SECRET
SECURITY INFORMATION
15514

COPY NO. 47
ASSISTANT DIRECTOR
FOR POLICY COORDINATION

ECONOMIC INTELLIGENCE REPORT

PRODUCTION AND USES OF LITHIUM AND BERYLLIUM IN THE SOVIET BLOC

BRANCH ONE

CIA/RR 10

15 September 1952

CENTRAL INTELLIGENCE AGENCY

OFFICE OF RESEARCH AND REPORTS

SECRET

~~S-E-C-R-E-T~~

S~~ECURITY INFORMATION~~

ECONOMIC INTELLIGENCE REPORT

PRODUCTION AND USES OF LITHIUM AND BERYLLIUM IN THE SOVIET BLOC

CIA/RR 10

CENTRAL INTELLIGENCE AGENCY

Office of Research and Reports

~~S-E-C-R-E-T~~

CONTENTS

Appendixes

PRODUCTION AND USES OF LITHIUM AND BERYLLIUM IN THE SOVIET BLOC

Summary

The production of lithium and beryllium in the Soviet Bloc is, as elsewhere, small, but these metals and their compounds have become increasingly essential to mass production in modern industry. The greatest demand for them began at the start of World War II in the manufacture of war materials and has continued unabated. Lithium as an alloying agent increases the hardness and toughness of many metals, and lithium stearate is utilized in greases to keep them fluid at extremely low temperatures. In some form, beryl or beryllium is used in virtually every piece of military equipment. Another possible use for these materials, of major importance at this time, is in nuclear energy programs.

The principal sources of the ores of lithium and beryllium are pegmatite formations, of which the USSR is believed to have an adequate supply. Processing facilities are found for lithium at Tsaritsino near Moscow, Novosibirsk in the West Siberian Plain, and Ust'-Kamenogorsk in East Kazakhstan and for beryllium at Asbest in the Ural Mountains and Kol'chugino near Moscow. These facilities are believed to be adequate.

In the Soviet Bloc, as elsewhere, lithium and beryllium metals and their compounds are utilized for the most part by the metallurgical industries. There is no evidence that either lithium or beryllium is being processed for use in the Soviet nuclear energy program.

I. Introduction.

1. General.

Lithium and beryllium metals and their compounds are not similar, and their uses are not interchangeable. They are discussed together in this report, however, because the minerals which provide the raw material for the production of these metals and their compounds occur together and are recovered at the same time.

2. History and Significance of the Industries.

a. History.

The element lithium was discovered in 1807 in the mineral petalite, and 10 years later, in 1817, the first small bead of lithium metal was recovered. The chemistry of the lithium minerals was studied thoroughly, but the general use of lithium has been restricted until recently because of limited known sources of raw material. The first, and for many years the main, use of lithium was in the medicine known as lithia water. Then its use in chemical compounds became important and finally its use as a metal.

Before the first Five Year Plan (1928-32) the USSR obtained lithium metal and its compounds from Germany, then the world's largest producer. Spodumene, lepidolite, and zinnwaldite are the lithium minerals recovered in the Soviet Bloc. Production in the USSR started in the Trans-Baikal area with the recovery of spodumene. Production of spodumene in the Ural Mountains area was next reported. By 1947 the Soviet Bloc was believed to be self-sufficient in lithium minerals. 1/*

Beryllium as an element was discovered in 1798, but it was not until 1926 that commercially successful experiments to produce the metal were concluded in the UK, Germany, and the US. Production of the metal remained at a low level until about 1940, when the output of beryllium-copper master alloy (about 4 percent beryllium) increased rapidly. This master alloy accounts for by far the largest part of the consumption of beryllium. The alloy was used in some form in almost every piece of military equipment manufactured during World War II.

The production in the USSR of beryl, the principal ore of beryllium, started in the Ural Mountains and in the Trans-Baikal areas, which are still the main producing areas. Experimental work on the commercial application of beryllium in the USSR started in 1922, and the first semicommercial equipment to recover beryllium was put into operation in 1932. Development of production and application was constant from that time, and by 1947 the Soviet Bloc was believed to be self-sufficient in beryl and in beryllium metals and their compounds.

