Other minerals

Mineral sands

Australia is the world's principal source of mineral sands, accounting for over 50% of world production of zircon, 50% of Western world production of rutile and 25% of Western world production of ilmenite in 1986. Australia also produces significant amounts of monazite and leucoxene—see Table 13.

Mineral sands were first mined in Australia in the 1930s, at Byron Bay in far north-eastern New South Wales. By the late 1940s rutile and zircon mining had extended into Queensland and further south in New South Wales. Soon after the start of ilmenite mining near Bunbury in south-west Western Australia in the 1950s, Australia became the world's leading producer of mineral sands. Australian companies have also led in the development of improved technology for mining and processing mineral sands, and now export processing equipment such as electromagnetic and electrical separators.

Up to 1974 mineral sands production along the east coast accounted for more than 95% of Australia's total annual output of rutile. By 1978, this had fallen to 65%, largely as a result of production at **Eneabba**, 270 km north of Perth, where mining started in 1974. Production of rutile is now divided about equally between the east coast (**North Stradbroke Island** near Brisbane and the **Newcastle–Forster** and **Taree–Kempsey** areas) and the west coast.

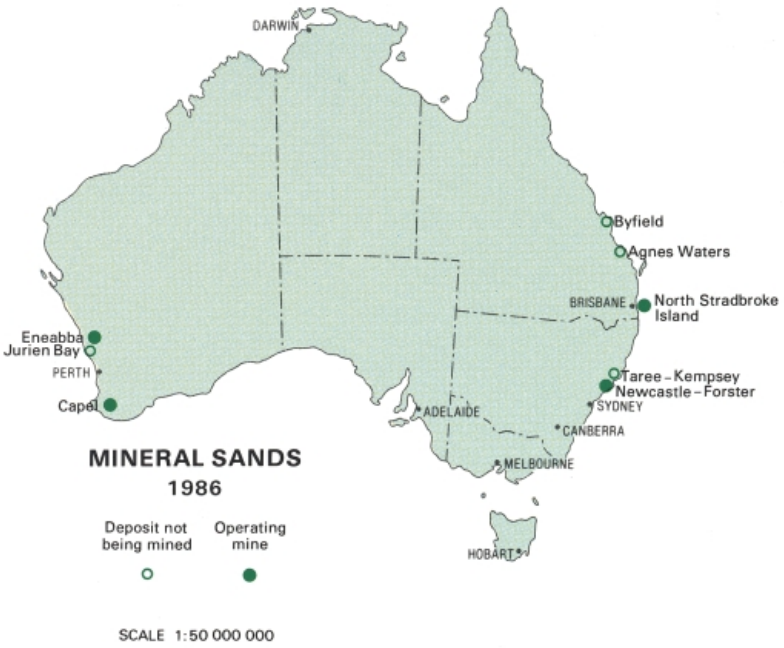
Western Australian mineral sands are rich in ilmenite and production from deposits in the **Capel** area and at **Eneabba** account for more than 80% of Australia's annual output of around 1.25 Mt of ilmenite. These deposits also provide about 70% of all zircon concentrates produced, virtually all of the monazite concentrates and all of the leucoxene concentrates. In addition the Capel deposits are an important source of xenotime, which contains the rare-earth element *yttrium*.

Since 1981 mineral sands production has declined on the east coast because of lower ore grades and environmental constraints on mining. However, the recent discovery at Byfield near Rockhampton (Qld) of one of the largest mineral sands deposits in the world could lead to a resurgence of mining on the east coast. Metallurgical testing of a large mineral sand deposit near Horsham (Vic.) is being carried out to assess its potential.

Most Australian mineral sands production is exported as concentrates. Only ilmenite is currently processed further in Australia—at Capel, where it is upgraded at three plants to produce about 160 000 t of synthetic rutile (92% TiO2) annually, and at Narngulu near Geraldton, where a 112 500 t per year synthetic rutile plant has been completed.

