Potential and Outlook

There is moderate to good potential for pyrophyllite deposits in association with hydrothermally altered felsic volcanic rocks of the Lachlan Orogen (Figure 21). In contrast, pyrophyllite occurrences are apparently much less frequent in the New England Orogen. Pyrophyllite is commonly associated with epithermal systems producing gold mineralisation. It developed through hydrothermal alteration of feldspar in felsic volcanic rocks.

Known occurrences of pyrophyllite in the Lachlan Orogen occur mainly in the Devonian Boyd Volcanic Complex of the Eden–Comerong–Yalwal rift zone and in the north at Yalwal. Although mainly associated with hydrothermally altered felsic volcanic rocks, several deposits/occurrences are hosted by andesitic volcanic rocks at Botobolar, Peak Hill, Gidginbung, and near Forbes.

New South Wales is the only Australian state producing pyrophyllite. Operating mines are at Back Creek, near Eden, and Botobolar, near Mudgee (Figure 21). The Back Creek Mine has substantial reserves and is the major producer of pyrophyllite in Australia.

Nature and Occurrence

Pyrophyllite ($Al_2O_3.4SiO_2.H_2O$) is a soft, generally white to pale yellow, hydrous aluminosilicate.

It consists of spherulitic aggregates of small crystals, large radiating acicular crystals or foliated lamellae (Table 32).

Properties of pyrophyllite, such as its chemical inertness, high dielectric strength, high melting point and low electrical conductivity, make it suitable for ceramic and refractory applications (Harben 1999).

Table 32. Main properties of pyrophyllite

Formula	$Al_2O_3.4SiO_2.H_2O$
Colour	White, greyish white, yellowish, pale blue, greenish, greyish or brown
Habit	Tabular and subhedral, radiated lamellar
Specific Gravity	2.65–2.9
Hardness	1–2

Source: Harben (1999)

Pyrophyllite is mainly produced in Japan, South and North Korea, Brazil, and Canada (Harben & Kužvart 1996).

World production of pyrophyllite in 2004 was 1.9 Mt (Virta 2004) (Table 33). Accurate figures of pyrophyllite production are difficult to obtain as many countries include pyrophyllite production with talc production.

Table 33. World pyrophyllite production 2004

Country	Production (tonnes)
Republic of Korea	910 000
Japan	550 000
Brazil	200 000
India	86 000
Pakistan	55 000
Thailand	74 000
Total	**1 875 000**

Source: Virta (2004)

Deposit Types

Pyrophyllite is commonly associated with epithermal mineralising systems. It is present in hydrothermally or metasomatically altered felsic volcanic rocks; metamorphosed volcanic ash; and, less commonly, in schist derived from metamorphism of volcanic ash.

A five-fold classification of pyrophyllite deposit types has been proposed by Zaykov et al. (1988). The first three classes involve hydrothermal alteration in different rock types. The five deposit types are summarised below.

1. Hydrothermal deposits in continental and island-arc volcanic zones, in Precambrian platforms and Palaeozoic and Mesozoic–Cainozoic orogens (e.g. Pambula).
2. Deposits in metamorphosed rocks in submarine Palaeozoic volcanic zones enclosing sulphide ores (e.g. Urals).

