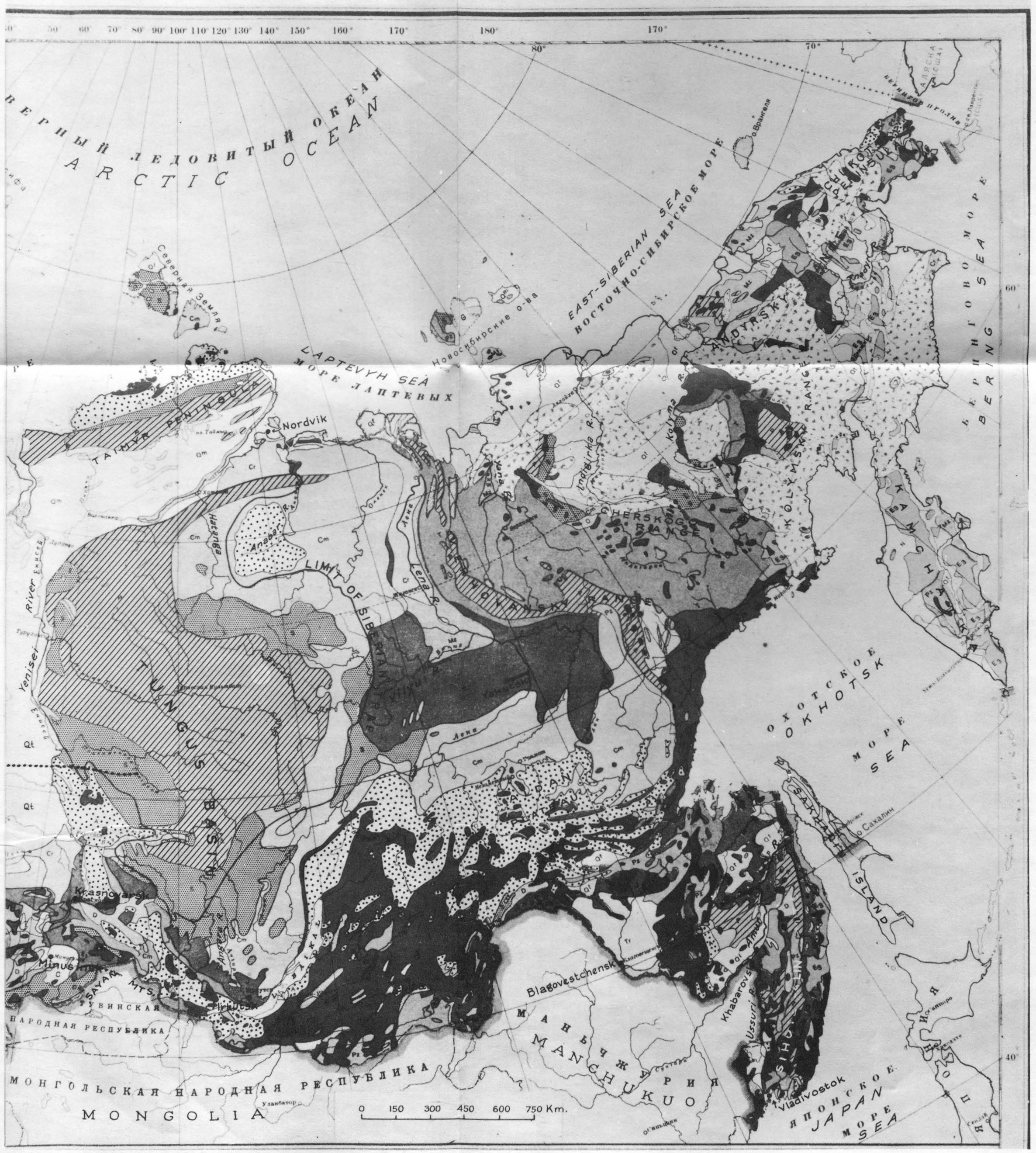
Reconnaissance map: The original map was not surveyed but seems to have been carefully prepared. General features are correctly shown but the details are incomplete and inaccurate for the scale.

Sketch map: The original map is highly diagrammatic and may contain gross errors.

EASTERN SIBERIA MAP I. TOPOGRAPHY



EASTERN SIBERIA MAP 2. GEOLOGY



Qt — Quaternary continental deposits.--Glacial and fluvio-glacial deposits, representing at least two periods of continental and mountain glaciation. Associated with these in extensive parts of the arctic which have not been glaciated are tundra deposits, interglacial deposits, and fossil ice masses of Pleistocene and Recent age. In lower latitudes are many isolated areas of lacustrine and fluviatile deposits, mostly clay, sand, and gravel. In the Lake Baikal depression these are more than 400 m. thick. Along the southern border of Siberia, in the arid and semi-arid regions, and in some coastal areas are loess and dune sand.

Qm — Quaternary marine deposits.--At least two marine transgressions deposited sand, clay, and gravel. These deposits are generally terraced. On Sakhalin they are 60 m. thick. These deposits underlie large areas on the Arctic Coast.

Tr — Tertiary deposits (undifferentiated).--See below.

N — Neogene (Miocene, Pliocene).--Dominantly marine in eastern coastal region; sand, clay, shale, conglomerate, lignite, gypsum. Interbedded lavas are extensive. Continental deposits in interior; sand, conglomerate, sandy clay, clay, shale, limy shale, brown coal, and lignite. Some diatomite in both continental and marine facies. Locally contains volcanic rocks.

Pg — Paleogene (Paleocene, Eocene, Oligocene).-- Dominantly continental deposits everywhere, but contains some marine facies particularly in the upper part of the column. Conglomerate, sandstone, sand, shale, clay, coal. Locally contains volcanic rocks.

E3 — Cenozoic volcanic rocks.--Range from basic to acidic and alkalic in composition. Occur principally in eastern coastal region with a few sporadic occurrences in the Baikal region, and along the Arctic coast.

Mz — Undifferentiated Mesozoic.--See below.

Cr — Cretaceous.--Extensive, dominantly continental and brackish water deposits; marine deposits are known in Sakhalin and in a few localities in the interior. Sandstone, shale, limy shale, conglomerate (good horizon marker in Sakhalin), coal, tuffaceous deposits, breccia. In Anadyr Basin Cretaceous is 4,690 m. thick; in Sakhalin 2,000 m. thick.

J — Jurassic.--Particularly extensive in basin of Lena and Vilyui Rivers where it consists of Upper Jurassic fresh water deposits, middle Jurassic marine deposits, and lower Jurassic continental deposits. Contains sand, sandstone, conglomerate, sandy clay, spherosiderite beds, shale, and calcareous sandstone. Coal beds occur at various horizons. Similar lithology elsewhere. In places Jurassic contains black shale, arkose, and conglomerate 1,000 m. thick. In general, coarser facies lie to the southeast. In Baikal region whole Jurassic is more than 3,000 m. thick.

T — Triassic.--Upper Triassic is principally black sandy shale, interbedded with sandstone. Middle Triassic is limestone, shale, sandstone, and conglomerate (best developed in northeast). Lower Triassic is sandstone, conglomerate, and sandy shale. In Baikal region Triassic is more than 2,000 m. thick. Locally the boundary with Jurassic is not established.

E2 — Mesozoic volcanic rocks.

Pz — Undifferentiated Paleozoic.--See below.

P — Permian.--Mostly continental. Consists of sandstone, shale, tuffaceous deposits, and coal beds. In the Sihote-Alin region and near Vladivostok marine limestone is present.

In the Central Plateau the Permian is extensive and belongs mostly to the Tuffite and Tungusian series whose age ranges from Carboniferous to Permian and perhaps lower Triassic. These rocks consist of tuff with basalt bombs and sandstone (Tuffite series); sandstone, conglomerate, shale, carbonaceous shale, and productive coal beds (Tungusian series).

C — Carboniferous.--Upper Carboniferous is continental; contains conglomerate, sandstone, shale, siliceous shale, carbonaceous shale, and productive coal measures. In the Minusinsk Basin the Upper Carboniferous is about 1,000 m. thick.

Lower Carboniferous consists of marine and continental deposits of limestone, shale, sandstone, conglomerate, tuff, and coal beds.

D — Devonian.--Limestone extensive, particularly in east and northeast. Also contains variegated sandstone, calcareous and siliceous shale, conglomerate, graywacke, tuff, and breccia.

Isolated areas of metamorphosed Devonian limestone occur in the Baikal region.

In general Devonian rocks are drab, a fact that helps distinguish them from the lower Paleozoic, but Devonian red beds occur in the south and southwest part of the area.

S — Silurian.--In general is similar to the Cambrian. Contains both continental and marine sedimentary rocks, many of which are red. Not so extensive as Cambrian, but covers a large area in the Central Plateau. Contains calcareous sandstone, siliceous limestone, limestone, dolomite, shale, salt and gypsum, and conglomerate. Limestone and dolomite form extensive deposits principally in the Yenisei Basin of the Central Plateau.

Cm — Cambrian.--Extensive in many parts of Siberia. Attains thickness of more than 7,000 m. In general is little metamorphosed and contains few beds of igneous origin. May be divided into three parts, two dominantly clastic series separated by one that is dominantly calcareous. Contains red beds, salt and gypsum. In Central Plateau Upper Cambrian contains sandstone, conglomerate, (red beds), impure limestone, and siliceous and calcareous shale. Middle Cambrian is limestone and dolomite with sandstone and shale, some gypsum. Lower Cambrian is sandstone, quartzite, shale, salt, limestone, and dolomite. A prominent conglomerate, called the Motski formation, is a good horizon marker near the base of the Cambrian.

E1 — Cambrian volcanic rocks.

A — Pre-Cambrian.--Proterozoic is in many places not severely metamorphosed. Consists of limestone, graywacke, conglomerate, slate, and shale. In the Angara region Proterozoic is dominantly limestone and dolomite and is about 4,400 m. thick. In Chukotsky peninsula is metamorphic schist and quartzite. In general the Proterozoic is folded much more than the Cambrian.

Archaean is in general more extensive than Proterozoic, is everywhere severely metamorphosed, and consists of gneiss, schist, syenitic granite, and quartzite. In many places thick marble and dolomite units are interbedded with the crystalline schist. Intruded in many places by basic igneous rocks.

T — Acidic and alkalic extrusive rocks.

S — Basic intrusive rocks.

Areas not investigated.

Limit of continental glaciation.

Limit of extensive trap flows, dikes, and sills. (Siberian trap of Late Paleozoic age.)

G — Existing glaciers.

Structure

Pre-Cambrian massifs.--The central Siberian region, including the Central Plateau, the Baikal region, and the western part of the Lena River Basin, is underlain by gently folded Paleozoic and Mesozoic rocks which appear to rest on a stable platform of strongly folded and metamorphosed pre-Cambrian rocks. These crop out extensively in the north end of the Taimyr Peninsula, in the Anabar River Basin, in the Aldan Plateau, in a large area north of Krasnoyarsk (Yenisei Horst) and in Transbaikalia.

Early Paleozoic orogeny.--Bordering this stable platform, particularly in the Sayan Mountains to the southwest, is a narrow band of early Paleozoic sedimentary rocks that were intensely folded in Silurian time (Caledonian orogeny).

Areas affected by Late Paleozoic and Mesozoic orogeny.--South and east of the Central Siberian massif extending from the Sayan Mts. to the Sea of Okhotsk in a northeasterly direction is a belt of strongly folded Paleozoic and Mesozoic sedimentary rocks, which were deformed in late Paleozoic time (Variscan Orogeny) and again at the close of the Triassic (Kimmerian orogeny) A similar structural relationship exists in the southeastern part of the Verhoyansky-Chukotsky Mountain System.

Areas affected by late Paleozoic orogeny.--The Maritime Provinces from Vladivostok to the south shore of the Okhotsk Sea were severely folded and thrust faulted during the late Paleozoic (Variscan orogeny) and in places also at the close of the Triassic (Kimmerian orogeny), with the prevailing trend of structural lines in a northeasterly direction. Also the area along the arctic coast (Eastern Siberian Sea) appears to have been folded in pre-Mesozoic time and possibly in the Variscan orogeny. The geology of this region is not well known.

Mid-Mesozoic orogeny.--The headwaters of the Yana, Indigirka, and Kolyma Rivers cut through Mesozoic rocks that were moderately folded at the end of the Triassic (Kimmerian orogeny).

Tertiary orogeny.--Sakhalin, Kamchatka, and a small coastal area on the northwest shore of the Okhotsk Sea form the area of Alpine folding. In these areas intense folding began in the Miocene and was accompanied by violent volcanic activity, particularly in southern Kamchatka, where vulcanism has continued to the present. There is evidence of pre-Alpine folding in Kamchatka but its date has not been definite established. In general Alpine folding was of lesser intensity than previous orogenies, although the accompanying volcanic activity was intense.

Faulting.--The areas of intensely folded rocks are commonly broken by low angle thrust faults and some by normal faults. Locally older structures have been modified by Tertiary normal faults which are particularly widespread in the Lake Baikal region, which is mostly an area of fault block mountains and in some areas along the Pacific coast. The Pacific coast area and the Baikal Lake region are today seismically active.

Igneous activity.--Extensive intrusions occurred in the pre-Cambrian, and in the late Paleozoic (Variscan). Intrusion and extrusion of basaltic rocks occurred over a wide area in the Central Plateau in Late Paleozoic time (Siberian trap). Throughout the Mesozoic extensive lava flows and dike rocks were formed. Some granites were intruded at the close of the Mesozoic. Tertiary to recent volcanic activity was widespread in Eastern Siberia and to some extent in other areas.

Geomorphology

Eastern Siberia is in general a huge area of table lands separating complex mountain systems of folded or fault block type.

Central and Eastern Siberian Plateau is a gigantic plateau-like highland between the Yenisei and Lena Rivers that owes its more or less uniform relief to the underlying flat Paleozoic rocks and sheets of flat-lying basalt. Two pre-Cambrian massifs, on the Anabar and Yenisei Rivers form island-like highlands with rough topography rising above the general level. Elsewhere masses of basalt in the form of dikes, sills, or flows form several high sharp cliffy hills and pinnacles. On the west the Paleozoic rocks dip gently to the east resulting in a series of broad cuestas. In the Angara region to the south, more severe folding gives the region a mountainous character. Several gravel-covered erosion surfaces are preserved in the region.

Arctic coast.--In general a lowland with a cover of terraced Quaternary marine deposits which is locally very thin or is altogether lacking. Broken by several highlands where more resistant folded rocks are exposed, as on the Taimyr Peninsula. Lena River forms a huge delta with many distributaries. Other rivers reach the sea in deep estuaries.

Baikal Region.--A region of folded and fault block mountains, which have been peneplained, and then again disturbed by later normal faulting. The drainage is for the most part adjusted to the structure, for the rivers flow in valleys filled with Tertiary sedimentary basin deposits, but in many places streams cross the intervening horsts. Contains several deep grabens, Lake Baikal, and others. The drainage originally was mostly to the Lena but has been partially diverted by later faulting and by capture by tributaries of the Yenisei.

Eastern Siberian Highland.--(From Lena River to Chukotsky Peninsula).--Contains several high mountain systems; low Verhoyansky Mts. on west, the high alpine Cherskogo Mts. in the center and the Anadyr and Kolymsky mountains on the east. The core of the region, although little known, is a highland called the Kolyma Table, which lies west of the Cherskogo Range and extends to the Chukotsky peninsula. This is a deeply dissected plateau underlain by more or less folded Mesozoic rocks.

Amur and Ussuri valley region.--Broad terraced river valleys between fault block mountains. Here and there the drainage traverses the fault block mountains.

Sihote-Alin.--Mature mountain mass cut by many canyon-like valleys. Mountains and ridges are in many places capped by basalt and are plateau-like. The region decreases markedly in altitude toward the mouth of the Amur River. Recent uplift of the coastal region, which is steep and rugged, has left marine terraces up to 500 m. above sea level.

Sakhalin.--Folded and faulted in Tertiary time. Owes its present relief to peneplaination, renewed uplift, and block faulting. Marine terraces up to 150 meters in altitude extend far inland.

Kamchatka.--A mountainous peninsula composed mainly of a rugged line of high volcanoes on east coast, a range of older mountains and extinct volcanoes in center, separated by a depression filled with Quaternary sediments. On west coast is a low terraced plain underlain by Tertiary and Quaternary sediments.

Northeastern coastal region.--North of Kamchatka is a range of mountains along the coast 1000-1500 m. in altitude. Its form is controlled by Tertiary normal faulting. Inland from this range and parellel to it is the Anadyr Basin, a great alluvial lowland broken by low plateaus, ancient volcanoes, and spurs of the adjoining mountain ranges.