Construction of a plant to produce 450 t of high purity zirconia powders and 250 t of zirconium chemicals per year has commenced at Rockingham near Perth. It is expected to be in operation by late 1988.

About 130 000 t a year of ilmenite concentrate from the Capel area is used for pigment production at nearby **Bunbury** and at **Burnie** (Tas.). The high chromium content of east coast ilmenite precludes its use for this purpose, though a plant with a capacity of 250 000 t a year has been built near Brisbane to extract relatively low chrome ilmenite, suitable for upgrading to synthetic rutile, from stockpiled high chrome ilmenite.



SOURCE: Bureau of Mineral Resources (1987).

Floating dredge and wet concentrator recovering mineral sands, North Stradbroke Island (Qld)
Sand dredged from the front of the man-made pond is piped to the floating concentrator. Here the heavier mineral sands are extracted by separators before being sent by barge to the dry separation plant near Brisbane for final separation into rutile, zircon and ilmenite. The residual sand from the wet concentrator is returned to the rear of the pond for progressive revegetation.

Mineral sands and their uses

Many different products are derived from mineral sands.

Ilmenite is a mixture of iron and titanium oxides (54–60% TiO_2). It is used in the steel industry for furnace linings, as a fluxing agent, for sand blasting, for pigment production by the sulphate process or by direct chlorination. Ilmenite is also beneficiated to synthetic rutile in a complex process which removes the iron.

Leucoxene is altered ilmenite containing about 87% TiO_2 and is mined in association with ilmenite in the **Capel** area of south-west Western Australia.

Monazite is a major source of rare-earth elements such as *cerium, thorium* and *lanthanum* used in high strength micro-alloyed steel, ductile iron, and super and pyrophoric alloys; as catalysts in petroleum cracking; in glass for television tube face plates, eye glasses and camera lenses; in electronics as phosphors for colour television tubes, x-ray intensifiers and computer components; and in the generation of nuclear energy.

Rutile. The major uses of rutile are in the production of titanium dioxide pigment for the paint, paper and plastics industries; as a flux coating for welding rods; and in the manufacture of titanium metal, which has important uses in aerospace applications.

Zircon is used in making refractory bricks and furnace linings, especially in glass and steel-making plants. It is also used extensively in the ceramics industry as a foundry medium and is the primary source of zirconium, a metal used mainly in nuclear reactors.

Table 13. Mineral sands production, 1984–86

	1984	*1985*	*1986*
	thousand tonnes		
Ilmenite concentrate	1 493	1 419	1 238
Leucoxene concentrate	32	14	14
Monazite concentrate	16	19	15
Rutile concentrate	170	212	216
Zircon concentrate	458	501	452

Barite

Barite (barium sulphate) is a high density mineral used extensively as a weighting agent in drilling muds to help confine high oil and gas pressures. Australia's main production is from an underground mine at **Oraparinna** (S.A.). Other producing centres include **Truro** and **Mount Mulga** (S.A.) and **Kempfield** (N.S.W.).

Clays

Clays are a complex group of minerals with different modes of geological occurrence, and different mineral composition and end-uses.

Bentonite is composed mainly of the clay mineral montmorillonite, a hydrous aluminium silicate. Bentonite clays are broadly classed as swelling or non-swelling. When mixed with water the naturally swelling clays expand to form a gel-like mass; the swelling capacity of the other group of bentonites can be increased through treatment with soda ash.

Bentonite has a wide range of uses, particularly as a bonding agent in moulding sand for foundry use, as a sealant to minimise seepage in dams, earthworks and drilling muds, and in stockfeeds. Bentonite production amounted to almost 40 000 t in 1986, mostly from the **Miles** area (Qld).

Fullers earth is the collective term applied to clay and other fine-grained earthy material noted mainly for its absorbent properties. Originally used for cleaning and thickening ('fulling') wool for cloth making, more modern uses include decolourising and purifying mineral, vegetable and animal oils. Australian production is small by world standards and currently all comes from the **Lake Nerramyne** (W.A.) deposit, which has demonstrated reserves of 10 Mt.