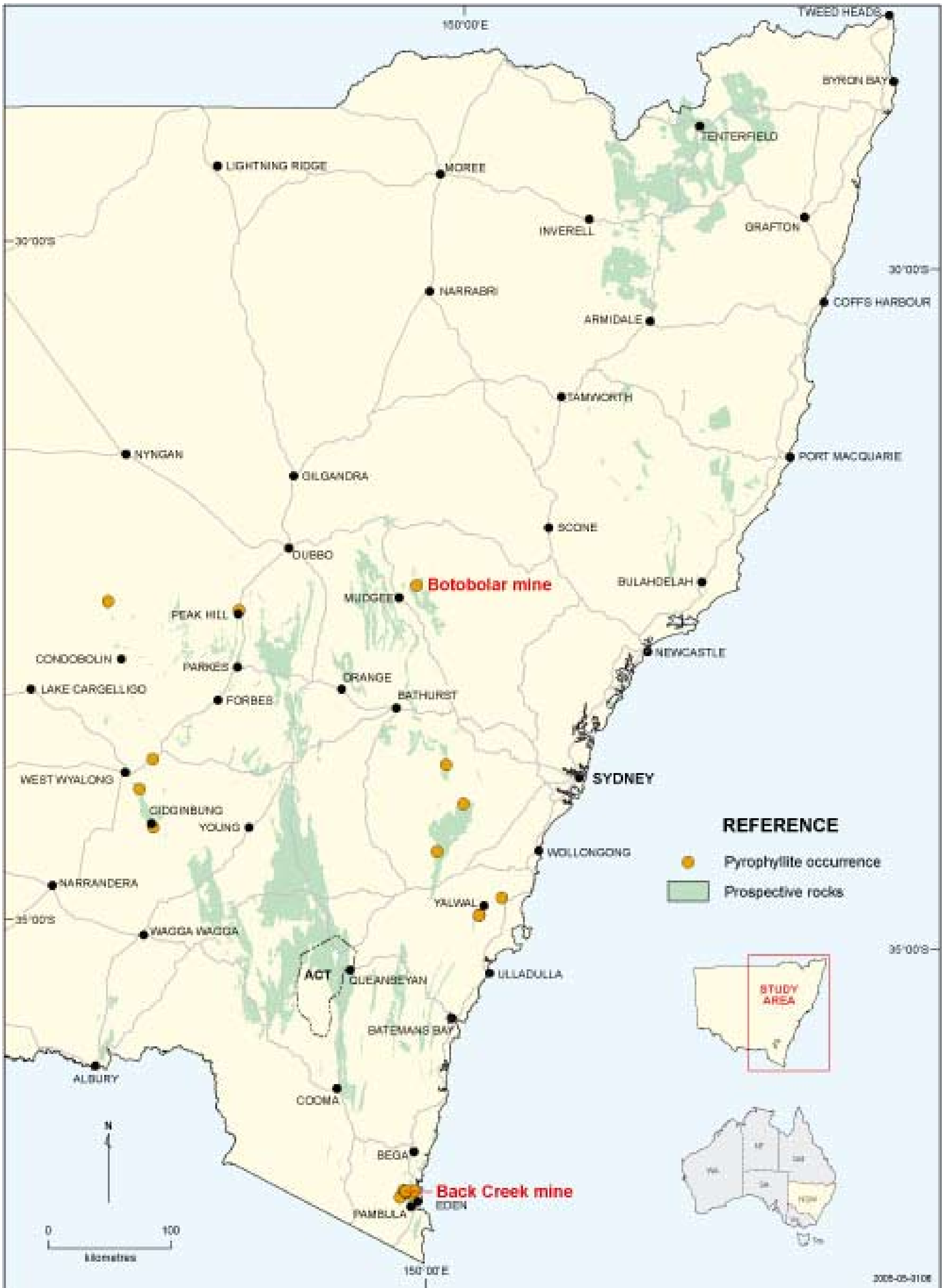

Figure 21. Pyrophyllite occurrences and distribution of felsic volcanic rocks in eastern New South Wales

3. Hydrothermal deposits in the wallrocks of hydrothermal quartz veins in Archaean and Palaeozoic granitoids and in metamorphosed Palaeozoic clastic suites (e.g. Madhya Pradesh, India).
4. Stratiform deposits in metamorphosed Palaeozoic and Mesozoic clastic-clay suites containing pyroclastic rocks and coal seams (e.g. Las Aguilas, Argentina).
5. Deposits in clay formed by weathering (e.g. Utah, USA).

