Central Intelligence Agency

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Washington, D.C. 20505

DIRECTORATE OF INTELLIGENCE

13 December 1984

MEMORANDUM FOR: Albert S. Chapman
Office of Oceans and Polar Affairs
Bureau of Oceans and International
Environmental and Scientific Affairs
Department of State

FROM: [redacted] 25X1
Chief, Geography Division, OGI

SUBJECT: Memorandum entitled The Soviet Arctic:
Environment and Economic Activity [redacted] 25X1

1. Enclosed is the final version of an expanded and classified memorandum we sent to you on 16 March 1984 detailing significant economic activity in the Soviet Arctic. It includes additional data on environmental constraints and economic costs of exploiting resources in the Soviet Arctic, as well as brief summaries of other Arctic activities including fishing, lumbering, and animal husbandry. As you requested, we have also enclosed 100 copies of each of the unclassified maps on the Soviet Arctic for inclusion in your review of United States Arctic Policy for the National Security Council. [redacted] 25X1

2. The research and analysis for the text and graphics were done by Eurasia Branch of the Geography Division, OGI, on the basis of a variety of classified an unclassified information drawn from recent Agency publications as well as from open-source literature. [redacted] 25X1

3. If you have any questions concerning this memorandum, please call me [redacted] 25X1
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[redacted]

Enclosures:
1. Soviet Arctic: Environment and Economic Activity [redacted] 25X1
GI M 84-10151, December 1984 [redacted] 25X1
2. Maps on the Soviet Arctic [redacted] 25X1

[redacted] 25X1

[redacted] 25X1

[redacted] 25X1

SUBJECT: Memorandum entitled The Soviet Arctic: Environment and Economic Activity [redacted] 25X1

DDI/OGI/GD/ERA [redacted] (13 December 1984) 25X1

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DIRECTORATE OF INTELLIGENCE

12 December 1984

The Soviet Arctic: Environment and Economic Activity

Summary

The Soviet Arctic, once valued primarily as a strategically located border wasteland for military bases, has in the past two decades become the main resource frontier of the Soviet Union and a mainspring of future Soviet economic development. Despite its remote location and extremely harsh environment, which continue to constrain all aspects of resource exploitation and to add significantly to developmental costs, the Arctic region supplies a wide variety of important natural resources that are in short supply in other regions of the Soviet Union. Valuable hydrocarbons of Arctic West Siberia are now the mainstay of Soviet energy production -- contributing some 60 percent of the USSR's total oil output and over 50 percent of its natural gas -- and will continue to dominate for at least the rest of the 1980s and probably well into the 1990s. Mineral deposits in the European, East Siberian, and Far Northeastern Arctic continue to account for the majority of Soviet nickel, cobalt, apatite, and diamonds and to be substantial contributors to coal, tin, and gold production. Arctic seas constitute a major source of Soviet fish, and the northern Siberian forests provide substantial amounts of timber and furs.

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This memorandum was prepared by [redacted] Geography Division, Office of Global Issues. The information contained herein is updated to 4 September 1984. Comments may be directed to [redacted] Chief, Geography Division [redacted]

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To ensure the prolonged economic viability of this remote and inhospitable region, the Soviets have continued to invest heavily in developing the necessary infrastructure and transportation links with industrial supply centers and markets. Particular emphasis has been placed on maintaining and supplementing their huge fleet of cargo vessels and powerful icebreakers operating in the waters along the northern coast -- the Northern Sea Route. Improvements to river transport facilities and construction of railroads, roads, and pipelines in areas of concentrated resource exploitation have also been afforded a high priority as the Soviets strive to tap their Arctic resources and to maintain their overall capabilities to operate effectively in this remote but strategic frontier. 25X1

Continuing Soviet investment in developing its Arctic territories is virtually assured as long as alternative sources of energy and other valuable natural resources are lacking. As they press farther northward and eastward, however, the Soviets will be required to commit ever larger amounts of both manpower and capital to overcoming the environmental and logistical constraints to accessing and exploiting their richly endowed frozen north. 25X1

INTRODUCTION

The Soviet Union has been far more active than other countries in developing its Arctic territories -- which constitute more than one-third of its total land mass.* In the years since the 1917 Socialist revolution, the Soviets have increasingly looked to the development of their frozen north as a means of attaining economic self-sufficiency and establishing a northern defensive barrier against their enemies. As a result, what was once a virtually uninhabited wasteland now boasts a population of more than 4 million engaged in resource extraction, fishing, forestry, and military activities. Several cities (Murmansk, Vorkuta, Surgut, Nizhnevartovsk, Noril'sk, and Yakutsk) have populations of over 100,000; many others, especially in the West Siberian region, have over 10,000 inhabitants.

While national security concerns have driven much of this growth, the major thrust came in the 1960s, when the Soviets -- faced with a growing depletion of energy and other natural resource supplies in the European USSR -- discovered oil and gas in West Siberia. In the two succeeding decades, they have both accelerated the development of this hydrocarbon-rich region -- swelling its population from 186,000 in 1959 to 1.1 million in 1983 -- and expanded their search for Arctic resources farther eastward and northward to include not only the more inaccessible and inhospitable East Siberian and Far Northeastern regions but the adjacent Arctic seas as well. The Soviets have long dominated these frozen waters by virtue of their Arctic sector claim,* the establishment of the Northern Sea Route (NSR), and later, their declaration of 12-mile territorial waters.* In recent years, however, they have expanded this control by claiming sovereignty over the economic resources they contain. With their March 1977 unilateral establishment of a 200-mile fishing zone and their February 1984 declaration of a 200-mile exclusive economic zone, the Soviets have claimed jurisdiction over the natural resources of the seabed and overlying waters of nearly 3.6 million square kilometers of the Arctic seas.

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*The Soviet Arctic, in this paper, is defined as the area north of 60 degrees latitude in Siberia and north of the Arctic Circle in European USSR, which generally conforms to the Soviet's "Far North" region. (See foldout map: The Soviet Arctic)

*In a 1926 decree, the USSR claimed all lands and islands within a sector bounded by the North Pole, the USSR's northern coast, and the meridians marking the coast's eastern and western extremities. This sector amounts to 44 percent of the Arctic Polar region.

*All miles are nautical miles.

Despite its obvious economic benefits, resource development of the Soviet Arctic is fraught with problems and constraints that increase with the distance from the country's heartland. Not the least of these is the higher cost of exploitation due to the inhospitable environment and difficulties of transportation and labor supply. (See figure 2). The Soviet government has for the most part been successful in providing sufficient inducements -- including wage differentials and fringe benefits -- to recruit and maintain a labor force adequate for developmental activities, although worker turnover remains high. (See figure 3). Resource exploitation and development of an effective transportation system in the harsh climate and difficult terrain of the remote Arctic, however, continue to present a formidable challenge, despite already enormous capital investment.

ENVIRONMENT

Severe climate, rugged and swampy terrain, and subsurface permafrost (permanently frozen ground) combine to make the Soviet Arctic one of the most forbidding areas of the world. All endeavors entail a struggle against the environment and result in sharply increased costs to exploit the region's increasingly important economic resources.

Climatic Conditions

The bitterly cold temperatures that characterize the prolonged winters of the Soviet Arctic result from its far northern location and its distance from the moderating influences of the Atlantic and Pacific Oceans. Apart from the approximately one-quarter of the Barents Sea adjacent to the Kola Peninsula -- which remains ice-free yearround -- the Arctic seas dominating the region are frozen for much of the year and act as a snow-covered landmass, producing extremely low coastal temperatures. Even on the relatively warm Kola Peninsula, which benefits from the tempering influences of its contiguous waters, temperatures remain below freezing for five months of the year. Toward the Arctic interior, temperatures gradually decrease because of continentality -- with East Siberia consistently recording the coldest winter temperatures of the entire northern hemisphere.

Although these frigid temperatures produce the frozen ground required for land operations in the predominantly soggy Arctic terrain, they also seriously impair the effectiveness of men and machines. According to a scale developed by Soviet researchers to measure the duration and severity of the Arctic winter cold, all regions experience some days with average mean temperatures of -15°C -- when metal parts and components begin to break -- and -30°C -- when steel breakages occur en masse. Despite references to the use of special "northern" technology the Soviets continue to use standard equipment in the Arctic, with the result that costly breakages occur three to five times more frequently than at mid-latitudes. The combination of low temperatures and the windchill factor force frequent work stoppages throughout much of the Arctic, substantially reducing workers' efficiency. Winds of 4 meters per second (9 MPH) or greater occur on about 60 percent of winter days throughout most regions except for the coldest sections of central East Siberia, where light winds and calms are frequent. Winds also adversely affect machinery by speeding the freezing process of components -- especially of internal combustion engines -- and generally reducing the frost resistance of metals.

During the relatively warm and short summer, snow and surface ice melt, causing extremely muddy, boggy conditions that reduce the service life of vehicles and machinery and make cross-country movement and construction difficult. Swarms of flies and mosquitoes, which saturate the regions during the warm season, take an additional toll on worker efficiency and health.