* Footnote references in arabic numerals are to sources listed in Appendix D.

b. Significance.

Beryl and beryllium, because of their small but vital part in the metallurgical industry, are of greater importance to the Soviet Bloc than lithium metal and its compounds. Substitutes for lithium metal more nearly meet specifications for uses of lithium than do the substitutes for beryllium metal and its compounds. Provided these commodities are not utilized in the Soviet nuclear energy program, the industries producing them will remain small but important industries, with a definite place in a wartime or peacetime economy.

3. Mineralogy and Occurrence.

a. Lithium.

There are about 18 known lithium minerals, but spodumene, amblygonite, lepidolite, and zinnwaldite have been until recently the only minerals from which commercial-grade lithium has been recovered. In the past few years, petalite from South-West Africa and dilithium sodium phosphate recovered from the brines of Searles Lake, California, in the US have been added to the commercial sources of this metal and its compounds. All of these materials, with the exception of dilithium sodium phosphate, are found in pegmatites. Lepidolite is the most widespread of the lithium minerals and contains 2.16 to 4 percent lithium oxide (Li_2O). Spodumene, containing 4 to 6 percent Li_2O, however, accounts for the largest tonnage of lithium ore recovered. Amblygonite, containing 7 to 9 percent Li_2O, provides only a small percentage of the total ore recovered. Dilithium sodium phosphate contains 19 to 21 percent Li_2O. Zinnwaldite, which is recovered in East Germany, Czechoslovakia, and North Korea, contains 1.7 to 2.6 percent Li_2O.

Some quantities of lithium minerals are found on all continental land masses. Commercial production, however, is confined almost entirely to the US and Canada in North America; to South-West Africa in Africa; to East and West Germany, Czechoslovakia, Sweden, France, Portugal, and Spain in Europe; to the Urals, Soviet Central Asia, and the Trans-Baikal areas in Asia; and to Australia. The US, followed by South-West Africa, is the largest producer of lithium ores. The USSR is not a major producer of lithium, but it is believed that its supply for war materials and manufacturing equipment is adequate for current or wartime demands.

b. Beryllium.

There are about 30 minerals which are known to contain beryllium, but only beryl ($BeO\ Al_2\ O_3\ 2SiO_2$), a beryllium aluminum silicate containing 9 to 14 percent beryllium oxide (BeO), constitutes a commercial source of beryllium. Beryl must contain 10 to 12 percent BeO to be recovered commercially. The clear, deeply colored green beryl is better known as the gem stone emerald, and the clear, lighter-colored variety is classed as the semiprecious gem stone aquamarine. Beryl, which occurs in pegmatites, mica schists, gneiss, and limestone, is recovered usually as a by-product of the mining of feldspar, mica, or lithium mica. Most commercial deposits are found in pegmatites, of which the principal minerals are quartz, feldspar, and mica in which beryl rarely accounts for more than 1 percent of the rock and normally for not more than 0.2 percent. Other beryllium minerals which are potential sources of beryllium are chrysoberyl, phenacite, helvite, and idocrase.

Brazil, Argentina, and India are the world's leading producers of beryl. Other producers are the Union of South Africa, South-West Africa, Australia, Madagascar, British East Africa, Nigeria, Portugal, the USSR, Southern Rhodesia, and the US. The US is an importer of beryl and is expected to remain so. It is believed, however, that the USSR has large deposits of beryl and could become a major producer.

4. Uses.

a. Lithium.

Lithium metal is used in small quantities to increase the hardness, toughness, and tensile strength of aluminum, lead, magnesium, and zinc. As a calcium-lithium alloy, lithium is used as a degasifier, deoxidizer, desulfurizer, and general purifying agent in iron nickel, and copper alloys. Lithium chloride and lithium fluoride are used in welding fluxes for aluminum and magnesium. Lithium chloride may be used in industrial air conditioning and in blast furnaces and foundry cupolas. Either lithium stearate or monohydrate lithium hydroxide is used in greases because it remains fluid in the extremely low temperatures encountered by aircraft at high altitudes.

b. Beryllium.

