

MINERAL RESOURCES

www.geolsoc.org.uk/factsheets



Images (left to right):
 Giant gypsum crystals, Naica, Mexico © Alexander Van Driessche / Wikimedia
 Biotite mica in thin section under a microscope © Strekeisen / Wikimedia
 Kaolin ('china clay') quarry at Wheal Martyn, Cornwall © Martin Addison / Flickr

Why do we extract minerals? The answer is simple: if you can't grow it, you have to mine it! Some minerals are prized for their beauty as gemstones, but many others have more important hidden uses. Almost everything in the modern world uses minerals or their by-products in some way.

Rock, mineral or chemical element?

A mineral is a naturally occurring substance, with a particular chemical formula and crystal structure.

Chemical elements are atoms with specific properties. **Minerals** are made up of one or more different elements, and **rocks** are composed of one or more different minerals.

We can extract certain minerals from rocks and separate out chemical elements from them. In the United Kingdom, the average person benefits from the use of about **10 tonnes** of minerals and metals every year.

Minerals in your diet

The human body needs a number of **essential 'minerals'** to function, which must be taken in through our diets. Calcium, iodine and iron are needed in the largest quantities, with 16 others in smaller amounts:

Essential dietary 'minerals':			
calcium	iodine	iron	
beta-carotene	boron	chromium	cobalt
copper	magnesium	manganese	molybdenum
nickel	phosphorus	potassium	selenium
silicon	sodium chloride	sulphur	zinc

Most of these are actually chemical elements, apart from **beta-carotene** (an organic pigment found in plants) and **sodium chloride** or salt (the only mineral listed above). However, we call them 'minerals' because the body will only accept them combined with other elements in food or drink. For example, we cannot consume **sodium** metal by itself as it would react violently with water in the body, so it is consumed as sodium chloride (salt).

Industrial and Construction Minerals

Fuels and metal ores are not the only geological materials we extract for their commercial value. The others are known as Industrial and Construction Minerals. Hundreds of these are extracted for an enormous range of uses, some of which can be surprising:

- You thought **paper** was made entirely from wood? Not so - it contains a clay mineral, **kaolin**, as a 'filler' and to make it white.
- The world communicates through crystals! **Quartz** is commonly used in microphones and telephones as **piezoelectric crystals** that convert sound into electrical signals.



Quartz © Didier Descouens / Wikimedia



Fluorite © Carles Millan / Wikimedia



Wolframite © Alchemist-hp / Wikimedia

DID YOU KNOW?

There are over **5,000** known minerals. Many of these are extremely rare and some occur in a single location on Earth.

The entire global supply of some of the rarest (such as 'hazenite' and 'fingerite') would fit into a thimble, less than 50 grams. By comparison, we may think of gold as rare, but humans mine about 3,000 tonnes of it every year.

MINERAL RESOURCES

www.geolsoc.org.uk/factsheets








The Geological Society

serving science & profession

Minerals in 'green energy' technology

Renewable energy technology uses a variety of chemical elements sourced from minerals:

Technology	Some chemical elements used	Where do we get them?
'Solar' (Photovoltaic) panels 	<ul style="list-style-type: none"> tellurium, selenium indium, cadmium gallium 	By-products of copper mining By-products of zinc mining A by-product of aluminium mining
Wind turbines 	<ul style="list-style-type: none"> neodymium (one of the rare earth elements*) 	Neodymium occurs most commonly in the minerals monazite and bastnäsite , with other rare earth elements*.
Steam turbines used in Geothermal Energy 	<ul style="list-style-type: none"> nickel titanium ruthenium rhenium 	We commonly mine for nickel and titanium. Rhenium and ruthenium are very rare and are by-products of copper and platinum mining.
Water turbines used in Hydroelectric Energy 	<ul style="list-style-type: none"> chromium nickel 	Chromium is usually produced from the mineral chromite .
Energy storage (batteries) 	<ul style="list-style-type: none"> lithium 	Lithium has two different sources: <ul style="list-style-type: none"> Mining for the minerals spodumene & lepidolite Extraction from brine pools by electrolysis (mostly in the Andes).

Steam turbine image © Siemens Pressebild / Christian Kuhna / Wikimedia

*Rare earth elements are a group of metallic chemical elements with similar properties.

Artisanal mining and conflicts

High value minerals are locally abundant in some developing countries, leading to small-scale subsistence mining, often using hand tools. While often illegal, this **'artisanal mining'** makes a significant contribution to local economies, but has sometimes been used to fund armed conflicts. Civil wars in Sierra Leone, Liberia and Angola were heavily financed by 'blood diamonds'. The Democratic Republic of the Congo has been hardest-hit, with conflict minerals including **gold**, **cassiterite** (for tin), **wolframite** (for tungsten) and **'coltan'** (for niobium and tantalum).



Image: Artisanal miners at a tantalum mine, Democratic Republic of the Congo © U.S. GAO

What is being done?

Some countries, such as the USA, have passed laws forcing companies to declare the origin of the minerals in their products. Voluntary schemes to increase accountability and traceability of minerals have also been introduced. Several charitable organisations campaign against the use of conflict minerals, including **Amnesty International** and **FairPhone**, which produces a 'responsibly sourced' smartphone. Organisations such as the **Alliance for Responsible Mining** work to improve the safety and welfare of miners, strengthen environmental protection and eliminate child labour.

What minerals do we produce in the UK?

Despite a long mining heritage, the UK currently has few metal mines. Important exceptions are the Hemerdon/ Drakelands Tungsten-Tin Mine in Devon and mining for precious metals near Omagh, Northern Ireland.

The UK mostly produces construction minerals including **sand, gravel** and crushed rock **aggregates**, as well as **limestone, clay, slate** and other minerals. These are relatively cheap to extract from quarries. They are mainly used domestically for building and construction, as well as for manufacturing processes in agriculture and the chemical industry.

Nevertheless, the UK does export some minerals, and is the world's third largest producer of the mineral **kaolin** or 'china clay'. This is extracted from two sites in Devon and Cornwall, and mostly used in the paper and ceramics industries. **Potash** is currently produced in North East England for use as crop fertilizer, with future plans to open one of the largest potash mines in the world in North Yorkshire.



Image: Boulby Potash Mine, North Yorkshire © Michael Jagger / geograph.org.uk