Precipitation can cause problems during the summer and winter. Summer air masses moving across the region are often accompanied by heavy thunderstorms that cause flooding. The Soviets recently attributed much of their failure to reach 1983 West Siberian oil production goals to heavy late summer rains and flooding, which washed out access roads and disrupted oilfield power supplies. Winter snowfalls are not heavy, but snow cover in the European North and in West Siberia accumulates to 30 centimeters (12 inches) or more, lasts about half of the year, and can disrupt construction and transportation. Snow cover is lighter in East Siberia but lasts for seven to eight months. Drifting snow at times severely impedes overland transport, allows movement by tracked vehicles only, or forces plowing to keep winter roads open.

Terrain Characteristics and Permafrost

The terrain and natural vegetation of the Soviet Arctic limit the accessibility of many areas and confine most economic activities to a few seasons. The dense forest belt that stretches across the entire Siberian area south of the Arctic Circle has contributed to the virtual isolation of the region from the rest of the country; access to the Far Northeast is further complicated by its rugged mountains. Moreover, the tundra zone existing as a broad band adjacent to the northern coasts as well as the swamps that cover over half of West Siberia turn into spongy morasses during the summer thaws -- rendering them virtually impenetrable without construction of extensive roadbeds or artificial islands of sand and fill dirt. Throughout West Siberia, the rivers are shallow and flanked by marshy flood plains; during the spring thaw they overflow their banks compounding the region's problem of soggy ground. The spring flood waters of all of the main Arctic rivers -- the Ob'- Irtysh, Yenisey, and Lena -- which flow from the south, are jammed by ice that has not yet melted in the north and broad areas are inundated.

Underlying the terrain of nearly all of the Soviet Arctic is a foundation of permafrost, a climate-dependent phenomenon that occurs where mean annual temperatures are below freezing. In the northern half of the area, it generally occurs in a continuous mass and lies within 1 or 2 meters of the surface. At its southernmost limits, permafrost appears in sporadic patches of no more than 25 meters thick. (See figure 4).

Coping with permafrost adds considerably to the complexity and cost of development activities in the Arctic. The seasonal freezing and thawing of the surface cause the ground to alternately heave and slump, breaking foundations and collapsing structures built on them. Foundations set in permafrost transfer heat to it, thereby extending the unstable area of freezing and thawing. As a consequence, buildings constructed in most parts of the Soviet Arctic require extraordinary insulation as well as special foundations that are able to withstand the effects of the unstable ground. Foundation construction, which usually involves driving wood or steel pilings into partially frozen or boggy ground, is especially expensive. The Soviets estimate that these pilings account for 15 to 20 percent of

construction costs in permafrost areas. Roads and railroads constructed on permafrost require extensive roadbed preparation that is costly in labor, equipment, and material. Several Soviet statements place the cost of this kind of construction at about 1 million rubles per kilometer -- almost double the cost in more hospitable climates. All phases of oil and gas exploration and extraction are affected by permafrost: seismic exploration is complicated by it, special muds and concretes are required to avoid freezing and thawing problems, and well casings must be carefully insulated to prevent collapse. [redacted] the additional cost of constructing pipelines in permafrost amounts to almost 40 percent. [redacted]

ECONOMIC ACTIVITY

Soviet economic development of its Arctic has been greatest in the most accessible and environmentally favorable regions where the largest concentrations of hydrocarbons and other resources most essential to the domestic economy are found. Consequently the most developed of the regions is the European North, which encompasses the Kola Peninsula and the coastal zone up to the Ural Mountains. Railroads connect valuable nickel, coal, apatite, iron, and aluminum resources to the industrial USSR. West Siberia is nearly in the midstage of its development, with significant hydrocarbon and timber exploitation well under way and with the rudiments of a transportation system in existence. Hydrocarbon exploration is just beginning in East Siberia, but for many years the region has been the site of nickel, cobalt, platinum, and diamond exploitation as well as the natural habitat of valuable fur-bearing animals. The Far Northeast -- the most remote and least developed of the four regions -- produces gold, tin, and coal from numerous small sites. [redacted]

Hydrocarbons

The Soviet Union ranks first in world oil and natural gas production. Moreover, with what are by most estimates among the largest petroleum reserves in the world as well as an estimated 43 percent of world gas reserves, it can be expected to maintain high fuel production well into the next century. Much of the Soviets' energy wealth can be attributed to their efforts during the past two decades to discover and exploit the hydrocarbon-rich regions of the Soviet Arctic. To date, these efforts have been concentrated on the West Siberian Basin, which in 1983 accounted for some 60 percent of the USSR's total oil output and over 50 percent of its gas output. While there are some producing oilfields in the European Arctic region and hydrocarbon exploration has begun in the East Siberia and, to a lesser extent, in the Far Northeast and off the Arctic coast in the Barents Sea, West Siberia -- where most of the vast reserves have been assessed and the infrastructure to support exploitation and transportation has been developed -- will probably continue to be the Soviets' leading hydrocarbon-producing region into the 1990s. [redacted]

Oil Reserves. Of the Arctic oil-bearing regions, the West Siberian Basin, most of which is in the Arctic area, contains the

largest oil reserves. Proved reserves, which include only drilled and well-explored reserves, are estimated at 33.3 to 48.4 billion barrels or some 66 to 68 percent of the total Soviet reserves in this category. Included in these estimates are proved reserves of gas condensate (categorized by the Soviets with oil), which amount to 6.8 to 10.9 billion barrels. Potential reserves in West Siberia, which include those partially explored or geologically inferred, amount to 58 to 78 billion barrels -- some 65 to 75 percent of the Soviet total of potential reserves. Proved reserves of the European Arctic are found in the Komi ASSR's Timan-Pechora Basin; only a small portion of its estimated at 3 to 3.5 billion barrels are located north of the Arctic Circle. East Siberia, which occupies the largest portion of the Soviet Arctic, has a potentially favorable area for oil and gas occurrence of over 3 million square kilometers. Based on preliminary exploration, however, proved reserves in this region are estimated at only 0.5 to 1.0 billion barrels while potential reserves are estimated at between 3 and 11 billion barrels. Little information is available about reserves in the Far Northeast. 25X1

Oil Production. The Soviets produced 12.3 million barrels of oil (including gas condensate) per day (mb/d) in 1983 and have set goals of 12.4 mb/d for 1984 and 12.6 mb/d for 1985. Attainment of these goals will be heavily dependent on production from West Siberian oilfields -- whose share of their total oil output the Soviets expect will increase from 60 percent in 1983 to 63 percent by 1985. Additional increases (from .38 to .46 mb/d) are expected from fields in the Timan-Pechora Basin of the north European USSR during the 1981-85 Five Year Plan, but only a few producing fields of this basin are north of the Arctic Circle. 25X1

The search for Arctic oil began in the West Siberian Basin in the 1960s as petroleum production in the then major producing areas, such as the Volga-Urals and Soviet Central Asia, was stagnating or declining. Since the 1970s, this basin has contributed the most to the growth of the Soviet oil industry and during recent years has been solely responsible for the small increase in overall Soviet production totals as output from its fields has continued to grow -- from 6.2 mb/d in 1980, to 7.1 in 1982, to 7.3 in 1983. 25X1

Three mammoth fields -- Samotlor, Mamontovo, and Fedorovo -- dominate West Siberian oil production, even though the first two are in decline. Samotlor produces 2.8 mb/d, Fedorovo .73 mb/d, and Mamontovo .56 mb/d. Other new West Siberian fields of lesser quality such as Vatyegan, Kholmogor, and Sutormin are now beginning production or are being expanded. (See figure 5). 25X1

Although West Siberian oil production is expected to increase for several years, the rate of growth has slowed and segments of the Soviet oil industry are arguing for a shift of focus to East Siberia and to the offshore basins of the Arctic seas. The Soviets acknowledge, however, that oil production from these areas will not be a factor until the next decade. 25X1

Gas Reserves. According to Soviet estimates published in 1983, the Arctic areas of Siberia contain about 75 percent of the Soviet Union's estimated 34.3 trillion cubic meters (m^3) of explored natural gas reserves. Northern West Siberia predominates with an estimated 24.8 trillion m^3, while almost 1 trillion m^3 are located in Arctic East Siberia. Exploration and discovery of reserves in the West Siberia area accounted for most (92 percent) of the increase in estimated Soviet reserves between 1974 and 1980. [redacted] 25X1

Several supergiant gasfields in West Siberia -- where the Soviets are currently concentrating their exploitation efforts -- hold the majority of these natural gas reserves, with Urengoy being the largest.