Glaciation.--The Eastern Siberian region had a large ice cover at least twice during the Pleistocene. Continental ice advanced from several centers, one west of the Yenisei River, one on the Taimyr Peninsula, and a small one on the rugged Chukotsky Peninsula. Most of the area of lowlands and table lands was, however, never covered by the ice. Mountain glaciers were widespread through the mountainous regions. Glaciers carved out deep fiords in the mountains along the coast of Bering Sea.

Permanently frozen ground.--Because of the intensely cold climate and lack of thick snow cover, most of Eastern Siberia is underlain by permanently frozen ground, ranging in thickness from a fraction of a meter in the south to several hundred meters in the north. In places there are layers of unfrozen ground between the frozen layers. The permanently frozen ground is overlain by a thin layer which thaws during the summer and freezes in winter. When thawed this ground is in many places muddy and poorly drained. In the far north it may be covered with isolated large frost mounds or boils. Permanently frozen ground requires the use of special methods for the construction of all roads and foundations, and for the development of water supply. Ground that is solid in winter may become very unstable during summer or when warmed by the presence of a heated building. Unfrozen layers within or below the permanently frozen ground are as a rule saturated with water under considerable pressure and may provide adequate water supply.

Economic Geology

Coal.--Coal-bearing rocks cover extensive areas in Siberia. Bituminous and anthracite coal occur in Carboniferous and Permian rocks and to some extent in younger rocks. Brown coal and lignite occur in Jurassic, Cretaceous, and Tertiary rocks. The principal Paleozoic coal basins lie in or on the borders of the Central Plateau. Important areas are at Minusinsk and in the Tungus Basin. The Irkutsk district is an important Jurassic coal basin with huge reserves. Smaller coal basins that supply coal of good quality occur in the Baikal region and the Vladivostok region. The most important producing field along the coast, however, is on Sakhalin Island. Total production for Eastern Siberia is between 4,000,000 and 5,000,000 tons per year (1937). Production has been increasing.

Graphite.--Graphite is associated with syenite in the Sayan Mts. Also occurs in Tungus Basin where coal beds have been metamorphosed by igneous intrusions. Between Blagoveschensk and Khabarovsk there are large reserves of low grade graphite ore. Production is only several thousand tons but has been markedly increasing.

Oil.--Eastern Siberia, as far as known at present, is poor in oil reserves. The only occurrences of any importance are in Sakhalin and Kamchatka where oil occurs in folded Pliocene sediments. Seeps of tar and gas occur in the Quaternary deposits along the shore of Lake Baikal. Indications of oil are recorded at Nordvik on the Arctic coast. Exploration is being carried on in the Aldan region and in the plateau west of Baikal Lake. Probably several hundred thousand tons produced per year (mostly Sakhalin).

Oil Shale.--Shale with a considerable bitumen content is present in the Irkutsk region. Appears to be of little industrial importance at present.

Salt.--Salt is obtained in Siberia by concentrating the brine of salt wells or springs. Most of these derive their salt from early Paleozoic rocks. Important occurrences are at Irkutsk, along the Arctic Coast, in the Minusinsk area, and in the Vilyui River Basin. Several tens of thousands of tons of salt are produced.

Iron.--Iron occurs in many places in Eastern Siberia, principally as magnetite or hematite formed in contact deposits or in hydrothermal deposits. The Angara River region has more than 5,000,000 tons of reserves associated with trap intrusions. Other large deposits are in the Amur River valley and Sihote-Alin Mountains. Production in all these areas is relatively small.

Copper.--Small vein or contact metamorphic deposits in rocks of pre-Cambrian age. Copper in veins in the late Paleozoic rocks of Minusinsk and Tungus Basins, and in the Baikal region. Reserves probably small, and production slight. Several mines near Vladivostok have been worked sporadically.

Silver, lead and zinc.--Some deposits in pre-Cambrian rocks, some in late Paleozoic (Variscan) hydrothermal deposits in limestones of Baikal region and Sihote-Alin, and in Tertiary sulfide deposits or contact metamorphic deposits of the far eastern region. There are important mines east of Chita (in the Baikal region), and in southern Sihote-Alin. These areas have large reserves but production is probably small.

Gold.--The principal gold veins are of pre-Cambrian age. The richest deposits are the associated placers. The largest are in the Lena River Basin. The alluvium of the Amur and Ussuri valleys is worked by dredges and contains large reserves, but production is small. Gold occurs in some Jurassic conglomerates of the eastern region. Vein deposits occur but are relatively unimportant.

Nickel.--Deposits of low grade copper and nickel ore are associated in origin with the Siberian Trap in the Tungus Basin. As far as known no nickel is produced. but mining has probably begun at Norilsk.

Tungsten.--Occurs in pre-Cambrian contact deposits of the Baikal-Amur region, and in late Paleozoic contact deposits of the far eastern region. Important source of domestic tungsten in Russia. Reserves large.

Molybdenum.--Occurs in granitic rocks of Sihote-Alin, and in pre-Cambrian veins of the Baikal region associated with copper and zinc. As far as known there is no important production.

Antimony.--Occurs in Tertiary pneumatolytic deposits near the east coast and can be obtained as a by-product of the silver-lead-zinc ores in the Baikal and Sihote-Alin regions.

Manganese.--Occurs in Archaean limestones as contact metamorphic deposits, and also occurs in association with siliceous sediments. Probably not developed.

Tin.--Deposits of tin are known in the Chita region and in the Lena River basin. Smelters were under construction in these two areas in 1938. Tin deposits in Sihote-Alin Mts. are not as yet developed.

Bibliography

Leuchs, Kurt, Geologie der Erde, Bd. 1, Teil, Geologie von Asien, Nord Asien. Berlin, 1935, 236 pp.

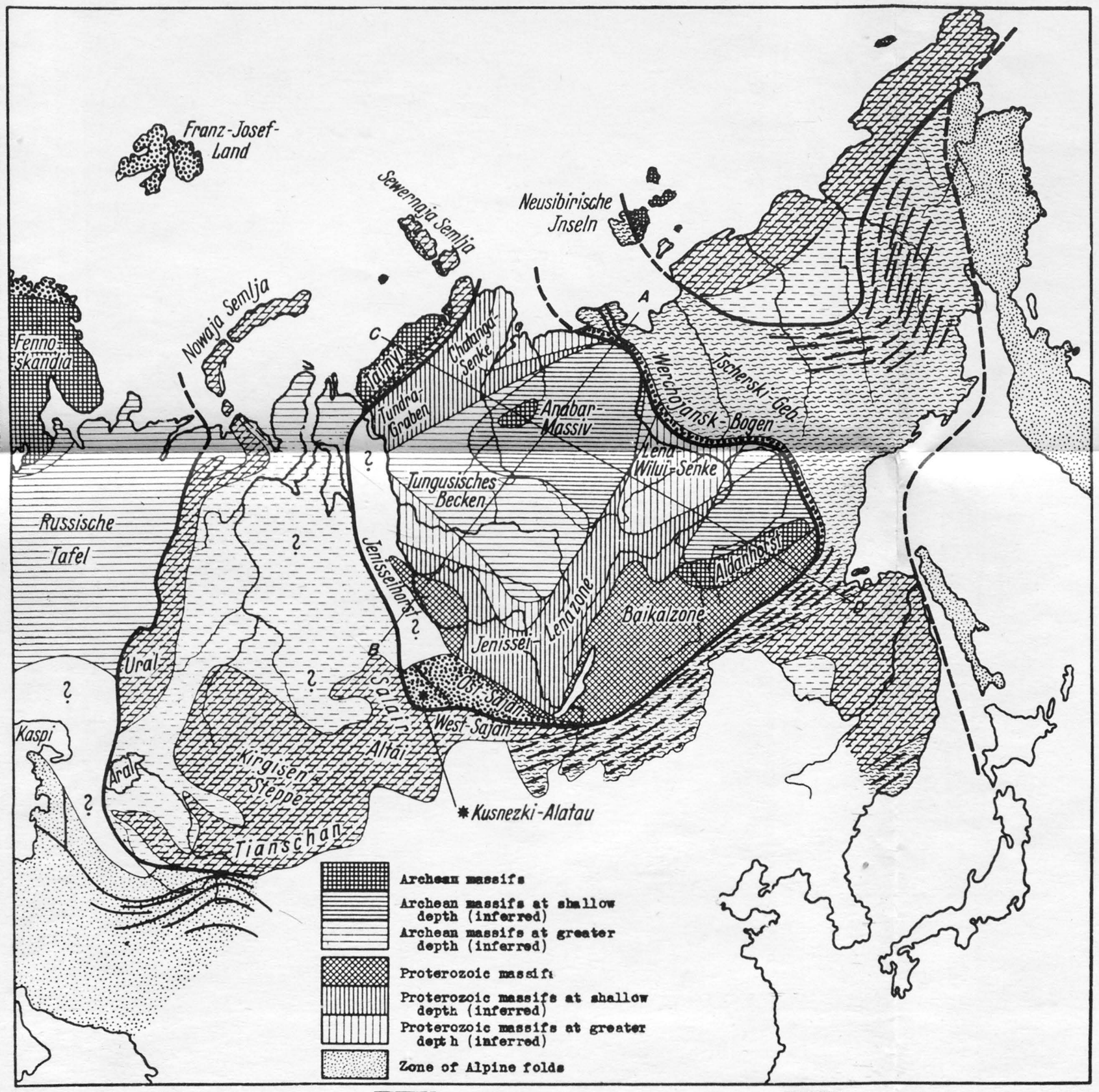
Obrutschew, W. A., Geologie von Siberien, Fortschritte der Geologie und Paleontologie, Heft 15, pp. 1-572, Berlin, 1926.

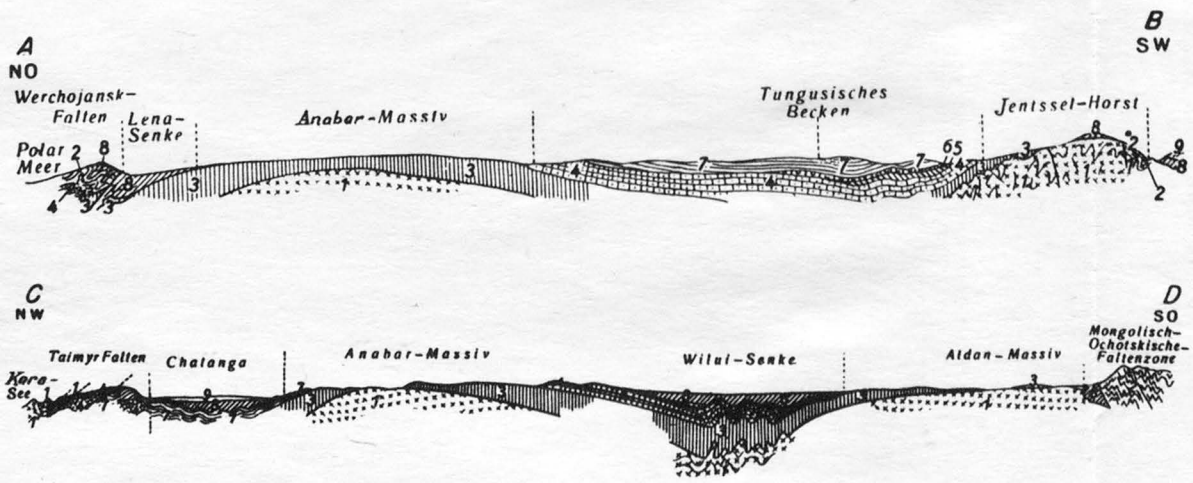
Geological Map of the U.S.S.R., scale 1:5,000,000, 1937.

Problems of Soviet Geology (in Russian) published by Geological Committee.

Publications of the Academy of Sciences, U.S.S.R. (in Russian).

Reliability rating: Class C.

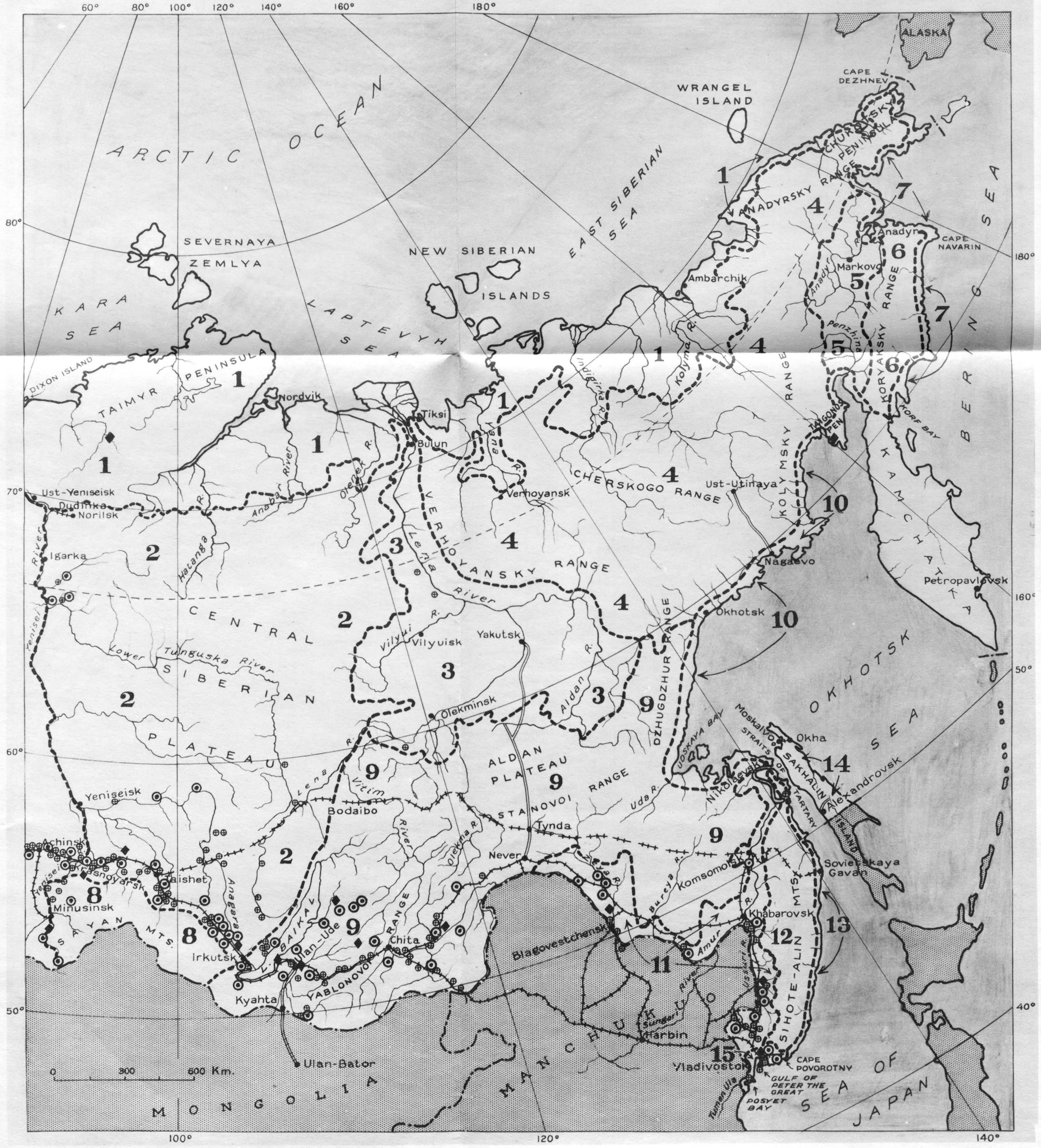




Generalized cross sections through the Central Siberian Plateau.

1. Pre-Cambrian, 2. Paleozoic, 3. Cambrian, 4. Silurian, 5. Devonian, 6. Lower Carboniferous, 7. Tungus series (Permo-Carboniferous), 8. Mesozoic, 9. Quaternary.

