



# Barytes

*This factsheet provides an overview of barytes supply in the UK. It is one of a series on economically important minerals that are extracted in Britain and is primarily intended to inform the land-use planning process.*

January 2006

**Barytes** (barium sulphate,  $\text{BaSO}_4$ ), also referred to as barite or baryte, is the most abundant and economically important barium mineral produced in the UK and worldwide.

**Witherite** (barium carbonate,  $\text{BaCO}_3$ ) was mined commercially in England in the northern Pennines until 1969; worldwide economic deposits of witherite are rare.

Barytes, when pure, contains 58.8% barium and 41.2% sulphate and with a specific gravity (SG) of 4.5 it is often referred to as 'heavy spar'. Inclusions of other minerals may reduce (or in the case of metallics increase) the SG, but a high density, chemical inertness and widespread occurrence are the properties that are valued for barytes' most important application as a weighting agent in drilling fluids. Colour and chemical purity are important properties when considering the suitability of barytes for non-drilling applications.

Barytes is produced in England and Scotland. In England barytes is now only produced as a by-product of fluorspar mining and processing. In Scotland, barytes is extracted as the sole mineral from the Foss Mine near Aberfeldy. The principal planning issues associated with barytes production in England are identical to

the more economically important mineral **fluorspar** ( $\text{CaF}_2$ ). The factsheet on **Fluorspar** should be consulted for more detailed information on these issues. In Scotland, the principal planning issues associated with barytes extraction relate to the location of the deposits in areas designated for their landscape quality.

## Demand

The most important use of barytes, accounting for about 83% of total world consumption, is as a weighting agent to increase the density of drilling fluids, principally for oil and gas exploration. Finely ground barytes is added to the drilling fluid and its function is to confine high formation pressures due to oil, gas and water liberated by drilling and thus prevent 'blowouts'. The suitability of barytes for this purpose is based on a combination of properties, in addition to a high SG (minimum 4.2). These include low abrasiveness, chemical inertness, a non-magnetic character, and being clean and easy to handle and grind. Barytes is also cheap and readily available and although alternatives are available, some of which are used for specialised applications, barytes is the standard weighting agent used in drilling fluids throughout the world. Demand is essentially a function of oil and gas exploration activity. Most of the barytes produced and imported into the UK is finely ground for use in hydrocarbon exploration mainly on the UK Continental Shelf.

Non-drilling applications of barytes are comparatively small, although still important because of their higher value. High purity grades of barytes with fine and controlled particle sizes are used as fillers in marine and industrial paints, in brake lining/friction materials and in plastics. A specialised use of barytes based on its high density and ability to absorb radiation, is as an aggregate in dense concrete for shielding applications in the nuclear industry and hospital radiation departments.

## Supply

Over 80% of total barytes sales in the UK of some 61 000 tonnes in 2004 were derived from the Foss Mine, near Aberfeldy in Scotland. The output is mainly used in drilling

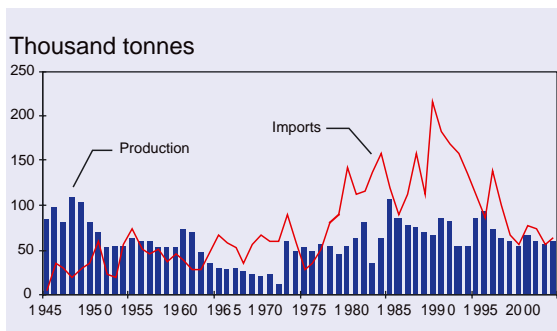
*Barytes extraction, Foss Mine, Scotland.*  
©M-I Drilling Fluids UK



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fluids, although some is used as an aggregate for radiation shielding. Following the closure of two small open-pit barytes workings in the Northern Pennine Orefield, at Closehouse in Durham in 2000 and Silverband in Cumbria in 2002, production in England is now confined to the Southern Pennine Orefield in the Peak District. The mineral is derived as a by-product of processing fluorspar ore at the Cavendish Mill, near Stoney Middleton in the Peak District National Park. Output is dependent on the barytes content of the fluorspar ore, which varies depending on the deposit being worked. Production was some 12 000 tonnes in 2004, most of which was sold locally for value-added processing by fine grinding (micronising) for filler applications in paints and plastics. Some was sold for use in oil well drilling fluids.