Reserves (in billion cubic meters)
as of January 1980

Supergiant	Explored	Probable
Urengoy	7,770	285
Yamburg	4,096	661
Zapolyarnoye	2,632	39
Bovanenko (Yamal)	2,239	1,912
Medvezh'ye	1,243	
Kharasavey (Yamal)	861	404
Kruzenshtern (Yamal)	363	757

Yamburg Gasfield, located just to the north of Urengoy, is currently beginning development; initial production is scheduled to begin about 1986 or at least sometime in the late 1980s. Zapolyarnoye Gasfield, lying about 130 kilometers northeast of Urengoy, and the three remaining supergiants on the Yamal Peninsula, located 450-500 kilometers north of the Arctic Circle, are not yet scheduled for exploitation. [redacted] 25X1

According to 1980 Soviet estimates based on preliminary exploration, recoverable gas resources in Yakutsk ASSR and Krasnoyarskiy Kray -- the Arctic sector of East Siberia -- amount to 989 billion m^3. In the Far Northeast little exploration work has been done and no overall estimates of gas reserves are available. In 1982 some exploratory drilling took place in an area near Anadyr', south of the Chukotsk Peninsula facing the Bering Sea. Showing some signs of oil and gas deposits, this area may be targeted for more detailed exploration in future. [redacted] 25X1

In the European Arctic the only onshore gas reserves are located in the northern Timan-Pechora Basin. The Layavozh Gasfield, lying north of the Arctic Circle, contains a little over 100 billion m^3 of probable reserves. The offshore extension of this basin, however, probably contains most of the gas reserves in the area. [redacted] 25X1

Gas Production. Exploitation of natural gas deposits in the Soviet Arctic lagged slightly behind oil development during 1965 to 1975, but by 1983 Arctic natural gas -- almost all from northern West

Siberia -- accounted for over 50 percent of the USSR's production of 536 billion m^3. [redacted]

The Medvezh'ye Gasfield, the first of the West Siberian fields to be exploited, plateaued in 1977 at about 70 billion m^3 per year. Urengoy Gasfield was discovered in the mid-1960s, but production did not begin until 1978. With the concentration of Soviet exploitation efforts on this field, Urengoy produced about 29 percent of the USSR's natural gas output in 1983 -- including that for the Export Pipeline to Western Europe. It is expected to peak at a production rate of 250 to 270 billion m^3 per year and to account for 34 percent of 1984 production. Arctic gasfields in areas other than West Siberia are not expected to be a significant factor in national production before the 1990s, although small gasfields in East Siberia now supply Noril'sk and Yakutsk via pipelines not connected to the national network. [redacted]

Offshore Hydrocarbons. The continental shelf areas of the Soviet Arctic are the largest in the world -- covering almost 4 million square kilometers (a little more than half the area of the contiguous United States). Encompassing seaward extensions of onshore basins known to contain hydrocarbons as well as individual Arctic sea basins with geologic formations potentially favorable for the occurrence of hydrocarbons, these shelf areas provide the Soviets with opportunities for extensive future hydrocarbon exploration. [redacted]

Offshore exploration in the Soviet Arctic is in the preliminary stages. The western Arctic seas, in particular the Barents Sea and parts of the Kara Sea, have for the most part been covered by seismic, gravity, and aerial magnetic surveys. In addition, the Soviets have conducted some exploratory drilling on islands and archipelagos of the western Arctic seas and have drilled into the southern edge of the western Arctic waters from improvised fixed platforms. Most recently, they have begun amassing more detailed information on the extent of offshore hydrocarbon occurrence by drilling farther offshore, in deeper waters of the Barents Sea. To facilitate their search for oil and gas under the difficult environmental conditions existing in the icy Arctic seas the Soviets in 1979 ordered three specially built drill ships from Finland -- each of which is capable of drilling to depths of 6,000 meters from waters up to 300 meters deep. By 1982, the Rauma-Repola Company had delivered all three of the vessels -- the Valentin Shashin, the Victor Muravlenko, and the Mikhail Mirchink. Also ordered from the Rauma-Repola Company for delivery in 1985 are two huge jack-up drill rigs (each costing some 72 million rubles) which can operate in Arctic seas drilling to over 6,000 meters in 100-meter waters. [redacted]

Barents Sea. Because of optimistic preliminary surveys, generally shallow depths (many areas, especially in the southern sector, are less than 200 meters deep), and the least amount of sea ice of the all the Arctic seas, the Barents Sea has been targeted first for extensive surveys by the Arctic drilling ships. The Soviet search for energy in these waters, however, has been impeded by their longstanding dispute with Norway over some 150,000 square kilometers of Barents Sea continental shelf -- a dispute which derives from the conflicting methods used by the two countries in defining maritime

[redacted]

boundaries.* Although the two countries have generally refrained from conducting seismic surveys or exploratory drilling in this portion of the shelf, in 1983 the Soviet's Valentin Shashin began oil-drilling operations at a point estimated to be 1 mile within the disputed area -- provoking the Norwegians to dispatch a Coast Guard vessel to monitor operations. Negotiations to resolve this dispute have occurred with increasing frequency in recent years; at the most recent round, in December 1983, the Soviets proposed an interim agreement that would allow resource exploitation pending a final settlement of the boundary. Meanwhile, a bilateral agreement permits the two nations to fish in the southern part of the disputed area.

The status of Svalbard, a Norwegian archipelago straddling the Arctic Ocean and the Barents Sea, compounds the Soviet-Norwegian dispute. Under the 1920 Spitzbergen Treaty, Norway maintains sovereignty over the islands. The treaty, however, did not cover Svalbard's continental shelf resources, which Norway claims exclusively. The Soviets claim that, as a signatory to the 1920 treaty, they also have rights to resource exploitation on the shelf.

Outside the disputed areas the Soviets have signed an agreement to cooperate with the Boconor Consortium (formed by seven Norwegian companies) in exploring Barents Sea oil and gas deposits. In the southernmost area, between the islands of Novaya Zemlya and the mainland, the Timan-Pechora Basin extends beneath the water creating a large offshore area with considerable hydrocarbon potential. According to USGS estimates, undiscovered recoverable hydrocarbon resources of the Timan-Pechora/Barents Sea area amount to 8.3 trillion m^3 of natural gas and 25.3 billion barrels of oil.

Kara Sea. During the next Five Year Plan (1986-90) the Soviets may extend offshore drilling to the Kara Sea, which lies off the coast of northern West Siberia. Some of the known onshore giant and supergiant gasfields extend into these waters, giving the area significant hydrocarbon potential. The Oil and Gas Journal reported in 1982 that a Soviet study placed Kara Sea gas resources at nearly 11 trillion m^3. Soviet geologists believe that large oil and gas accumulations may be found in the southwestern part of the Kara at relatively shallow depths of 1,000 to 2,000 meters.

Laptev, East Siberian, Chukchi, and Bering Seas. Much less is known about the hydrocarbon potential underlying Arctic seas in the eastern sector of the Soviet Arctic, where only gravity and magnetic surveys have been conducted. Because of the region's harsh climate and difficult ice conditions, only a giant find would be economical to exploit. Although a 1983 USGS survey concluded that the hydrocarbon potential of the northeastern Siberian continental shelf was poor, A. A. Meyerhoff, a US consulting geologist, believes the Chukchi Sea

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*The Soviet position is based on their 1926 decree claiming an Arctic sector enclosed by the meridian lines to the Pole. Norway maintains that the boundary should be an equidistant line between its mainland and island territories and those of the USSR.

Basin area may be a continuation of the hydrocarbon-rich strata of northern Alaska. In addition, the Anadyr' and Khatyrka depressions of northeastern Magadan Oblast probably extend into the Bering Sea toward US waters south of St. Lawrence Island.

Minerals

Despite increased costs incurred as a result of adverse environmental conditions and the remoteness of exploitation sites, the Soviets extract more Arctic minerals than any other country. Mineral exploitation is most heavily concentrated in the north European Arctic, which is closest to the Soviet industrial and population base and to links with the main transportation network. Mineral exploitation is less developed in remote East Siberia and the Far Northeast, which can be reached only by lengthy water routes using the Northern Sea Route supplemented by river transport and by a few road and air links to central cities. (See figure 6).

The Noril'sk area, between East and West Siberia, is the most important extraction and processing center in the Soviet Arctic. The Noril'sk Complex produces about half of the nickel and nearly half of the cobalt refined in the Soviet Union. In addition, Noril'sk ores yield copper and valuable platinum-group metals. The Soviets plan to increase nickel and cobalt production by 30 percent during the 11th Five Year Plan and most of the increase will probably come from the Noril'sk area. Because of the importance of Noril'sk, the Soviets have prioritized yearround operation of the Northern Sea Route between Murmansk and Dudinka, the main river port serving Noril'sk, for shipments of ore and concentrates and for delivery of supplies to the mining center.

The Kola Peninsula in the north European region also contains large mining and metallurgical operations for nickel, as well as for phosphate-bearing apatite, iron ore, and copper. Copper-nickel ores extracted and processed at Monchegorsk, Nikel', and Zapolyarnyy yield a substantial part of the USSR's nickel as well as valuable byproducts such as cobalt, silver, gold, platinum, and copper. Together the Kola centers and Noril'sk produce most of Soviet refined nickel and cobalt.

