Potential and Outlook

The eastern Lachlan Orogen has potential for large, high-purity barite deposits (Figure 2). Although many occurrences of barite are known, there has been little systematic exploration. Barite occurrences are rare in the New England Orogen.

One hundred and thirty barite occurrences are recorded in New South Wales (Holmes et al. 1982; Ray et al. 2003). These are mainly associated with volcanic-hosted massive sulphide mineralisation, an association strongly evident in Late Silurian felsic volcanic rocks in the eastern Lachlan Orogen.

Demand for barite is primarily driven by its use in drilling deep boreholes for petroleum exploration and development.

The largest barite deposit in New South Wales is the volcanic–sedimentary silver–lead–zinc–barite deposit at Kempfield, south of Bathurst, in the eastern Lachlan Orogen. Kempfield hosts significant silver, barite, lead and zinc resources along a 3 km strike length in the Late Silurian Kangaloolah Volcanics. Exploration has identified a barite resource of 3.72 Mt at 26% $BaSO_4$ (60 g/t silver cut-off) within a much larger potential resource (Golden Cross Resources Ltd 2002). At Gurrunda, about 100 km south of the Kempfield deposit, resources of about 300 000 tonnes have been identified.

The Kempfield–Gurrunda zone is considered the most prospective part of the eastern Lachlan Orogen for barite and the prospective Late Silurian felsic volcanic–sedimentary rocks may occur over a much larger area than previously recognised.

Table 2. Main properties of barite

Formula	$BaSO_4$
Colour	Colourless, white, yellow, brown, grey, blue
Specific Gravity	4.5
Hardness	2.5–3.5
Habit	Commonly as tabular crystals or leaf-like aggregates; less commonly as cockscomb masses and fibres; also as compact or grainy masses

Source: Harben (1999)

Nature and Occurrence

Barite (barium sulphate) is characterised by high specific gravity, low hardness and low reactivity (Table 2). Barite is primarily used in drilling muds for petroleum exploration wells.

World production of barite in 2004 was 6.9 Mt (Table 3) (Searls 2005). The major world producers of barite include China, USA, Morocco, India, Turkey, Mexico and Iran.

Deposit Types

Barite deposits are most commonly classified into bedded (stratiform) deposits, veins and cavity fillings, and residual deposits. Bedded barite deposits are commercially the most significant because of their large size, and amenability to modern large-scale mining methods.

Bedded (Stratiform) Deposits

Barite occurs in bedded deposits either as a principal mineral or cementing agent, or associated with stratiform massive sulphide deposits (Harben & Kužvart 1996). Most bedded deposits occur in sequences of sedimentary rocks characterised by

Table 3. World barite production 2004

Country	Production (tonnes)
China	3 800 000
India	800 000
USA	550 000
Morocco	340 000
Mexico	270 000
Iran	170 000
Germany	120 000
Turkey	120 000
Other countries	730 000
Total	**6 900 000**

Source: Modified from Searls (2005)