EASTERN SIBERIA Map 3. Construction Materials



MAP 3, CONSTRUCTION MATERIALS — EASTERN SIBERIA

Province	General Description	Limestone	Clay and Shale	Concrete Aggregate	Road Metal	Sand and Gravel	Building Stone
1 Arctic Coast	For the most part this area is a low tundra-covered plain underlain by clay and sand with some gravel. East of the Kolyma River and on the Taimyr Peninsula, however, the area is hilly or mountainous and hard rocks crop out over wide areas. Elsewhere there are isolated knobs and hills of rock that rise above the low tundra. Even in the Lena delta a knob of bed rock rises sharply above the water of one of the large distributaries.	Occurs in the Taimyr Peninsula and in other scattered localities along the coast. It is known to occur near the mouths of all the large rivers except the Kolyma.	Can be found in places beneath the tundra, and in many rock formations along the whole coastal region.	Can be found in abundance in Taimyr and Chukotsky Peninsulas. Between the Kolyma and Hatanga Rivers occurs only in widely separated localities near the coast.	Rock for crushing, or gravel, may be found in many places east of Kolyma River or on Taimyr Peninsula and in isolated areas along the coast between these points.	Sand occurs in abundance on low coastal terraces, and in bars and spits. Gravel may be found along streams or on stream terraces especially where the coast is hilly, as on Taimyr Peninsula or east of the Kolyma River.	Building stone of various types occurs in abundance east of Kolyma River and on Taimyr Peninsula. It may be found in isolated localities between these points.
2 Central Siberian Plateau	In general the huge interior of this region is likely to be of little strategic importance because of its inaccessibility and completely undeveloped state. The accessible and important parts, along the Trans-Siberian Railroad and also along the Yenisei River probably contain the greatest variety of construction materials. Coal is also of wide occurrence in these regions (See fuels map).	Limestone of many types occurs in wide belts in many areas, particularly in the northeast and south parts. Limestone is lacking in much of the interior, although narrow belts can probably be found within 100-200 kilometers of almost any locality.	Clay occurs in many river valleys and shallow depressions on the plateau surface. Shale is abundant except in an area around the middle course of the Anabar River.	Limestone and other suitable rocks for crushed stone can be found in abundance. Trap rock is widely distributed throughout the area but may be unsuitable locally because of zeolite minerals.	Trap rock and limestone abundant. Gravel occurs in river valleys and terraces.	Abundant in river valleys and terraces.	Trap rock, limestone, and sandstone suitable for building stone are widely distributed.
3 Lena River Basin	This region consists of the flood plain of the Lena River and tributaries and adjacent terraces and slopes. Because of the great width of the alluvial bottom land along the river, construction materials except sand, gravel, and clay are not easily available in most places near the rivers. In the southern part, the valleys are narrow and abundant building materials may be found in the adjoining hilly regions.	Limestone of many kinds is distributed in broad belts through the southern part of this area. It is found in places in the northern part, but is likely to be far from the river, difficult to find, and long hauls may be necessary. A cement plant is located at Yakutsk.	Clay occurs in many places in this area especially in the river valleys and in river terraces. Shale may be found in many places though it may be far from the river.	Limestone for crushed rock may be found most easily in southern part of area. Some limestone and hard flinty rock may be found in northern part, though it may not be easily accessible.	Limestone available over wide areas in southern part. Some limestone and flint probably can be found in northern part. Coarse gravel may be found in river valleys and terraces.	Abundant in river valleys and terraces.	Much sandstone and limestone suitable for building stone occurs and is probably within access of any locality, except where river flood plain is very wide.
4 Verhoyansky-Chukotsky Mt. System	This area is mountainous and hard rocks are abundantly exposed. Many varieties of construction materials are available, but there are wide stretches of country that have more or less uniform bed rock (usually sandstone and shale or volcanic rock) so that a choice of materials may not be had in certain localities. This region is largely undeveloped and unexplored and is probably of little strategic importance.	Limestone probably occurs in narrow belts over much of this country, but will not be easily found near every locality and in places long hauls may be necessary.	Clay can be found in the alluvium of valleys. Shale is widely distributed.	Limestone probably occurs in narrow belts. Many isolated localities that are widely distributed in the region contain granitic and volcanic rocks suitable for hard crushed stone. Some localities may not be within easy reach of good rock.	Limestone, granitic, and volcanic rock, puddingstone or gravel may be obtained in most parts of the area and perhaps everywhere.	Occurs widely in stream valleys and stream terraces.	Sandstone and granitic rocks probably suitable for building stone available in most places.
5 Anadyr Depression	This area is a low alluvial plain with isolated hills or low mountains. Many construction materials are available in the hilly areas.	Limestone occurs in thin belts in this area but it is not widely distributed.	Clay is abundant beneath the tundra of the Anadyr and Penzhina River valleys, as well as in the soft rocks of the higher areas. Shale is abundant in many areas of harder rocks.	Many areas of granitic and volcanic rock suitable for good concrete aggregate occur in the hills or mountains that rise above the low plains. Trap rock, abundant in hilly areas, probably contains zeolite minerals that are undesirable in concrete aggregate.	Gravel available in some valleys. Good crushed stone available in most of the hilly areas.	Occurs widely in the valleys. Large areas, especially in the lower courses of the Anadyr and Penzhina Rivers, may contain mostly silt and clay.	Sandstone suitable for building stone probably available, but may be closely jointed; granite and volcanic rocks available.
6 Koryaksky Range	This region is mountainous. Building materials are probably available in many places but only a few small areas of the region have been explored. Large areas are covered by tundra so that rock exposures are apt to be few.	Limestone not known but information is incomplete.	Clay probably abundant in valleys. Shale is widely distributed.	Chert is reported but distribution is not known. Should not be used with high alkali cement. Trap rock, apparently widespread, would be suitable if free of zeolites.	Gravel probably abundant in stream valleys and terraces. Trap rock apparently widespread. Distribution of chert is not known. Puddingstone is apparently widespread and may make good crushed stone.	Sand and gravel abundant in valleys.	Sandstone is abundant but is probably closely jointed. Other building stones available.
7 Coast of Bering Sea	The coast of the Chukotsky Peninsula is mostly rocky and mountainous and a great variety of construction materials are available and accessible. The coast of the Gulf of Anadyr is for the most part low and tundra-covered. Large areas of clay and sand underlie the surface of this coast, though other materials occur a short distance inland. The coast of the Koryaksky range is mountainous in most parts and construction materials available should be the same as in area (6) above. Coal is mined near Anadyr and at Ugolnaya Harbor (See fuels map).	Limestone occurs on the shore of the Chukotsky Peninsula in several localities. It is not known elsewhere but probably can be found.	See General Description.	See General Description.	See General Description.	See General Description. Sand and gravel can also be found on beaches and spits.	See General Description.
8 Sayan Mts.	This area contains an abundance of construction materials of all kinds. The Minusinsk Basin is the most strategic part and like the rest of the region contains many materials that are easily accessible because of many roads. This basin is also an important developed coal basin and industrial center (See fuels map).	Many varieties of limestone are widely distributed in the area.	Clay abundant in stream valleys and terraces. Shale widely distributed in harder rocks.	Many of the rocks are suitable for concrete aggregate. Granitic rocks are widespread in mountain area.	Abundant limestone and granite suitable for crushed stone.	Present in river valleys and terraces.	Limestone and sandstone suitable for building stone probably are widespread.
9 Baikal-Amur Upland	The northern part of this area is plateau-like. Construction materials are widespread but large areas may have uniform type of bed rock so that in places some materials may be inaccessible. The most strategic part is that along the Trans-Siberian Railroad, where there are many industrial towns. Construction materials are here made accessible by the presence of the railroad.	Limestone and marble are widely distributed in this area, particularly in the northern part. The southern part, which is traversed by the Trans-Siberian Railway, has large areas where limestone is not extensive but it can be found in numerous isolated localities.	Clay abundant in river valleys and terraces. Shale is widespread in northern part and present in numerous scattered areas in southern part.	Abundant materials for concrete aggregate are available. Granitic rocks cover large areas.	Abundant limestone, granite, and gravel. Gravel occurs in river valleys and terraces. Harder rocks on slopes.	Occurs in river valleys and terraces.	Limestone and sandstone widespread in northern part of area. Many areas contain suitable granite. Several quarries are located on Trans-Siberian Railroad.
10 Coast of Okhotsk Sea	Except for limestone, building materials of all kinds are abundant. At many localities, however, some of the materials are inaccessible because the only means of transportation is by sea, and harbor and landing facilities are few and poor. The greater part of the coast is largely unexplored.	Limestone may be present but information is incomplete. It is, however, not widespread.	Clay occurs in river valleys. Shale abundant in many areas along coast.	Granitic rocks available at numerous localities. Volcanic rocks, including trap rock and other materials, would be suitable in part.	Abundant granitic rocks, trap, and other volcanic rocks. Good gravel occurs in coastal terraces and on beaches as well as in river valleys.	Abundant on terraces along low coasts, and in river valleys, also on spits and bars.	Suitable sandstone and granite abundant.
11 Amur-Ussuri Lowland	The lowland is underlain mostly by fine-grained sediments, but many stretches are narrow and rocky hills lie close to the rivers. In these areas many materials are available. The Trans-Siberian Railroad, spur lines, and highways make materials in this and adjacent regions easily accessible.	Limestone is available at numerous places accessible to this region. Probably it is especially widespread around Khabarovsk and in the middle course of the Ussuri River. A large cement plant is near the head of the Ussuri Valley on the Trans-Siberian Railroad.	Clay probably widespread in this region in the valley floor and in some soft rocks found at the edges of the valley. Shale probably widespread in adjacent regions.	Abundant at many places in the valley floor especially where the valley is hilly and cuts through highlands. Also available at many easily accessible places in the adjacent regions.	Abundant. Same occurrence as concrete aggregate.	Probably abundant in river terraces especially along the smaller tributaries.	Abundant. Same occurrence as concrete aggregate. Several granite quarries on Trans-Siberian Railroad.

MAP 3. CONSTRUCTION MATERIALS (2)

EASTERN SIBERIA

Province	General Description	Limestone	Clay and Shale	Concrete Aggregate	Road Metal	Sand and Gravel	Building Stone
12 Sihote-Alin	A mountainous region with a great variety of rocks, probably furnishing every kind of building material.	Limestone is available at many scattered localities, particularly along the southern part of the coastal region.	Clay is available in many localities in river valleys. Shale widespread.	Granitic and suitable volcanic rocks are available at numerous scattered localities.	Limestone, granite, and suitable volcanic rock are available at localities in the interior and near the coast. Gravel can be found in most stream valleys.	Probably available in most stream valleys.	Sandstone, limestone, and suitable volcanic rock probably widespread.
13 Coast of Sihote-Alin	The whole northern part of coast line is composed of volcanic rocks. The southern part is composed of sedimentary rocks with scattered areas of granite.	Limestone is available at scattered localities in the southern part but is not present in the northern part of the coast.	Clay available in many stream valleys.	The southern part of the coast has many scattered areas of suitable granitic rock. The northern part is composed entirely of volcanic rock much of which is suitable.	Probably available in the whole coastal area.	Available in many stream valleys and in beaches.	Volcanic rocks of northern part of coast may be suitable building stone. Sandstone and limestone available in southern part.
14 Russian Sakhalin	Northern part of area except for the wide peninsula at the northern tip is mostly covered by soft clay, sand, and gravel. Hard rocks of considerable variety are widespread in the southern part.	Available in several localities on west side of Sakhalin. Exposures of hard limestone are known in the vicinity of Alexandrovsk. Marl or shale may be found at many localities. Marble available at northern tip of peninsula, as well as in the mountains of the southern part.	Clay available in numerous stream valleys and in soft rocks. Shale abundant.	Good aggregate may be difficult to obtain in parts of the island. Granite available on the southwest coast and at isolated spots in the southern interior. Some suitable volcanic rocks are present, especially on southwest coast. Marble in extreme north would be suitable.	Gravel in river terraces, and in beaches of southern part. Granite, trap, and limestone available in southwestern part. Hard rocks available locally elsewhere.	On beaches and bars and river terraces, also in soft rocks of the northern interior.	Sandstone is abundant but does not appear to be suitable because it is soft. Rocks used for limestone, concrete aggregate, and for road metal may make suitable building stone if not closely jointed.
15 Vladivostok Area	Area is readily accessible. Building materials of all kinds are available and exploited.	Several isolated localities of limestone are reported along the coast, accessible by boat as well as by road.	Clay can be found in stream valleys. Shale available in many scattered localities.	Granitic rocks are abundant.	Abundant road metal in the form of granite, limestone, and sandstone.	Available in stream valleys and on beaches.	Sandstone, and granite of this area are used for building stone.

Map Explanation

♦ Fire clay quarry

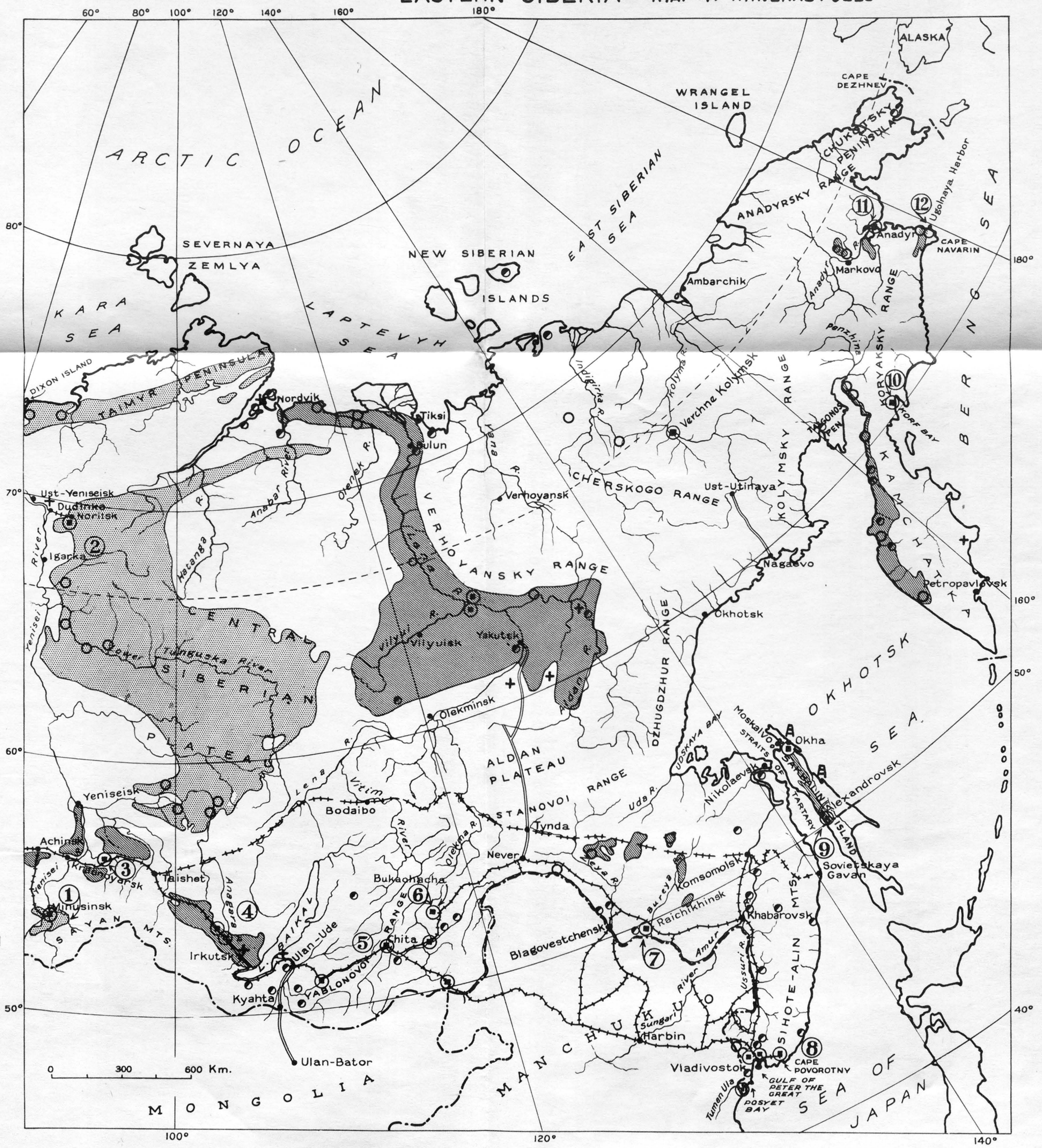
◉ Limestone quarry

⊕ Building stone quarry (includes material for fill, road metal, and dressed stone).

Note: Data on quarry locations are incomplete.

Reliability rating: Class C.

EASTERN SIBERIA MAP 4. MINERAL FUELS



Map Explanation

Coal

Areas probably containing beds of bituminous coal. Many areas undeveloped and unsurveyed.

Areas probably containing coal beds of poorer quality. In these areas coal may range from lignite to semi-Anthracite, but is mostly brown coal. Many areas undeveloped and unsurveyed.

○ Known bituminous coal localities (some worked).

◐ Known brown coal localities.

◙ Large coal mines (all grades of coal).

① Principal Mining Areas.

Oil

A Producing oil fields.

\+ Areas favorable for the occurrence of oil where prospecting was being done in 1939.

Note: In some areas peat and oil shale are used as fuel. Timber is available for fuel in most places except along the Arctic and the Pacific coasts.