The world's largest apatite deposits are located in the Kirovsk-Apatity area of the Kola Peninsula, which in 1982 produced 17.7 million tons of apatite concentrate used to supply about 70 percent of the raw materials for Soviet phosphate fertilizers. The Soviets plan to increase apatite production at Kirovsk-Apatity to 19 million tons in 1985 and to build a third concentration plant there. Iron ore extraction on the Kola Peninsula is centered at Olenegorsk, which has proven reserves of over 300 million tons.

The most important coal-producing area in the Soviet Arctic is the Pechora Basin in the northern Urals. Centered on the cities of Vorkuta and Inta, the basin produced 28 million tons of coal in 1983; about 60 percent of its output is coking coal.

With explored reserves of some 9 billion tons, the Pechora Basin is likely to continue as an important coking coal source in the future. Large unexplored coal resources are in East Siberia's Lena and Tunguska Basins, most of which lie in the Arctic region. The Soviets estimate that these basins contain some 58 percent of the overall geological coal resources of the USSR. Since, however, only a small percentage of these have been explored and since they are so remotely located, they probably will not be exploited to any significant degree in this century.

Numerous small mining sites in East Siberia and the Far Northeast regions of the Arctic produce minerals of national importance for the Soviet Union. Substantial amounts of gold are mined in the Far Northeast, particularly from sites along the Kolyma River. Magadan Oblast in the Far Northeast is the largest Soviet gold-producing region; in 1980 Magadan placer mines accounted for about 26 percent of the Soviets estimated gold production of 315 metric tons. Because of its importance as a source of hard currency, the Soviets attach a great deal of importance to the mining of this mineral -- as evidenced by the construction of a nuclear powerplant at Bilibino, a main gold mining support city located north of the Arctic Circle. In addition, much of the cargo carried on the eastern sector of the Northern Sea Route is designated for the gold exploitation areas.

Although not as significant as gold, diamond sales are estimated to be an important earner of foreign exchange for the Soviet Union. Since they were discovered in the mid-1950s, diamonds from the Yakutsk ASSR of Eastern Siberia have dominated Soviet production (accounting for about 90 percent). Mirnyy, with a population of over 30,000, is the center of the Soviet diamond industry -- which in 1978 produced about 8 million carats (approximately 20 percent gemstones and the rest of industrial quality).

Tin mining areas in the Arctic regions of the Far Northeast and East Siberia account for a large share of Soviet tin production. In 1975 tin produced in the Soviet Arctic amounted to nearly 10,000 tons. Because demand for this metal is high, however, the Soviets continue to import large amounts of it. Scheduled increases in tin extraction and production in East Siberia will probably be used to offset domestic deficits. In addition to tin, a major mining and concentrating complex at Iul'tin in the Far Northeast produces substantial amounts of tungsten.

Fisheries

Fish constitutes about 15 percent of the animal protein in the Soviet diet; Soviets eat over three times as much fish per capita as do US citizens. On the basis of partial 1981 data, we estimate that Arctic waters supply the Soviets with some 2

million metric tons of fish annually -- about 20 percent of their total sea catch. About 1.5 million tons come from the Barents Sea, the Svalbard/Bear Island area, and the Norwegian Sea, which is a relatively recent contributor to the Soviet catch. The Arctic waters of the Bering Sea, which constitute only a part of the valuable northwest Pacific fishing grounds, probably provide nearly a half million tons.

Soviet fishermen were forced to change some of their traditional Arctic fishing patterns in the 1970s, when many of the popular fish stocks dwindled as a result of uncontrolled fishing and when most coastal nations established unilateral control over fish resources within 200 miles of their shores. As a result whitefish has been replaced by capelin and blue whiting (processed mostly as fish meal) as the most popular Soviet species, with the latter being caught in newly established fishing grounds in the Norwegian Sea. The Bering Sea off the northeastern Siberian coast continues to be an important source of Alaskan pollack. When the US withdrew Soviet fishing quotas because of the Afghanistan invasion, the Soviets ceased fishing in the Bering Sea off the coast of Alaska, and Soviet factory ships purchased fish caught by US fishermen under terms of a joint venture with a private company. In July 1984, US policy was revised to permit the Soviets to take about 50,000 tons of fish in US waters, including those in the Bering Sea.

Timber

The Soviet Arctic contains a wealth of timber resources that will remain largely unexploited until adequate transportation routes can be developed to provide access to them. Although only scrub forests and tundra grow north of the Arctic Circle, extensive coniferous forests (taiga) abound south of it. Larch is the predominant species -- especially east of the Yenisey River -- but good stands of pine, fir, spruce, and birch occur in many Arctic forests. The East Siberian region contains the largest forested areas. Much smaller forests occur in the swamps and floodlands of West Siberia and in the rugged uplands of the Far Northeast region.

Timber cutting and wood processing activities are concentrated along main rivers and the few existing railroads. The Ob'-Ivdel' railroad, for example, was constructed specifically to access timber stands -- mostly pine -- and to transport wood products to markets. When railroads to Surgut and Vorkuta gave the Soviets access to oil, gas, and coal resources, they also opened up some areas for timber exploitation. Some logging also takes place along the Ob', Yenisey, and Lena Rivers, where the northward flowing arteries are used to carry log rafts to processing centers and to main ports of Salekhard/Labytnangi, Yakutsk, and Igarka. Because of its location on the Yenisey and its connection to the NSR, Igarka has become the main timber transshipment port in the Soviet Arctic; in 1981 over 1 million cubic meters of timber was shipped out via the NSR.

Animal Husbandry

Tending, hunting, and trapping animals provides the livelihood for many of the indigenous peoples of the Soviet Arctic, where the environmental conditions preclude significant agricultural activity. Reindeer herding exists throughout the region -- providing meat and milk for food and hides for clothing. Reindeer thrive in the treeless tundra and on the northern edge of the taiga, where the land is frozen for much of the year and waterlogged for the remainder. As a result of the Soviets' denomadization policy, most reindeer herding has been collectivized, with only a few herders allowed to follow reindeer migrations. Numerous reindeer collective and state farms now span the entire northern Arctic region. Of the 2.2 million head of Arctic reindeer, slightly more than half are located on farms in East Siberia and the Far Northeast -- farms in the Chukotsk area alone have 539,000.

Although reindeer herding constitutes the largest and most important animal husbandry activity, some dairy and meat cattle are raised in pastures along the Viluy, the southern Ob', and the Lena Rivers of West and East Siberia. Hog raising is minimal, but the number of hogs in the area of West Siberia's main support cities has increased (from 9,000 in 1975 to 61,000 in 1982) -- probably to help feed the growing population of workers engaged in the oil/gas industry. East Siberia is the main supplier of valuable sable, fox, and mink furs, which are purchased by the government. The number of individual hunters and trappers, however, has been gradually shrinking as increasingly more fur-bearing animals are being raised on farms located in the Siberian forests and in Arctic coastal areas, where the remains from fish processing plants are used to feed the animals.

TRANSPORTATION SYSTEMS

Despite enormous capital investment, Soviet efforts to develop the transportation systems needed to support resource exploitation in their Arctic territories have been severely constrained by the region's remote location, difficult terrain, and harsh climate. Although air, water, and land transport routes span vast distances -- usually thousands of kilometers -- to connect material suppliers and markets in the European USSR with the main Arctic cities and settlements, resource exploitation sites often lie hundreds of kilometers beyond these regional centers. No all-weather roads connect the Arctic regions to the industrialized parts of the USSR, and only a few of the key regional cities are interconnected. Railroads -- the backbone of Soviet transportation elsewhere -- are lacking in all but a few Arctic regions. Water transport -- the principal mode of Arctic transportation -- is seriously impeded during the long winters by the severe icing, which makes the region's rivers and most of the NSR impassable. Air transport, while providing an effective alternate mode of transportation, is extremely

costly. [redacted]

In overcoming these obstacles, the Soviets will continue to be forced to make difficult decisions concerning the priorities they assign to developing the various modes of Arctic transportation. Recently, particular emphasis has been placed on updating the fleet of icebreakers that extend the navigation season of the NSR and on constructing the lengthy cross-country pipelines that link formerly inaccessible Arctic energy resources to Soviet industries and consumers. Construction of roads and rail lines, however, lags far behind and continues to be constrained by high costs, long distances, and harsh environmental conditions. [redacted]

Approximate Distances to Key Arctic Resource Centers (Kilometers)

