HALITE

Halite, or rock salt as it is more commonly known, is the mineral form of Sodium Chloride (NaCl). It is an evaporite mineral, meaning it forms through the process of water evaporation in a partially or entirely stranded water body. Modern day examples of this include the Dead Sea, famous for its salinity, which is evaporating faster than it can be replenished. A more extreme example was the substantial evaporation of the Mediterranean Sea, which has happened three times in geological history.

Salt has been used by humans to flavour and preserve food for millennia, with salt processing dating back to around 8000 BCE. Salt is one of our basic taste groups and is used in the body to regulate fluids.

The salt flats of Bolivia are the result of a warm, shallow sea that evaporated with the rise of the Andes.

Only 6% of mined salt is used in food. Salt is also used to de-ice roads, in agriculture and in water conditioning. It is also used in the production process of plastic, aluminium, paper and soap.

The halite here comes from Northern Ireland and was deposited in a shallow sea that covered much of northern England in the Triassic period, 252 to 201 million years ago. The biggest exporters of salt, however, are China, the US and India.

GRAPHITE

Graphite is one form of pure carbon. It is produced by the metamorphism of organic material in sedimentary rocks but can also be found in igneous rocks and meteorites. China, India, Brazil, Turkey and North Korea are the main exporters. Graphite can also be produced synthetically by mixing powdered carbon with silicon, making silicon carbide, then burning off the silicon. This process creates solid graphite from powdered carbon.

Graphite is the only non-metallic element that conducts electricity and therefore has many uses in electronics, particularly in the batteries of phones and laptops. Graphite is very soft and breaks into thin flakes that slide on top of each other. This property makes graphite a very good lubricant and is used in industrial processes where wet lubricants are unsuitable. It is also this flakiness that makes graphite perfect for the inside of pencils!

Feel free to try drawing with the graphite but remember to wash your hands afterwards!

SMITHSONITE

Smithsonite was named after James Smithson, founder of the Smithsonian museum, and is a zinc carbonate mineral $ZnCO_3$. The zinc is often replaced in the crystal structure by other metals such as iron, magnesium or calcium but it is for the zinc that smithsonite is mined. A hard, brittle metal, zinc has very few applications but, when mixed with other metals in an alloy, zinc becomes very useful. Many of the items we use on a day to day basis will include zinc as an alloy: cars, cosmetics, steel manufacture, plastics, paints, even as a varnish for wood.

Zinc also has biological uses, it is a critical part of over 300 of our enzymes! Zinc was first mined by the Romans who were aware of its health benefits. In fact, a Roman ship that sank in 130 BC had zinc pills on board which were prescribed as a treatment for sore eyes. Nowadays zinc tablets are still used in pharmaceuticals, often as a remedy for the common cold.

The smithsonite here comes from western Mexico, mined from igneous rocks of the Cretaceous, 66 to 145 million years old.

Metals that substitute for zinc in smithsonite cause the mineral to change colour. On the left, the blue is caused by small amounts of copper. The specimen on the right is slightly purple, so contains a little bit of cobalt.

LEPIDOLITE MICA

Lepidolite is a shiny, pink mica with a pretty complex chemical formula: $K(Li,Al)_3(Si,Al)_4O_{10}(F,OH)_2$ and is the most abundant lithium-bearing mineral. Lithium is the 25th most abundant element in the Earth's crust.

Lithium is a metal that is soft enough to be cut with a knife and has a very low melting temperature. It is also the least dense solid metallic element: at room conditions it is about as dense as pine wood.

The main use of lithium is in batteries. Lithium-ion batteries are rechargeable and, because of lithium's low density, they can be used in handheld devices without adding much weight. They are used extensively in laptops phones and other digital devices. Lithium-ion batteries are also used in electric vehicles, a rapidly expanding industry. Demand for Lithium, and the price, has soared in recent years as a result. However, these batteries carry a risk, as Lithium is flammable.

The lepidolite mica in this rock set came from Brazil, where it formed in the pegmatite of a granite pluton. Pegmatites are veins of mineral-rich fluid that grow large crystals. Lepidolite can also be found in the North East Cairngorms of Scotland.

LIMONITE

Limonite is an iron ore that forms from the weathering of mafic lavas and intrusions. A mafic lava is one that does not contain much silica, like the runny lavas found on Hawaii. Iron is the most abundant element in the crust by weight and accounts for over 90% of all metal production worldwide. It is commonly alloyed to produce steel.

Limonite is perhaps the first mineral that truly linked humans with geology. Evidence of the use of limonite as an ore has been found in Africa and it is thought to have been be the first metal ore to be smelted and used in metallurgy. Though haematite and magnetite are easier to process and were used extensively in Europe and China, mining and smelting of limonite ores has taken place in Tanzania since 2500 BCE. Our first use of limonite occurs even earlier, as limonite was first used as a yellow pigment. Ancient cave paintings and pictograms reveal that limonite was one of the first man-used materials. Nowadays, limonite is primarily used as an indicator of gold.