Description of Principal Coal Mining Areas

Area	Mining Area	Quality	Production and Reserves	Accessibility	Mining Methods	Geology
①	Mimusinsk Basin. Important coal basin, containing several producing mines, on the upper Yenisei River.	Quality differs considerably; mostly bituminous. Heat value exceeds 6,000 calories. In part suitable for coking.	Reserves probably exceed 60 million tons.	Reached by rail on a spur line from Achinsk on the Trans-Siberian Railroad. Also may be reached by river boat from the north.	Inclined shafts where dips are steep; drifts where dips are slight.	Coal occurs in Permian rocks which are gently folded; maximum dip is 25°
②	Tungus Basin. A huge area of numerous and extensive coal beds east of the lower Yenisei River. Only important mine is in the Norilsk area. Coal beds worked at many places on the Angara and Lower Tunguska Rivers.	Bituminous coal. Heat value probably exceeds 6,000 calories. Ash content 2 - 8 percent. Coking quality not known.	Reserves enormous. Probably much over 300 million tons.	Reached only by river boats.	Much of this coal can probably be mined by stripping, or by underground drifts and rooms.	Coal is in gently dipping or flat-lying Permo-Carboniferous rocks. Locally coal is intruded by basalt dikes and sills.
③	Kansk Area. Several mines of no commercial importance, but worked for local use.	Brown coal, of poor quality.	Reserves 2,400,000 tons.	On Trans-Siberian Railroad.	Can be mined by drifts and in places by open pit or stripping methods.	Coal occurs in Jurassic rocks. Beds 1 - 2 meters thick.
④	Irkutsk Basin. One of the larger coal basins in all Russia. Whole basin traversed by Trans-Siberian Railroad. Supplies local industry and the Trans-Siberian Railroad.	Quality ranges from brown coal to bituminous coal; in part suitable for coking. Some has heat value exceeding 6,400 calories.	Reserves estimated at 75 billion tons. Production 3,057,000 tons in 1937.	On Trans-Siberian Railroad.	Mostly by open pit and stripping methods; some by underground drifts and rooms.	Nearly flat-lying Jurassic rocks, cut by normal faults.
⑤	Chita Area. Coal mined in several places along Trans-Siberian Railroad at and near Chita.	Brown coal.	Reserves probably more than 10 million tons.	On Trans-Siberian Railroad.	Same as above.	Coal occurs in slightly folded or horizontal layers, cut by normal faults.
⑥	Bukachacha.	Brown coal.	Reserves probably more than 65 million tons.	On spur of Trans-Siberian Railroad.	Same as above.	One of the beds is 4 meters thick. (Probably of Tertiary age).
⑦	Raichikhinsk. (Near junction of Bureya and Amur Rivers). Many other mines now developed in this region.	Coal ranging from brown coal to bituminous. Heat value 6,000 - 7,800 calories.	Reserves not known.	Reached by spur of Trans-Siberian Railroad from Bureya, on Bureya River.	Same as above.	Coal occurs in several thick beds. Dip 15°-20°.
⑧	Vladivostok Area. Coal is in several isolated basins. Has been commercially mined for many years.	Quality ranges from brown coal to semi-anthracite. Much good coking coal.	Reserves more than 25,000,000 tons.	All mines reached by railroad. Some reached by sea-going vessels.	Inclined shafts and stopes.	Coal is in highly folded Jurassic rocks intruded and metamorphosed by granite and by later diabase dikes. Some coal is of Tertiary Age.
⑨	Sakhalin. Coal mines developed near shore of Gulf of Tartary near the harbor of Alexandrovsk. Other coal fields but location uncertain.	Quality ranges from lignite to bituminous coal of excellent quality. In part suitable for coking.	Reserves estimated at 2 billion tons.	Mines accessible to sea-going vessels. Coal is brought to piers by trams.	Horizontal tunnels, inclined shafts and stopes.	Coal occurs in folded and faulted Tertiary and Cretaceous rocks.
⑩	Korf Bay. Small mines on west shore of Korf Bay north of the Peninsula of Kamchatka. Can be mined by open pit methods.	Brown coal. Heat value 4,140 calories or more.	Reserves: 30,000,000 tons.	Accessible to sea-going vessels.	Open pit.	The coal is in Tertiary rocks.
⑪	Anadyr. Several deposits; includes the northernmost locality of mined coal along the Pacific coast.	Brown coal, heat value 3,500 - 5,500 calories.	Reserves: 12,000,000 tons. Production 5,000 tons in 1936.	Accessible to sea-going vessels. Short navigation season (July to Sept.).	Inclined shafts.	Coal beds 4 meters thick in Paleocene and upper Cretaceous rocks, strongly folded into deep syncline.
⑫	Ugolnaya Harbor. Good coal deposits on shore of Bering Sea. Undeveloped in 1936, but probably exploited now.	Bituminous coal of good quality. Heat value 7,625 calories.	Reserves: more than 2,000,000 tons.	Accessible to sea-going vessels, near main coastal steamship routes. Short navigation season.	Underground methods must be used. Inclined shafts or drifts and rooms.	Gently folded Cretaceous and Tertiary rocks.

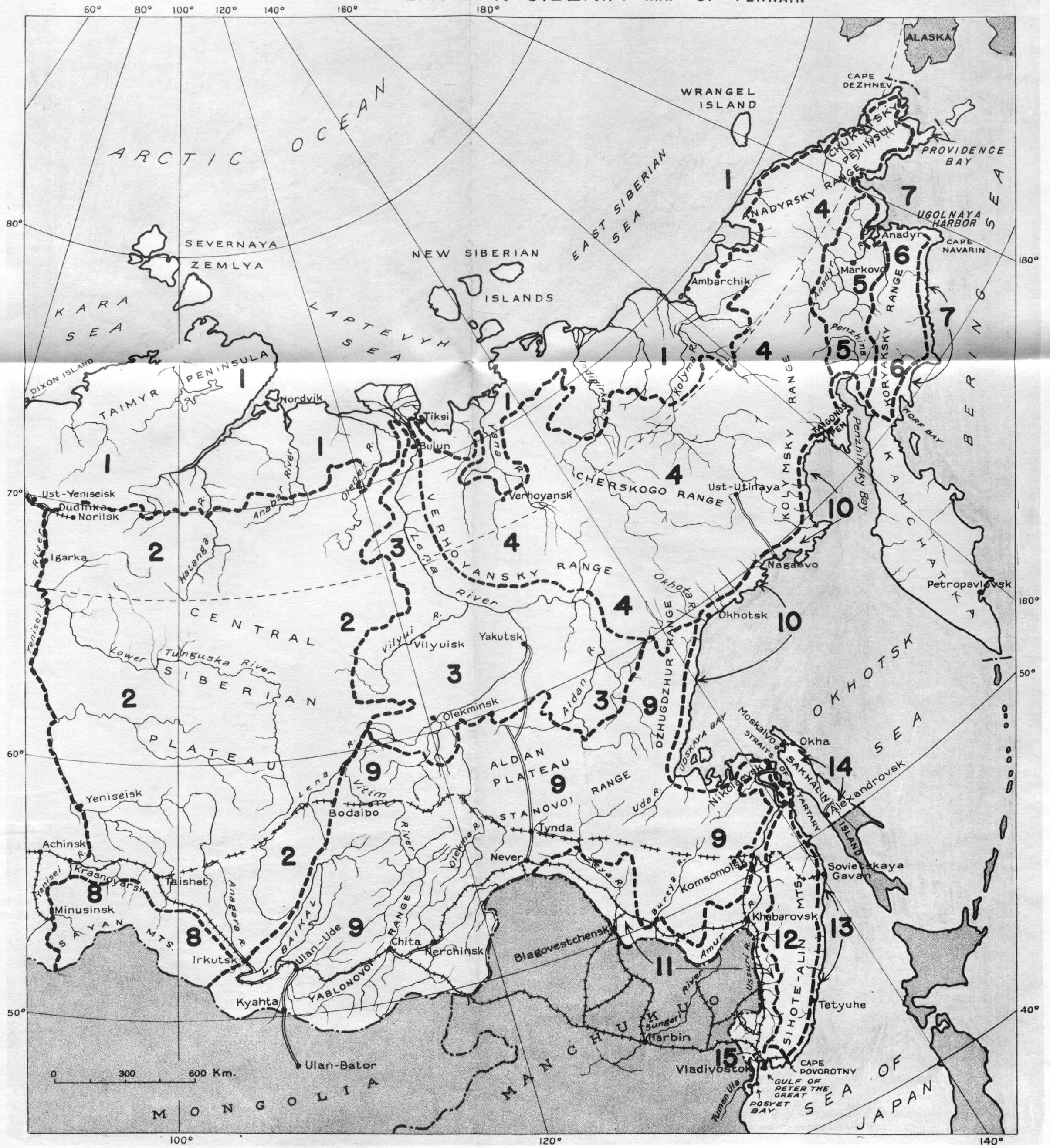
Production, 1937, 777,000 tons

Production, 1937, 1,800,000 tons

Production, 1937, 4,983,000 tons

Reliability rating: Class C.

EASTERN SIBERIA MAP 5. TERRAIN



MAP 5, TERRAIN

Eastern Siberia

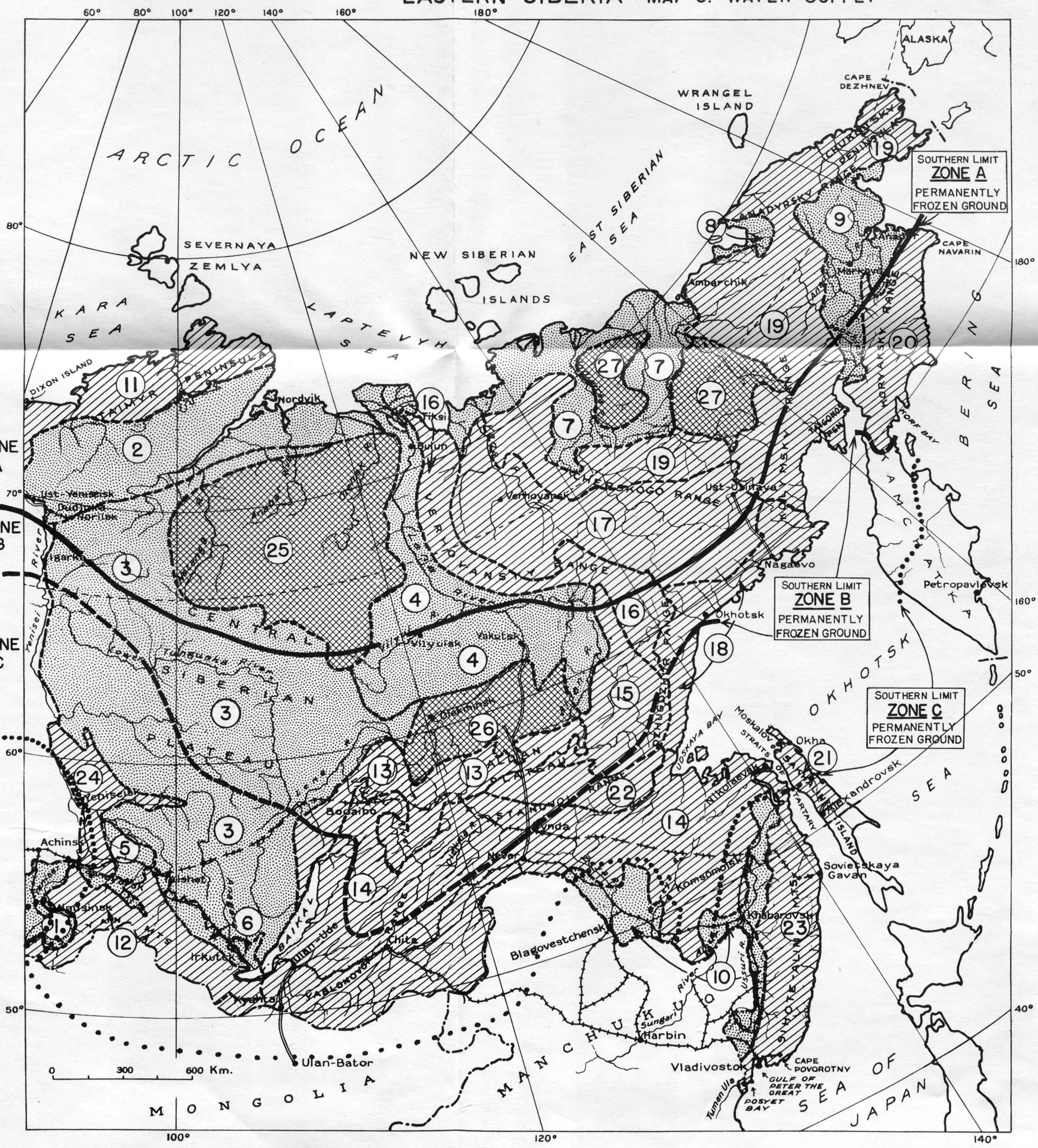
Unit	Definition and Topography	Drainage	Climate	Vegetation	Means of Communication and Settlements	Remarks
1 Arctic Coast Approximately 500,000 Sq. Mi. or 12% of total area. About 2,500 Mi. long.	Low coastal plain from the mouth of the Yenisei River to Cape Deshnev. Ranges in width from a few to more than 1,000 kilometers. Rises from sea level to an elevation of slightly more than 200 meters, except in the Taimyr Peninsula where a hilly plateau several hundred kilometers long rises to an altitude of 500 to 1,000 meters Most of the area is flat, but the even surface is broken in places by frost mounds that rise anywhere from a few to one hundred meters above the surrounding terrain. The coast line has numerous long river estuaries and large bays. The Lena and several small rivers, however, have built deltas into the sea.	This area is traversed by lower courses of sluggish rivers, which flow into the Arctic Ocean. Small lakes and swamps are numerous. Most of the rivers begin far to the south where the break-up of the ice occurs earlier than in the north, causing ice jams and extensive flooding of the land.	Cold continental climate. 300 days per year have average temperature below 32°F Precipitation is mostly in summer; ranges from 150 mm. a year in western part to 200 mm. in eastern part. Snow cover about 30 cm. in western part and 90 cm. in eastern part.	Low, swampy areas covered by moss. Hilly country covered by bushes and dwarfed trees.	The existing means of communication are chiefly by water during the summer and by dog and deer sleigh during winter. The firm frozen ground of the tundra is in most places made impassable by summer thawing. Important outposts are connected by regular airlines. The main settlements are on the Arctic coast. The Arctic sea is navigable during the short summer but ice makes navigation precarious. Harbor and loading facilities are available at: Ust-Yeniseisk, Dixon (coaling station), Nordvik (coaling station), Tiksi (coaling station), Ambarchik.	Permanently frozen ground lies from a few cm. to 1 meter below the surface. This fact should be taken into consideration in all construction work. Tides along Arctic coast are insignificant. Landing fields for airplanes may be found along the coast on sandy beaches and bars as well as on smoothly frozen surfaces of Lagoons and lakes. Roads or trails for use in winter by tractors or aero sleds may be constructed in most places with little grading.
2 Central Siberian Plateau Approximately 1,000,000 Sq. Mi. or 25% of total area.	Essentially a low plateau whose average altitude ranges from 500 to 1,000 meters. On the west the plateau ends abruptly at the low flood plain of the Yenisei River. To the south and southeast it rises into the Sayan Mountains and the mountainous Baikal region. On the east it is bordered by the flood plain of the Lena River and its tributaries. On the north the plateau descends to the Arctic coastal plain. In several places in the interior broad table lands reach elevations of 1,100 meters. Someof these are sharply bounded by a trap rock rim. Others have a broad dome like form. Areas of trap rock locally have sharp pinnacles. The highest part of the plateau, altitude 1,400 meters, is in the northwest corner. Numerous streams cut through the plateau. Most of them originate in swampy upland surfaces and gradually descend into broad, well-defined valleys that are bordered by steep slopes. Some rivers are bordered by terraces.	Most of the drainage in this area is by tributaries of theLena and Yenisei Rivers, which flow into the Arctic Ocean.	Cold continental climate little warmer than (1). Annual precipitation is 200-450 mm. and is heaviest in southwest part. Heaviest precipitation in summer.	Most of the area is thickly covered by evergreen forests, with open areas of grassy and peat swamps. The northern limit of farming runs approximately along Lat. 65°N.	The chief artery of travel is the Yenisei River. The Trans-Siberian Railroad skirts the southern limit of the plateau, with a branch from Taishet running in a northeasterly direction around the north end of Lake Baikal. The port of Dudinka on the Yenisei River is connected by railroad with the important mining district of Norilsk. The Yenisei River is navigable to Krasnoyarsk and above. Many of the tributaries are also navigable. Krasnoyarsk, the main city in the region, is located where the Trans-Siberian Railroad crosses the Yenisei River. Igarka on the Yenisei River is a coaling station for ocean going ships and the chief port of export for lumber. Many smaller settlements along the Trans-Siberian Railroad, along the navigable rivers, and a few in the less accessible interior. Airline routes follow the Trans-Siberian Railroad and the Yenisei River, from Krasnoyarsk to Dudinka, and from this latter route several branches reach eastward into the interior.	Except for the southwesternmost corner including Yeniseisk and Krasnoyarsk, the entire plateau region is situated in the province of permanently frozen ground. Terraced river valleys and flat areas in the lower part of the plateau can furnish numerous sites for air bases. During the summer rivers and lakes provide landings for seaplanes. In winter their frozen surfaces accomodate land planes. Most of this country is readily adapted to winter transportation by tractors or aero sleds with little grading necessary, as there are few serious topographic barriers. Clearing the dense forest is necessary. Roads for summer travel can be constructed only with great difficulty because the ground is so boggy.
3 Lena River Basin Approximately 350,000 Sq. Mi. or 9% of total area.	The Lena River Basin is a lowland along the Lena River and its main tributaries, extending from the Arctic Ocean to about Lat. 60°N. The region is bordered on the east and south by the mountain ranges of Eastern Siberia and the Baikal-Amur region. It includes river flood plains and the immediately adjacent terraces and slopes which rise to altitudes slightly about 200 meters. The inter-stream divides in the southern part rise to slightly higher altitudes. The area contains numerous lakes and swamps. The larger streams are braided leaving numerous islands between the channels. Areas of sand dunes are found along several streams.	The area is drained by the Lena River and its two main tributaries, the Vilyui and the Aldan. Because the ice in the headwater breaks up sooner than the ice farther north, the streams overflow banks and occasionally shift their channels. This is in part responsible for the abundance of lakes on the flood-plain and on some of the terraces. Many are oxbow lakes. The river current is sluggish but there are rapids in the headwaters and in occasional narrows.	Dry cold continental climate. Annual precipitation 200-250 mm.; occurs mostly during warm season. Snow cover 40-50 cm.	Higher slopes with evergreen and to some extent deciduous trees. Peat and grass swamps abound near the stream channels. Low terraces are grassland.	Travel routes almost exclusively restricted to rivers, pack trails, and sleigh trails. Yakutsk, the main town, is connected by highway with the Trans-Siberian Railroad at Never. Other settlements in the area are Olekminsk, Vilyuisk and Bulun. Lena River is navigable to Olekminsk and above. Air route from Irkutsk to Tiksi on the Arctic Ocean passes through Yakutsk and Bulun.	The entire area is within the province of permanently frozen ground. Air base sites may be found on river terraces and on frozen rivers and lakes. During the short summer seaplanes can land on numerous lakes and rivers. Much of this country is easily adapted to winter transportation by tractor or aero sled, as roads for these vehicles may follow the frozen surfaces of large rivers. Summer transport by land is difficult because most of the region is swampy and thickly forested.
4 Verhoyansky-Chukotsky Mts. Approximately 960,000 Sq. Mi. or 24% of total area.	Mountainous region extending from the Lena River to the northeastern tip of Siberia. Includes several mountain ranges and marginal plateaus. Most of the mountains rise to 2,000 meters. The mountains are deeply incised by streams most of which flow to the north. The headwaters of the rivers are in steep canyons, but as the streams reach the Arctic coastal plain they widen onto broad swampy plains covered with numerous lakes and scattered frost mounds. The northeastern tip of this mountainous region (the Anadyrsky Range) is cut by the tributaries of the Anadyr River on the south and by other short streams on the north.	The main rivers draining this area are the Yana, Indigirka, and Kolyma all of which flow north. The headwaters of the Kolyma and Indigirka Rivers reaches far inland almost to the Okhotsk Sea.	The climate is very cold and relatively dry. A record winter temperature of - 70°F. has been recorded at Verkhoyansk. Coldest part of Siberia. Annual precipitation 200-250 mm.; occurs mostly in summer. Snow cover 70 to 80 cm.	Mountain slopes covered by forests except for the mountain summits which are bare. Plateaus contain grass and peat swamps.	Chief means of travel is by rivers and dog or deer sleigh (during winter). The rivers Yana and Indigirka are navigable for only a short distance from the sea, but the Kolyma is navigable farther inland to Ust Utinaya, which is connected by highway to Port Nagaevo on the Okhotsk Sea. An airline connects Yakutsk and Anadyr.	Northern limit of farming extends along the 69th parallel from the River Yana to the Kolyma, then drops abruptly southeastward to the Okhotsk Sea. Air base sites may be found along the lower courses of the Yana, Indigirka, and Kolyma Rivers. The mountainous terrain of this region makes grading necessary even for winter trails for use by aero sleds and tractors. Aero sleds, however, have been successfully used by an exploring party in the Chukotsky Peninsula. Many wide valleys can be followed with ease, if clear of trees and underbrush. Construction of summer roads is difficult because so much of the terrain is rough and the ground is boggy.
5 Anadyr Depression Approximately 75,000 Sq. Mi. or 20% of total area.	A lowland that includes the Penzhina and Anadyr Valleys. It is bounded on the east by the Koryaksky Range and on the northwest by a plateau which forms the foothills of the Kolymsky-Anadyrsky Ranges. Scattered low mountains, most of which are less than 1,000 m. high, rise above the wide stretches of monotonous plain. The northern part of the depression is traversed by the meandering Anadyr River and its tributaries. There are numerous lakes and swamps both on the flood plain and the bordering terraces some of which are 20 m. above the streams. Lakes are absent, however, from the piedmont tundra slopes, where the rivers have dominantly straight courses and gravelly beds. Similar topography is found in the southern half of the depression in the basin of the Penzhina River. The main mountain ranges and some of the prominent spurs as well as some of the larger streams show a prevailing northeast-southwest trend, reflecting the geologic structure of the region.	The northern half of the depression is drained by the Anadyr River, which empties into a broad estuary that connects with Anadyr Bay through a narrow straight. The Anadyr River is sluggish braided stream with islands in mid-channel. The southern part is drained by the Penzhina River, which flows into the Sea of Okhotsk.	Cold continental climate. Annual precipitation 200-250 mm. Snow cover 70-80 cm.	Dominantly peat and grass swamps with scattered bunches of trees. Small areas, principally on west, in river valleys are covered by forests. Forests are also found along the Penzhina River and its tributaries.	Travel through the region is by boat. Small tugs can reach Markovo which is more than 300 km. by river above the mouth of the Anadyr. Winter travel is by dog and deer sleigh. The chief settlement is Anadyr at the mouth of the Anadyr Estuary. It is now the administrative center for the northeast section of the Arctic Sea steamship route. There are fisheries and coal mines in the vicinity. Kamenskoe (near the mouth of the Penzhina River), Markovo, and Anadyr are connected by an airline.	The flat tundra surface is hummocky and has slight irregularities in the surface, making landing by land planes dangerous. The entire area is within the province of permanently frozen ground. During the short summer season, sea planes can land on ice. Extensive areas are available for landing fields but grading, drainage, etc. would be necessary. This region is easily adapted to winter transport by tractor and aero sled, without grading. Construction of summer roads difficult because the ground is boggy and swampy.
6 Koryaksky Range Approximately 75,000 Sq. Mi. or 2% of total area.	Mountainous region east of the Anadyr Depression from Korf Bay to Cape Navarin. Consists of parallel mountain ranges along the shore of Bering Sea; average altitude 1,500 m., some summits are more than 2,000 m. The ranges are separated by many longitudinal valleys and are cut by shorter transverse valleys. This topography is most pronounced in the southern part. The highest ridges are near the coast, particularly in the central and southern part of the area. The slope to the east is steeper than to the west. The crests have been etched into jagged peaks by ancient glaciers. Locally the ridges are bevelled by flat upland surfaces. Several irregular spurs branch eastward from the main ranges and form prominent headlands along the Bering Sea coast. Similar spurs form low ridges in the Anadyr Depression to the west.	The western slope is drained by tributaries of the Anadyr River in the north and the Penzhina River in the south. Numerous short streams flow down the steeper eastern slope into Bering Sea. Only a few of these streams have their headwaters far inland where their courses tend to follow the longitudinal structural lines of the range. Many of the eastward flowing streams occupy steep-walled, glaciated canyons.	Extremely cold climate. Annual precipitation 300-450 cm., is greatest near Bering Sea coast. A large part occurs in both winter and summer. Snow cover 80-100 cm.	The area is without forests and only some of the valleys have grass-covered flood plains. The mountain slopes are covered by shrubs and dwarfed, creeping pine. Mountain summits mostly bare rock. Tundra abounds on low slopes.	Travel by dog and reindeer sleigh in winter and pack train in the summer. No large settlements in the area. Is sparsely populated by nomad aborigines.	Generally rugged terrain. Only a few wide, glaciated valleys that open onto Bering Sea have wide gravelly stretches large enough for landing fields. Construction of roads difficult because of the mountainous terrain and the boggy ground in summer. Aero sleds or tractors can probably travel with ease during winter over the frozen surface of the valley floors.