Resource exploitation center	By air via great circle route from:		By water from:		By rail from:	
	Moscow	Novosibirsk	Murmansk via NSR and rivers	River port on Trans-Siberian railroad	Moscow	Moscow to Nearest rail city
West Siberia						
Surgut	2100	800	3800	11-1600	2800	--
Nizhnevartovsk	2300	700	4100	13-1600	3000	--
Novyy Urengoy (Nadym on water)	2300	1200	2500	25-2800	3500	--
Noril'sk	2800	1600	2500	1900	--	3300
East Siberia						
Yakutsk	4800	2700	5200	1800	--	7300
Vilyuysk	4400	2300	5200	2400	--	5200
Khatanga	3400	4000	3600	--	--	4100
Far Northeast						
Anadyr'	6100	4800	6300	--	--	8500
Cherskiy	5500	4000	4600	--	--	7300
Zyranka	5300	3700	5400	--	--	7300
European:						
Murmansk	1400	2900	--	--	1900	--
Vorkuta (Labytnangi on water)	1800	1700	2700	22-2400	2200	--

Water Transport

In the absence of an effective road and rail network leading to most of the Arctic region, the Soviets have relied heavily on marine transportation, which can move large quantities of cargo over long distances at low cost. The Northern Sea Route, which extends along the entire Soviet Arctic coast, has long been an important northern supply route to Arctic sea and river ports. Supply routes from the south are provided by arterial rivers flowing northward from key ports that junction with the Trans-Siberian railroad -- the only cross-country east-west transportation route in the USSR. The BAM (Baikal-Amur Mainline) railroad being constructed north of and parallel to the Trans-Siberian will provide additional tie-ins to Siberian cities and resource development areas as it intersects major rivers of East Siberia. [redacted] 25X1

Northern Sea Route. Established in the 1930s, the NSR is still the primary maritime lifeline for cities along the Arctic coast. Extending over 6,000 kilometers, the route is completely ice free only in the westernmost sector at Murmansk. Icebreakers, however, keep the route open from Murmansk to Dudinka on the lower Yenisey almost yearround except for a short six-week period in May and June when the river ice is breaking up. The Murmansk-Yenisey route accounts for about 3 million tons of cargo out of the annual total of nearly 7 million tons carried on the NSR. [redacted] 25X1

In the central portion of the NSR, where particularly heavy icing occurs in key straits off the East Siberian coast, shipping lasts only from August to October. Navigation is also seasonal in the eastern sector, lasting from June to December in the Bering Sea off the Soviet eastern coast and from mid-June to mid-October in the East Siberian Sea off the northeastern extremities of the USSR. [redacted] 25X1

Besides Noril'sk, the western sector of the NSR serves the oil and gas exploitation areas of West Siberia through ports on the Ob' River estuary. The seasonal ports in the central and eastern NSR serve mineral exploitation in East Siberia and the Far Northeast. Severe icing and an early onslaught of the Arctic winter, however, can jeopardize activity, especially in the eastern sector. In October 1983, for example, some 40 supply vessels were stranded in the ice in the Chukchi Sea off the northeastern Arctic coast, forcing the Soviets to use all available icebreakers to effect rescue operations. [redacted] 25X1

Indications are that the Soviet Union intends to maintain and supplement its extensive fleet of over 400 vessels operating along the NSR. Icebreakers are instrumental in keeping the western sector open and the eastern sector navigable as long as possible. Three nuclear-powered icebreakers are the backbone of the fleet -- the Sibir', the Leonid Brezhnev (formerly named the Arktika), and the Lenin; a fourth, the Rossiya, was launched in

November 1983 and will join the fleet in 1984 or 1985. The USSR and Finland are collaborating on a new shallow-draft nuclear-powered icebreaker for the Yenisey River to be constructed during the period 1986-90. [redacted]

Several other types of diesel-powered icebreakers are employed along the NSR -- many built by Finnish companies. In addition, in 1983 Finnish shipbuilders delivered two of seven extremely shallow draft (2.5 meter) icebreakers for operation on the Ob' and other Siberian rivers. [redacted]

Besides icebreakers the Soviets have invested heavily in multipurpose icebreaking freighters capable of negotiating ice up to 1 meter thick. Two Finnish companies (Wartsila and Valmet) were contracted to construct 14 of these cargo vessels designated the Noril'sk class; so far 11 have joined the fleet. Capable of carrying 200,000 tons of cargo, the vessels combine special features of a container carrier, Ro-Ro ship, and a bulk carrier; they can also deliver cargo directly onto ice if port facilities are lacking. In addition the Soviets are constructing their first nuclear-powered icebreaking lighter and container ship. The ship can carry 70 to 80 lighters (barges), each with a cargo capacity of 360 tons. [redacted]

Rivers. Inland waterways provide the easiest approach routes to many of the interior Arctic regions and to parts of the Arctic coast. Although their use is seasonal, the northward flowing rivers of Siberia are of great importance for movement of freight and passenger traffic, surpassing the NSR in volume. More than half of the freight shipments for the West Siberian oil and gas complex are carried by river transport and, according to Soviet journal Rechnoy Transport, by the end of the 11th Five Year Plan (1985) river transport will account for 53 percent of total shipments, railroads for 45.4 percent, and maritime for 1.6 percent. [redacted]

Vessels on the Ob' and Irtysh Rivers supply bulk cargo to main bases in the West Siberian oilfields at Surgut and Nizhnevartovsk and to the support city of Nadym in the gasfield exploitation area of northern West Siberia. The Yenisey traffic handles some of the mineral export from and supplies to the Noril'sk area via the ports of Dudinka and Igarka. River vessels on the Lena River bring cargo southward from the NSR ports and northward from Ust'-Kut ports on the BAM railroad. Kolyma River vessels carry bulk cargo between NSR ports and mining areas and also link the NSR ports to the Yakutsk-Magadan highway. [redacted]

The short river navigation season--ranging from four to five months in the southern Arctic to one month in most of the north--magnifies the need for maximum efficiency at ports. As river traffic has increased throughout the Arctic, the provision of effective port loading facilities and adequate storage space has not kept pace. The situation is most acute in West Siberia, where resource development activities are most intensive. As a

result, during the current Five Year plan, the Soviets are concentrating their efforts on improving facilities at major ports and on building new ports in the oil and gas region. construction that would more than double the quayage and docking space at Sergino, Labytnangi, and Staryy Nadym, in addition to new port development near Urengoy. The lack of sufficient cranage for transloading operations at most Arctic river ports indicates that even with such improvements, most facilities are inadequately mechanized to cope with large seasonal concentrations of freight.

Rail, Road, and Air Transport

Although water transport provides the initial access to Arctic areas and dominates Arctic freight shipments, rail, road, and air transportation are also important for resource exploitation. The only operating railroads connected to the national network are the few trunk lines leading to base cities centered in resource areas -- in West Siberia, to Surgut, Nizhnevartovsk, Novyy Urengoy, and the Ob' River at Labytnangi and Sergino; in the north European USSR, to Murmansk, Arkhangel'sk, and Vorkuta. Although distances are great and these lines often are only single tracked, they provide important all-weather connections with industrial centers of the Soviet Union. An isolated railroad connects the Noril'sk mining complex with the port of Dudinka. In East Siberia the Soviets plan to extend a BAM branch line 800 kilometers northward into the Arctic region to Yakutsk.

Main road links in the Arctic are few and far between. Only the Kola Peninsula and the Yakutsk-Magadan areas have long-distance all-weather roads. Instead the Soviets are concentrating road development on the construction of yearround hard-surfaced connections between established port or base cities and resource exploitation sites. For exploration access to Arctic wilderness areas the Soviets use winter roads built by compacting snow or rough dirt-log roads.

Air transport to all major cities in the Arctic and to most base cities in the hydrocarbon exploitation areas is provided by Aeroflot, the Soviet civilian airline. Although the most expensive means of transportation, aircraft are essential for transporting people and priority freight into the Arctic when other modes are shut down. Intraregional air operations are confined to hard surface runways in summer; in winter, however, air transport expands with the use of snow airfields, constructed by packing snow on frozen ground. In resource exploitation areas helicopters are widely used to transport people and construction materials. In West Siberia, for example, helicopter pads are located at almost every settlement and drilling area.

Pipelines

High on the list of Soviet priorities is the construction of trunk pipelines from West Siberia to the more developed areas of the country. Five large-diameter (1,020 to 1,220 millimeter) pipelines carry West Siberia crude oil to refineries in the Volga, Ural, and Siberian areas; numerous gas pipelines span vast distances carrying fuel for industries and power plants in the European USSR. During the current Five Year Plan the Soviets invested some 25 to 30 billion rubles in constructing six new 1,420-millimeter cross-country gas pipelines emanating from the huge Urengoy field. Despite the environmental and logistical problems, by April 1984 four of the lines -- including one intended exclusively for exporting gas to Western Europe -- were operating, although probably not at full capacity. Another was recently completed. The gas export pipeline is currently transporting gas to domestic consumers.