Kaolin is a clay consisting principally of kaolinite, distinguished by its softness, whiteness and low absorption properties. The paper industry is the largest consumer of kaolin though the fibreglass, paint, plastics, adhesive, rubber and ceramics industries are also significant users. Production in 1986 totalled 186 000 t.

Kaolin is mined in the **Mudgee** and **Gulgong** areas (N.S.W.), at **Coorabin** (N.S.W.) and at **Tongonah** (Tas.). Mining of the large deposit of kaolin which occurs in association with bauxite at Weipa (Qld) commenced in the latter part of 1986. The kaolin, which is of paper-coating quality, is at present all exported to Japan. A similar grade of kaolin is also being mined at **Pittong** near Ballarat (Vic.) and shipped to the U.K. Kaolin from the tin–tantalum–lithium mine at **Greenbushes** (W.A.) is also exported to Japan.

Fireclay and brick, stoneware, tile and pipe clays are produced throughout Australia, with mines characteristically located close to major centres of consumption.

Fireclay is a term used to describe those refractory clays which do not burn white; it therefore excludes kaolin. Fireclays are classified as low, medium, high or super duty depending on their resistance to high temperatures; they are also characterised by low coefficients of expansion and some degree of thermal insulation. They are used in the manufacture of refractory products such as firebricks and various other shapes, ramming and airgun mixes, castable materials, retorts and crucibles.

Brick, ***stoneware***, ***tile*** and ***pipe clays*** include a wide variety of bulky, low value clays and other fine-grained earths, and the names given to them reflect their end-uses rather than their mineral structure. All the products derived from these clays are fired, and often based on a blend of clays to obtain a mix with the required physical properties.

Construction materials such as low grade red-burning clays and shales used to make common building bricks and higher grade clays used for making face bricks are generally quarried in and around major consuming centres throughout Australia. For this reason they have not been shown on the map 'Minerals other than Fuels'.

Diatomite

Diatomite or 'diatomaceous earth' is a siliceous rock composed mainly of the skeletal remains of aquatic organisms called diatoms. Its main uses are as an insulator, as a filter medium for swimming pools and food and drink processing, and as a filler. Annual production is less than 10 000 t and comes mainly from a deposit near **Barraba** (N.S.W.), with lesser amounts from **Black Duck Creek** (Qld) and **Lillicur** (Vic.). About half of Australia's diatomite requirements are imported.

Dolomite and magnesite

In Australia the only magnesium minerals of commercial importance are dolomite and magnesite, which are used mainly as raw materials for magnesia-containing products such as refractories, fluxes, fillers, cements and fertilisers.

Almost all dolomite produced is consumed domestically, about 85% of it as flux in the iron and steel industry. Production in 1986 exceeded 700 000 t, the bulk of which came from **Ardrossan** (S.A.).

Australian production of crude magnesite is small by world standards and has fallen in recent years to just over 40 000 t in 1986. Production is mainly from mines at **Fifield** and **Thuddungra** (N.S.W.), and **Copley** (S.A.). Over 10 000 t of dead-burned magnesite and magnesium oxide are imported each year to overcome a shortfall in domestic production. Magnesium metal is not produced in Australia and all requirements are imported.

In 1985, what is believed to be the world's largest deposit of magnesite, containing an estimated 250 Mt, was discovered at Kunwarara, just north of Rockhampton (Qld). Current development plans envisage output of 100 000 t of magnesite per year, with production of magnesium metal commencing around 1992.

Felspar

Felspars are the most abundant mineral constituents of igneous rocks and are used as a source of alumina and alkalis in glass and ceramics. Small amounts of felspar are produced at **Londonderry** and **Wialki** (W.A.), and in the **Cockburn area** near Broken Hill (N.S.W.).