Unit	Definition and Topography	Drainage	Climate	Vegetation	Means of Communication and Settlements	Remarks
7 Coast of Bering Sea (Cape Dezhnev to Korf Bay) Approximately 36,000 Sq. Mi. or 1% of total area. About 1,200 Mi. long.	Forms the shore of the Chukotsky Peninsula, the Anadyr Depression, and the Koryaksky range. Mostly a mountainous, embayed coast, with cliffs rising from the shore. In places the coast is low, where the mountains recede from the shore and sandy barrier beaches separate occasional wide lagoons from the sea. The coast of the Gulf of Anadyr near and south of the Anadyr Estuary is mostly of this type. Many deep fiords occur along the more mountainous coasts. South of Cape Navarin the coast falls steeply to the sea but is broken by narrow mountain valleys where the shore is low. Some long stretches of lagoon coast have boulder-strewn sandy beaches. Approaches to the coast are relatively free from danger, except where promontories jut out from the land, as at the southeastern end of the Chukotsky Peninsula where there are many islands and reefs.	The coast is traversed by many mountain streams, some of large size having flat valley floors 15 km. wide. The Anadyr River reaches the coast in a broad brackish water estuary.	Climate severe, cold, and damp with frequent fog. Coast north of 59°N. Lat. has more clear days than the coast to the south Annual precipitation ranges from 200 mm. in north to 450 mm. near Korf Bay. Except in southern part, precipitation occurs mostly in summer. Cloudy winter and summer, especially in the south.	Flat stretches of the coast are usually covered by shrub tundra, except in some valleys where there are groves of poplar, birch, willow, larch, and alder. Mountain slopes are covered with grass and shrubs.	Numerous harbors along this coast, either in deep fiords or in open lagoons and estuaries. Anadyr Bay is the only much-frequented harbor and is the administrative center for part of the Arctic Sea steamship route. It has generally low, sandy shores with sand spits at the entrance, and contains muddy, brackish river water. Other harbors or roadsteads may be found at numerous bays. The early formation of ice makes navigation possible only for a short time in summer. The estuary and a large part of the Gulf of Anadyr may be covered by ice by September 10. Farther north harbors may be used only during the latter part of August and the first part of September. Bering Sea itself does not freeze but contains much drift ice brought from the north. Drift ice usually leaves a channel along the shore sufficiently wide for navigation, but during onshore storms the ice is crowded against the coast for short periods. Except at Anadyr there are no large settlements, but there are several fisheries and canning factories. There is a coaling station at Providence Bay. Coal is mined at Anadyr and Ugolnaya Harbors.	This area is within the province of permanently frozen ground. Air base sites may be found at many places along the coast. Where the coast is low travel by aero sled or tractor would probably be feasible. It is probable however, that roads or trails could not follow the coast very far without considerable grading. Roads for summer travel must be constructed with allowances for the bogginess of the ground. Tides: The Tidal ranges are low, about 3-1/2 feet near the east end of Chukotski Peninsula but increasing to 6 feet at Anadyr and to about 7 feet at the southern end of this coast. The mean high-water interval increases from 5 hours 48 min. at north to 9 hours at Anadyr Bay, then decreases southward. There may be considerable irregularity, however. November and December are the stormiest months.
8 Sayan Mts. Approximately 60,000 Sq. Mi. or 1-1/2% of total area.	Mountainous, deeply-dissected terrain between the headwaters of the Yenisei River and Lake Baikal; rising from the central Siberian Plateau and reaching a crest at the border of Outer Mongolia. In general, altitudes range from 500 m. to 3,000 m. but some peaks reach 3,500 m. Flat surfaces cut many of the ranges in the eastern part of the province, and are locally accentuated by flat basaltic lava flows. The main mountain range along the Mongolian border has an arcuate trend with branches or subsidiary ranges trending east-west both in the Baikal region on the east and in the Minusinsk region on the west. In the central region upland spurs gradually descend northward to the Central Siberian Plateau. The highest areas have the rugged topography characteristic of glaciated mountains. River valleys between ranges form broad flood plains in their lower courses and in places are bordered by river terraces. In the Minusinsk area several rivers join, forming a broad, steppe-like lowland. Lakes are present in the mountain region.	In the western part the drainage is carried by the head waters of the Yenisei River which begin mostly in high mountain lakes and flow westward through broad valleys. The drainage of the northern slope is to the Angara River, a tributary of the Yenisei.	Extremely moist in west, annual precipitation more than 1,000 mm. About 200-450 mm. in eastern part. Snow cover small in east.	Mountain slopes are forested up to about 2,000 m. Some flat-topped highlands are covered by swampy tundra and scraggly shrubs. High peaks are covered by alpine meadow.	The most important populated region is that around Minusinsk, an industrial and farming center, connected by a spur railroad line with the Trans-Siberian Railroad, and by a highway with the Tuvin Republic, south of the Sayan crest. Other parts of the country are less developed but there are dirt roads and pack trails.	Except for the Minusinsk area this region is situated within the province of permanently frozen ground. In the Minusinsk Basin and lower slopes of Sayan Mountains roads can be constructed for all year travel by wheeled vehicles. Considerable grading necessary in the higher parts of the area. Snow fall is apt to be extremely heavy in the mountains.
9 Baikal-Amur Upland Approximately 600,000 Sq. Mi. or 15% of total area.	The area begins a short distance west of Lake Baikal and extends eastward north of the Mongolian and Manchurian borders to the coastal plain of the Okhotsk Sea, and the Amur lowland. To the north and northwest the mountainous region gradually descends into the Lena River Basin and to the Central Plateau. Southeast and east of Lake Baikal disconnected but closely spaced mountain ranges have an east and northeast trend roughly paralleling the shore of the lake. The central part is a series of dissected plateaus extending from the junction of the Vitim and Lena Rivers southeastward to the lower Amur River. Northeast of this belt of plateaus is the Stanovoi Range, a continuous mountain system, which runs eastward to the south end of the Okhotsk Sea and then turns northeastward along the coast to the Kolymsky Range. The mountains and plateaus average from 1,200 to 2,000 meters in altitude, but high ridges and peaks reach 2,500 feet or higher. The highest mountains and steepest slopes lie in the southern part of the area near the Mongolian border. The region east and southeast of Chita is a continuation of the Mongolian steppes with sporadically distributed hills of low altitude. Many of the rivers have broad flat valley floors, some with wide terraces. Some of these are erosional features, others are structural depressions.	Most of the area is drained by the tributaries of the Amur and Lena Rivers. Lake Baikal drains to the Angara River, a tributary of the Yenisei. The northeastern part is drained by a series of smaller rivers which flow into the Sea of Okhotsk. The drainage pattern is markedly controlled by the geologic structure.	Cold continental climate. Warmer than more northern region, but winters are long and extremely cold. Annual precipitation more than 700 mm. south of Lake Baikal and more than 600 mm. in lower Amur and Okhotsk Sea region. In the central part, near Chita precipitation is only about 300 mm. From here southward to Mongolian steppes the climate becomes progressively more arid. Summers are rainy, damp, and hot; winters very dry. Snow cover 10-70 cm., being greatest in eastern region, and thinest in the Chita or South central region.	Most of the region is thickly covered by forests, and undergrowth of shrubs. Some upland surfaces are swampy. River valleys and inter-mountain plains are grassy. Many high ridges and summits are bare of vegetation.	The area is traversed by the Trans-Siberian Railroad and the new Baikal-Amur Railroad. Several spur lines branch from these. The stage of completeness of the new Baikal-Amur Railroad is not known. A north-south highway connects the Trans-Siberian Railroad at Never with Yakutsk. Highways connect Ulan-Ude on the Trans-Siberian Railroad and Ulan-Bator in outer Mongolia. There are also other highway connections within the region. Baikal Lake which, at its deepest part, is one mile deep is navigable during summer. The tributaries of the Amur River are navigable by small craft, connecting with navigation on the Amur itself. The main airline route from European Russia passes through Irkutsk Ulan-Ude, Chita, Nerchinsk and Rukhlovo (near Never). An airline also extends from Ulan-Ude to Ulan-Bator in Mongolia. The region is moderately populated. The main towns are Irkutsk Ulan-Ude, Chita, Nerchinsk, and others. The East Chinese Railroad from Harbin connects with the Trans-Siberian Railroad a short distance east of Chita.	The entire area is underlain by permanently frozen ground. Numerous air bases could be constructed along the river flats and terraces, and the intermountain plains. Much of this region permits use of all season roads for wheeled vehicles provided due allowance is made in construction for the permanently frozen ground. The terrain is mountainous, but valleys with flat floors are numerous. Drainage problems may be serious.
10 Coast of Okhotsk Sea Approximately 50,000 Sq. Mi. or 1.2% of total area. About 1,700 Mi. long.	This area includes the narrow coastal region from the mouth of the Amur River to Penzhinsky Bay. It is bordered by the foothills of the Amur highland on the south, by the Dzhugdzhur Mountains on the north. The highest peaks are from 20 to 100 kilometers inland. The coastal region is occupied by low spurs of these ranges, by low hilly plains rising inland, or by low hills which parallel the coast close to shore. The south shore of the Okhotsk Sea is hilly and cliffy, island-studded, and deeply embayed, with long gulfs extending far inland, separated by ranges of hills. Areas of sandy beaches and low coast may be found, particularly near the heads of gulfs. The west shore of the Okhotsk Sea has a straight coast line. The southern part is hilly and cliffy and mostly bordered by a range of hills or by spurs of the Dzhugdzhur Range. Farther north, toward and beyond the port of Okhotsk the shore is low and sandy with many lagoons and streams. The northern coast is a lagoon coast near Okhotsk but for the most part is steep with a range of hills paralleling the shore. Behind these frontal hills is a belt of lowland covered by rolling, swampy tundra which rises gently to the summit of the Kolymsky Range. In several places the coast line penetrates these frontal hills forming bays and peninsulas which trend parallel to the coast. The Taigonos peninsula, a low mountainous headland, is the largest of these.	Several large river valleys reach the south and southwest shores of the Okhotsk Sea forming Gulfs with low shores at the coast. On the west shore the smaller streams have bouldery beds and steep gradients. The Okhota and several other rivers, however, reach the sea in wide flat valleys. The rivers on the north begin in lakes on the flat summit of the Kolymski Range and reach the sea in shallow but broad valleys with many lakes. The Penzhina River has a flat valley floor, about 20 km. wide where it meets the coast but farther inland is considerably wider.	Annual precipitation 250 mm. at mouth of Penzhina River, increasing to more than 600 mm. on southwest shore. Most precipitation is in summer. Snow cover ranges from 50 to 70 cm. Foggy and cloudy, especially in summer.	Grass and moss tundra in the low areas. Inland mountain slopes are forested except in northeastern part. Some river valleys have evergreen forests interspersed with swamps.	Chief means of communication is by sea. Some rivers, especially the Uda and Okhota are navigable by small craft. There are no good harbors along this coast but anchorage may be made at a number of places as along the indented south coast at Okhotsk, at Nagaevo, and in Penzhinsky Bay. The port of Nagaevo is connected by highway with the Kolyma River Basin in the interior. The navigation season in the Okhotsk Sea is very short because of pack ice and shore ice.	The area lies in the province of permanently frozen ground. Tides: In general tides along the coast of the Okhotsk Sea are higher than on Pacific Coast. In Penzhinsky Bay and in Udskaya Bay spring ranges reach 20 to 24 feet. Elsewhere along the coast they average 10 to 12 feet. Terrain is mountainous in most places. Grading and drainage necessary for all weather roads. Permanently frozen ground.
11 Amur-Ussuri Plain Approximately 120,000 Sq. Mi. or 3% of total area.	A flat lowland along the Amur River and its tributaries, including the Ussuri River. It is irregular in outline, penetrating the adjacent mountain regions along the larger rivers. The valley is constricted in places by transverse mountain ranges or spurs. At the south end of the Ussuri Valley the area passes imperceptibly into the drainage that empties into the Gulf of Peter the Great, near Vladivostok. Except for low river terraces and the foothills along the bordering mountains the area has a very even surface, and is swampy in most places. There are several large lakes near the mouth of the Amur River and one large but shallow lake at the head of the Ussuri Valley.	The area is drained by the Amur and its tributaries. The Amur is a large navigable river, meandering through most of its course but has an accelerated flow where it traverses the mountains. The Amur River is subject to floods during July and August caused by rains in the headwaters thus differing from other Siberian rivers which flood during the spring as a result of ice jams in their lower courses. Much valuable land has been reclaimed by artificial drainage.	Climate is decidedly continental, cold in winter and hot in summer. Annual precipitation 500-600 mm., occuring mostly in summer. Snow cover from 20-70 cm., increases toward Lower Amur Valley.	Forested with large areas of grassy swamps. Much land is under cultivation.	The area is traversed by the Trans-Siberian Railroad with several short branches, and in the lower Amur Valley, by the northern railroad (under construction). These two railroads are connected by a trunk line running between Khabarovsk and Komsomolsk. No information is available on the projected road from Komsomolsk to Nikolaevsk at the mouth of the Amur. The Amur River is navigable across this area. Small craft can ascend the larger tributaries. Occasionally during early summer or late fall the river becomes very shallow, hindering navigation. Usual navigation season is from June to October. The chief towns are: Khabarovsk, administrative and military center, Komsomolsk, industrial center, Blagovestchensk, Nikolaevsk, and several others. The main towns are connected by air line routes.	This area lies just outside of the province of permanently frozen ground. Numerous areas are suitable for Military bases and airfields. Area suitable for construction of all weather roads. Much low swampy country necessitating drainage.

