



The new strategic minerals III: lithium

By Gill Burke

In the third part of our series on strategic minerals Gill Burke looks at lithium and the platinum group metals.

Uses

Lithium has a wide range of industrial uses. In its chemical forms (Lithium carbonate, L.hydroxide, L.chloride, L.fluoride, L.bromide, butyl-lithium) it is used in glass and ceramics, as fluxing, greases, glazing and in pharmaceuticals, polymerisation, organic synthesis etc. However, it is the uses of lithium metal that are more relevant in the strategic context, even though this represents a smaller proportion of total usage.

Lithium metal is used in the manufacture of lithium batteries, an industry which has grown rapidly over the last five years. Development of a rechargeable heavy duty battery is under way and should be commercially available in the next ten years. Current un-rechargeable battery uses are in computer memory backup systems and military field applications as well as medical and photographic use.

Another growth area is in lithium and aluminium alloys particularly in the aerospace industry. These alloys contain between 1.5% and 3% lithium and their main properties in increased strength, improved elastic modulus and up to 15% weight reduction for an aircraft.

Research is being carried out in Japan and the USA into molten carbonate fuel cells. Present designs have nickel based anodes and cathodes that are separated by a lithium-aluminium matrix and lithium-potassium carbonate electrodes. These are scheduled for commercialisation in the 1990s. In addition, research is continuing in the use of lithium in the nuclear power industry. This use would be in the deuterium-tritium fusion power generation process, where deuterium-lithium would be used for fuel and lithium used to create tritium by nuclear bombardment.

Production and reserves

Lithium sources can be broadly categorised into two types, pegmatite deposits and brine deposits. Brine de-

posits yield aqueous concentrates of lithium which are used as feedstocks for lithium carbonate production. Lithium minerals are extracted from pegmatites. The lithium ore minerals are spodumene, petalite, lepidolite, amblygonite and eucryptite. Pegmatites can be of simple or complex varieties and complex pegmatites can sometimes be rich in beryllium, tantalum, niobium, tin and uranium which are found especially at junctions of zones.

Until 1984, 60 to 70 per cent of lithium products came from the USA and the market was dominated by the duopoly situation that prevailed there.

However, the market subsequently became less watertight as new producers started in Australia, Canada and Chile. Of these the Chilean output has been most significant. China has also become a lithium products exporter. Although the USSR produces significant amounts of lithium, there seems little evidence of attempts to influence price and almost all production is consumed internally. The USA imports over 50 per cent of its lithium requirements from Chile. However, although lithium was previously categorised as a necessary war material and stockpiled by the USA, this is no longer the case.

Total demonstrated resources in the market economies amount to 3.4 Mt of contained lithium, 53 per cent contained in brines and 47 per cent in pegmatites. Of these, 2.2 Mt is recoverable, 59 per cent in Chile, 13 per cent in the USA, 11 per cent in Australia and 11 per cent in Canada. The remaining 6 per cent is located in Bolivia, Zaire and Zimbabwe.

PRODUCING COMPANIES

USA and Chile

The long duopoly of USA lithium production was shared by the *Lithium Corporation of America* (Lithcoa) and *Foote Mineral Ltd*. Both companies

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produced lithium compounds from pegmatite ores, Lithcoa at Bessemer City and Foote Mineral at Kings Mountain, whilst Foote also used brine sources at Silver Peak in Nevada. Lithcoa's production capacity by 1987 was 124 kt spodumene concentrates. Foote had 66.6 kt/year production capacity spodumene concentrates at King's Mountain and 6.35 kt/year lithium carbonate from Silver peak.

In 1982, Foote Mineral began a joint venture with the Chilean Government development company *Corporacion de Fomento de la Produccion* (CORFO). This developed low-cost lithium brine in the Salar de Atacama, Chile. Production capacity by 1987 was 6.35 kt/year lithium carbonate.

However, in 1985, demand for lithium batteries temporarily plateaued due to production difficulties in the Minute-

man missile silos and to concerns about safety. This set-back was more severe for the US companies than for more recent entrants still at development stage. Newmont Mining Corporation had had an 87.5 per cent holding in Foote from 1974, but continuing losses led to the stake being put up for sale from 1986. In 1988 this was acquired by *Cyprus Minerals Company*. Similarly, Lithcoa had been a subsidiary of Gulf Resources and Chemical but was sold in 1985 to FMC Corporation (this was more a consequence of the oil industries general retreat from near disastrous mining investment than of lithium price).