Much of the enormous cost of constructing these pipelines results from their remote location originating far from supply centers as well as the harsh environmental conditions and the difficult terrain, especially along the Siberian sector of the route. Swampy areas necessitate the use of expensive anchoring techniques to prevent the pipes from floating to the surface; permafrost areas require costly insulation in pipeline trenches to prevent heat transfer to the unstable ground. To minimize costs in preparing pipeline routes and to facilitate repair and maintenance, the Soviets have concentrated their trunk pipelines along a few corridors. To save time and prevent pipe damage through numerous transloadings onto railcars, trucks, and barges, the Soviets are increasing shipments of large-diameter pipe, all of which is imported, via the Northern Sea Route to Novyy Port in West Siberia.

OUTLOOK

The accelerated pace that has characterized Soviet Arctic development during the last two decades is likely to continue for the foreseeable future, despite the necessarily higher costs incurred from operating in this remote and environmentally hostile region. The rapid depletion of hydrocarbons and other vital natural resources in the European USSR and the progressive leveling off of oil and gas production in the West Siberian Basin through the 1990s will almost certainly drive the Soviets farther eastward and northward--first into the remotest areas of West Siberia, where reserves have already been explored, and eventually into East Siberia and the Barents and Kara Seas, where preliminary surveys indicate potentially rich hydrocarbon reserves.

The degree to which the Soviets will be successful in further tapping their enormous Arctic resources will depend in large part on their willingness and ability to develop the infrastructure--particularly the transportation networks--and to

acquire the technology necessary to overcome the locational and environmental constraints imposed by their remotest frontier. After more than half a century of confronting the Arctic environment--through scientific, military, and, most recently, economic activities--the Soviets have emerged as one of the World's leaders in cold-weather operations, including permafrost construction. In addition, they have recognized opportunities to reap large dividends not only from improvements in domestic technology but from imports of foreign technology, mostly from the West. Recent and planned acquisitions of Finnish and Norwegian technology will facilitate the Soviet search for energy supplies in the frozen Arctic Seas, and the continuing investment in powerful icebreakers and ice-going freighters will enable them to further extend the navigation season on the Northern Sea Route. Nonetheless, development of land access routes is in its infancy and the entire Arctic transportation system is in need of expansion, improvement, and better integration.

As the Soviets press deeper into their frozen north, developmental activities will become increasingly more costly--both in terms of the capital expended and in terms of the manpower and material diverted from other sectors of the economy and other regions of the country. As long as they lack viable alternatives for acquiring key resources needed both for domestic consumption and for foreign export, however, the Soviets can be expected to remain committed to developing their vast Arctic storehouse.

The Soviet Arctic

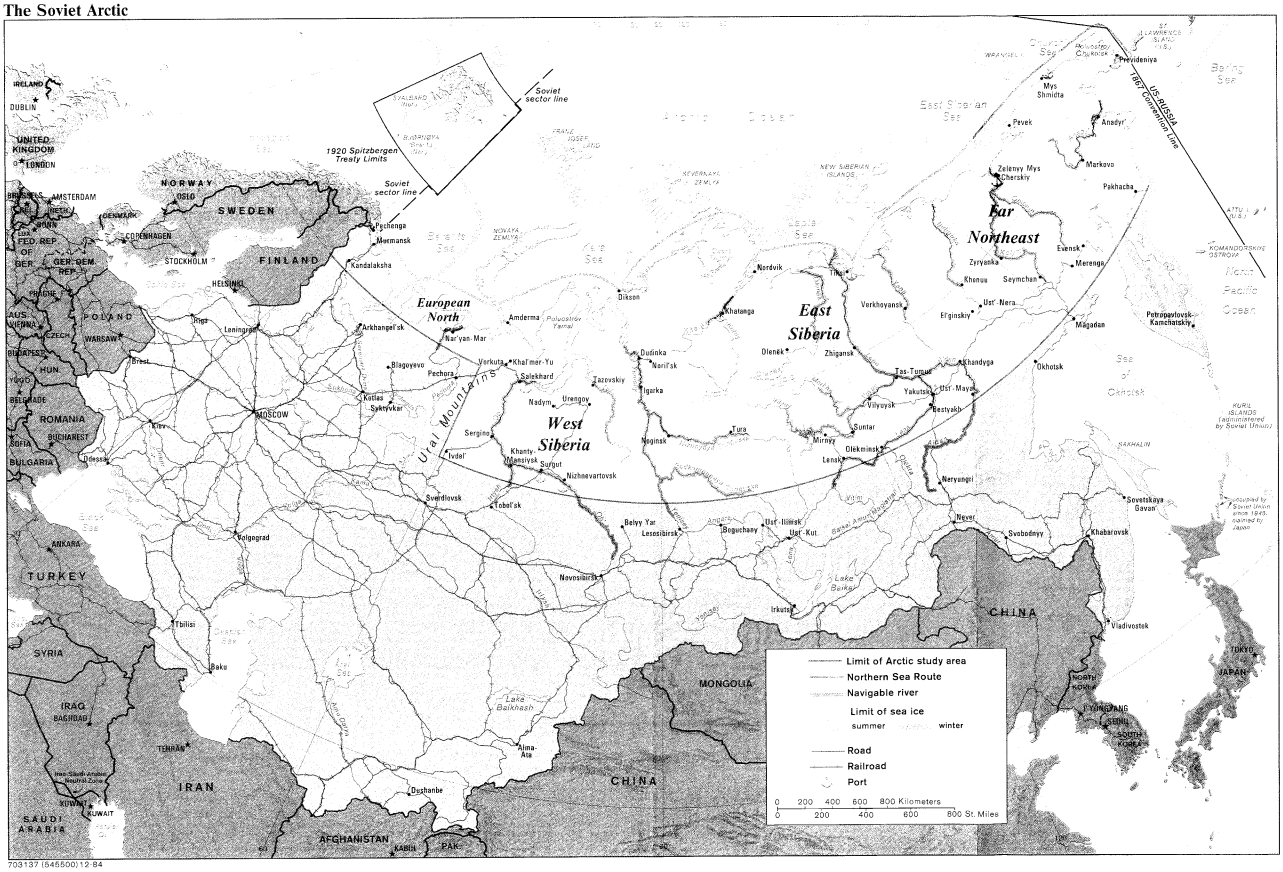

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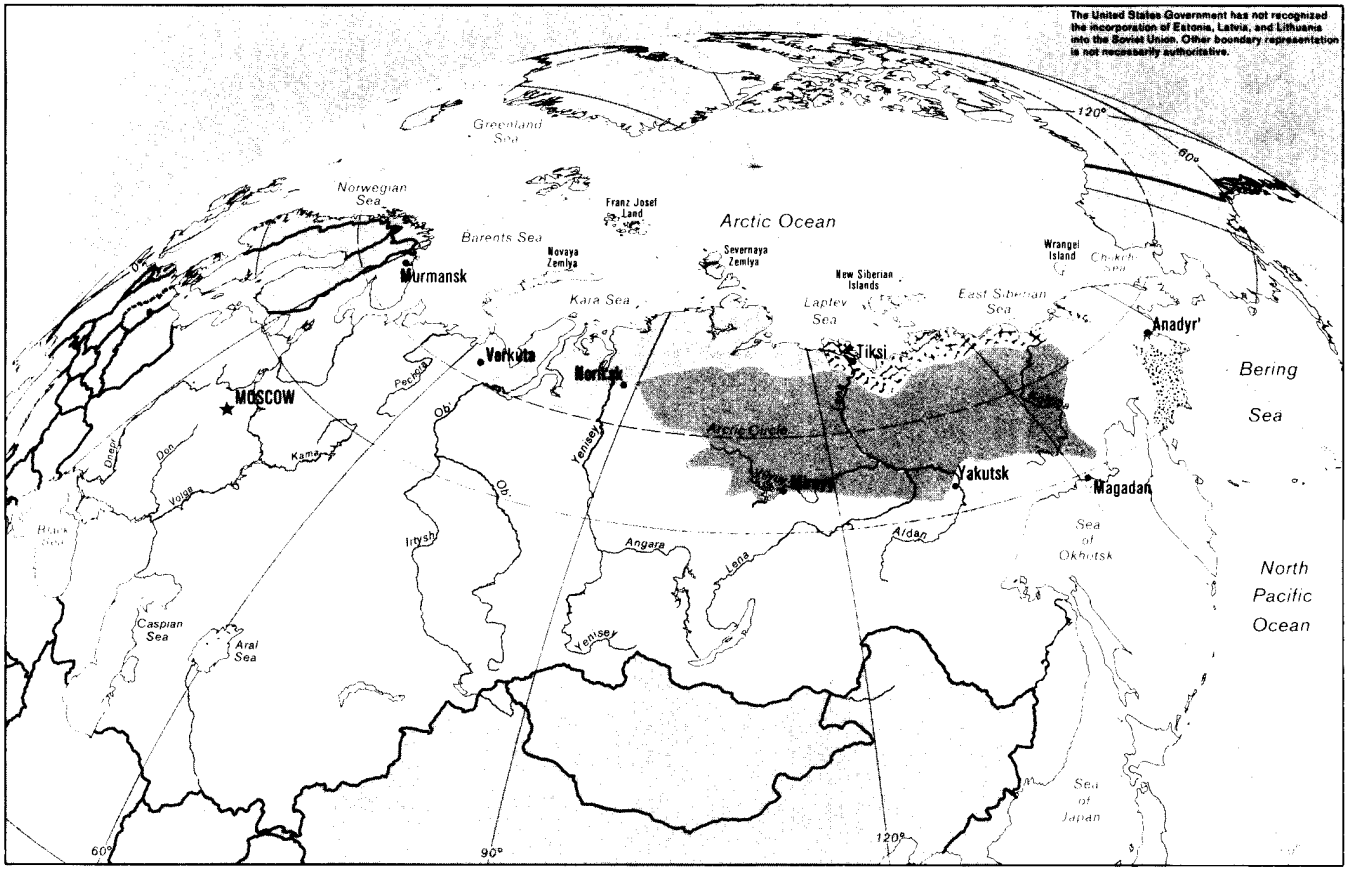
Figure 2
Soviet Arctic Region: Additional Developmental Costs