Unit	Definition and Topography	Drainage	Climate	Vegetation	Means of Communication and Settlements	Remarks
12 Sihote-Alin Mountains Approximately 90,000 Sq. Mi. or 2.2% of total area.	These mountains consist of a series of parallel ranges with a dominant northeast trend. Their average altitude is from 1,000-2,000 m. except in the northern part near the mouth of the Amur River where they are only several hundred meters high. The highest part of the range is situated in the southern half where the drainage divide is close to the Sea of Japan. Farthern north the crest of the range recedes from the coast and tends to become less distinct. Most of the streams on the east are short and flow through steep-walled valleys to the sea. The valleys on the west side are also steep walled in their headwaters but gradually open onto flat and wide flood plains as they near the Ussuri Valley. Most of the mountain tops are gently rounded.	Most of the area is drained by tributaries of the Ussuri and lower Amur. The narrow coastal strip has tynical mountain streams which empty into the Sea of Japan. The northernmost tip of the area is traversed by the Amur Estuary. Here are also found several large lakes. At the south tip, where the range is truncated by the sea, several longitudinal rivers flow into the Gulf of Peter the Great.	Annual precipitation 600-750 mm., occuring mostly in summer but is considerable in winter along coast. Snow cover greatest in north (over 70 cm.); prevailingly cloudy.	The area is thickly forested, with evergreen and deciduous trees.	A railroad under construction (now probably completed) crosses the northern half of the region, between Sovietskaya Gavan and Komsomolsk. Coal mines at the south tip of the area are connected by railroad with Vladivostok. A number of unimproved roads are found in the southern part of Sithote Alin. The mountainous region is sparsely populated. There are small settlements in the foothill area facing the Ussuri and lower Amur Valleys and on the coast of the Sea of Japan.	Except for the northern tip near the mouth of the Amur River this area is free of permanently frozen ground. Suitable for construction of all weather roads. Snows may be heavy in winter. Much grading necessary for a road of any length.
13 Coast of Sihote-Alin Approximately 24,000 Sq. Mi. or 0.6% of total area. About 800 Mi. long.	The coast of Sihote-Alin is precipitous and mountainous. Except for the part facing the Straits of Tartary the coast conspicuously lacks flat stretches, and is relatively straight. A number of deep indentations at the mouths of some of the rivers, provide excellent harbors.	The area is traversed by the lower courses of mountain streams, which form only narrow flood plains at the coast.	Same as above.	Same as above.	Except for the southernmost part and Sovietskaya Gaven, which is connected with the interior by railroad, communication is by boat. There are several excellent harbors. These freeze for several months in winter, but navigation can be continued with the aid of ice breakers. Nikolaevsk, Sovietskaya Gavan, and Tetyuhe are the main settlements.	Suitable landing places may be found near the mouths of some of the larger rivers. Suitability for road construction same as above (12).
14 Russian Sakhalin Approximately 21,000 Sq. Mi. area or .5% of total area.	Sakhalin is an island separated from the mainland by a strait, only 4 miles wide in its narrowest place, which is frozen over during the winter. There are two mountain ranges in the region, one along the west coast, which is rugged and rises steeply from the coast, and one on the eastern side which rises more gradually but is higher, reaching an altitude of more than 2,000 m. Both chains descend to a low upland without marked relief in the northern part of the area. In the south they are separated by a broad valley or depression, drained by two rivers one (the Tym) flows north, the other (the Poronai) flows southward into Japanese Sakhalin (Karafuto). Both ranges are rugged but have rounded summits. The east coast is mountainous and steep in the southern part but north of Lat. 51°N. the mountains recede inland and the shore is bordered by great barrier beaches and wide lagoons. The northern tip of the island is a broad peninsula called Schmidt Peninsula which is mountainous and has a rugged coast line. The west coast is extremely steep in the southern part. In the middle part it is terraced and in the north, on the Okhotsk coast, is low with broad lagoons and spits.	Except for the rivers Tym and Poronai which drain the central depression in the southern part of the area most of the streams flow in short courses to the shore.	Annual precipitation ranges from 400-600 mm. To the south precipitation occurs mostly in summer, to the north in the winter in the form of snow, which accumulates to as much as 2 meters. Winter winds reach velocity of 100 to 150 km. per hour. Temperature at Alexandrovsk ranges from 79° to 29°F. About 28 days a year are foggy. Most rivers freeze in mid-November but are entirely free of ice in mid-May. Straits of Tartary remain solidly frozen from mid-December to the end of January.	Most of Sakhalin is covered by forests containing fir, spruce, larch, a dwarf variety of pine, birch, and aspen. Many of the higher mountain summits are bare or covered with alpine meadow. Some lowlands are covered by swampy tundra.	Communication in the interior is by pack train in summer and by sleigh in winter. A railroad runs across the narrow part of the northern part of the island, south of Schmidt Peninsula, connecting the Okha oil fields with Moskalvo. A road connects Alexandrovsk with the settlements in the central depression. Motor boats and steam tugs travel between small coastal settlements. The important harbors are Moskalvo on the northwest coast and Alexandrovsk on the west coast. Coal is mined at Alexandrovsk and vicinity and there are important oil wells at Okha. Oil is piped to Moskalvo where loading facilities are available. The coast is accessible to steamers but is steep in the southern part, and on the Schmidt Peninsula. Elsewhere the coast is lower but there may be shallow water off shore. Heavy surf off the beaches of the east coast makes landing operations difficult. Many lagoonsof the east and northwest shores make good harbors for vessels of 200 tons or less and that draw less than 8 feet. During the months of December and January light sleigh traffic is carried on between the island and the mainland. Regular air routes connect Alexandrovsk and Okha with Khabarovsk. Telephone connections exist between many communities.	Some parts of this area have permanently frozen ground, 3 meters or less in depth. In the southern half landing fields must be restricted to flat places along the river valleys, but in the northern half there are extensive flat areas. In construction of buildings entrance doors should open inwards to permit exit when the house is buried in a snow drift. Tides: Tidal ranges on the west coast are from 4 to 8 feet. Area suitable for construction of all-weather roads, but winter snows and drifts are heavy. Considerable grading necessary in southern part, drainage necessary in all low areas.
15 Vladivostok Area Approximately 4,000 Sq. Mi. or .1% of total area. Coast line about 200 Mi. long.	The Vladivostok area includes the Gulfs of Peter the Great and Possiet from Cape Povorotny to the Korean border. It extends inland several tens of kilometers. It is moderately mountainous, the shoreline is deeply indented and has numerous harbors and bays. The excellent port Vladivostok is situated at the tip of the peninsula, which juts southward into the Gulf of Peter the Great dividing it into two smaller bays. Seaward from the peninsula is an archepelago of hilly islands, the largest of which contains another well-sheltered harbor. The mountains average about 500 meters in altitude and only a few isolated peaks exceed 1,000 meters. At the head of some of the bays are flat and partly swampy river floodplains. In general the coast is rocky and precipitous but between headlands there are wide sandy beaches.	The area is drained by numerous small rivers which originate in the nearby mountains, and which do not exceed several tens of kilometers in length. Exceptions to this are the Suifun and Suchan Rivers, both of which are more than 100 km. long. There are several lakes between Possiet Bay and the mouth of the Tumen-Ula River which is on the Korean border.	Cold rainy, cloudy. Annual precipitation about 750 mm., occuring markedly during warmer season. Snow cover thin. Coastal region very foggy during May-July.	Mountains are covered by forest interspersed with clearings. River valleys contain grassy swamps.	Vladivostok is the chief populated center and the terminus of the Trans-Siberian Railroad. A branch road connects coal mines with the main railroad about 30 kilometers from Vladivostok. There are several improved highways and a number of unimproved roads. Communication between the coastal points is chiefly by sea. There are many small settlements throughout the area.	This area is outside of the province of permanently frozen ground. River flood plains and some beaches provide flat surfaces for airfields. Area suitable for construction of all-weather roads but grading is necessary. Tides: Tides at Vladivostok are extremely low. Mean high water interval is 2h. 31 min., spring range 0.7 foot, mean range 0.6 foot.

Reliability rating: Class C.

EASTERN SIBERIA MAP 6. WATER SUPPLY



Ground water

Basins: Depressed areas filled with thick sedimentary material containing alternating pervious and impervious layers. Favorable for accumulation of abundant ground water which, as a rule, is under hydrostatic pressure.

1 — Minusinsk Basin: Gently folded sandstone, conglomerate, and limestone overlain by flat-lying alluvial sand. Good water from shallow and moderate depths. Deeper wells are likely to contain salt water. Most of this area is free of permanently frozen ground.

2 — Hatanga Basin: Gently folded sandstone interbedded with shale and overlain by horizontal beds of sand and gravel. Good water from shallow to moderate depths except near the Arctic coast where salt water may be encountered, some having salinity almost twice that of normal sea water. Drilling for water in coastal area should be avoided where pervious strata dip inland.

3 — Tungus Basin: Gently folded sandstone and volcanic ash beds (Permo-Carboniferous) interbedded with shale and argillite. Good water may be found. Water in places may contain H_2S. Examination of rocks is necessary before sinking a well as the underlying formations (early Paleozoic) as a rule contain water with variable amounts of salt and H_2S.

4 — Lena-Vilyui Basin: Good water in gently folded sandstone interbedded with shale (Mesozoic) overlian by variable thickness of glacial and Recent alluvial deposits. Underlying older formations usually contain salt water.

5 — Kansk Basin: Good water in a shallow structural depression containing sandstone and shale (Jurassic). Underlying sandstone and limestone (Devonian) also yield palatable but slightly more mineralized water.

6 — Irkutsk Basin: Good water, mostly having artesian flow, in sandstone interbedded with shale folded into a series of synclines.

7 — Indigirka-Kolyma Basin: Good water from alluvial sand and gravel at shallow depth near the larger streams and lakes that do not freeze completely during the winter. Salt water is likely to be encountered in the coastal area.

8 — Chuan Basin: Water occurs at the depth of several hundred meters in folded sandstone and pyroclastic rocks interbedded with shale. Shallow wells near the coast may yield palatable water but many are salty.

9 — Anadyr Basin: Good water in gently folded sandstone interbedded with shale at moderate to great depth and in alluvial sand and gravel near the coast and near the Anadyr River.

10 — Amur-Ussuri Basin: Water shallow to moderate depth in sandstone and conglomerate and in alluvial deposits. Surface water supply available through the year. Most of this area is free of permanently frozen ground.

Uplands of folded rocks: Mountainous areas with strongly folded, alternating pervious and impervious formations. Individual pervious units serve as basins of accumulation of ground water. Careful selection of well sites is required as the water-bearing rocks, as a rule, outcrop over a limited area but may extend to a considerable depth below the surface. As a rule, the yield of water in these areas is less than in the basins described above. Limestone is likely to furnish ample water but quality is likely to be poor.

11 — Taimyr folded area: Probably good water at the depth of several hundred meters in folded sandstone and limestone interbedded with shale; probably also at shallower depth near the coast. Wells in alluvial and glacial sediments near the coast are likely to have salt water.

12 — Sayan Mts.: Good water at shallow and moderate depths in alluvium filled valleys and along structural and formational contacts. Surface water supply abundant, locally interrupted during the winter at which time underground seepage from rivers may be tapped.

13 — Vitim-Olekma area: No notably pervious rocks. Good water may be obtained at moderate depth along structural and formational contacts. Springs may be improved. Shallow wells near the streams that do not freeze completely in the winter can furnish good water.

14 — Transbaikalia-Bureya area: Good water can be obtained from shallow wells in alluvium at the foot of south-facing mountains and along large rivers. Locally, wells of moderate depth penetrating water-bearing sandstone or limestone will yield good water. Good water is also obtained along structural and formational contacts. Surface water plentiful. Dr. Beck's disease, which prevails in this area, may be caused by the local water supply.

15 — Uchur-Maiya area: Water, as a rule, too salty to be palatable in limestone and sandstone at moderate to great depth.

