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DEPOSITS OF LITHIUM-BEARING MINERALS
IN AUSTRALIA.

by

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DEPARTMENT OF SUPPLY & SHIPPING

Mineral Resources Survey Branch

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DEPOSITS OF LITHIUM-BEARING MINERALS
IN AUSTRALIA.

The following summary of deposits of lithium-bearing minerals in Australia has been compiled from office records, including the previous statement on amblygonite deposits by P.B. Nye, and reports on Western Australian deposits by H.A. Ellis of the Geological Survey of the State. Much of the information on the Northern Territory deposits has been obtained from an article by A.E. Williams in 'Chemical Engineering and Mining Review' of July, 1940.

GENERAL.

The following lithium-bearing minerals have been recorded in Australia -

<u>Mineral.</u>	<u>Composition.</u>	<u>Theoretical % of Lithium Oxide Present.</u>
Amblygonite	Fluo-phosphate of Aluminium and Lithium	10
Montebrazite	A variety of amblygonite	
Spodumene	Silicate of aluminium, lithium and Sodium	7-8.4
Lepidolite	Fluoride and silicate of potassium, aluminium and lithium	5
Petalite	Silicate of Lithium and Aluminium	5
Lithiophyllite	Phosphate of lithium and manganese	9.6

Deposits of lithium-bearing minerals likely to be of commercial value have been discovered in New South Wales, Western Australia and in the Northern Territory and small quantities have been produced from each of these States. No deposits of lithium-bearing minerals have been recorded from Queensland, Tasmania and South Australia.

AUSTRALIAN SOURCES.

New South Wales -

A deposit of amblygonite occurs in association with pegmatite and greisen at Euriowie 30 miles north of Broken Hill. The mineral is present in small lenticular bodies, pipes and isolated patches in quartz. In the weathered zone the amblygonite occurs in nodules in a matrix of white clayey material. The workings are very shallow, with a maximum depth of 8 feet, and expose amblygonite over a maximum width of 6 feet. It is stated that in the largest pipe, exposed to a depth of 8 feet the amblygonite had been sericitised along cleavages with impoverishment of lithia and deposition of minute crystals of pyrite.

An analysis of a sample taken in 1919 is as follows -

Water	5.24 per cent
Al ₂ O ₃	31.76 "
CaO	5.72 "
SiO ₂	0.82 "
Na ₂ O	0.11 "
Li ₂ O	8.77 "
MnO	0.06 "
P ₂ O ₅	45.88 "
Fluorine	1.74 "
	<u>100.12 per cent</u>
<u>Specific Gravity 3.006 less 0. = t.F.</u>	<u>0.73 "</u>
	<u>99.39 per cent.</u>

Production - Only 23.45 tons of amblygonite have been produced from Euriowie, 15 tons in 1934 and 8.45 tons in 1943. In 1934 the lithium oxide content of the ore was stated to be 5% and was considered too low for the market at that time. Ore produced in 1943 was stated to assay 5.05% lithium oxide and was sold for \$10 per ton f.o.r. Broken Hill.

Transport - Transport from the Euriowie deposit would entail 36 miles road cartage to Broken Hill and approximately 240 miles rail haulage to Port Pirie on Spencer's Gulf, South Australia. The distance by rail from Broken Hill to Sydney, the nearest East Coast point, is approximately 700 miles.

Western Australia -

Wodgina: Lithiophyllite has been recorded from two mining leases in the Wodgina area which lies about 70 miles by road southeast of Port Hedland in the Pilbara goldfield. The mineral occurred in masses of a few pounds up to 10 cwt. in weight in the outcrops of pegmatite dykes. No details of the deposit are available, but it was stated that the price offered per unit for lithium ores was too low to warrant development in this remote locality.

A detrital block containing lithiophyllite was found in another locality 25 miles distant in which the pure lithiophyllite was found to contain 7.81% lithium oxide, but apparently the source of the mineral has not been discovered.

Ubini: Amblygonite occurs in a quartz reef with pegmatitic concentrations about 4 miles by road northwest of Ubini Siding which is 10 miles west of Coolgardie on the Perth Coolgardie railway line. H.A. Ellis reported that in October 1943 the workings had all collapsed but a dump of about 2 cwt. of broken amblygonite was found nearby. A careful search was made along the outcrop of the reef but no further occurrences of amblygonite were noted. Partial analyses of amblygonite and montebrasite from this deposit are as follows:

	Clean Mineral	3 ton Parcel 1910.	Impure Montebrasite
	<u>%</u>	<u>%</u>	<u>%</u>
Li ₂ O	9.21	8.67	5.98
P ₂ O ₅	48.01	46.49	44.36

Spodumene has also been reported from this deposit but this occurrence is unconfirmed and of mineralogical interest only.

Production - A production of 3.2 tons of amblygonite was recorded from Ubini in 1910, but no amblygonite has been produced since then and, in 1943, Ellis reported that the deposit was of no economic importance.