Beryllium is important in three forms: as an alloy with copper and aluminum, as beryllium oxide (BeO), and as a pure metal. The use of beryllium with copper to form an alloy from which other alloys are prepared is its most important use and accounts for about 85 percent of all beryllium consumed. This master alloy, beryllium-copper, is used in the preparation of other alloys in which great strength and hardness are required and in which electrical conductivity and corrosion resistance are important. Products requiring these qualities include springs for use in pressure-sensitive diaphragms and capsules, Bourdon tubes for pressure gauges, and flat or cantilever-type springs for small switches and relays. There are about 40 uses for these products which are essential to a military program. Because of the nonsparking quality of beryllium-copper master alloy, a moderate amount is used in safety tools where a cutting edge is required. Large quantities are used as electrodes in resistance welding and in bearings, bushings, diesel-engine reversing clutches, and castings.

BeO is used in two grades: regular-quality grade and high-purity, or fluorescent, grade. The regular-quality grade is used as a refractory where its high melting point, good thermal-shock properties, and resistance to oxidation are required. High-purity BeO is used in fluorescent lamps, radio-tube cathode-heating elements, and ceramic coatings on lamp filaments and as a "getter" in vacuum tubes. Beryllium metal in thin hot-rolled strips is used for the windows in X-ray tubes. Beryl may be used directly in the manufacture of a glaze to produce a thin ceramic shell for spark plugs utilized in high-altitude aircraft.

BeO and beryllium metal are now used in relatively small quantities in the nuclear energy program of the US and presumably have analagous uses in the Soviet program. Beryllium may well have future use in major quantities in nuclear reactors for power or propulsion purposes.

5. Substitutes.

Lithium and beryllium metals and their compounds have many important uses, but only a few can be called essential, because substitutes may be used.

a. Lithium.

There are satisfactory substitutes for lithium in most of its applications. There is a large number of products available in quantities equal to those of lithium that may be used as scavengers to remove impurities from melts. Either barium or strontium may be substituted for lithium compounds in greases, and calcium may be substituted for lithium chloride in industrial air conditioning and dehumidification in steel plants, foundry cupolas, airplanes, and submarines. Lead silicate may be substituted for lithium carbonate in the ceramic industry, since lithium carbonate was originally substituted for lead silicate. Beryllium is a better scavenger in copper refining than lithium, but beryllium is not so available as lithium and is thus higher priced.

b. Beryllium.

The uses of beryllium products are so extensive and widespread that it would be difficult to cover the substitution possibilities of each use. Therefore, only the possible substitutes for beryllium-copper master alloy, beryllium oxide (BeO), and beryllium metal will be considered.

Phosphor bronze, aluminum bronze, stainless steel, and chromium-copper alloys, listed in the order of their importance and suitability, are the materials that may be used instead of beryllium-copper master alloy. In some cases the use of these substitutes would entail redesigning the product completely and would cause a reduction in the efficiency and the service life of the product manufactured. Either magnesia or stabilized zirconia may be substituted for BeO to attain high-temperature refraction. Very thin aluminum strips, however, may be used as X-ray windows, and other products may be substituted for beryllium metal as a "getter" in vacuum tubes.

II. Production and Reserves.

1. Lithium.

a. Production.

Lithium minerals, consisting for the most part of spodumene averaging 5 percent lithium oxide (Li_2O), are recovered by open-pit operations, chiefly in the Trans-Baikal region, the Ural Mountains, and East Kazakhstan.

The Zavitinskiy deposits east of Lake Baikal are reported to be the largest deposits of lithium ore in the USSR. Large deposits of spodumene and lepidolite have been reported near Samarkand in Soviet Central Asia, but no information is available on their development. (A list of the main lithium ore mines and mining areas in the Soviet Bloc is given in Appendix A.) The deposits of lithium ore in the Soviet Bloc outside of the USSR are the low-grade lepidolite and zinnwaldite deposits located in East Germany and near Rozna in Czechoslovakia and small quantities of spodumene, lepidolite, and zinnwaldite from one of six mines or occurrences in North Korea. Plants for the recovery of lithium metal and its compounds are located at Tsaritsino near Moscow, at Novosibirsk near the Kuznetsk Basin, at Ust'-Kamenogorsk in East Kazakhstan.