16 — Verhoyansk area: Good water in sandstone and tuffaceous rocks at a depth of several hundred meters. Underlying strata (early Paleozoic) are likely to contain salt water.

17 — Yana-Kolyma area: Good water in sandstone and tuffaceous rocks at a depth of several hundred meters. Salt-water-bearing strata possibly underlie this area but are much deeper than in (16). Shallow wells situated near large rivers may yield good water.

18 — Okhotsk area: Good water at moderate to great depths in volcanic rock interbedded with impervious sedimentary rocks. Along the coast shallow wells near the mouths of rivers may yield moderate amounts of good water.

19 — Cherskogo-Chukotsky area: Most of this area is unexplored. Good water probably occurs at a considerable depth in sandstone interbedded with shale. Wells of shallow to moderate depth along the coast probably will yield good water.

20 — Koryaksky area: Good or fair water in gently to moderately folded sandstone interbedded with shale. Shallow or moderately deep wells along the larger streams, especially near the coast will probably also yield good water.

21 — Sakhalin: Good water in sandstone interbedded with shale at shallow or moderate depth and in shallow wells in alluvium along the streams. Surface water supply plentiful especially in the south. Shallow wells near the coast may have salty water. Only part of this area is underlain by permanently frozen ground.

22 — Stanovoi area: No noteworthy water-bearing areas but moderate supply of good water may be obtained at moderate to great depths along structural and formational contacts.

23 — Sihote-Alin area: Good water in sandstone, conglomerate, and limestone at shallow to moderate depth. Ample supply of water can also be produced from the flood-plains of most rivers. Generally, structural and formational contacts are water-bearing. Surface water supply plentiful. Except for the northernmost portion this area is entirely free of permanently frozen ground.

24 — Yeniseisk area: Water at moderate depth in dolomite, limestone, and quartzite interbedded with slate and phyllite; along structural and formational contacts, and in the fracture zone of crystalline metamorphic rocks. Quality of water is probably fair but locally may be salty. Good water probably can be obtained from shallow wells along Yenisei River. Permanently frozen ground occurs only in isolated islands and is entirely absent in the westernmost part.

Broad, upwarped plateaus: Uplifted areas of anticlinal or horst structure. Impervious floor as a rule is at a relatively shallow depth. Conditions are unfavorable for the accumulation of large bodies of ground water. Moderate amounts of ground water can be found in the upper jointed or fissured parts of the massive crystalline rocks and locally in the overlying mantle of sedimentary rocks.

25 — Anabar area: Water is scarce because the is/jointed and fissured zone of crystalline rocks is entirely within the area of permanently frozen ground. Sedimentary rocks around the border of the crystalline area contain salt water.

26 — Aldan area: Same as above, except that locally shallow wells near the rivers that do not freeze completely during the winter may yield good water.

27 — Kolyma area: Same as above but in addition locally may yield good water from (Mesozoic) sandstone, which lies above the formations that contain salt water.

Effect of frozen ground on ground water supply

Most of Eastern Siberia is underlain by permanently frozen ground which may be subdivided into:

Zone A: Permanently frozen ground forms a continuous layer (except beneath the larger rivers?) that ranges in thickness from 100 to 500 meters. In the north the summer surficial thaw penetrates only a fraction of a meter but in the south it may be slightly more than 2 meters.

Zone B: Area of permanently frozen ground is here and there interrupted by islands of unfrozen ground. Ground water from beneath the permanently frozen ground usually finds its way to the surface through these islands of unfrozen Permanently frozen ground in this zone ranges from a few meters to 200 meters or more in thickness. In the north the permanently frozen ground is only a few meters or more in thickness. In the north the permanently frozen ground is only a few meters below the surface but to the south it is progressively deeper and the islands of unfrozen ground become more numerous.

Zone C: Area of sporadic occurrence of permanently frozen ground, which may begin as much as 10 meters or more below the surface and may be several tens of meters thick, but as a rule is much thinner and completely disappears at the southern boundary of Zone C. In most of this area a layer of unfrozen ground overlies the permanently frozen ground and separates it from the surficial ground that freezes in winter. This unfrozen layer is, as a rule, saturated with water and serves as a good source of water supply.

Water above the permanently frozen ground

In Zone A, and in most of Zone B, the surficial ground, which lies immediately above the impervious permanently frozen ground, thaws in the summer from a fraction of a meter to couple of meters deep. Little if any ground water can accumulate in this layer. The fact that this layer freezes again in the winter eliminates any consideration of water supply from it, except near large rivers and lakes that do not freeze completely during the winter. In the southern part of Zone B, and in most of Zone C, especially where an unfrozen layer overlies the permanently frozen ground and separates it from the surficial ground that freezes in the winter, a limited supply of water may be obtained above the permanently frozen ground. This requires only shallow wells but the wells should be properly lined to prevent silting and caving. Seepages or springs fed by seasonal precipitation are likely to fluctuate with the changes in the amount of rainfall and may entirely stop or freeze when the supply at the surface is greatly diminished. Abundant supply of good water is found locally above the permanently frozen ground where the flow through a fissure is fed by the water from beneath the permanently frozen ground.

Water in the permanently frozen ground

May occur in a permeable layer or may flow through a pipe-like fissure. The flow of such water should not be retarded or interrupted because if underground circulation is slowed the water-bearing layer may freeze. Excessive or accelerated pumping may also cause freezing of the water in the underground channel.

Water below the permanently frozen ground

Water is abundant in all three zones where pervious rocks are present and is as a rule under considerable hydrostatic pressure beneath the impervious cap of permanently frozen ground. Water from the highest layers is generally very cold and is likely to freeze while flowing to the surface through the frozen ground. Deeper water-bearing layers contain water warm enough to rise without freezing.

Drilling methods in the area of permanently frozen ground

Shallow wells in unconsolidated sediments that are frozen may be dug effectively after a preliminary thawing by steam points or directed flow of water above freezing temperature. This method of thawing may also be employed in drilling for water to a depth of about 20 meters provided no solid bedrock or firmly indurated sediments are encountered. Drilling through hard rocks and drilling of deep wells in frozen ground probably should be done with rotary drills supplied with heated drilling mud.

Upkeep of wells and pipe in the area of permanently frozen ground

Shallow wells in unconsolidated sediments should be lined to prevent silting and caving. Local conditions of ground water supply require careful regulation of pumping. Accelerated or retarded flow of water may result in the freezing of the underground channels. Well openings should be insulated from the cold winter air; preferably placed in heated buildings. Water pipes should be insulated and buried at least 3 meters deep. Water pipes less than 3 meters from the surface should be covered by fill so that the pipe is about 3 meters deep. Damaged pipes should be drained immediately. It is therefore necessary to provide a system of valves, that will permit prompt draining of pipes. Current practice is to heat the water (utilizing the condensation of the steam of the pump) to the temperature sufficient to thaw a layer of ground surrounding the pipe which then acts as an additional insulating cover, preventing the freezing of water when pumping is interrupted. Water pumped through pipes for the first time or after being shut off should be warmed a little more than during the normal flow.

Surface indications of ground water in the area of permanently frozen ground

Although most of the area of permanently frozen ground is saturated with water or ice, a supply of water that will yield continuously the year around is not easy to locate. The best time to survey for suitable water supply is during the latter part of winter when all the surface moisture is frozen.

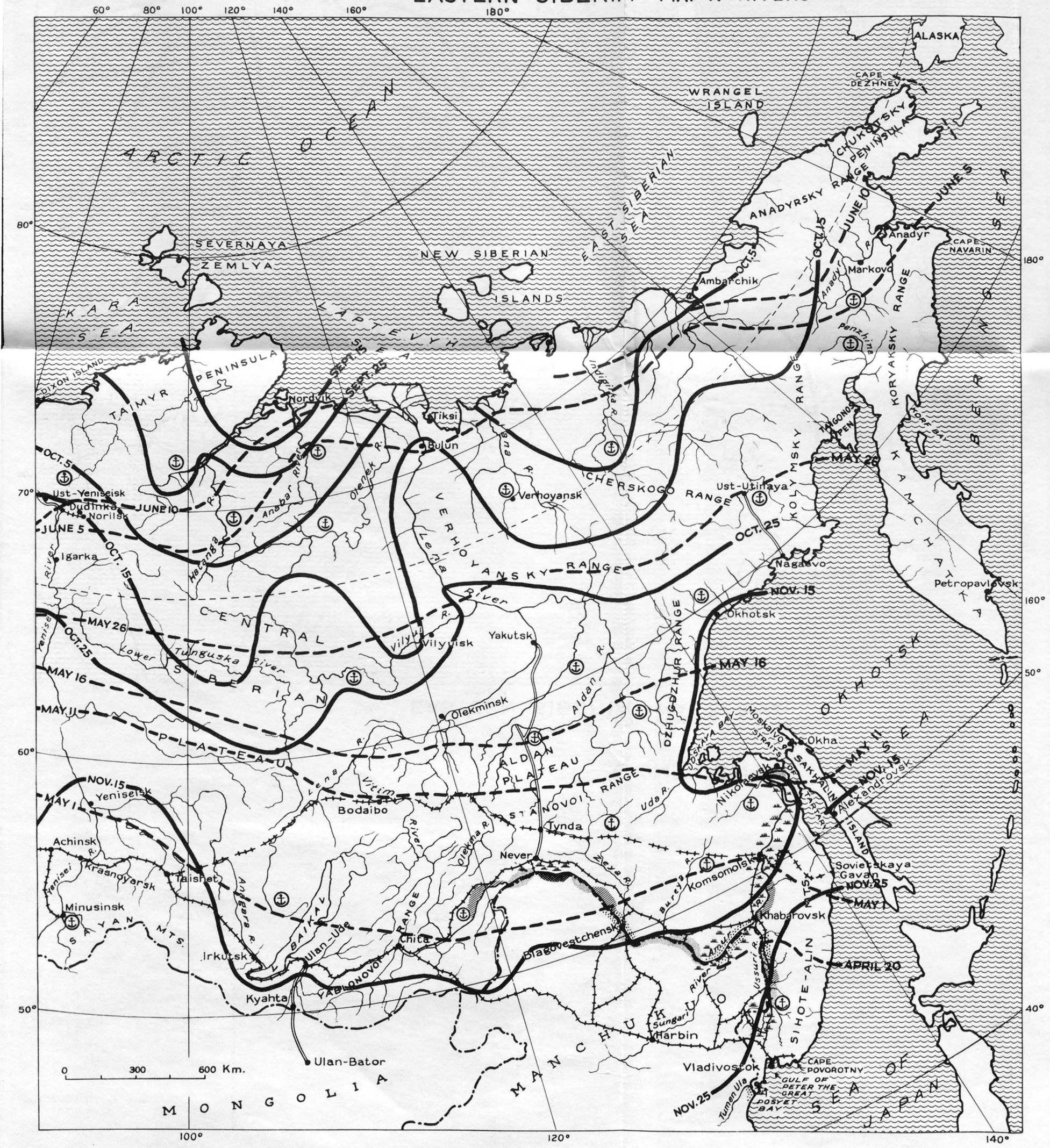
A good indication of a deep-seated water supply is a mound of ice from which water will keep flowing all through the winter. The outlet of ground water is usually situated immediately below the crest of the ice mound or ice-ridge. Some ice usually remains at such localities even through the summer. Ice-mounds from which water ceases to flow during the winter will obviously not serve as a supply of water the year around. Permanently flowing ice-mounds or ice-fields commonly occur at the break of slope at the foot of a south-facing mountain and along structural lines or formational contacts, and in the flood plains of large rivers.

Surface water supply

Includes rivers, lakes, springs, ice, and snow. Large and small rivers are the main source of water during the summer. In the winter smaller streams freeze to the bottom. In some streams deeper water may become stagnant and unfit for use. Only large rivers and deep lakes that do not freeze completely can be used as a source of water supply in the winter. The towns of Khabarovsk and Blagovestchensk use Amur River water. River or lake ice may be used for small supplies of water. The use of snow is similarly limited.

Reliability rating: Class B.

EASTERN SIBERIA MAP 7. RIVERS



MAP 7, RIVERS EASTERN SIBERIA

Lines showing usual dates when rivers freeze and the approximate southern limits of freezing. Several days after the indicated date the ice is generally thick enough to support light vehicles.

Lines showing usual dates of ice break-up and the approximate northern limit of the break-up. Several days after the indicated date the rivers are sufficiently clear for navigation.

Upper limit of navigation for barges and small boats.

Shown only along Amur and Ussuri Rivers:

Gently sloping or low river banks with local terraces in the order of 10-20 feet high requiring only minor improvement for vehicle travel. Usually pebbly, sandy, or clayey banks.

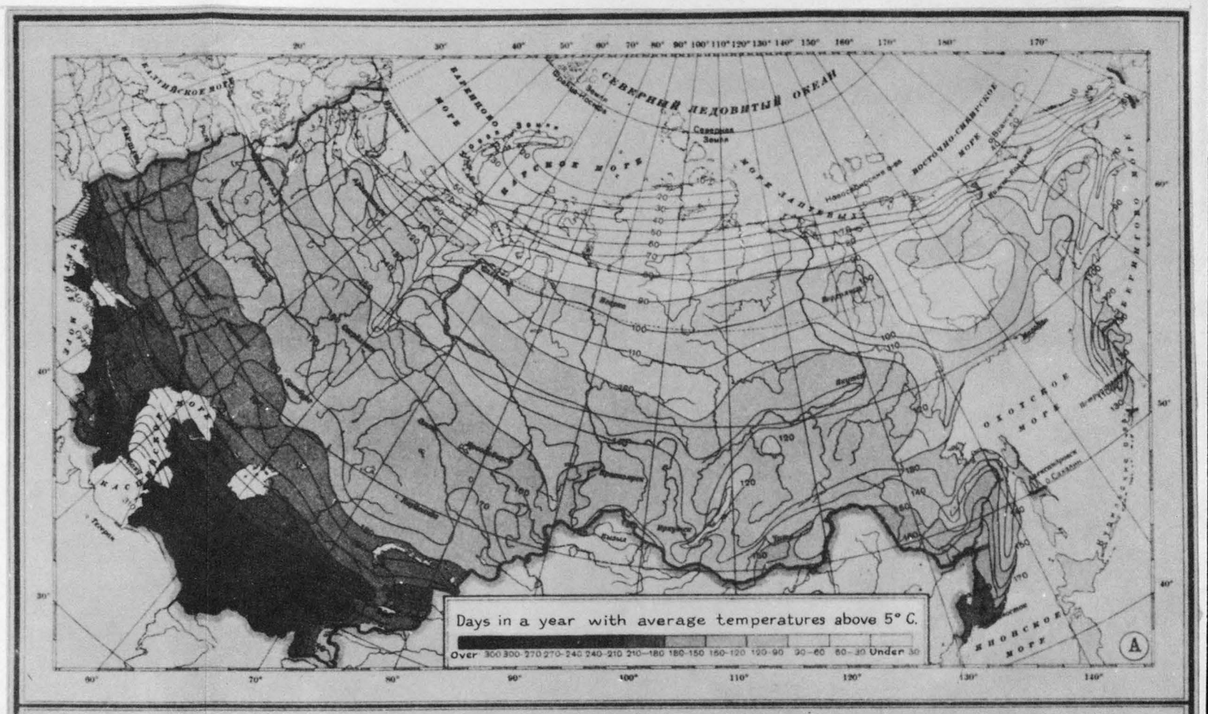
Swampy river banks.

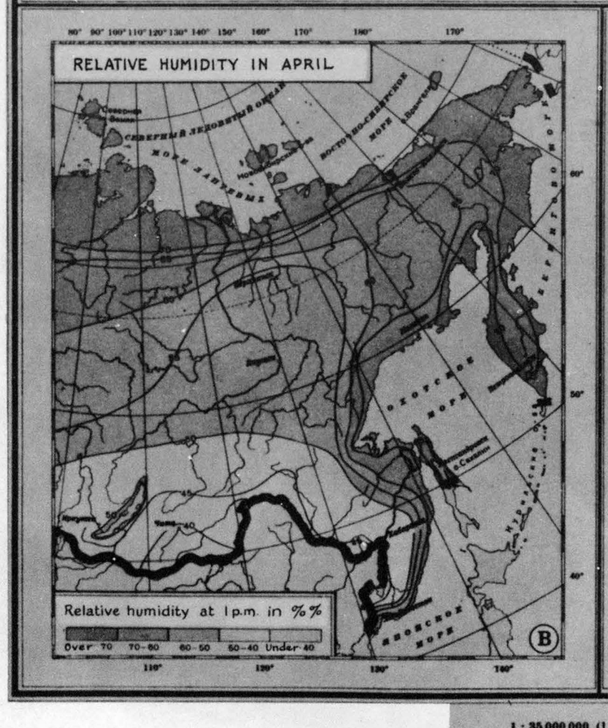
High river banks requiring moderate to considerable improvement for vehicle travel.

