Potential and Outlook

New South Wales has moderate potential for the production of mica as a by-product of the mining of feldspar from granite and alaskite sources.

Muscovite

Minor production of mica as a by-product of feldspar mining has occurred near Broken Hill. A large resource of feldspar, muscovite, and silica has been identified within an alaskite deposit (Rossdhu Granite) near Oberon (Figure 17) (see chapter on feldspar) and muscovite is a potential co-product if mining were to proceed. Extensive areas of granitic rocks in the Lachlan and New England orogens contain muscovite-bearing leucocratic granite and alaskite from which flake mica could potentially be extracted as a by-product or co-product of feldspar mining.

Phlogopite

New South Wales has no known resources of phlogopite. Commercially important deposits are mainly associated with metamorphosed limestone and mafic rocks. Rocks with significant phlogopite contents have been recorded from a number of localities which may have exploration potential. These include phlogopite greisens in the Broken Hill region and pyroxenite of the Ordovician Tout Intrusive Complex in the Fifield area of central New South Wales (cf. Figure 6).

Nature and Occurrence

Micas are a group of complex hydrous alumino-silicate minerals, with the general formula $X_2Y_{4-6}Z_8O_{20}(OH,F)_4$ where X is mainly K, Na or Ca; Y is mainly Al, Mg or Fe; and Z is mainly Si or Al.

Micas exhibit a number of characteristic physical properties. They form monoclinic crystals with perfect basal cleavage which enables them to split into thin, flexible and elastic sheets. Micas also have good electrical and thermal insulating properties, toughness, and good reflective and refractive properties.

Of the 37 varieties of mica, the most common are biotite (magnesium–iron), muscovite (potassium–aluminium), phlogopite (potassium–magnesium), lepidolite (potassium–lithium) and zinnwaldite (lithium–iron). Vermiculite, which is sometimes referred to as a mica, is an alteration product of biotite or phlogopite and is dealt with separately (see chapter on vermiculite).

Muscovite, phlogopite and lepidolite are the only mica minerals of economic importance. Lepidolite is discussed separately in the chapter on lithium.

Mica is produced commercially in two main forms, sheet mica and flake (scrap mica).

Sheet mica

Sheet mica occurs in crystal forms (known as 'books') which are several centimetres in diameter and can be split into thin sheets.

Flake, scrap or ground mica

Flake, scrap or ground mica is fine-grained mica ground for use in a wide variety of applications. In the past, flake mica was produced as a waste product from processing sheet mica hence the name 'scrap mica'. However, today flake mica is largely a by-product from mining pegmatites or alaskites for feldspar and other minerals.

Sheet mica is graded according to colour, visual quality and the maximum useable rectangle which can be cut from a single lamina. It is commonly divided into four categories that include block mica; thins; film mica; and splittings. Flake mica is graded primarily on the basis of the grinding technique used and the resultant particle size.

Muscovite

Muscovite, $K_2Al_4[Si_6Al_2O_{20}](OH,F)_4$, is an aluminium-rich mica which occurs as a primary constituent of felsic igneous rocks, such as granite, pegmatite, aplite and alaskite. It is also common in a wide range of metamorphic rocks, and detrital flakes occur in many sedimentary rocks.

Commercial production of muscovite comes mainly from pegmatites and alaskites and is generally a by-product or co-product of the mining of feldspar