Soviet Bloc marketing statistics on ore production and finished product outputs are not available, but estimates of 1,000 metric tons of concentrate containing 5 percent Li_2O have been reported annually for 1949 and 1950, representing an output of about 50 metric tons of Li_2O annually. The lithium content of ores and concentrates is frequently reported in terms of lithium chloride. The estimated Soviet production of 50 metric tons of Li_2O would provide 113.5 metric tons of lithium chloride. It is estimated that about 20 percent (22.7 metric tons) of the 113.5 metric tons of lithium chloride produced annually in the USSR is utilized in the manufacture of lithium metal. Since 7 metric tons of lithium chloride are required to produce 1 metric ton of lithium metal, it is estimated that about 3.2 metric tons of lithium metal are produced. The remaining 90.8 metric tons of lithium chloride are consumed in the production of various lithium compounds such as stearates, fluorides, monohydrates, hydroxides, and hydrides. The 1949-50 production rate is believed to be adequate for the 1951-52 requirements of the Soviet Bloc.

b. <u>Processing</u>.

Spodumene, the main source of lithium in the USSR, occurs largely as individual crystals or as masses of crystals in pegmatite rock. Lepidolite and amblygonite, mined in smaller quantities, occur as masses but rarely as individual crystals. The lithium minerals are hand-picked from broken pegmatite rock. Soft, claylike material which adheres to some spodumene must be removed; and if lepidolite for use in the glass industry is not low in iron, most of the iron minerals associated must be removed.

Spodumene, lepidolite, and zinnwaldite are ground and calcined. Spodumene is then recovered by screening, and the ground lepidolite and zinnwaldite are mixed with an excess of potassium sulphate and heated. Lithium sulphate is extracted from this process by solution. The lithium oxide (Li_2O) obtained from the spodumene and the sulphate obtained from lepidolite and zinnwaldite can be changed to either lithium carbonate or lithium chloride and then processed into metal or compounds. Lithium metal is obtained by electrolysis of lithium chloride.

2. Beryllium.

a. Production.

The main beryl producing area in the USSR is the emerald mine region of the Urals in the vicinity of Sverdlovsk. The chief mines in this region are located at Malyshevo, Krestovik, Pervomayskiy, Krasnobolotskiy, Ostrovskiy, Krupskiy, Sretenskiy, and Cheremshanskiy. Many small mines are also located in this area. 2/

Second in importance to the Ural Mountains deposits is the Sherlovaya Gora Mine, east of Lake Baikal, near the boundary line of Eastern Siberia, Manchuria, and Mongolia. The large mica mine at Taseyevo, about 300 kilometers north-northeast of Krasnoyarsk, is another important beryl production center. In Soviet Central Asia the large producing areas are the Tigirek deposits, 200 kilometers northeast of Semipalatinsk; the Lake Balkhash region; the Ust'-Kamenogorsk area; and the Sinkiang frontier, about 300 kilometers northeast of Alma-Ata. Beryl deposits of varying size have also been discovered in the Pamir Mountains, on the Afghanistan border; in the Caucasus Mountains; along the Lena River in Yakutskaya ASSR; and on the Chukotskiy Peninsula, just opposite Alaska. It is believed that other beryl deposits have been found in the Dalstroy region of northeastern Siberia. (A list of the major beryl mines and mining areas in the Soviet Bloc is given in Appendix A.)

Outside of the USSR, rich deposits of beryl are reported in the Hsing-an Mountains (Hsiaokhingan Shan) of Manchuria, and small quantities of beryl also may be found in the Huang-Hua-Ko-Tung deposit in Siuynan province in China. 3/ However, additional information on development or recovery of beryl from these deposits has not been received. Small quantities of beryl have also been recovered from deposits located in the northern part of Kangwon Province in North Korea. 4/ The beryl crystals are small and are associated with topaz, cassiterite, quartz, and feldspar in pegmatites. 5/

There is little information on which production figures may be based, but it is estimated that the annual output of beryl (10 to 12 percent BeO) in the Soviet Bloc is 35 to 40 metric tons. Of this total, 30 to 35 metric tons are recovered in the USSR and the remainder in North Korea. This production rate is believed to be adequate for 1951-52 Bloc requirements.

b. Processing.