Cave paintings from Kondoa Irangi, Tanzania. When limonite is heated, it reddens and may therefore have been used in these 50,000 year old paintings.
Photo by D. Tamino Boehm, CC 4.0.

Our limonite comes from Australia, which is the world's second biggest producer of iron after China.

Anthracite (Coal)

Coal is a carbon-based mineral, produced when organic matter is subjected to heat and pressure (metamorphosed) over a long period of time. In Britain, plants buried in boggy swamps around 320 million years ago have been converted into coal.

Anthracite is a particularly high-grade type of coal, meaning that it has a high percentage of carbon and therefore produces fewer contaminants when it is burnt. This makes it more expensive when compared to lower-grade coal. Coal has been used as a fuel in Wales since at least the medieval times and it is from South Wales that the majority of the UK's anthracite originates. It has a close connection with British history, fuelling the industrial revolution.

In recent times, coal mining has been declining in the UK because of the carbon dioxide that it releases when it is burnt. It continues to be the primary source of fuel in China, where the majority of global coal is now produced. Anthracite, however, is too expensive to be practical for power plants and is now mainly limited to use in some people's homes.

There were no flowering or deciduous plants 320 million years ago so our coal is made up of plants similar to modern ferns.

Shale

Shale is the most common sedimentary rock, created by the accumulation of mud, silt and organic material on the sea floor. Shale isn't a resource in itself but can act as a trap for oil and gas. Or as is the case with shale gas, the gas can be held in the pore spaces of the shale rock. Like coal, oil is a carbon-based product, formed by applying heat and pressure to organic materials. When oil is formed, it rises through rock units due to its low density and escapes at the surface but oil cannot pass through shale so shale is often explored when looking for oil.

When oil is extracted, it is called crude oil. Crude oil must undergo fractional distillation – split into each component – before being used. Each fractionation of oil has a different purpose. These include: petrol for cars, aircraft fuel diesel for cars and bitumen for roads and roofs. Oil can also be turned into plastics, 99% of plastics use an oil base and 4% of all oil goes towards producing plastic.

Our shale comes from Yorkshire, though most of the UK's oil comes from the North Sea. See if you can spot some of the fossils that could have turned into oil.

The breakdown of fossil plant and marine micro-organisms and also larger animals, such as this ammonoid, create oil with heat, pressure and time.

NATIVE COPPER

Copper is the 26th most abundant element in the Earth's crust and can be extracted in deep underground mines or from open cast pits. The largest copper deposit currently being mined underground is the Escondida mine in Chile, and the biggest mine is Bingham Canyon in the US, the largest man-made excavation in the world. Copper is one of few metals that can be found in its native form but it is more often found in minerals such as Cuprite, Chalcocite and Covellite, which all contain over 65% copper by weight.

Copper is an incredibly useful material because it is a good thermal conductor, electrical conductor and is corrosion resistant. It is also ductile, which means that it can be drawn out into wires which can then be used to transport electricity over great distances.

This piece of copper came from the Keweenaw Peninsula in Michigan. An incredibly pure copper, Keweenaw mine opened in 1845 and led the world in copper production until it closed in 1968. The copper here gathered in cracks within lava flows.

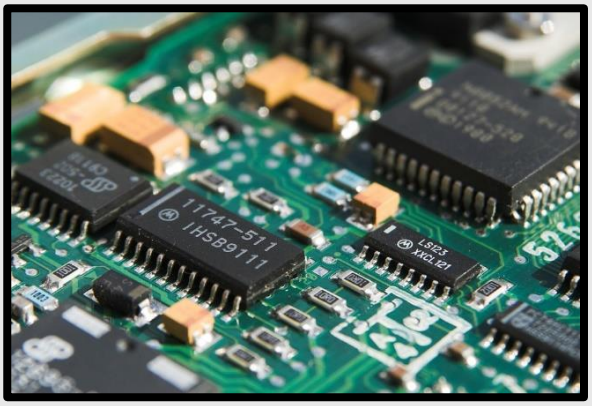
These native copper deposits are exposed at Rio Tinto, Spain.

SPHALERITE

The specimen below is grey (sphalerite) with some gold - coloured crystals (chalcopyrite). Sphalerite is a sulphide of zinc (ZnS) and is relatively common in the earth's crust. Zinc often bonds with indium (In), a metal with some very useful properties. It has a very low thermal conductivity and is so soft that you could cut it with a knife.

It is very ductile, meaning that it is easily drawn into wires and because of its low melting temperature, indium is often used in soldering, completing circuit boards for all sorts of electronics. It can also act as a heat sink, lowering the working temperature of electronics by 10 ℃. The main use for indium, however, is as a superconductor. A superconductor is a material with no electrical resistivity, meaning that electricity can flow without the need for an internal battery. For this reason, indium is found in LCD screens all over the world.

This piece of sphalerite with chalcopyrite came from Mexico. Chalcopyrite is also a very useful mineral as a source of copper and as an indicator of nearby gold deposits.



Circuit boards are found in almost all consumer electronics. Zinc is in the components of circuits and in the solder, linking the whole system.