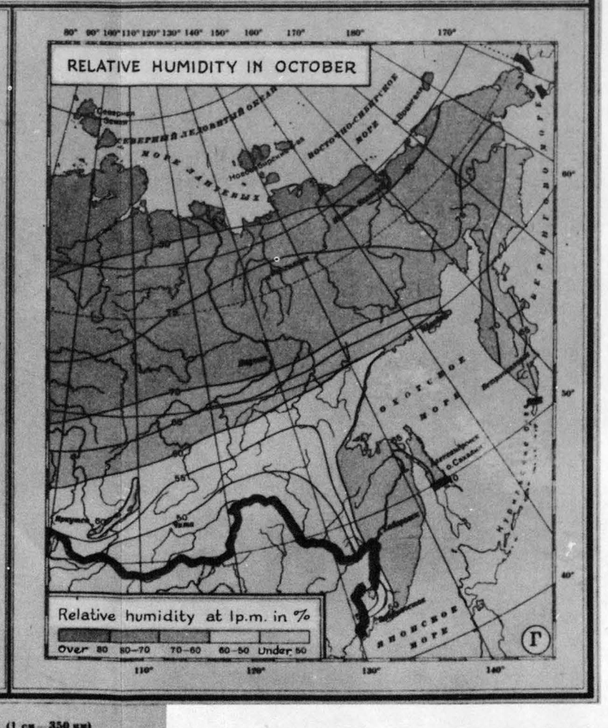
Steep mountainous banks or canyons unsuitable for vehicle travel, except where steep banks are broken at a tributary stream.

Braided channel with many islands.

EASTERN SIBERIA MAP 8. CLIMATE

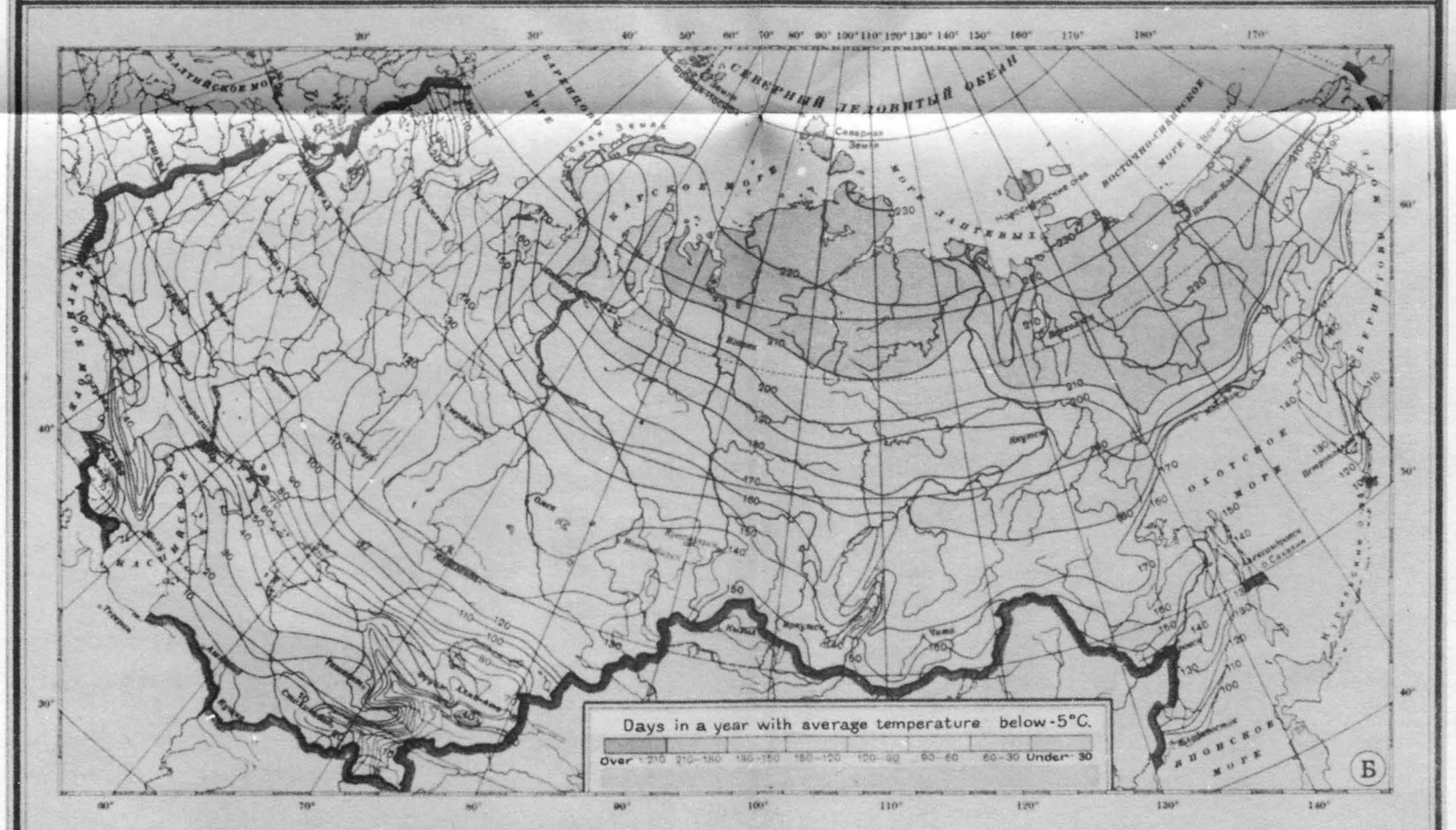






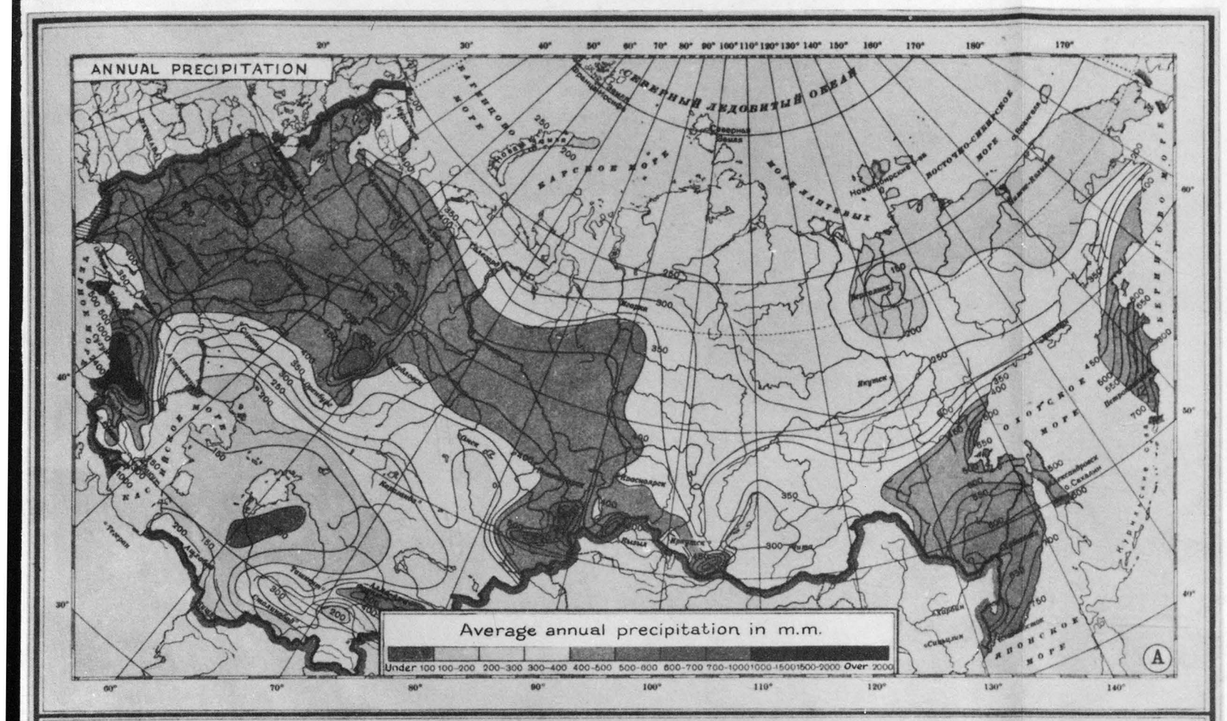
1 : 35 000 000 (1 см — 350 км)
350 0 350 700 1050 1400 1750 Км

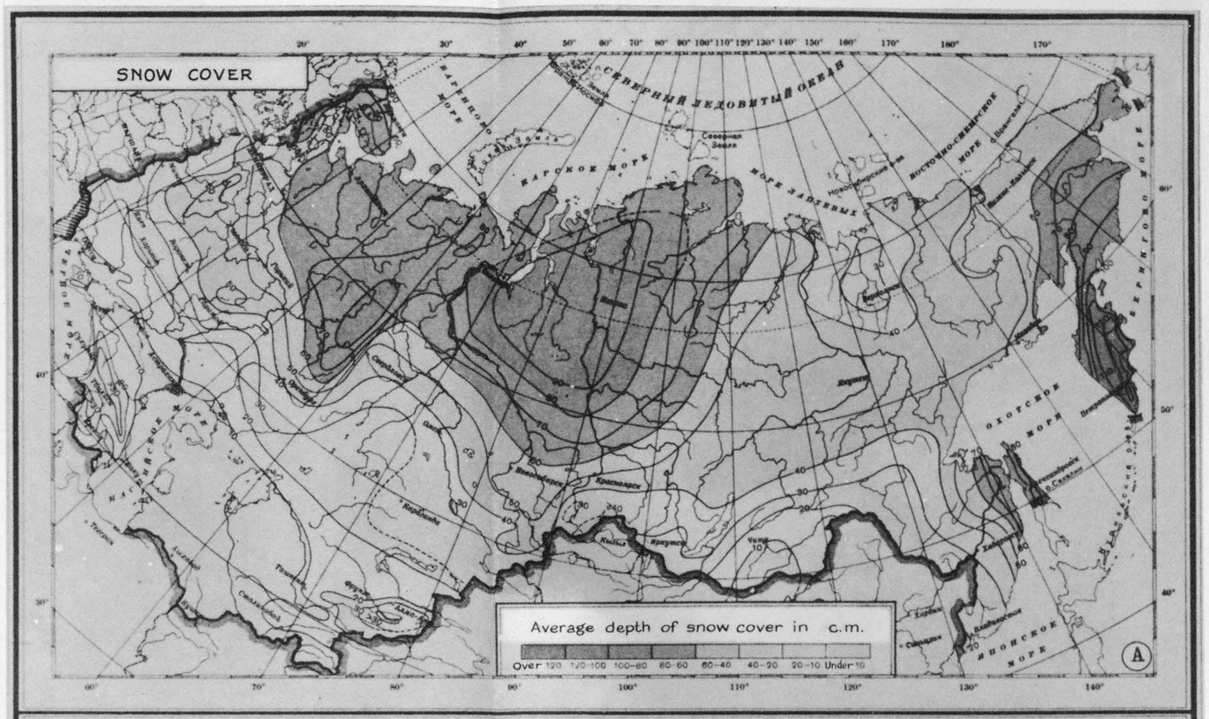
CONFIDENTIAL

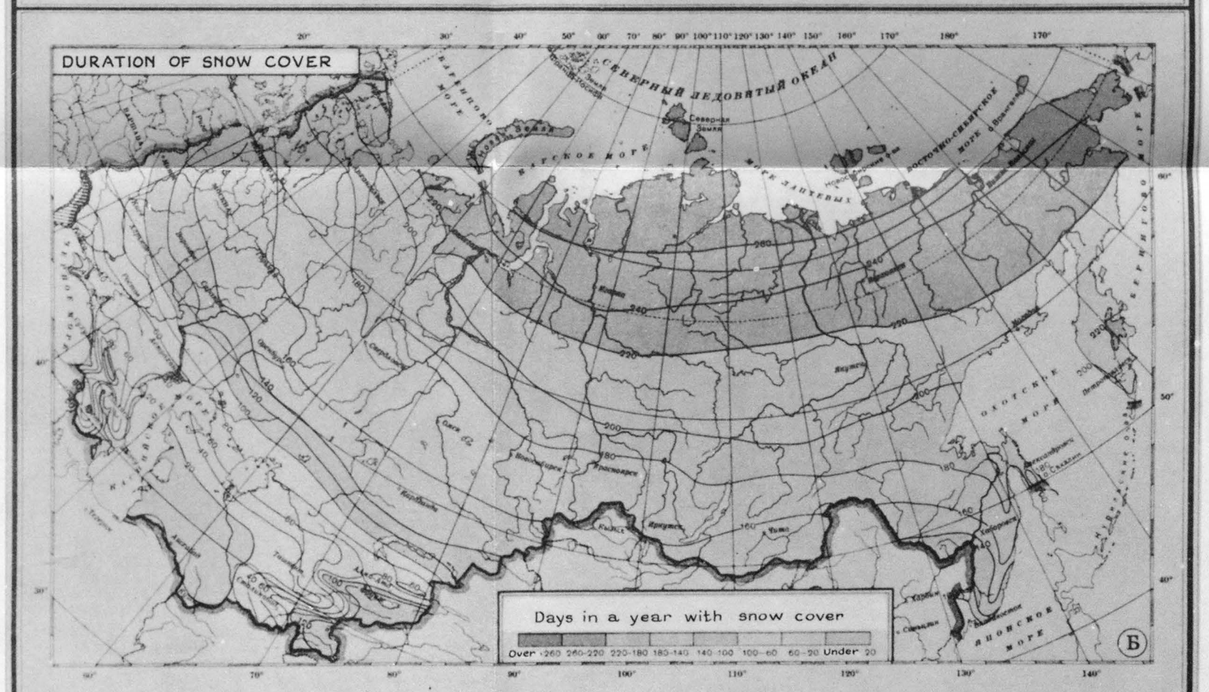


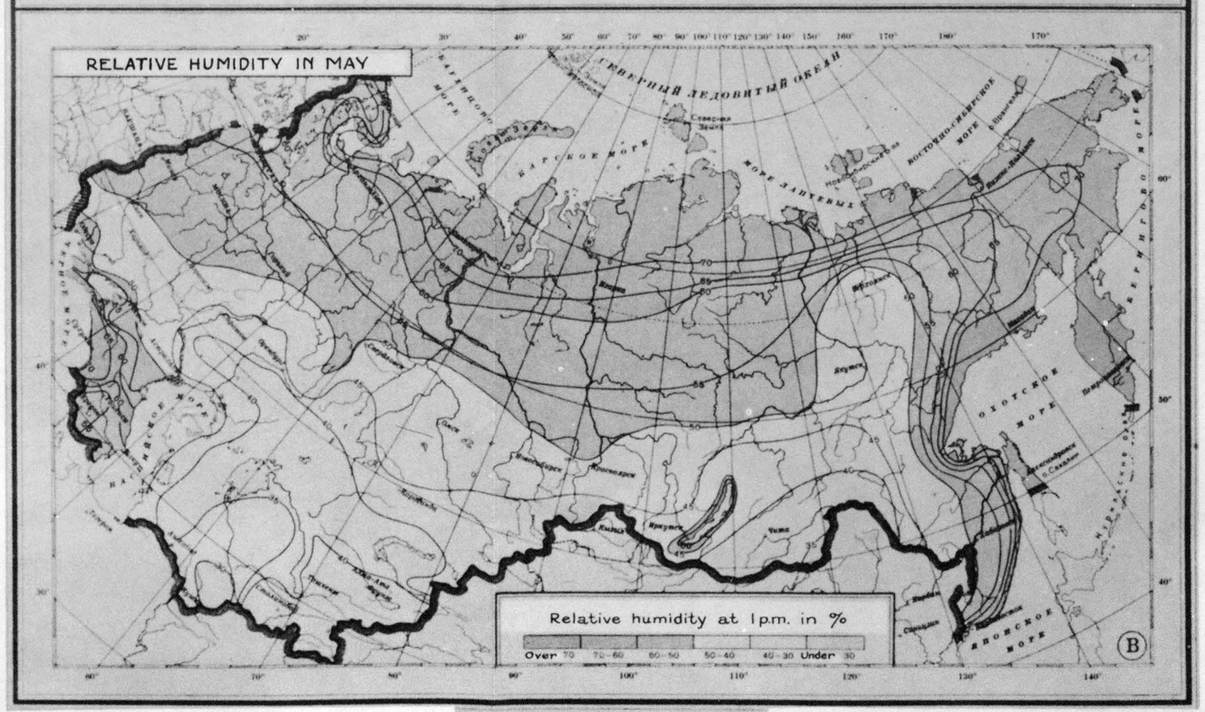
1 : 35 000 000 (1 см – 350 км)

350 0 350 700 1050 1400 1750 Км









1 : 35 000 000 (1 см — 350 км)

1 : 35 000 000 (1 см — 350 км)