In the recovery of beryl the usual practice is to separate the beryl crystals and crystal masses by hand and stockpile them until sufficient quantities have been accumulated to make a shipment. The recovery of small beryl crystals by various beneficiation processes such as flotation has been accomplished on an experimental basis, but the costs are relatively high.

In the USSR the recovery method is the same, and the crystals and crystal masses are shipped to reduction plants, one near Asbest in the Urals and the other near Kol'chugino in the Moscow area. Beryl from Korean mines is treated also at these plants. The Asbest and Kol'chugino plants are believed to be the only factories in the USSR producing beryllium oxide (BeO) and beryllium metal.

Beryl is reduced to BeO or to beryllium metal by treating the ore to make it reactive and then extracting the beryllium content in the form of water-soluble salt. The separation of the BeO from the iron, aluminum, and other impurities in this salt is difficult. It is a complicated chemical process which may be done by either the Joy-Windecker, Copaux-Kawachi, or Sawyer-Kjellgren processes.

Beryllium-copper master alloy is produced by thermal reduction of BeO with carbon in the presence of finely divided copper. Metallic beryllium is produced by converting BeO to beryllium chloride and then reducing the chloride to metal by electrolysis.

A metric ton of beryl contains about 264 pounds of BeO, approximately 198 pounds of which are recovered. About 10 to 15 percent of the beryllium content is lost in the reduction of BeO to beryllium-copper master alloy. Thus about 173 pounds of beryllium is utilized in producing the alloy. The loss of beryllium content in the conversion of beryllium-copper master alloy to the finished product may be almost 50 percent. The quantity of beryllium metal recovered from a metric ton of beryl containing 10 to 12 percent BeO, therefore, is about 82 to 90 pounds. 6/

3. Reserves.

It is virtually impossible to present firm figures on reserves of lithium minerals and beryl, since these minerals rarely make up more than 1 percent of the pegmatite and an even smaller percentage of the schists in which they occur. However, estimates based on known geologic evidence of the large number of pegmatites and schist rocks containing mica, feldspar, beryl, spodumene, and lepidolite in the USSR suggest that reserves of lithium minerals and beryl are large and will be adequate for many years. There are several brine lakes in European USSR that, like Searles Lake, California, in the US, may carry recoverable quantities of dilithium sodium phosphate.

III. Consumption.

1. Lithium.

Consumption of lithium metals and their compounds in the Soviet Bloc is estimated to be about equal to production. The industry is small, and the only stocks available would consist of working inventories rather than stockpiles. Statistics on annual consumption are not available. Military requirements would have precedence in the Soviet Bloc and would be largely for lubricants, welding fluxes, flares, and metal and alloys used in production and use of military equipment. It is believed that the most essential uses for lithium products in the USSR would be lithium metal and lithium alloys used as scavengers and hardening agents in the metallurgical industries, lithium stearate and monohydrate lithium hydroxide greases, and lithium chloride. There is no evidence to date, however, that the USSR is interested in the use of lithium products for the production of thermonuclear weapons. Recent requests for information on or for shipments of lithium compounds from the US have been made by Eastern and Western European countries. These requests may be attributed to interest in using these compounds in jet fuels for airplanes or in guided missiles or to an effort to fulfill normal economic demands which formerly were met by Metallgesellschaft plants now in East Germany. 7/

2. Beryllium.

On the basis of an estimated production of 35 to 40 metric tons of beryl ore a year and an average of 85 pounds of metal recovered per ton of ore, the available annual supply of beryllium metal in the Soviet Bloc would be about 3,400 pounds, or about 1.5 metric tons. Statistics on annual consumption and stocks of beryl and beryllium products in the Soviet Bloc are not available, but it is estimated that consumption is approximately equal to production. Stocks, if any, are considered as working inventories rather than as stockpiles.