Recent entrants

Africa

The Zimbabwe company *Bikita Minerals* mines petalite and has a production capacity of 38.5 kt/year from which 700

t lithium was produced in 1987. The Zairean *SMC Geomines* (see germanium, RMR Vol 7 No 3) are still at exploration and development stage of an estimated 39.5 kt/year spodumene project at Kitotolo.

Australia

There is only one company producing lithium products, this is *Greenbushes*, already discussed under columbium/nio-bium (RMR Vol 7 No 3, see also tantalum). In 1988 a new company, *Lithium Australia*, acquired Greenbushes lithium assets for 17 million Australian dollars (MAUD) in 24M shares and 5 MAUD cash. Lithium Australia is 50% owned by Greenbushes and handles production and sales of lithium products. Production capacity is an estimated 49.2 kt/y spodumene concentrates.

Table 1

World production of lithium minerals (t)

	1984	1985	1986	1987	1988
Argentina	25	35	184	178	24
Australia ¹	6 668	545	347	363	454
Brazil ²	814	1 574	2 059	3 503	3 500*
Canada*	700	4 500	7 500	10 000	15 000
Chile ³	2 110	4 508	4 458	6 139	7 332
China*	15 000	15 000	15 000	15 000	15 000
Namibia	904	1 8073	855	916	1 558
Portugal ⁴	985	130	1 800	9 380	14 109
USA ^{*1,5}	5 000	4 500	4 000	4 000	4 000
USSR	50 000	55 000	55 000	55 000	55 000
Zimbabwe	22 548	27 910	32 760	14 959	15 073
World total^{*5}	7 400	7 600	7 200	7 400	7 900

* Estimates

¹ Spodumene, ² Including amblygonite, lepidolite and spodumene, ³ Carbonate, ⁴ Lepidolite, ⁵ Li content,

Source: British Geological Survey

Evaporation ponds at Silver Peak, Nevada, which produce energy free concentration of lithium values which are then processed into lithium carbonate. Silver Peak is controlled by Foote Mineral Company, a leading US producer.



Brazil

Lithium pegmatites are found in the Minas Gerais state, where proven reserves of 735 kt ore contain spodumene, amblygonite and petalite. In 1986 a joint venture was formed between *Arqueana de Minérios e Metais Litio (CBL)* and *Remetálica* to produce 1.5 kt lithium carbonate.

Canada

Although there are six developing mines in Canada there is only one that is currently producing. This is Bernic Lake, owned by *Tanco Mining Group*. This has a production capacity of 72.9 kt/year spodumene and produced 150 t lithium in 1987. Bernic Lake, like all the Canadian ventures, is an underground mine and thus has higher costs and lower grades than the other recent entrants and USA companies, which are open pit.

Europe

Apart from a small operation in Portugal, owned by *Pegmatitica*, the European companies are processors rather than primary producers, their plants supplied with raw materials for lithium products. FMC's subsidiary *Lithium Corporation of Europe (UK)* produces lithium salts for the European market as does *Leverton-Clarke Ltd* which is also UK based.

The principle European producer is *Chemetall AG* a wholly owned subsidiary of *Metallgesellschaft AG*, which produces organic and inorganic lithium compounds.

Japan

Japan is the major export market for USA lithium carbonate (45 per cent in 1986). Lithium minerals, metal and hydroxide are imported from various sources. *Asia Lithium Co*, a joint venture between *Lithco* and *Honjo Chemi-*

cal Co, markets lithium compounds and downstream products. Foote Mineral has agreements to supply chemicals to *Mitsui* and *Sumitomo*.

Other companies that manufacture lithium compounds include: *Nihon Kagaku (Nissho Iwai)*, *Asahi Glass*, *Sanko Kasei* and *Nihon Alkyl Aluminium*. Of the 50 t/year imported lithium metal, 60 per cent is used to make foil by *Kyokuto Metal* (a subsidiary of *Honjo*), *Mitsui Mining and Metals* and *Showa Cabot Super Metal*.

Thus it can be seen that by the late 1980s control of lithium price has moved from the primary producers to the producers of compounds. The USA Lithcoa/Foote duopoly that previously determined prices for smaller producers was not only hit by the demand trough of 1985/86, but more importantly by the growing complexity of lithium products. ■