



BENTONITE

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Bentonite is a complex absorbent clay mineral, with unique swelling properties and a wide range of industrial applications. Queensland is the main producing state in Australia, with production from shallow open cut deposits in the State's south-east.

CHARACTERISTICS

Bentonite is a clay consisting dominantly of smectite minerals. It is soft and highly plastic, with a waxy appearance and soapy texture. Its colour may be white, grey, yellow, green, brown or blue. The important properties of bentonite include its ability to exchange cations, its swelling and hydration capacity, its ability to act as a binder, its impermeability and its viscosity and thixotropy.

The most common smectite mineral in bentonite is montmorillonite. It is a hydrous aluminium silicate arranged in loosely bound sheets, containing exchangeable cations. The many uses for bentonite are based on the chemical activity provided by the cation exchange characteristics.

The most common and commercially significant bentonites are sodium, calcium and calcium-magnesium varieties. **Sodium bentonite** has very high swelling capacities, swelling 15 to 20 times its original volume, forming stable gel-like masses. As well, sodium bentonite is an excellent absorbent, absorbing up to 10 times its own weight of water. Sodium bentonite also exhibits good dry strength, plasticity, lubricity, impermeability and low compressibility.

Calcium and **calcium-magnesium bentonites** have lower swelling and absorbency capacities than sodium bentonite. Calcium bentonite, one of the Fullers' earths, has detergent properties, and absorbs mineral, vegetable and animal oils.

Bentonites can be chemically treated to produce clays with a wide range of applications. **Activated clays** are calcium bentonites treated with acid to produce clays with excellent absorbent and catalytic properties. Calcium bentonites can be converted to the sodium variety by the addition of soda ash.

Organoclays are treated sodium bentonites where the exchangeable inorganic cations are replaced by organic cations. When added to liquid organic systems, the organoclay changes the viscosity, suspension and thixotropy of these liquids.

USES

Drilling: In water-based drilling muds, sodium or calcium bentonite is used as a sealant. Its gel-like suspension properties also enable it to carry drill cuttings to the surface.

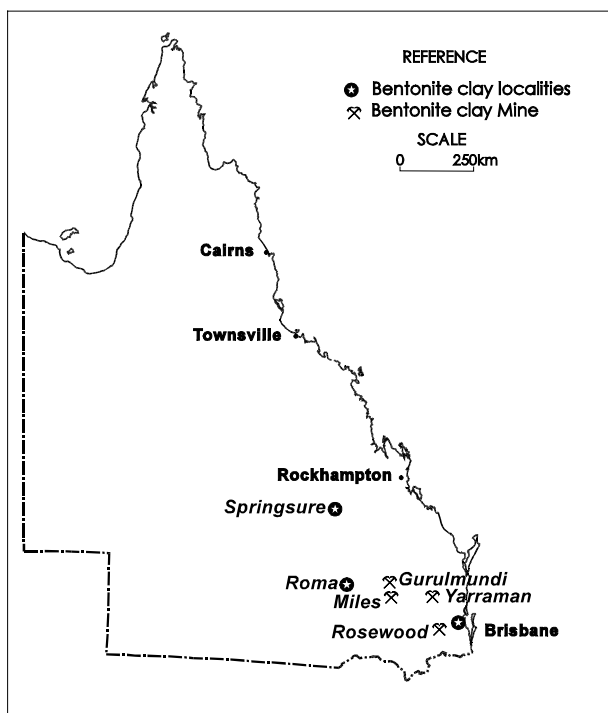
Civil engineering: As an impermeable barrier, sodium bentonite minimises fluid loss by seepage in dams and other earthworks, and retains water and fluid in engineering works.

Bonding agent: Sodium and calcium bentonites withstand high temperatures as bonding agents in pelletising iron ore, and in forming foundry sand moulds.

Animal feed: Bentonite is used as a pellet binder in stock feed. It increases retention times in the digestive tract to aid food digestion and helps prevent acidosis.

Pet Litter: Sodium or calcium bentonite is used in pet litter as an absorbent and to control odour.

Other uses include horticulture, wine making, absorbents, catalysts, binders, furnace linings, ceramics, pesticides, paints, purifying and decolouring oils and fats and in medical and pharmaceutical products.



Queensland bentonite localities.

