VERMICULITE

Photograph 24. Expanded vermiculite (enlarged). The vermiculite used to prepare this material was obtained from the Hillview vermiculite deposit (north of Fifield), western New South Wales. Rapid heating of raw vermiculite produces expanded, low-density, high-temperature resistant material suitable for use in construction materials, and as filler materials in paints and pigments. (Photographer D. Barnes)

Potential and Outlook

New South Wales has good potential for vermiculite production based on the identified resources in the Tottenham area (north of Fifield). Two separate large deposits have been found among the Ordovician Alaskan-type ultramafic intrusions of this area (Tout Intrusive Complex, Figure 6). There is high potential for the discovery of more deposits in the area.

Vermiculite is a versatile industrial mineral but suffers from the ready availability of substitutes, some of which are cheaper (e.g. perlite). It is a mineral of considerable value to any modern industrialised economy (particularly for use as a lightweight insulating construction material). There are limited overseas deposits and few producing mines in the southwestern Pacific region (Table 42).

Table 42. World vermiculite production 2004

Country	Production (tonnes)
South Africa	187 000
USA	150 000*
China	70 000
Russia	25 000
Brazil	25 000
Zimbabwe	16 000
Other countries	47 000
Total	**520 000**

* Estimate
Source: Potter (2005)

Nature and Occurrence

Vermiculite forms from the alteration of phlogopite, biotite or chlorite weathering processes or by hydrothermal solutions. Almost all known occurrences are associated with basic or ultrabasic rocks, many of which bear evidence of intrusion by acid magmas or carbonatites. Vermiculite is believed to form by supergene alteration by weathering and meteoric water, and its occurrence is depth-dependent. With the important exception of the Libby deposit in Montana, USA (where hydrothermal fluids are thought to have been the altering medium) most deposits are less than 100 m thick.

Only a few countries have major commercial vermiculite deposits. World production of vermiculite in 2004 was 520 000 tonnes (Table 42) (Potter 2005). World production is dominated by South Africa and the USA (about 70% of production) (Table 42). Other countries with significant known deposits include Argentina, Australia, Brazil, China, Egypt, India, Japan, Kenya, Mexico, Russia, Uganda and Zimbabwe. Uses of exfoliated vermiculite are summarised in Tables 43 and 44.

The largest known deposits are in Montana in the USA, at Palabora in South Africa, and in Xinxiang Province in China (Harben & Bates 1990; Hindman 1994).

Main Australian Deposits

Australia's only current commercial source of vermiculite is the Mud Tank deposit near Alice Springs in the Northern Territory. The mine has produced up to 12 000 tpa of vermiculite in recent years. The vermiculite is in a carbonatite rock that has intruded calc-silicate and quartz–feldspar gneiss of the Neoproterozoic Strangways Metamorphic Complex. The vermiculite is thought to have formed by the low-temperature hydrous alteration of phlogopite mica (DME 2003).

New South Wales Occurrences

In 1991, a major vermiculite orebody was discovered at Hillview in the Tout Intrusive Complex (Figure 6), near Tottenham in central New South Wales. Published resources are 12.5 Mt at 33% vermiculite (Helix Resources NL 1993; Martin 1998). Additional inferred resources of 4.8 Mt at 34% vermiculite have been reported in another body at Tigers Creek, about 14 km southwest of Hillview (Platinum Search NL 1994).

The potential for vermiculite in ultramafic rocks elsewhere in New South Wales has yet to be assessed.

Applications

Vermiculite (especially exfoliated vermiculite) has a micaceous mineral habit, splitting readily into thin, flexible, inelastic flakes. In its natural state, vermiculite incorporates a water layer in each unit cell, and this provides its remarkable capacity to expand after heating (Photograph 24). Rapid heating to temperatures above 760°C should theoretically induce an expansion of up to 30 times its original volume,

Table 43. Vermiculite — uses, properties and specifications

Uses	Properties sought	Specifications
Construction • Lightweight material • Thermal insulation • Fire-proofing • Acoustic insulation • Aggregate	• Low bulk density • Low thermal conductivity • High sintering and fusion temperatures • High sound absorption • Chemically inert • Rotproof • Odourless • Non-irritating	Depends on enduse but specifications generally include vermiculite content of concentrates (90–99%), particle size, exfoliation efficiency, density after exfoliation
Filler	• Chemically inert	
Refractory	• Low thermal conductivity • High sintering and fusion temperatures	
Agriculture/ horticulture	• High cation exchange capacity • Ability to absorb moisture and remain free-flowing	

Source: Harben (1999)

but in practice this is more normally in the range of 8 to 12 times. The increase in volume is accompanied by a decrease in density of over 90%. Most of the applications (Table 43) for vermiculite seek to take advantage of its exfoliation properties. Exfoliation properties vary with grainsize, the coarser material being superior.

Vermiculite is generally a product of the weathering of other minerals and the quality of most vermiculite deposits tends to decline with depth, as the proportion of vermiculite decreases.

Substitutes are available for vermiculite in all of its applications, with perlite being the most universally acceptable alternative. Substitutes for the main applications include those in Table 44.

Economic Factors

Annual world production of vermiculite has stabilised at about 450 000 to 500 000 tpa since 1992. There have been several new entrants to the market since the closure of the Libby Mine in the USA in 1990 (Harben 1999). Demand is closely linked to the relative prosperity of the building and construction industries in developed nations. Nearly 70% of world vermiculite production is consumed in North America and Europe.

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Table 44. Vermiculite — main uses and substitutes

Use	Substitute
Lightweight aggregate	Expanded clay, perlite, pumice, expanded shale
Thermal insulation	Asbestos, cellulose, cement, diatomite, fibreglass, various metals, perlite, pumice, wollastonite, zeolites
Fire-proofing	Antimony oxide, borates, bromine, chromite, diatomite, magnesite and magnesia, perlite, phosphates, pumice
Acoustic insulation	As for thermal insulation, and also includes masonry bricks
Filler	Bentonite, diatomite, kaolin, limestone, perlite, talc
Refractory	Diatomite, expanded perlite, expanded clay, foamed aggregate, mineral wool, synthetic alumina–silica
Agriculture / horticulture	Bentonite, diatomite, gypsum, kaolin, peat, perlite, zeolites

Source: Harben (1999)