Mica

Mica is a complex hydrated aluminium silicate mineral which can be split into very thin, tough and transparent flakes with outstanding dielectric and insulating properties. Australian production comes mainly from the **Williamstown** deposit near Adelaide though output has been low and declining in recent years. Most domestic requirements are now met by imports.

Peat

Peat is the first stage in the formation of coal. It is a spongy material made up of partly decomposed organic matter, minerals and water. Because of its water retaining qualities peat is used extensively as a soil conditioner and as a mulch. In some countries it is an important energy source.

Australian production of peat is small (about 10 000 t annually) and most is consumed domestically. The main producing centres are **Lake Muir** (W.A.), **Wingecarribee Swamp** near Bowral and **Killarney Swamp** near Bombala (N.S.W.), and the **Bronte** area of central Tasmania.

Silica and garnet

Silica and garnet are weathering-resistant minerals that occur in beach sands. Silica is abundant along the east and west coasts of Australia and by far the greatest proportion of that produced (over 2 Mt in 1986) is for glass manufacture from deposits in and near the capital cities.

Silica for metallurgical applications (as either an alloying or a fluxing agent) is preferred in lump form, generally as quartz or quartzite. Such deposits are mined at **Marrangaroo** near Lithgow (N.S.W.) for use as a flux at the Port Kembla steelworks; at **Beaconsfield** (Tas.) and **Iron Knob** near Whyalla (S.A.) for manufacturing ferrosilicon and silicomanganese at **Bell Bay** (Tas.); and near **Mount Isa** for use locally as a flux. About 100 000 t of silica sand per year from **Douglas Lake** (W.A.) is used as metallurgical flux at the nearby Kalgoorlie nickel smelter.

Hardrock silica is also used in the production of elemental silicon. Australia's first silicon smelter, with an annual capacity of 9000 t of metallurgical grade silicon, was commissioned at Electrona near Hobart in 1987. Silica treated at the plant is mined near **Smithton** in north-western Tasmania. A second silicon plant, at Bunbury, is scheduled to commence production in 1989 and will treat silica to be mined at **Moora**. Silicon is used as an alloying material, particularly with aluminium, and in the electronics and chemical industries.

Over 500 000 t of silica sand is exported annually to Japan from **Cape Flattery** in north Queensland. A further 250 000 t is exported from deposits mined in the **Perth** area.

Garnet is an important natural abrasive and in world terms Australia has become a significant producer in recent years. Almost 10 000 t of garnet concentrate was produced in 1986, mainly from the large **Port Gregory** deposit north of Geraldton (W.A.).

Sillimanite

Sillimanite is an aluminium silicate mineral used in a broad range of acid-refractory products, especially mortars and castables. Production is small and comes from **Williamstown** (S.A.), along with kaolinised sillimanite, kaolin and mica.

Talc and pyrophyllite

Though not related chemically talc and pyrophyllite have similar physical properties, in particular a high degree of lubricity or 'slip' and a high fusion point.

Talc is used mainly in ceramics, paints, rubber, plastics, cosmetics, insecticides and agricultural dusts. Most Australian production (nearly 180 000 t in 1986) is exported, principally to Japan. The main producing centres are **Three Springs** and **Mount Seabrook** (W.A.); **Mount Fitton**, **Gumeracha** and **Lyndoch** (S.A.); and near **Mudgee** (N.S.W.).

Because of its high fusion point pyrophyllite is used mainly in refractory applications and in whiteware ceramics. Production averages around 8000 t annually, mainly from the **Pambula** area of southern New South Wales.

Vermiculite

Vermiculite resembles mica but its commercial value lies in its ability to expand into worm-like particles with a bulk of 8 to 12 times that of the as-mined material when heated quickly to about 1000°C. Its main uses in Australia are with plaster in acoustic and fireproof sprays and as an insulating material. As production from the sole producer, at **Young River** near Esperance (W.A.), is both small and sporadic most domestic needs are imported.