GEOLOGY AND OCCURRENCE

Bentonite forms *in situ* by the alteration of minute glass particles in volcanic ash or tuff beds which were deposited in sedimentary sequences. Occurrences are widespread in eastern Australia, mainly in Queensland and New South Wales.

Worldwide, most economic bentonite deposits are of Cretaceous age or younger, but occurrences in Queensland are known from older formations.

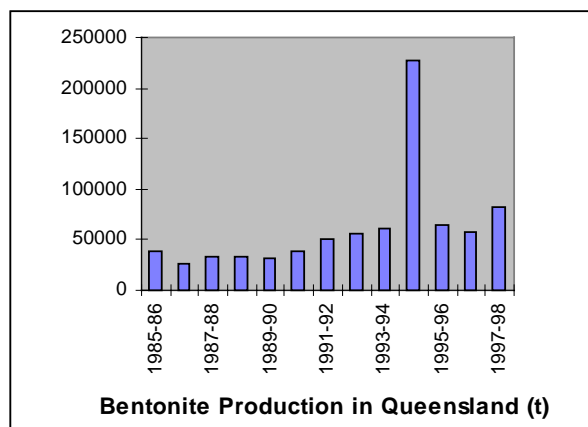
The most significant deposits in Queensland occur within the Late Jurassic Orallo Formation north of Miles at **Gurulmundi**, south of **Miles** and between **Roma** and Miles

Seams of bentonite occur in the Middle Jurassic Walloon Coal Measures in the **Rosewood district** west of Brisbane with exposures at the Oakleigh, Jeebropilly and Ebenezer coal mines and in a small disused underground mine at Malabar, north of Rosewood.

Bentonite deposits also occur in the Late Permian Black Alley Shale to the south and south-west of **Springsure** in central Queensland, within the Tertiary Petrie Formation in the northern suburbs of Brisbane and in deeply weathered Tertiary volcanics at **Yarraman**, south-east of Kingaroy.

PRODUCTION, PRODUCERS & RESOURCES

Queensland is the main bentonite producing state in Australia. In 1997-98 Queensland production was 82 830t of bentonite valued at \$14.6 million, compared with 57 753t valued at \$5.5 million in 1996-97. Australian production in 1997-98 is estimated to have been 100 000 tonnes, and 95 000 tonnes in the previous year. Queensland mine production since 1985-86 is shown in the following bar chart. Production has increased from 1996-97. The anomalous peak in 1994-95 was due to a major mining campaign being undertaken in that year by one producer.



Commercial Minerals Limited, a division of Normandy Industrial Minerals Limited, is Australia's largest producer of bentonite. The operation at Gurulmundi has a 120 000 tpa capacity processing facility producing a range of sodium bentonite products. A pet litter production plant has just been installed. Proved reserves comprise over 3 Mt of premium grade sodium bentonite, within a 12 Mt total bentonite resource. The products are used for many applications including drilling mud, civil engineering applications, pet litter and as a binder for foundry sands and stock feed. More refined mining techniques at the Gurulmundi site are allowing differentiation of bentonite fractions into a greater variety of applications. Commercial Minerals also mines a calcium bentonite deposit near Scone in NSW. The company sells into domestic and export markets.

United Minerals Corporation is selling its operation north-west of Gurulmundi into a new company called Pacific Rim Minerals Pty Ltd. It produces a high-swelling sodium bentonite and a medium-swelling sodium bentonite through its 60 000 tpa processing plant at the mine. The bentonite is used for many applications including pet litter and engineering purposes. Recent drilling has substantially increased the resource base to 23 million tonnes, including a measured resource of 8.3 million tonnes.

Bioclay Pty Ltd trading as **Miles Bentonite** produces sodium bentonite from a deposit south-west of Miles. Proven reserves are calculated at 0.4-0.5 Mt. The bentonite is used primarily for stock feed and pet litter.

Bentonite is mined by **PCP Douglass Pty Ltd** from a deposit of Tertiary age south-west of Yarraman. The deposit is relatively small and includes some kaolinitic clay. It is processed in a plant with a capacity of 20 000 tpa. Bentonite resources are claimed to be sufficient for the next 20 years at current production rates. The bentonite is used for many applications including stock feed, as an air filter in septic systems and sewage pumping stations, and as an odour

absorbent in chicken manure. It has also been used successfully as a pellet binder and in refractories.