Main Australian Deposits

New South Wales is the only Australian state producing pyrophyllite. Operating mines at Back Creek, near Eden, and Botobolar, near Mudgee, have a combined annual production of about 350 tonnes (Figure 21). The Back Creek mine is the major producer of pyrophyllite in Australia, producing between about 300 tonnes per annum and 700 tonnes per annum during the 1990s.

New South Wales Occurrences

There are 21 known pyrophyllite occurrences in New South Wales (Ray et al. 2003). There is great potential for more occurrences associated with epithermal systems.

In the Lachlan Orogen, major deposits occur in the southern part of the Eden–Comerong–Yalwal rift zone at Back Creek and Yowaka near Pambula, and Sugarloaf Mountain, west of Eden. Minor occurrences of pyrophyllite are also present in the Yalwal area.

Near Mudgee, the Botobolar deposit is hosted by Ordovician mafic volcanic rocks of the Coomber Formation. At Peak Hill, in central western New South Wales, inferior-quality pyrophyllite occurs in andesitic lavas of the Goonumbla Volcanics in the alteration zone of a gold–copper system. Also in the central west, pyrophyllite has been recorded as an alteration product of andesitic volcanic rocks at Gidginbung Mine, near West Wyalong, and in altered andesitic and rhyolitic volcanic rocks southeast of Forbes and near Condobolin.

In the New England Orogen, pyrophyllite occurs in altered felsic volcanic rocks at the Alum Mountain alunite deposit near Bulahdelah.

Hydrothermally altered felsic volcanic rocks of the Lachlan and New England orogens, particularly those associated with epithermal mineralising systems, and schists derived from the metamorphism of volcanic ash, represent the main target for identifying new sources of pyrophyllite in New South Wales.

Applications

Pyrophyllite is used in refractories, whiteware, foundry mould dressings, pesticides, paint, rubber, cement, fibreglass and soap.

Pyrophyllite decomposes at 1200°C to form mullite and cristobalite, has low thermal conductivity, a low coefficient of expansion, low hot-load deformation, and resistance to molten metals. It is used in alumina–silica monolithic refractories, insulating firebricks and monoliths, kiln car refractories, metal-pouring refractories and foundry mould coatings. In combination with zircon it is used in refractories in contact with molten metals, such as in ladle, tundish and cupola liners (Harben 1999).

In ceramics, pyrophyllite partly substitutes for feldspar as a source of alumina and silica, to reduce shrinkage, cracking and thermal shock, and lower electrical conductivity. It is also used as a pesticide carrier, anti-caking agent in animal feed, for agricultural chemicals, as a filler in wallboard and in paints and plastics (Harben 1999).

Economic Factors

Holmes et al. (1982) noted that the establishment of export markets would considerably stimulate the development of pyrophyllite in New South Wales. Large pyrophyllite deposits in countries such as Japan, Korea and the USA, which are closer to the world markets, inhibit the Australian export market.

References

Harben P.W. 1999. *The industrial minerals handybook*, 3rd edition. Industrial Minerals Information Ltd, London.

Harben P.W. & Kužvart M. 1996. *Industrial minerals: a global geology*. Industrial Minerals Information Ltd, London.

Holmes G.G., Lishmund S.R. & Oakes G.M. 1982. A review of industrial minerals and rocks in New South Wales. *Geological Survey of New South Wales, Bulletin* **30**.

Ray H.N., MacRae G.P., Cain L.J. & Malloch K.R. 2003. New South Wales industrial minerals database, 2nd edition. Geological Survey of New South Wales, Sydney, CD-ROM.

Virta R.L. 2004. Talc and pyrophyllite. *In*: United States Geological Survey. compiler. *Minerals Yearbook: Volume 1 — Metals and Minerals 2004*. United States Department of the Interior.

Zaykov V.V., Udachin V.N. & Sinyakovskaya I.V. 1988. Pyrophyllite deposits. *International Geology Review* **30**, 90–103.