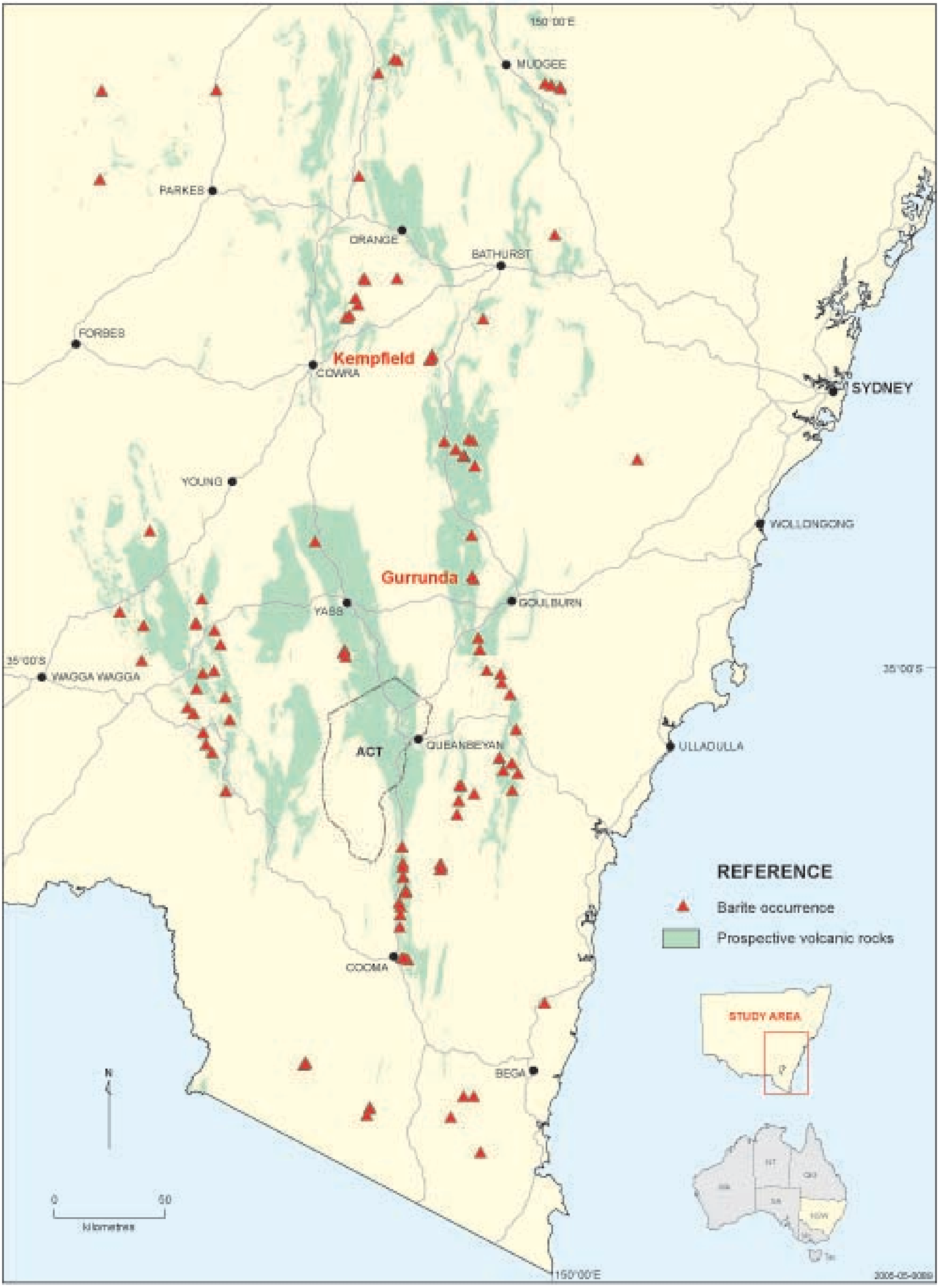

Figure 2. Barite occurrences and prospective rocks, eastern Lachlan Orogen, New South Wales

abundant chert and black siliceous shale and siltstone, known as 'black bedded barite'. They range in age from Precambrian to Tertiary, but are usually early to mid-Palaeozoic (Ramos & de Brodtkorb 1989). Individual beds are massive to laminated, fine-grained and may contain from 50% to 95% barite that can be used with little or no treatment other than grinding.

Bedded barite deposits were divided by Clark et al. (1990) into five types.

- With base metal sulphides (cratonic rift type), associated with alkali volcanic rocks, e.g. Meggen and Rammelsberg, Germany; Ballynoe and Silvermines, Ireland; Selwyn Basin, Canada; and Red Dog, Alaska, USA.
- Without base metal sulphides (continental margin type), e.g. Arkansas and Nevada, USA; Quinling District, China.
- In volcanic sequences, e.g. Kuroko, Japan.
- Stratiform barite deposits, e.g. Sardinia, Italy; Andhra Pradesh, India.
- Exogenetic barite deposits, e.g. Krakow area, Poland.