Coefficients of Cost Differentials From Central European Soviet Union
(combined effect of climate, terrain, and remoteness)

Generalized Arctic area	Construction/ operation of winter roads	Construction of improved roads	Truck transport	Housing construction
Northern West/East Siberia	1.7–2.0	4.0–5.0	2.0–4.0	2.0–7.5
Coastal East Siberia	1.7–2.0	4.0–5.0	3.0–4.5	5.0–8.0
East Siberia and Far Northeast	1.7–2.0	3.0–6.0	2.0–4.0	4.0–8.0
Coastal Far Northeast	2.0–2.1	4.0–6.0	2.0–4.5	3.5–8.0
West Siberia	1.3–1.7	3.0–4.0	1.5–3.0	3.0–4.5
Southern East Siberia	1.3–1.7	3.0–5.0	1.5–3.0	1.5–4.5
Pacific Northeast	1.6–2.1	5.0–6.0	3.0–4.0	4.0–5.0
European North	1.3–1.7	1.5–2.0	1.0–3.0	NA
Southern West Siberia	1.1–1.4	1.5–4.0	1.0–2.0	1.0–3.5

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Figure 3
Soviet Arctic Region: Dual Wage Incentives

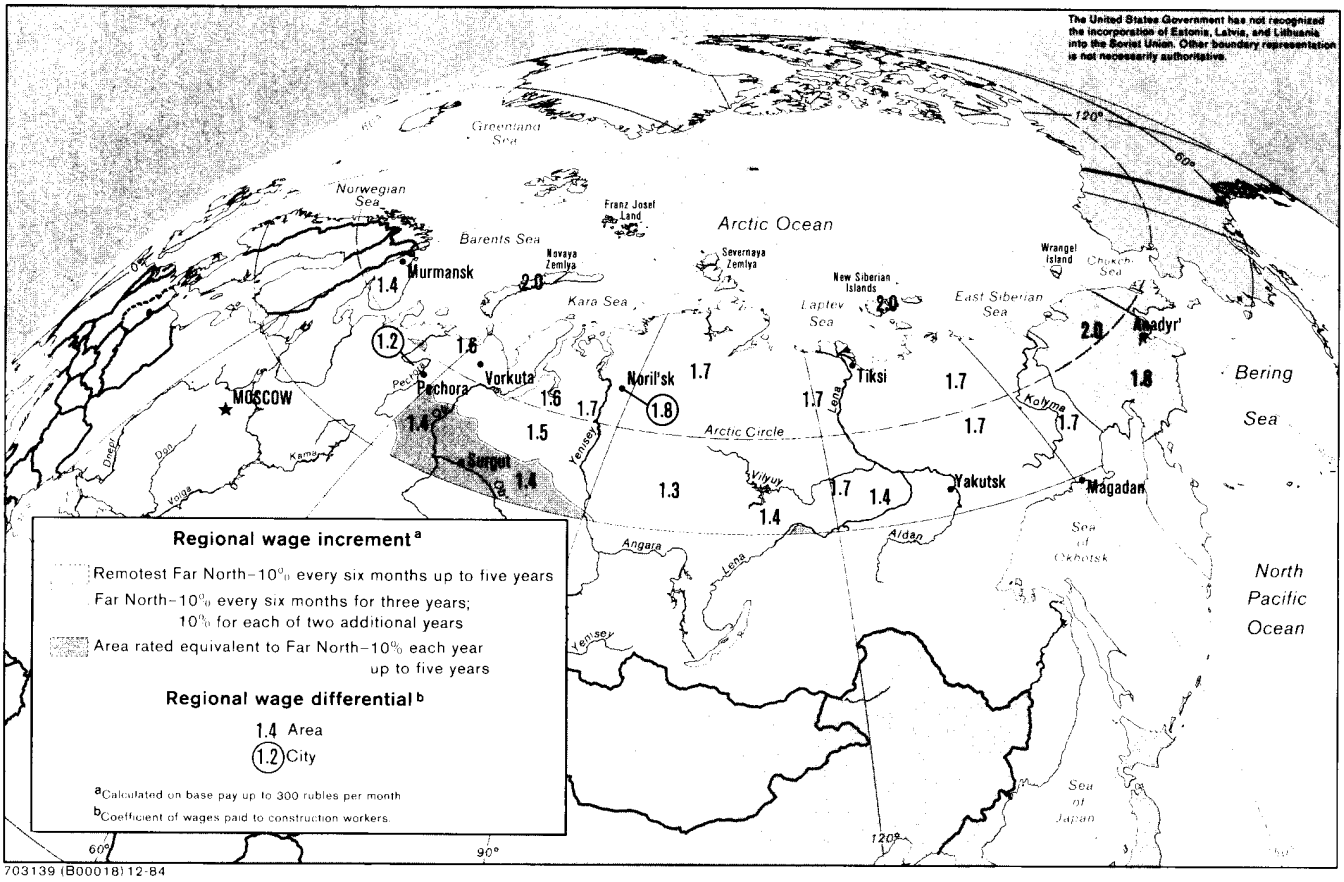

Figure 4
Permafrost Regions in the Soviet Union

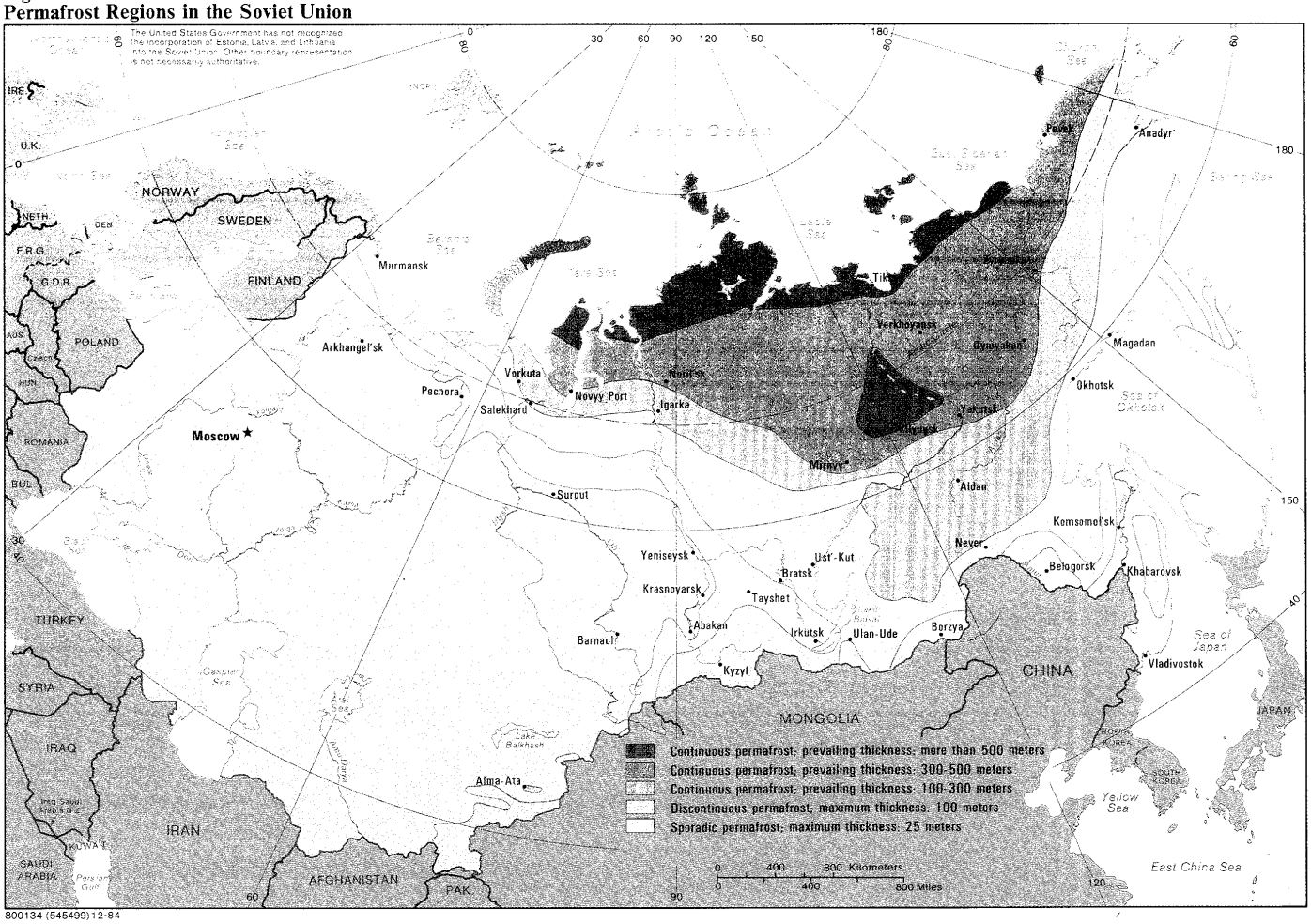

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Figure 5
West Siberian Oil and Gas Region