At the **New Hope Corporation Ltd** Jeebropilly open-cut coal mine south-east of Rosewood, a calcium-magnesium bentonite was recovered as a by-product and has been stockpiled pending processing and sale. The in-pit resource has now been fully depleted. Resource figures for other areas under lease have not been calculated.

Clay Resources Company, a subsidiary of Ebenezer Mining Company Pty Ltd, produces sodium bentonite as a by-product at the **Ebenezer** mine south-west of Rosewood. Substantial resources are available within the current lease area. Production capacity is 30 000 tpa. Applications for the products include stock feed, pet litter, civil engineering, dam sealing and wine fining.

PROCESSING

Bentonite is extracted in open cut mines by strip mining methods using scrapers. It is then spread thinly on pads and frequently tilled for controlled air drying to 'weather' it for enhanced performance. The clay is then processed through a rotary drier and hammer milled, classified and packaged.

WORLD PRODUCTION AND RESOURCES

World production of bentonitic clays in 1995, for which the most recent figures are available, was 9.8 Mt. The USA is the world's largest producer, renowned for its high quality sodium bentonite from Wyoming which was originally used in drilling mud. Other major sources are the CIS, Greece, Germany, Japan, and Turkey which, together with the USA, account for about 84% of the world's total output. Australia's contribution is about half a percent.

Total world identified resources of bentonite and allied clays were estimated to be 1452 Mt of bentonite and 4445 Mt of Fullers' earth (USBM Mineral Facts and Problems, 1985). Australia's bentonite resources were estimated at 45 Mt of bentonite and 18 Mt of Fullers' earth.

IMPORTS & EXPORTS

Australian exports of bentonite in 1997-98 were 15 256t, of which 13 817t valued at approximately \$2.4 million were sourced from Queensland. The exports were mainly to the Asia-Pacific region for engineering, foundry and drilling mud applications.

Imports of bentonite are mostly from the USA. Australian imports of bentonite in 1997-98 were 12 124t, of which 885t were for consumption in Queensland

PRICES

The reported price of unprocessed bentonite averaged \$98/t in 1997-98. After processing and packaging for foundry, stockfeed, engineering and drilling applications, the price ranges from \$50 to \$250/t, depending on quality, quantities and demand.

Average bentonite prices at mine (A\$/t)

91/92	92/93	93/94	94/95	95/96	96/97	97/98
96	91	95	95	92	97	98

Source: Qld Dept. of Mines and Energy Annual Production Returns.

POTENTIAL & OUTLOOK

The established world bentonite markets such as drilling muds, foundry sands and iron ore pelletising are affected by prevailing economic conditions. On the other hand, world demand for pet litter has shown strong growth in the last decade, independent of the prevailing economic conditions.

The domestic bentonite stock feed market has improved, however increased production for feedlot use and greater competition has driven the price of the product down. Queensland producers are looking for opportunities to expand export sales. Export markets are mainly in south-east Asia and Japan with sales to these countries dominated by the higher grade products. Domestic sales of industrial grade bentonite are expected to increase due to demand created by developments associated with the Sydney Olympic Games.

Commercial Minerals and Clay Resources Company both have Third Party Accreditation to Australian Standard ISO 9001. Commercial Minerals also has APIQ1 accreditation and Clay Resources Company has product registration as a stockfeed medicine to prevent acidosis and urea toxicity.

New applications include the production of geosynthetic clay liners for environmental purposes and the pelletising of magnetite. Two patented applications for sodium bentonite produced by PCP Douglass are as an air filter in septic systems and sewage pumping stations, and as an odour absorbent in chicken manure. Pacific Rim Minerals is investigating the development of value added products with environmental applications.

With advances in technology new uses will be found for bentonite, thus assuring growth in the industry.

PRODUCER DETAILS

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FURTHER READING

CARMICHAEL, D.C., 1995: Bentonite. Queensland Mineral Commodity Report. *Queensland Government Mining Journal*, **96** (1128), 14-24.

CARR, D.D., ROONEY, L.F. and FREAS, R.C., 1994: **Clays, Bentonite**. In Industrial Minerals and Rocks. D.D. Carr (Senior Editor), 6th Edition. *Society for Mining, Metallurgy and Exploration Inc, Littleton, Colorado*, 233-246.