**Figure 1 UK: Production and imports of barytes, 1945–2004.** Source: United Kingdom Minerals Yearbook, BGS.

## Trade

The UK has been a significant net importer of barytes for many years. Imports are mainly used in drilling fluids, although a proportion is also imported for fine grinding for filler applications. Imports have been in the range 60 000 to 210 000 t/y over the last 20 years, the level of imports essentially reflecting hydrocarbon exploration activity on the UK Continental Shelf. However, in recent years imports have declined due to a general decrease in exploration activity (See Table 1). Exports are modest and have been between 5 000 and 10 000 tonnes in most years. However, since 2000, exports have reportedly been much larger.

	Imports		Exports	
	Tonnes	£thousand	Tonnes	£thousand
1996	82 656	3 938	5 433	1 270
1997	138 499	5 712	9 438	1 847
1998	98 480	4 394	6 579	1 384
1999	65 356	2 833	8 148	1 516
2000	57 244	2 845	28 472*	2 843
2001	77 153	3 431	58 952*	3 880
2002	74 843	3 117	37 759*	3 163
2003	56 867	2 406	69 094*	3 837
2004	63 924	2 733	25 160*	2 887

\*These figures are believed by the BGS to be too high

**Table 1 UK: Imports and exports of barytes, 1996–2004.** Source: HM Revenue & Customs.

## Consumption

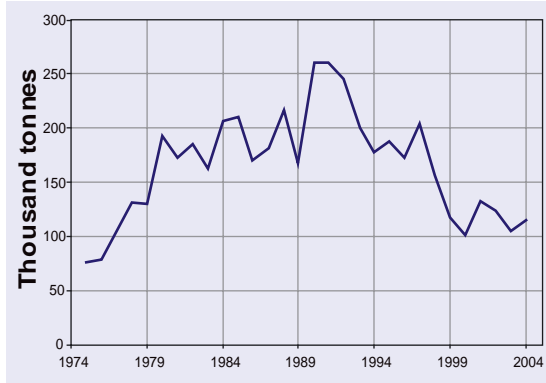
Barytes consumption in the UK mainly reflects the level of hydrocarbon exploration activity on the UK Continental Shelf. Following the discovery of hydrocarbons in the North Sea in the early 1970s consumption of barytes increased to a peak of 260 000 tonnes in 1990–91, the major proportion of which consisted of imports. More recently consumption has been in the range 100 000 to 200 000 t/y due to a decline in exploration activity (Figure 2). Although UK oil and gas production is in decline, the large increases in the price of oil and gas experienced in 2005 may stimulate more exploration activity offshore as smaller fields become more viable. Consumption of barytes for fine grinding for filler applications is about 20 000 t/y. Some of the material is exported.

## Economic importance

Barytes production in Britain generates only modest amounts of direct revenues of about £3

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**Figure 2 UK: Apparent consumption of barytes, 1974–2004.** Source: BGS. Exports estimated for 2000–2004.

million. The mineral is, however, essential for hydrocarbon exploration and thus contributes to maintaining the UK's economically important oil and gas production. Barytes recovery is also an integral part of the economic viability of fluorspar mining and processing in the Peak District. Moreover, the high purity product recovered is further processed by fine grinding in Derbyshire for filler applications yielding additional sales of £1.5 to £2 million.

### Structure of the Industry

M-I Drilling Fluids UK, a subsidiary of the USA-based global drilling fluids manufacturer M-I SWACO, operates the Foss Mine in Scotland and also has title to the nearby world-class Duntanlich barytes deposit. Annual production from Foss Mine is about 50 000 tonnes, and the broken ore is sent to either Aberdeen (where it is finely ground for use in oil exploration drilling as a weighting agent) or to Great Yarmouth. With CIF<sup>1</sup> costs representing 80% of the cost of delivered drilling grade barytes (US\$65-70 per tonne) the location of the deposit and relatively short transport distance to Aberdeen make Foss barytes locally competitive.

<sup>1</sup> Cost, Insurance, Freight — CIF is the term used to indicate total value of a shipment. This compares with Free On Board (FOB) where the seller's commitments end when the shipment is placed onto the transport carrier, thus FOB is usually the value of the commodity only.