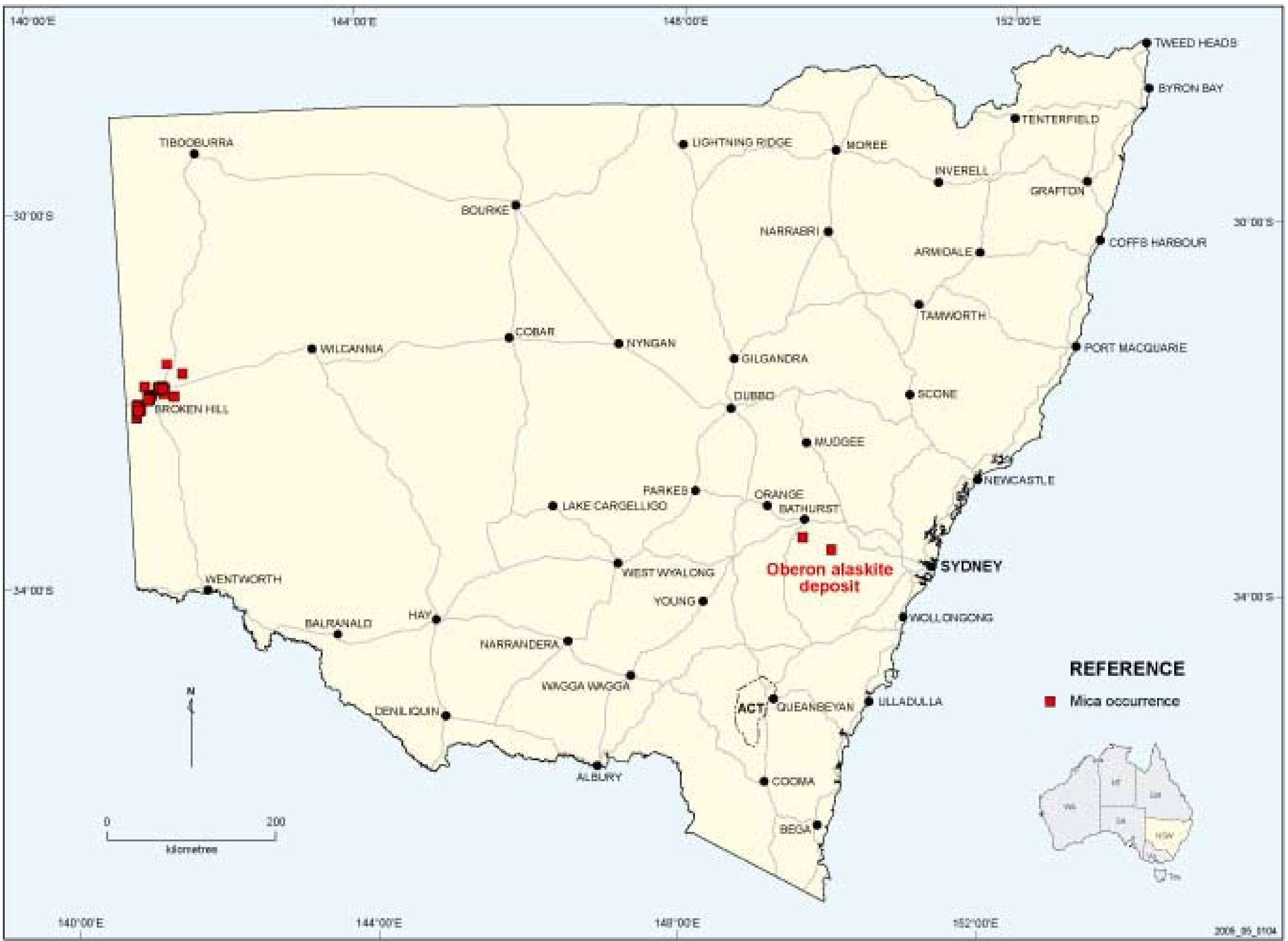

Figure 17. Mica occurrences in New South Wales

or other minerals. In some cases, mica survives the kaolinisation of granite and can be recovered as a by-product of kaolin production. Muscovite of metamorphic origin does not exhibit the mineral's physical properties to the same extent as primary muscovite and tends to be brittle.

Phlogopite

Phlogopite, $K(Mg,Fe)_3(OH,F)_2[AlSi_3O_{10}]$, is a magnesium-bearing mica. Phlogopite deposits are mainly associated with metamorphosed limestone and mafic rocks and occur particularly in hydrothermal veins formed through metasomatism of magnesium-rich rocks, such as dolomite (Harben & Kužvart 1996). Phlogopite deposits also occur in mafic and carbonatite ring intrusions (e.g. the Kovdor deposit, Russia, and Kuopio in Finland). Canada and Madagascar are the major phlogopite producers.

Commercially significant mica-bearing pegmatites are commonly associated with Precambrian shield rocks. The Siberian, Scandinavian and Indian shields are generally recognised as the sources of the highest-quality mica.