It is believed that, as in the US, the major use of beryllium in the Soviet Bloc is in the formation of beryllium-copper master alloy. There is no evidence to date that the USSR is using beryllium oxide (BeO) or beryllium metal in its nuclear energy program.

APPENDIX A

LIST OF LITHIUM AND BERYLLIUM ORE MINES IN THE SOVIET BLOC

1. Lithium Ore Mines. — Coordinates

USSR

Zavitinskiy	51°43'N - 115°34'E
Kanaika	49°40'N - 87°10'E a/*
Lipovka	58°05'N - 61°53'E
Murzinka	57°42'N - 61°01'E
Boyevka	56°23'N - 62°09'E

European Satellites

Rozna, Czechoslovakia	48°45'N - 20°23'E
Zinnwald, East Germany	50°58'N - 13°25'E

North Korea 8/

Tachikot	38°10'N - 126°10'E

2. Beryllium Ore Mines. 9/

USSR

Caucasus

Dzirulskiy Massiv	42°10'N - 42°05'E
Shrosha	41 51'N - 45°39'E

Urals

Malyshevo	57°00'N - 61°11'E
Pervomayskiy	b/
Krestovik	b/
Krupskiy	b/
Cheremshanskiy	b/

* Footnotes follow on p. 15.

[p. 12 blank]

2. Beryllium Ore Mines. 9/ (Continued)

USSR (Continued)

Urals (Continued)

	Coordinates
Krasnobolotskiy	b/
Sretenskiy	b/
Ostrovskiy	b/

Western Siberia and Altay

	Coordinates
Lake Kazachka	53°02'N - 82°59'E a/
Tulata Village	51°18'N - 83°24'E
Upper Shchyseta Creek	52°00'N - 89°58'E a/
Kolyvan Lake	51°20'N - 82°40'E
Chemal	51°25'N - 86°10'E
Chulyshman River (Watershed)	51°15'N - 87°40'E
Bashkaus River (Watershed)	50°51'N - 87°48'E
Kolyvanskiy	55°03'N - 82°53'E a/
Tigirek	51°08'N - 83°04'E

Central Asia

	Coordinates
Kara Su Glacier Field	42°54'N - 76°07'E a/
Ak Su Glacier Field	42°54'N - 76°07'E a/
Dukunek Glacier Field	42°54'N - 76°07'E a/
Tamyngren Glacier Field	42°54'N - 76°07'E a/
Kyrk Bulaka	39°44'N - 65°34'E
Lower Shakh-Dara River	37°30'N - 71°30'E
Pamir Mountains	37°05'N - 73°00'E
Sherlovaya Gora	50°35'N - 116°21'E
Belukha	51°15'N - 116°50'E
Maty Saktui Village	50°40'N - 116°33'E a/
Antonova Gora	50°40'N - 116°34'E a/
Kuranzha Village	50°27'N - 114°02'E
Dzhida	51°27'N - 116°03'E
Kadaya	50°56'N - 119°17'E
Taseyevo Mine	57°14'N - 94°05'E
Anadyr River	64°50'N - 176°18'E
Chukotskiy Poluostrov	65°00'N - 170° to 180°W
Dalstroy Region	c/

2. Beryllium Ore Mines. 9/ (Continued)

	Coordinates
Outer Mongolia	
Ulan Bator	47°20'N - 106°05'E
Manchuria	
Hsiaokhingan Shan	50°00'N - 126°00'E
China 10/	
Huang-Hua-Ko-Tung	41°09'N - 112°30'E
North Korea 11/	
Chonpul, Kumkansan	38°50'N - 128°19'E
Monmurcho, Kumkansan	38°49'N - 128°25'E
Sinpungni, Sinpungni	38°50'N - 128°20'E
Sumoni, Yanggumyon	38°02'N - 128°00'E

---

a. Approximate coordinates.
b. The mines in the Urals are all in one region about 90 kilometers northeast of Sverdlovsk; the coordinates are 57°03'N - 61°12'E.
c. Includes Kolyma, Yakutskaya ASSR, and Khabarovsk north of 55° latitude.

