# MINERALS — WHAT MAKES A MINE?

## Mineral reserves and resources—what are they?

The words *resources* and *reserves* are often used in discussing economically important minerals. It is important to know the definitions of these two terms and to understand how they relate to one another, and to minerals in the ground.

Mineral resources are natural concentrations of minerals or bodies of rock that are, or may become, of potential economic interest as a basis for the extraction of a commodity. They have physical and/or chemical properties that make them suitable for specific uses and are present in sufficient quantity to be of intrinsic economic interest. Measurement of the size and shape of the resource is the first step towards delimiting a mineral reserve.

That part of a mineral resource that has been fully geologically evaluated and is commercially and legally mineable is called a mineral reserve. In the UK the term should strictly be limited to those minerals for which a valid planning permission for extraction exists, termed permitted reserves. Mineral reserves are sub-divided in order of increasing confidence into *probable* mineral reserves and *proved* mineral reserves. The ultimate fate of mineral reserves is usually to be either physically worked out or to be made non-viable, either temporarily or permanently, by changing economic circumstances.

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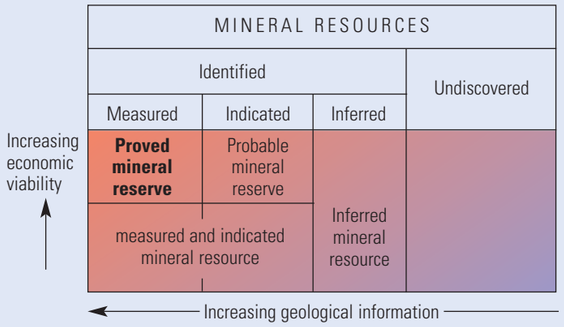
## What makes a mineral deposit workable?

*It is important to know how mineral resources are classified and what the terminology means to ensure that sound commercial decisions are made.*




*This illustrates the fundamental relationship between resources and reserves and the variables that define them. More complicated classification schemes and more heavily qualified definitions have been devised for the purpose of providing financiers, investors and others with dependable reserves data.*

Intensive geological investigations must be undertaken to demonstrate that a mineral reserve exists. This typically involves drilling and detailed sampling to determine the total tonnage of material and its quality–or, in the case of a metallic mineral deposit, its *grade*, that is, the percentage of metal that the rock contains. The resource becomes a reserve only after a full feasibility study that considers economic, mining, metallurgical, marketing, social, environmental, legal and governmental factors. In this way the initial capital cost and the eventual operating cost (including such overheads as taxes, royalties and environmental restoration) can be calculated and measured against the expected income from the products of the mine over its lifetime. This also provides the mining or quarrying company with a business case that might justify an application for planning permission for extraction.

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## What decides the price of a particular mineral or metal?

In general minerals that are widespread and easy to mine or quarry and do not need much preparation before they are used are relatively cheap e.g. sand and gravel, which costs only a few pounds per tonne. Minerals that are rare in the earth's crust and need costly mining and several treatment steps before they can be used are expensive. They include metals such as nickel, which costs several thousand pounds per tonne, and gold which costs hundreds of pounds per ounce. In between is a range of minerals that does not need so much treatment, such as coal, iron ore and gypsum. Aluminium, magnesium and titanium, although common in the earth's crust, are fairly costly because of the high input of energy, in the form of electricity, that is needed to separate the metals from their ores.

**Mineral prices and annual UK consumption**

| | *Price* £/tonne* | *UK consumption* tonnes/year* |
|---|---|---|
| Platinum | 10 000 000 | 10e |
| Gold | 6 000 000 | 10e |
| Silver | 105 000 | 1 000 |
| Nickel | 2 500 | 56 000 |
| Copper | 1 180 | 311 000 |
| Aluminium | 960 | 430 000 |
| Lead | 375 | 298 000 |
| Fluorspar | 90 | 83 000 |
| Coal | 33 | 64 500 000 |
| Iron ore | 16 | 15 350 000 |
| Sand & Gravel | 7 | 92 000 000 |

*approximate e estimate

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## What happens if a mineral is in short supply?

Reduced supply of a particular mineral will lead to a rise in price if demand is constant or rising. Deposits that were formerly uneconomic to mine, because of their low grade, inaccessibility, or other factors, may consequently become economically viable and may be brought into production. Mineral supplies held in commercial stockpiles may be released to the market to alleviate shortages, and other minerals or non-mineral materials may be substituted for the material in short supply.

However, it may take several years to plan, finance and built a new mine. As a result, periods of oversupply can alternate with episodes of shortage. Substitution is not always simple to effect quickly and stockpiles are expensive to maintain.