Veins and Cavity Fillings

Barite deposited from hydrothermal fluids or deep-seated brines occurs in faults, joints, bedding planes, breccia zones, solution channels and cavities. The resulting veins are characterised by sharp contacts, extensive pinching and swelling, and extreme variations in length, depth and attitude. Because of complex geometry, mining vein deposits can be difficult and expensive. These deposits are generally smaller than the stratiform deposits. Vein barite is usually extracted as a by- or co-product of lead–zinc mining — as in Sardinia, Italy, and the United Kingdom.

Residual Deposits

Residual barite occurs in surficial deposits in which the barite is present as loose fragments embedded in residual clay. The barite and the clay are derived from weathering of the underlying rock, generally dolomite. Barite fragments range in size from sand size to lumps weighing 100 kg or more. Residual deposits of commercial grade are found in the USA (in Georgia and Missouri).

Main Australian Deposits

Australia is not a major source of barite, although it has been mined in small quantities in most states. Most production is currently from vein deposits in the Proterozoic Wilpena Group in the Flinders Ranges of South Australia. A large barite resource at North Pole, Western Australia, consists of barite originally deposited in sedimentary rocks of Archaean age. The barite has been mobilised and injected into fractures in an overlying series of volcanic rocks domed by a granite pluton.

New South Wales Occurrences

Known occurrences of barite in New South Wales are restricted almost entirely to the eastern portion of the Lachlan Orogen, particularly in association with Late Silurian felsic volcanic sequences (Stevens 1976). Barite occurrences in the Lachlan Orogen are bedded and vein types.

Barite is associated with base metal sulphides in stratiform (bedded) deposits within Late Silurian felsic volcanic sequences at the following localities:

- Kempfield (in the Kangaloolah Volcanics
- Gurrunda (Wet Lagoon Volcanics)
- Jerangle and Captains Flat (Kohinoor Volcanics)
- South Barite Gossan or Black Springs, Junction Point and Dinner Hill near Peelwood (volcanic rocks within the Campbells Group)
- Bredbo, Chakola, Billilingra, Dartmoor and Harnett deposits near Cooma (Colinton Volcanics and Rothlyn Formation)
- numerous locations in the Jackalass Slate and Blowering Formation of the Tumut Trough
- east of Mudgee (Dungeree Volcanics).

The Kempfield silver–lead–zinc–barite deposit occurs about 25 km south of Bathurst. It is contained within a large volcanogenic massive sulphide system occurring over a strike length of more than 3 km. Barite is present in small lenticular bedded units, consisting of fine-grained greyish barite with lenses of chert and minor disseminated sulphides. The host sequence includes siltstone, felsic volcanic rocks, volcanic-derived sandstone, and minor limestone, chert and quartz porphyry. This sequence is within the Late Silurian Kangaloolah Volcanics, which is part of the Campbells Group. These rocks have been deformed by two periods of folding and have undergone mid-greenschist facies metamorphism.

Recent exploration has identified resources of 3.72 Mt at 26% barite (60 g/t silver cut-off in a lead–zinc–silver–barite deposit) (Golden Cross Resources Ltd 2002). Historically, the Kempfield deposits produced a total of about 65 000 tonnes of barite (about 70% of the state's production) in the period 1918 to 2000. Production ceased around 2001 to allow for investigation and development of the resource. Golden Cross Resources Ltd has yet to mine the barite resource.

South of Kempfield, at the Gurrunda deposit, west of Goulburn, an exploration program in 1970 outlined reserves of 202 700 tonnes containing 74.9% $BaSO_4$ and a possible further 95 000 tonnes at 75.6% $BaSO_4$

(Stevens 1976). The hosts are sedimentary rocks and rhyolitic to rhyodacitic volcanic rocks of the Wet Lagoon Volcanics of the Campbells Group.