APPENDIX B

GAPS IN INTELLIGENCE

Reasonably accurate information is available on sources and reserves of lithium minerals and beryl in the Soviet Bloc. The largest gaps are in information concerning marketing statistics on current output, stocks, and consumption of these metals and their compounds.

[p. 16 blank]

APPENDIX C

METHODOLOGY

The estimate of availability of lithium minerals and beryl in the Soviet Bloc is based on published geologic reports of the occurrences of these materials and is believed to be firm. Production estimates of ores and concentrates were obtained from various sources. The figures used for the lithium and beryllium content of the ores are those used in the US, and these are considered highly reliable, since the ratio of mineral to impurities remains essentially constant for these minerals regardless of the place found. Figures for the metals and their compounds are based on the manufacturing processes used in the US and Western Europe and those used in Germany before World War II.

Spodumene is indicated as the main lithium mineral. In US practice the lithium oxide (Li_2O) content of spodumene is found to be 5.5 to 6 percent. In accordance with the belief that the Soviet methods of processing the ore are not so efficient, an estimate of 5 percent is used for Li_2O content. The conversion of Li_2O to lithium chloride is computed by using the standard chemical factor used for this type of ore. The estimate that 20 percent of the lithium chloride produced is being utilized in the production of lithium metal is again based on US and pre-World War II German practice, with a reduction factor applied because efficiency is believed to be lower in the USSR. Estimates of the beryllium content of the ores and concentrates of beryl in the Soviet Bloc were determined on a similar basis.

The estimate of the major utilization of lithium and beryllium metals in the Soviet Bloc is based on the available information on the production and current industrial uses of the metals and the various compounds of the products of these minerals. The estimate that these metals are not in demand for the Soviet nuclear energy program is based on a simple lack of evidence indicating such a demand. The Soviet Bloc is assumed to be self-sufficient in these materials on the basis of world-wide industrial practices for these metals and their compounds and on the lack of evidence indicating that the Soviet Bloc is trying to obtain imports of lithium and beryllium.

[p. 18 blank]

APPENDIX D

SOURCES AND EVALUATION OF SOURCES

1. Evaluation of Sources.

Source numbers 1, 2, 4, 5, 6, and 9, which contain for the most part information on the location of lithium and beryl deposits and their possible output potential, are the most valuable. Source numbers 3, 7, and 8, containing material on uses and substitutes for the finished products, are of value, but they are of a general nature and not so specifically tied to the requirements of the Soviet Bloc. Source numbers 11, 12, and 13 are of a general nature and were of little use in the preparation of this report.

2. Sources.

1. P.E. Liebman, Trebovaniya promyshlennosti kachestvu mineralnogo syrya, Vypusk 41-Litiy (Industrial Specifications of Raw Minerals, Issue 41-Lithium), Moscow, 1947.
2. Minerals Year Book, US Bureau of Mines, 1949.
3.
4. NRS Report No. 84, Mineral Resources of Southern Korea, SCAP, Tokyo, 1947.
5. D.R. Faulconer, Rare Element Mineral Resources of North Korea, SCAP, NRS-NR646, 25 Aug 1947.
6. E.S. Downs, R.J. Anderson, and R.J. Lund, Economic Survey: Beryl, Beryllia, and Beryllium, Construction Materials for Aircraft and Guided Missiles, Project Rand, USAF MX-791, R-155, Jun 1949.
7. CIA OO, 11 Oct 1950.
8. Faulconer, op. cit.
9. A Collation of Available Information in Russian Texts on Beryllium and Tantalum Resources of the Soviet Union, State Department Report 302, American Embassy, Moscow, 3 Mar 1944.
10.
11. A.E. Fersman, Pegmatites, Leningrad, 1931, Vol. 1, p. 117.
12. D.B. Shimkin, The Mineral Self-Sufficiency of the Soviet Union, Mar 1949.
13. ID WDGS, Industries of the USSR, based on captured German documents, information to 1941, Jun 1947.