Common Fossils, Rocks and Minerals in Scotland

Scotland is extremely lucky as it has many different types of fossils, minerals and rocks. It is possible to find and collect rock, fossil and mineral specimens provided it is done in a responsible manner and the **Geological Fieldwork Code** is followed. In time the **Scottish Fossil Code** will provide detailed information on the collection and care of fossils in Scotland (both codes can be found on www.ScottishGeology.com). The following pages list some of the more commonly found geological specimens.

In museums and books, we often see only the best examples. Here, we have chosen not to photograph such specimens, but instead have chosen examples which are more likely to be found. The pictures here have a pencil for scale.

Words in **bold** type will be explained, and you'll find a geological timescale at the end to explain words shown in blue.

The Fieldwork Code - the most important bits...

- Remember the Country Code and observe local bylaws - shut gates and leave no litter
- Look for loose material to collect first, to avoid hammering at all
- Don't hammer indiscriminately and remember you don't always need to take a sample
- Keep collecting to a minimum; leave material left for other people to enjoy
- If you find anything interesting, tell the local museum. Always make a note/take a photo of where you found it
- Try to leave sites as you find them
- Always wear protective goggles when hammering and be aware of where other people are around you
- Make sure you don't get cut off by the tides

Fossils - Animals with Backbones

Animals with backbones, for example fish, dogs, and humans are grouped together and called **vertebrates.**

Fish

Fish fossils can be found in Scotland as fish have been living on Earth, or should we say in the water, for more than 450 million years, and parts of Scotland have been around for much longer than this.

One of the most impressive fish fossils you can find is a tooth from a giant fish called *Rhizodus* - have a look at the photograph of a baby tooth. This fish was a very large animal and could grow up to 7 metres in length, whereas a great white shark today only grows to about 6 metres. It had big, sharp, pointed teeth that could be up to 20 cm long. With teeth that large and pointed it didn't eat plants, but other fish. The fossils are found with other fish and marine fossils.

Age: Upper Carboniferous

Where: Central Belt

Scales, spines and bones from earlier fish can be found in certain types of rock from the Devonian. The area around Caithness is especially rich in such fossils.

Fossils - Animals without Backbones

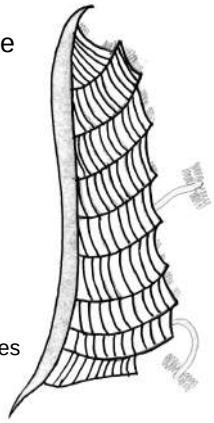
Animals without backbones are all called **invertebrates.** All the following animals are invertebrates.

Graptolites

In the photograph, you can see what looks like a mark or scratch on a dark piece of rock. This is what remains of a sea animal called a graptolite. Each fossil is not just one animal, but many, which all lived together in a small colony that floated in the ocean. In the drawing you can see what the small animals looked like when they lived.

Age: Ordovician & Silurian

Where: Southern Uplands



A sketch of how graptolites might have looked when searching for food

Arthropods

Trilobites, shrimps

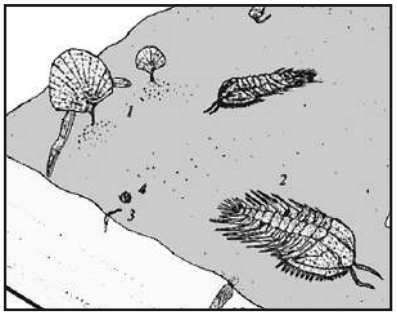
Arthropod is an unusual name that describes many different animals, and is one you might, or might not have heard before. It comes from the ancient Greek language and means 'jointed feet'. It describes animals without backbones which have jointed limbs and a hard **exoskeleton** - instead of having their soft body parts on the outside and bones on the inside, they have the soft parts inside and a hard outer casing.

Trilobites

Trilobites belong to the group of animals called arthropods. In the photograph, the trilobite's **exoskeleton** has been preserved as a mould. They were sea animals, and became **extinct** - or died out - at the beginning of the Triassic. In Scotland, we usually find trilobite 'bits', instead of whole fossils.

Age: Cambrian to Permian

Where: Southern Uplands, Highlands (Cambrian) and Central Belt



A drawing of trilobites on the sea floor
Picture from Dr S Stewart

Shrimps

These are also arthropods. Due to their small size you can sometimes find them as whole fossils, though they are less common than trilobites.

Age: Carboniferous

Where: Central Belt

Molluscs

Ammonites, belemnites, bivalves, brachiopods

Ammonites

Two ammonites

These animals were ancestors of the octopus. They had a spiral outer shell, and it is this part of the animal that is mostly fossilised. They are generally found in limestone and are common in England, but less so in Scotland. This is because ammonites were more common in the Cretaceous and Scotland doesn't have many rocks from this time. Ammonites became extinct at the same time as the dinosaurs at the end of the Cretaceous.