Grosmont: Lepidolite occurs in a pegmatite dyke at Grosmont, an abandoned goldmining locality situated 10 miles by road southwest of Coolgardie. The old workings are now in a state of collapse but the dyke is exposed in an old open cut 210 feet long, 15 feet wide and 12 feet deep. It strikes north 15° west, dips west at 80 to 85° and is approximately 12 feet in thickness. The pegmatite is composed mainly of microcline feldspar and quartz with lepidolite mica as a minor constituent. A rough estimate of the percentage by volume of the main constituents are given as -

Feldspar	50 per cent
Quartz	45 "
Lepidolite	5 "

Biotite, beryl and topaz also occur as accessory minerals, but are not present in commercial quantities. Quartz and feldspar do not occur in large masses, but feldspar could probably be saved in any flotation process designed to recover lithium ore. Lepidolite is not confined to any particular section of the dyke and occurs as books and scales or in massive or foliated form.

A second pegmatite dyke 8 feet in thickness and 3 chains east of the principal deposit was also observed to carry lepidolite, but in very much smaller proportions.

Reserves of Ore: H.A. Ellis has calculated the following reserves of proved and possible ore but carefully states the assumptions that had necessarily to be made and warns that tonnage estimates in this and other deposits need to be confirmed by prospecting campaign. The only analysis of the lepidolite then available recorded a lithium oxide content of 5.97%.

	Approx. Quantity of ore <u>Long tons.</u>	Approx. Quan- tity of Lep- idolite in ore <u>Long tons.</u>	Approx. Li ₂ O content <u>Long tons.</u>
Proved ore (in dumps)	3,600	197	12
Possible ore	<u>34,200</u>	<u>1,862</u>	<u>111</u>
	37,800	2,059	123

Transport: Removal of the ore would involve cartage by road to Coolgardie (10 miles) and rail haulage of 351 miles to Perth.

Londonderry: Petalite occurs in a felspar quarry situated 4.4 miles by road southwest from Londonderry Siding, which is 10 miles south-southwest from Coolgardie and 366 miles by rail from Perth. It is 13 miles by good road from Coolgardie to the quarry.

The following description of the deposit has been taken from a report by H.A. Ellis, 1943.

" The quarry has been developed as a source of microcline felspar and has been opened up to a maximum depth of about 70 feet on the western side, and to an average depth of about 50 feet over an area roughly oval in shape about 400 feet long by 270 feet wide. (Oct.1943).

Approximately 100,000 tons of pegmatite dyke material have been excavated for a return of 23,500 tons of felspar up to August 31st, 1943.

Approximately 80,000 tons of waste products comprising mostly impure felspar, quartz, petalite and its decomposition products have been removed to the dump.

Petalite occurs in masses in the quarry capable of being selectively mined, in large scale pegmatite formation along with microcline felspar and quartz. Some of the petalite masses exposed in the quarry (Oct.1943) would contain up to 15 tons of unaltered petalite, and others, whose full dimensions cannot be judged, contain considerably more.

The main concentration of petalite occurs in the western part of the quarry, but it has occurred to a greater or less extent throughout the workings with the exception of the present (Oct.1943) north face of the quarry."

The approximate composition of the pegmatite by volume is given as -

Felspar (all types)	Approx.	35%
Petalite plus alteration products likely to contain lithium	"	25%
Hornstone and albite chalcedony rock probably completely replacing petalite	"	15%
Quartz	"	25%

Analyses of petalite and altered petalite from the quarry show a lithium oxide content of 3.72 to 4.13% and 0 to 1.11% respectively. For the purpose of his calculations Ellis assumes the lithium

oxide content of petalite to be 4%. He does not submit estimates of the quantity of altered petalite on account of its low lithium content.

The estimated ore reserves are as follows -

	Approx. Quantity of ore <u>Long tons</u>	Approx. quantity of Lithium-bear- ing mineral in ore <u>Long tons</u>	Approx. Li ₂ O Content. <u>Long tons.</u>
Ore at Grass (dumps)	1040	1040	41.6
Ore in Sight (quarry faces)	1000	1000	40.0
Possible ore	<u>37400</u>	<u>37400</u>	<u>1496.0</u>
	39440	39440	1577.6

Production: There is no record of production of lithium-bearing ore from this deposit.

Transport: Ore could be carted by road either to Londonderry Siding or to Caalgardie, thence 351 miles by rail to Perth.

Tantalite Hill: Some small lenses of massive scaly lepidolite mica occur in a pegmatite dyke at Tantalite Hill, 3 miles by airline southwest from Londonderry Siding. An unsuccessful attempt has been made in this area to treat eluvial and pegmatitic material for columbite and tantalite. Ellis states that "a generous estimate of the tonnage available from this deposit is 450 tons of massive scaly lepidolite containing 3.87% of Li₂O." A search of the locality failed to reveal any further occurrences of lepidolite.

A small quantity of lepidolite was produced from this deposit between 1892 and 1900 and recorded as mica with a total value of £291.