Barite veins occur in a wide variety of rocks (Stevens 1976). Granitoids, andesites and felsic volcanic rocks are common hosts, but many deposits have no obvious relationship to granitic intrusions. Included in the vein category are more diffuse deposits which could be described as lodes and disseminations.

Veins consisting essentially of barite with minor base metal sulphides occur within felsic volcanic sequences at Tullamore, Mitta Mitta near Junee, Back Creek south of Bathurst, Tarago, Reedy Creek south of Boorowa, Wyelba–Sapling Point near Yass, and Dripstone near Wellington.

Minor amounts of barite occur either within or very close to Devonian granites at Harolds Cross, Round Hill, Braidwood, Cobargo, Tantawanglo Mountain, Paupong and Currowidgin. The barite is present mainly as veins or veinlets.

Andesitic volcanic rocks host occurrences of barite in the central west of New South Wales near Wellington, Cowra and Blayney (Steam Engine Prospect), Peak Hill, and near Tumut (Basin Creek and Mooney Mooney).

Applications

Barite has high specific gravity, is relatively soft and virtually inert. The main uses of barite are based on its density, colour and radiation absorptive properties. About 90% of all barite produced goes into drilling muds used in petroleum exploration. It is also used as a filler material and wetting agent in a range of products from golf balls and bowling balls to paint, heavy printing paper, rope finishes and rubber products (Harben 1999). It is used in mould-release compounds in the metal casting industry. X-rays and gamma rays are strongly blocked by barite and so it is used in cement vessels used to contain radioactive material, and medicinal and medical applications. Barite is also used in faceplates and funnel glass of cathode ray tubes of televisions and computer monitors. For details of specifications refer to Harben (1999).

Barium compounds will continue to be used for most of their current industrial uses because they are less expensive than competing materials, and they will be used increasingly in new, highly technical applications.

Alternative Materials

A number of materials, including celestite, ilmenite, iron ore and synthetic hematite, have been used as alternatives to barite in drilling muds. However, they have had little impact on demand for barite because of their higher cost or inferior performance.

Alternatives to barite as filler material include calcium carbonate, diatomite, feldspar, kaolin, mica, nepheline syenite, perlite, talc, microcrystalline silica, silica flour and wollastonite. Calcium carbonate may be used as a substitute for barite in glassmaking.

Economic Factors

The barite market is dominated by drilling mud supply companies and is directly affected by the petroleum drilling industry. The level of activity in the petroleum drilling industry is influenced by the price of oil, the state of the world economy, and politics. The price of barite varies according to grade. The highest prices are for fine-ground white and off-white paint and pigment grades, which are more than double the price of drilling and other lower grades. Most barite is a commodity of relatively low to moderate unit value and, therefore, the cost of transportation to market is an important economic consideration.

References

Clark S.H.B., Gallagher M.J. & Poole F.G. 1990. World barite resources; a review of recent production patterns and a genetic classification. *Transactions of the Institute of Mining and Metallurgy, Section B, Applied Earth Sciences* **99**, 125–132**.**

Golden Cross Resources Ltd 2002. Annual Report — 2002. www.goldencross.com.au/Annual/Annu2002/PDF/Annu2002.pdf

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**.

Ramos V.A & de Brodtkorb M.K. 1989. Celestite, barite, magnesite and fluorspar: stratabound through time and space. *In:* de Brodtkorb M.K. ed. *Nonmetalliferous stratabound ore fields,* pp. 297–321. Van Nostrand Reinhold, New York.

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.

Searls J.P. 2005. Barite. *In* United States Geological Survey. compiler. *Mineral Commodity Summaries 2005,* pp. 28–29. United States Department of the Interior.

Stevens B.P.J. 1976. Barite—New South Wales. *In:* Knight C.L. ed. Economic geology of Australia and Papua New Guinea: Volume 4. Industrial minerals and rocks, pp. 24–25. *Australasian Institute of Mining and Metallurgy, Monograph* **8**.