Glebe Mines Ltd, a privately-owned company, is now the only producer of barytes in England following the closure of two small open-pit operations in the northern Pennines in 2000 and 2002. The company operates the Cavendish Mill, near Stoney Middleton, where barytes is a by-product of processing fluorspar ore. Some of the barytes is sold into the drilling fluids market but most is sold to Viaton Industries Ltd, a Derbyshire-based company specialising in the fine grinding (micronising) of both domestically produced and imported barytes for filler applications. The Cavendish Mill supplies about half of the company's barytes requirements.

### Resources

Barytes has been worked in many parts of the UK. The most important deposits are near Aberfeldy in Perth and Kinross in Scotland and in the Southern and Northern Pennine ore-fields. Significant production was also formerly recorded in other areas, notably Shropshire, the Lake District, south Devon and central Scotland. In England, barytes occurs mainly as vein infillings in faults, which cut a variety of rock types. The most important are limestones of Carboniferous age but veins cutting slates, mudstones and volcanic rocks of Precambrian, Lower Palaeozoic and Devonian age have also been worked. Intense alteration of limestone wall rocks has also led locally to the formation of replacement deposits adjacent to major veins in the Northern and Southern Pennines. However, vein and replacement deposits tend to be small.

In contrast, bedded or stratabound deposits are much larger. Foss Mine (located in the Ben Eagach Schist Formation) works a stratabound baryte deposit near Aberfeldy in Scotland, which occurs in highly, folded Precambrian (Proterozoic) metasedimentary rocks, and is the major source of barytes in the UK. Much larger resources of barytes have been proved at the nearby Duntanlich deposit, which is also geologically much less complex and would be easier to mine. Dalradian Supergroup rocks that host barytes deposits near Aberfeldy extend for over 200 km across central Scotland from Islay in the south west to Portsoy in the north east.

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Indications of barytes mineralisation have been found at a number of localities along this zone. The possibility that similar styles of mineralisation could be found in England cannot be discounted.

## Reserves

Permitted reserves at the Foss Mine in Scotland are sufficient for about four or five years production, after which the UK will have no major domestic source of barytes. The nearby Duntanlich barytes deposit has an inferred resource of 13 million tonnes, with measured resources of high-quality barytes of 7 million tonnes. This would be sufficient to meet the UK's apparent consumption of barytes for many decades, and would bring to an end the current need to import barytes. Measured resources of barytes at Duntanlich are larger than the estimated 6.7 million tonnes that have been extracted from all UK sites since records began in 1876.

In England, barytes extraction ceased in the Northern Pennines in 2002, due to economic factors. All production of barytes in England is now as a by-product of fluorspar mining and processing in the Southern Pennine Orefield. Reserves of barytes are, therefore, confined to fluorspar deposits, where the barytes content is variable depending on location within the orefield. (See Factsheet on **Fluorspar**).

## Relationship to environmental designations

The Foss Mine and the Duntanlich deposit are located in the Tummel National Scenic Area (NSA). Barytes mineralisation of current economic interest in England is confined to the Southern Pennine Orefield, most of which is located in the Peak District National Park.

## Extraction and processing

At Foss Mine the ore is of sufficient purity to be extracted from underground workings and sent for further grinding at Aberdeen without any upgrading.

The typical feed grade to the Cavendish Mill contains 28% CaF<sub>2</sub>, 8–9% BaSO<sub>4</sub> and <1% Pb. Extraction is geared towards maximising the