Ravensthorpe: A deposit of spodumene occurs one mile north of Ravensthorpe which lies 34 miles by rail north from Hopetown in the Eucla division. Spodumene occurs as crystals up to 3" in width in a pegmatite dyke outcropping over an area of about 2 acres. Spodumene amounts to possibly a quarter of the rock which could readily be mined by open cut.

Tests made on the ore indicate that crushing to 1" mesh would be necessary to enable spodumene to be hand picked efficiently. J.S. Foxall of the Western Australian Mines Department has estimated that approximately 6 tons of ore would be treated to obtain one ton of spodumene and that the hand picked spodumene could be landed at Fremantle for approximately £12 per long ton, including freight and wharfage charges and the cost of crushing, hand picking and bagging at the source. ~~The grade of~~ This spodumene is said to contain not less than 6% lithium oxide. The ore would presumably be railed 34 miles to Hopetown and thence shipped to Fremantle.

Other Localities: A deposit of lepidolite mica has been reported from the vicinity of Yalgoo, in the Yalgoo goldfield, about 130 miles by rail east from Geraldton, but no further information on the deposit is available.

Caesium-bearing lepidolite is recorded from the Tabba tin mine in the Northwestern division of Western Australia but no details of this occurrence are available.

Northern Territory -

Finniss River: Well defined dykes of white crystalline amblygonite occurs 4 miles north of Mount Bennett near the Finniss River, 30 miles south of Darwin. A smaller deposit occurs one mile east of

the principal dyke and similar occurrences are reported in other parts of the area. An analysis of the amblygonite is as follows:

	<u>Per cent.</u>
Water	6.16
P ₂ O ₅	47.16
Al ₂ O ₃	35.26
FeO	1.36
Na ₂ O	1.12
Li ₂ O	7.94
Fluorine	0.85
SiO ₂	<u>0.57</u>
	100.42

Amblygonite occurs as veins and large segregations associated with pegmatite dykes containing both columbite and tantalite. In the principal deposit (the Enterprise or Porters) the mineral is coarsely crystalline near the surface, but it is more massive at a depth of a few feet. The coarsely crystalline amblygonite near the surface contained 8% lithium oxide but it is reported that there was a marked decrease in lithium oxide content at a shallow depth. Lepidolite and tourmaline are associated with amblygonite in the principal deposit. There is apparently no record of the dimensions of the deposits or of the tonnage of amblygonite available but there is reported to be little mineral showing in the floor of the principal deposit and amblygonite showing in the smaller deposit is reported to be admixed with country rock.

Various analyses of amblygonite from this deposit are shown in the following table which appeared in the 'Chemical Engineering and Mining Review' of July, 1940.

	<u>1905</u> <u>Adelaide</u> <u>School of</u> <u>Mines.</u>	<u>1924</u> <u>Assays</u> <u>for</u> <u>Buyers.</u>	<u>1925</u> <u>Universite de Nancy.</u>		
Al ₂ O ₃	35.26		35.32	37.64	34.35
Fe ₂ O ₃	1.36		0.47	1.28	0.81
Na ₂ O	1.12		2.61	2.61	2.51
Li ₂ O	7.94	5.6 to 6.9	6.65	5.69	5.03
P ₂ O ₅	47.16		43.58	41.26	42.37
F	Not detd.		6.04	4.15	4.77
H ₂ O	6.16		5.18	6.05	9.77
SiO ₂	0.57		2.05	3.01	2.00
Undetd.	0.85		K ₂ O) 0.43	0.21	0.63

A total of 63.9 long tons of amblygonite has been mined from the two deposits since 1905. The bulk of this came from the Enterprise or Porters claim. Amblygonite from these deposits was hand picked and bagged for transport by road to Darwin, whence it was shipped to Germany. The basis of valuation was a content of 8.5% lithium oxide with a minimum allowable grade of 7%. In 1924 various samples of ore showed a decline in lithium oxide content and later parcels proved unsaleable as lithia content fell to 3.18%, presumably due to the increased difficulty of extracting clean mineral.

Amblygonite has also been recorded from Mount Litchfield, approximately 6 miles south of Darwin.

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16/1/45.

AUSTRALIAN AMBLYGONITE PRODUCTION.

Year.	Kurilowie New South Wales.		Ubini Western Australia		Finniss River Bynoe Harbour Northern Territory.		Total		Remarks.
	Qty. tons	Val. £	Qty. tons	Val. £	Qty. tons	Val. £	Qty. tons	Val. £	
1905					20x	204	20x	204	
1910			3.2	25.8			3.2	25.8	
1924					4.65	42.2	4.65	42.2	
1925					39.25	343.1	39.25	343.1	
1934	15						15		5% Lithia trial parcel.
1943	8.45						8.45	84.5	
	23.45		3.2	25.8	63.9	589.3	90.55	699.6	

No lithium-bearing minerals other than amblygonite have been produced in Australia with the exception of a small quantity of lepidolite produced from Tantalite Hill, Londonderry, between 1892 and 1900, to which reference has been made in the text.