World production of mica in 2004 was about 300 000 t (Hedrick 2005), virtually all of which is flake mica. The USA and Russia are the largest mica-producing nations, accounting for about two-thirds of total world production. South Korea is also an important producer. Much of the USA production is from alaskite deposits in North Carolina that are mined in bulk, primarily for the production of feldspar and, in one case (weathered alaskite), kaolin.

India is the world's leading producer of sheet mica, providing around 80% of global production — which is around 5000 tpa.

Main Australian Deposits

Fine-grained pale green muscovite is selectively mined from shear zones in the Williamstown kaolin–sillimanite deposit, near Adelaide, South Australia. About 1000 tonnes of muscovite are produced annually.

Minor quantities of muscovite have been produced from pegmatite in the Olary district of South Australia as a by-product of feldspar and beryl mining. Small amounts of mica have also been produced from other Australian states. There has been no Australian production of phlogopite to date.

New South Wales Occurrences

There is no current production of mica in New South Wales, although there has been minor production in the past from pegmatites in the Broken Hill area as a by-product of feldspar mining. One pegmatite in the Broken Hill region was prospected and mined specifically for muscovite (Lishmund 1982).

Muscovite is a common constituent of pegmatite deposits in the Broken Hill area (Lishmund 1982) and there has been minor production from these sources in the past. However, the mica is reported to have generally been of low quality.

A large resource of muscovite has been identified at Ferndale, near Oberon, within an alaskite stock (Rossdhu Granite), consisting essentially of potassium feldspar, quartz and muscovite. The alaskite, which covers an area of approximately 4 km^2, has been extensively investigated as a potential source of feldspar, with flake mica and silica as potential by-products or co-products. Resources of 3.3 Mt of alaskite have been identified, although total resources present would be much greater. Muscovite constitutes 10% to 15% of the deposit and is reported to be particularly suitable for use in paints because of its high reflectivity. However, recent work (Martin 2005) indicated that the recovery of high-quality muscovite mica may be difficult to achieve without the construction of a potentially costly processing plant.

Applications

Muscovite

Sheet mica

Sheet mica is mainly used in electrical applications; as a capacitor in condensers, insulating material in vacuum tubes and as a non-conducting agent in electrical appliances.

Flake and ground mica

Flake and ground mica have a wide range of uses. They can be bonded with various materials to form micanite, mica paper and glass-bonded mica, which can substitute for natural sheet mica.

Dry-ground mica

Dry-ground mica is used as a filler (in plasterboard joint cement, plastics and electrical cables); as a dusting agent in roofing paper; as a surface coating in welding rods; as an absorbent (explosives, disinfectants and fire extinguishers); and in drilling muds for sealing off broken ground. Dry-ground mica is also used as glitter on greeting cards etc.

Wet-ground mica

Wet-ground mica is used as specialised filler material in plastics and rubber; as an anti-sticking agent and antifriction powder; in wallpaper to provide sheen; for mould lubrication and dusting in tyre manufacture; and in some industrial paints. Micronised mica is used in emulsions to provide matte finish, increase durability, control flow and serve as an anti-cracking agent. Surface-treated grades are used in pearlescent pigments and drilling muds for oil and gas drilling.

Phlogopite

Phlogopite is generally regarded as inferior to muscovite except where resistance to high temperatures is important (phlogopite is stable to temperatures of 900–1000°C). Ground and screened phlogopite is mainly used as filler material in thermoplastics, as an asbestos replacement, and in joint cements. Minor uses include petroleum well drilling muds, friction materials, fireproofing and soundproofing materials.

Alternative Materials

A variety of materials may be used as substitutes for mica in particular applications. A range of other industrial minerals, including diatomite, vermiculite, perlite and talc, may be substituted for ground mica as filler material. Ground synthetic fluorophlogopite (fluorine-rich mica) can be used as an alternative to natural ground mica in applications where the thermal and electrical properties of mica are required (Hedrick 2005).

Substitutes for sheet mica include alumina ceramics, fused quartz and organic polymers.

Economic Factors

Demand for flake and ground mica is largely dependent on the performance of the construction industry and demand for plastics and pearlescent paint in the automotive industries.

Although sheet mica consumption is low, demand for high-quality material exceeds supply.

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