MINERALS — EARTH'S NATURAL RESOURCES

What are minerals?

In science, a mineral is a natural substance, characterized by its distinctive composition, atomic structure and physical and chemical properties. In an economic context, a mineral is any solid or fluid substance that can be extracted from the earth for profit. Economic minerals, often called 'mineral commodities', include metals such as gold and copper, materials extracted for their calorific value such as coal and oil, and materials such as sand and clay used for specific industrial or construction purposes.

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What is a mineral deposit?

A mineral deposit is any accumulation of a mineral or set of minerals that may be economically valuable. The value of a deposit depends on how much mineral there is available, what it costs to mine and process, how rare the mineral is, either locally or internationally, and its current or future market price. For example, gold is a very rare metal that commands a high price so a deposit containing only a few grams of gold in each tonne of rock may be economic to mine. For less rare minerals such as iron, between 25% and 60% of iron in the ore is required before it can be mined. For abundant minerals like sand, almost the entire deposit may be marketable, if its quality is acceptable, with very little waste.

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Mineral deposits only occur where geological processes have concentrated the mineral. Minerals cannot be mined where they do not exist in sufficient amounts. As minerals are used up exploration reveals new deposits but the economic viability of these and known deposits also depends on prevailing market conditions and technology. For example, as oil production declines through the 21st century, and the price of oil increases, oilfields that were previously considered to be too small or costly to exploit will become economical. Oil companies may also develop new ways of extracting additional oil from fields that could not be recovered using older methods.

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Types of minerals

There are four main classes of minerals:

Metals

Metals are required for a wide variety of uses: for example, iron (as steel) in cars or framed buildings, copper in electrical wiring and aluminium in uses from aircraft to beverage cans. Generally, if a metal is rare in the earth's crust, it is more difficult to find in significant quantities and it is more costly to extract. The final product is always nearly-pure metal or a useful alloy of the metal and its price reflects both the costs of mining and of converting ore to metal (smelting and refining). In some cases, for example aluminium, mining cost is low but refining is costly since it requires large amounts of electricity. For most metals, their price makes it economic to transport them great distances from mine to market.

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Energy minerals

Energy minerals include coal, oil and natural gas. They are used in the production of electricity, as fuel for transportation, for heating homes and offices, and in the manufacture of plastics. Coal found at the surface of the earth can be easy to extract from opencast mines. Otherwise, it may be economical to work high-quality coal seams at depth in underground mines. Oil and gas are trapped under layers of rock at depth, and thus they are difficult and costly to find and extract. As a result they command high prices and are often transported by pipelines across continents and by large tankers across oceans.

Industrial minerals

Industrial minerals are non-metallic minerals including salt, china clay and limestone that are used for a range of specific industrial applications such as the manufacture of chemicals, glass, fertilisers and paper. They tend to occur in large quantities, but only in very few locations. They are usually mined in open pits or in shallow underground mines. As they are extracted for specific end uses, the quality of the mineral product is very important. Commonly, a range of specialised processing treatments is required to produce the necessary purity of the final product. Hence the costs of the materials are high compared to other bulk minerals, such as construction materials, and they may be transported moderate distances.

Construction minerals

These minerals include sand and gravel, brick clay, and crushed rock aggregates used for a wide range of construction purposes such as making concrete, manufacturing bricks and surfacing roads. Deposits of these minerals are often extensive and common. They occur at or near the surface of the earth and so are extracted from quarries or by dredging the bottom of rivers, lakes and the sea. They are produced in very large quantities at low cost and transportation is usually only economical over short distances.

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Where do our mineral supplies come from?

Minerals used in the UK economy are either produced within the country or are imported from elsewhere in the world. The UK has varied geology and thus a wide variety of minerals can be found within our borders. Many of the high-value commodities, such as metals, do not occur in the UK in economic quantities, and the indigenous production of some bulk minerals, such as coal, is not sufficient to meet demand. Significant imports of these minerals from around the world are required to meet market requirements in the UK.

UK self sufficiency in minerals and metals and per capita consumption, 2002.

	Self sufficiency	Per capita consumption kg	Total consumption '000 t
Primary aggregates	100%	3 955	232 000
Crude Petroleum	100%	1 246	73 800
Coal	50%	990	58 642
Iron ore for steel	0%	223	13 181
Cement	90%	210	12 361
Brick clay	100%	118	6 985
Salt	100%	96	5 700
Lead (refined)	65%	5.2	298
Tin (refined)	0%	0.16	10

UK population 2002 59.2 million

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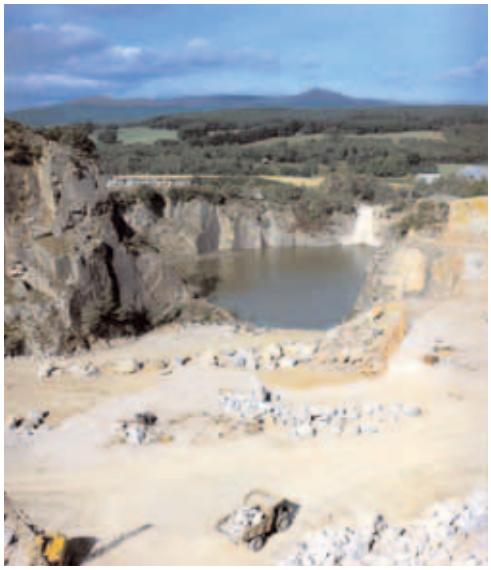
From the earth to the end user

Minerals are found throughout the earth's crust in varying proportions but only under certain circumstances have geological processes produced mineral deposits that can be exploited economically by man. Following discovery there are many steps before final delivery to the end user, whether in a factory, a building site, or in an electricity generating station.

First, the quantity and quality of the mineral in a deposit needs to be assessed. This might include drilling holes through, or using geophysics to assess the extent and structure of, a deposit. The cost of extracting the mineral needs to be related to the market price for the final product. An assessment of the cost includes investigation of the environmental impacts of a mining operation as well as the cost of setting up the infrastructure at a mine.

The mineral usually needs some processing into a form that is usable for the customer. For example, metal ores may be up-graded ('concentrated') and then processed to refined metal. Finally, the mineral needs to get to the consumer. A variety of transportation methods are used, including rail, road, sea, and pipelines. The method of transport will depend on the commodity and how far it needs to travel. For sand moving to a local market, road transport is usually the most efficient method, whereas for oil, which may need to be transported great distances, large tankers or pipelines are used. Metals, in various forms, are also transported around the world. Transportation of minerals and related products to their markets is also discussed in Mineral Matters Four, 'Minerals trade — a global picture'.

Mineral deposits are still being formed by geological processes. For example, gold is being deposited in hot springs on volcanoes, and sand is being laid down in glacial streambeds, but the accumulation of new minerals can take thousands or millions of years. Hence, as known resources are depleted there is a need to discover new mineral deposits and develop new technology to make extraction of minerals more efficient. In addition, reducing consumption of minerals, recycling minerals and metals and finding alternative materials for certain uses will all have important roles to play in the 21st century.



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