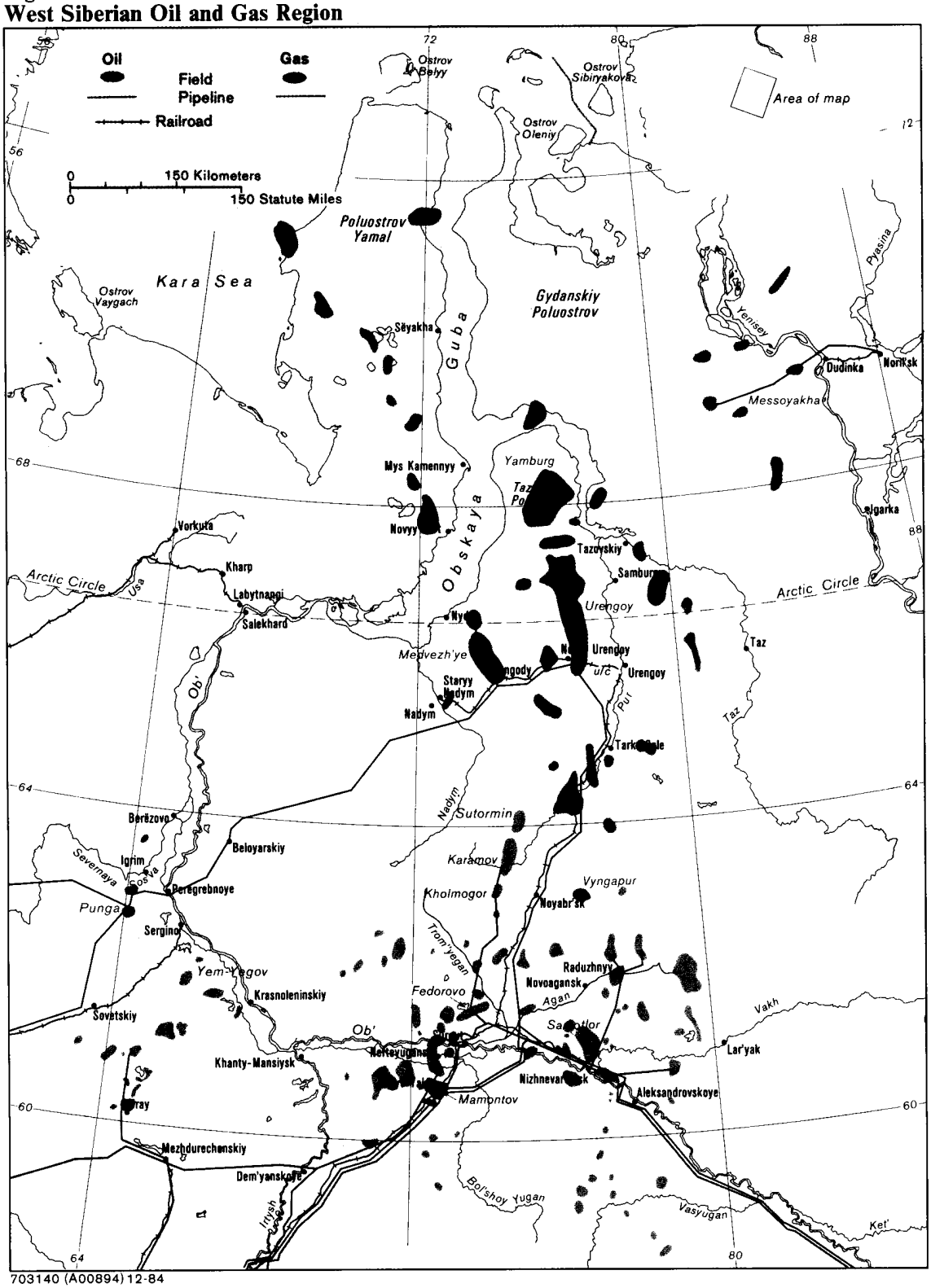
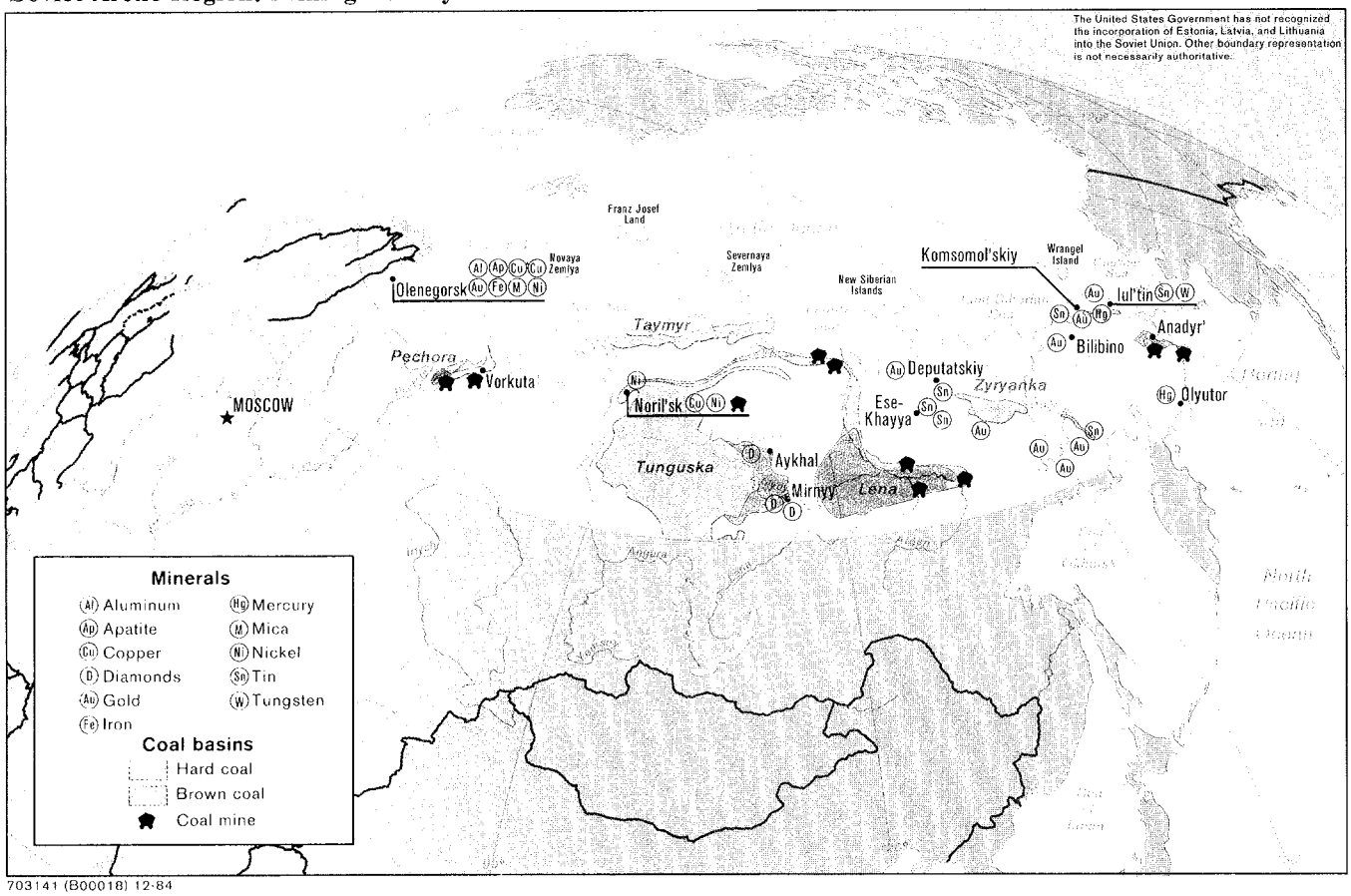


Figure 6
Soviet Arctic Region: Mining Activity



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