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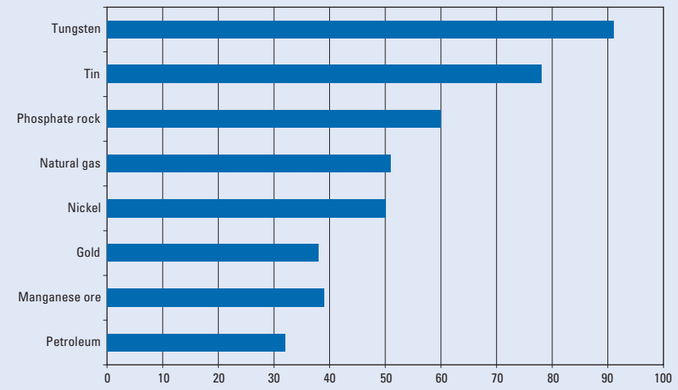
## What are 'strategic minerals'?

Some minerals are both *critical* to certain industry sectors – that is, to part of the national economy or to the national defence capability, which would be seriously affected if they were not obtainable – and at the same time are perceived to be *vulnerable* to interruptions in supply. Such interruptions could be caused by political interference in the market, acts of sabotage, war, accident or industrial action. By definition, these strategic minerals are supplied by a limited number of primary sources that could not be replaced quickly or easily by alternative sources. An example is chromium, used in numerous industrial applications such as stainless steel production and chrome-plating, for which two thirds of world production comes from South Africa and Kazakhstan. Another example is platinum, a key component of autocatalysts, of which more than 90% of world production is from South Africa and Russia.

***Percentage of world output from the three largest producing countries in 2002***




*This shows how production of some minerals, such as tin and tungsten, is concentrated in a few countries, while, for other minerals, such as managanese and petroleum, sources of supply are much more diversified.*

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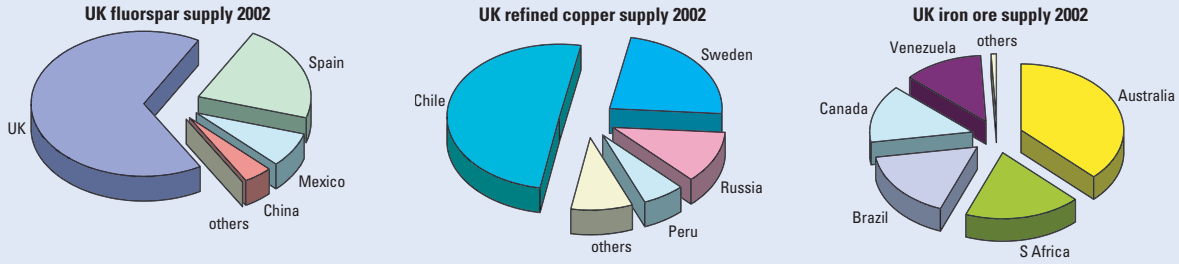
### *Sources of UK mineral supplies*




*Minerals used by UK industry include some, such as fluorspar, that are derived chiefly from domestic sources and others, such as copper, where the bulk of supply is from 2–3 countries. For other minerals, such as iron ore, supply is spread more evenly among more countries. For more information, see Mineral Matters Four, 'Minerals Trade — A Global Picture'.*

## ❑ Will we run out of minerals?

Minerals are a non-renewable resource so if we keep on using them at the present rate they must inevitably run out at some point. However there is no prospect of this happening at present, except possibly in the cases of oil and gas where global production is predicted to begin to decline between 2010 and 2020. New non-fuel mineral deposits are continually being discovered and developed. Most of the deposits worked at present are close to the surface but the earth's crust is on average 35 km thick and the deepest open-pit mine is less than a kilometre deep, while the deepest underground mine goes down to 3.5 km from the surface. However, the most likely reason that we shall not run out of minerals is because we shall not, in fact, go on using them for ever in the same way and for the same purposes. It is likely that some materials currently in use will be replaced by others for technical, economic or environmental reasons.

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*For further information on 'Mineral Matters' contact:*

The Manager
ODPM-DTI Joint Minerals Programme
British Geological Survey
Keyworth, Nottingham, NG12 5GG
Tel: 0115 936 3494
Fax: 0115 936 3520
Email: minerals@bgs.ac.uk
Web: www.mineralsuk.com

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Minerals and Waste Planning Division
Office of the Deputy Prime Minister
Zone 4/A2 Eland House
Bressenden Place
London SW1E 4DU
Tel: 020 7944 3852
Fax: 020 7944 3859
Email: mineralswaste@odpm.gsi.gov.uk
Web: www.odpm.gov.uk

OFFICE OF THE DEPUTY PRIME MINISTER





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