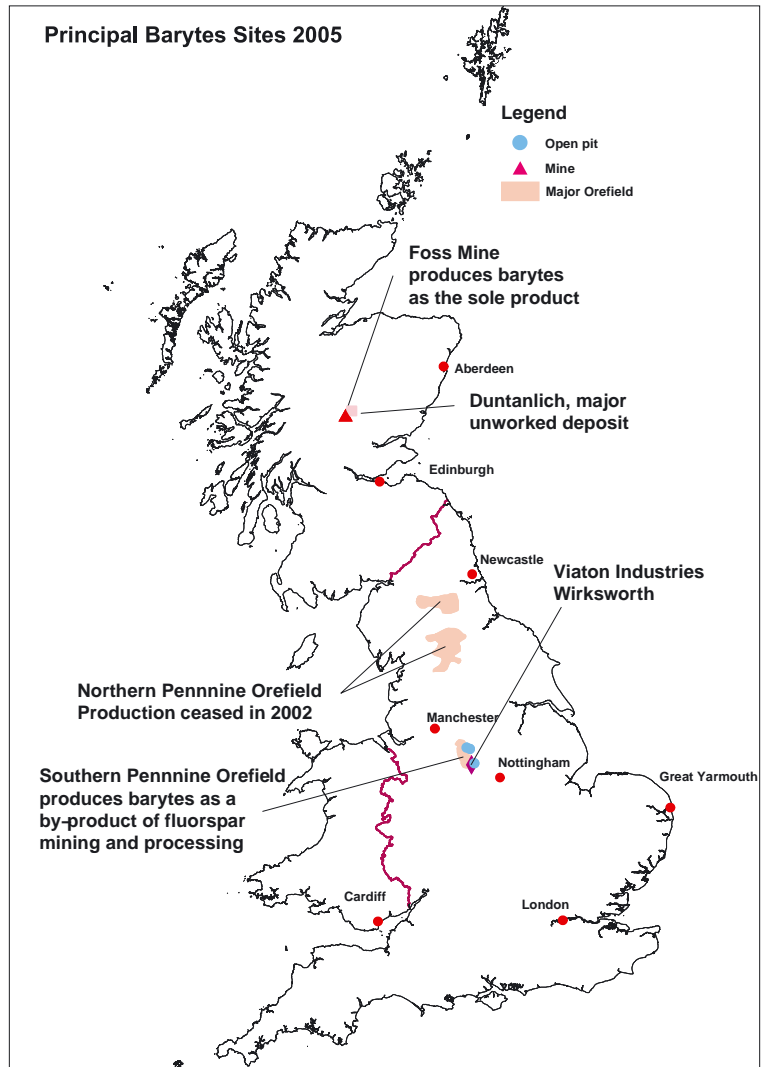


Figure 3 Barytes producing areas.

recovery of fluorspar, which is the most valuable product. Barytes is recovered by a combination of heavy media separation and froth flotation to produce a final product grading 92–95% BaSO<sub>4</sub>. In addition to fluorspar, a lead (galena) flotation concentrate is also produced which is sold locally.

## By-products

There are no by-products of barytes extraction in Scotland. Barytes extraction in the Peak District is itself a by-product of fluorspar mining and processing.



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## Alternatives/recycling

Small quantities of hematite and ilmenite are used as alternatives to barytes as weighting agents in drilling fluids. Calcium carbonate (limestone/marble) may also be used where wells are relatively shallow. New developments with synthetic-based fluids allow the cuttings to be discharged offshore whilst the drilling fluid is returned to a shore base for remediation and re-use. This is resulting in an overall reduction in new barytes consumption per metre drilled.

## Effects of economic instruments

Barytes is not subject to the Aggregates Levy.

## Planning issues

The principal planning issue is the location of barytes resources in national landscape designations, both in Scotland and England. In the most important case in Scotland, this has prevented mineral development, even where the proposed extraction method was by underground mining.

The Foss Mine and its associated surface operations cover an area of about 15 ha and fall entirely within the Tummel NSA. The much larger Duntanlich deposit, some 6 km to the east, also lies in the same NSA. A planning application to develop an underground mine at Duntanlich with an output of 200 000 t/y was refused in 1992. The application was the subject of a public inquiry in 1993, but the appeal was dismissed in 1994. The Court of Session upheld this decision in 1996 on the grounds that the

economic benefits did not outweigh the environmental disadvantages. There were additional concerns about providing access for lorries to the trunk road system. Although the company may submit a revised planning application, there remains the likelihood that this world-class deposit of barytes will never be worked.

## Further information

Barytes Profile. <http://www.mineralsuk.com>

The Barytes Association  
<http://www.barytes.org/>

## Authorship and acknowledgements

This factsheet was produced by the British Geological Survey for the Office of the Deputy Prime as part of the research project 'ODPM-BGS Joint Minerals Programme.'

It was compiled by David Highley and Kevin Bonel, with the assistance of Don Cameron and Deborah Rayner.

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*Mineral Planning Factsheets* for a range of other minerals produced in Britain are available for download from [www.mineralsUK.com](http://www.mineralsUK.com)

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