Age: Jurassic and Cretaceous

Where: Skye and northeast Highland coast

Belemnites

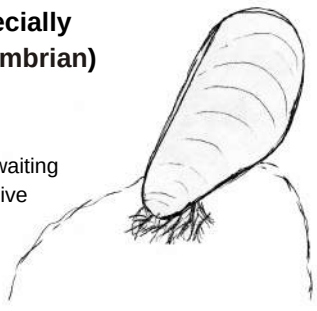
Belemnites can be found in rocks of the same age and type as the ones that contain ammonites. Belemnites also became extinct at the same time as the ammonites but they are related to the squids that are alive in the sea today. The fossil part of the belemnite is from the hard part of the animal. They look like straight ammonites (or long bullets).

Bivalves

Bivalves are shelled animals that are also related to ammonites and belemnites but they do look very different. In the photograph and the drawing you may notice that they look similar to brachiopods (next page) but they are not related to them. Bivalves are probably familiar to most people, as you can find them on the seashore today. Although they have two shells, you tend to find only one shell as they fall apart quite easily after they die.

Age: Cambrian to present

Where: much of Scotland, especially Central Belt and Highlands (Cambrian)



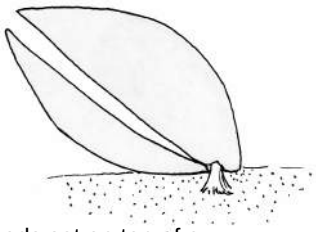
A picture of a bivalve sitting on a rock waiting for the tide to come in. Some bivalves live in beach sand or under the sea, but they are able to live in many places in water. This is why today, you can see a lot more of them compared to brachiopods.

Brachiopods

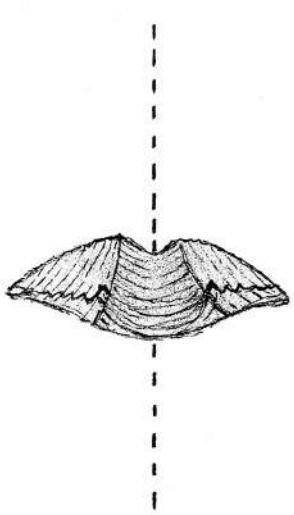
Brachiopods look very similar to bivalves. They have been living for more than 500 million years, probably even longer than bivalves. Today, brachiopods are not that common and tend to live in deep sea, unlike bivalves which can be found in shallow water and on rocks when the tide goes out.

Age: Carboniferous

Where: Central Belt



How a brachiopod may have looked when it lived on the sea floor. The two shell halves are open so it can feed. Most brachiopods sat on top of a stalk called a **pedicle**; this stalk is not usually found fossilised.



A diagram of a **brachiopod** showing its line of symmetry

What's the difference between a bivalve and a brachiopod?

The main difference is the line of symmetry. Have a look at the diagrams - if you took a mirror and placed it along the dotted lines you would see that the two halves of the shell would look the same. The bivalve shell is symmetrical between its two shell halves, whereas the brachiopod is symmetrical across its two shell halves.

A diagram of a **bivalve** showing its line of symmetry

Corals

Solitary, colonial

Corals can be found in many places in Scotland, but mainly in the Carboniferous rocks of the Central Belt. This was when Scotland was near the equator and parts of the land were at times, under shallow, warm seas. There are two types of coral that can be found - solitary and colonial.

Age: Carboniferous (mainly) to present

Where: Central Belt

Solitary

Solitary corals lived on their own and formed a hard skeleton that looks a bit like a bent ice cream cone (have a look at the photograph). The soft part of the animal lived at the top of this cone and would catch food as it drifted by in the sea.

Top: a solitary ('horn') coral

Bottom: a colonial coral ('spaghetti rock')

Colonial

Colonial corals look very different. They liked to live in groups of many animals, where they all built their own skeletons next to each other. The fossils are nicknamed 'spaghetti coral'.

Crinoids

Crinoids may look like flowers or plants but they are animals - they are a member of the starfish family.

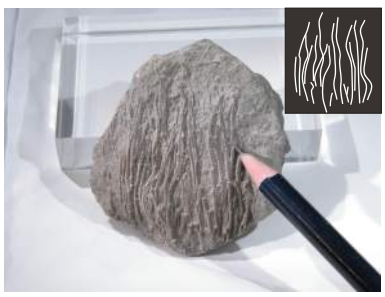
It is rare to find the whole animal fossilised, but easy to find the small rings that stacked up to make the support stem - these are called **ossicles**. In the top photograph you can see the rock has these little rings. Some are face up and some are lying on their sides. In fact it has so many ossicles, it is called crinoidal limestone. Crinoids would sit on the seabed waiting for small pieces of food to drift by so it could catch them in their feathery arms.

Age: Carboniferous

Where: Central Belt

Top: crinoid ossicles

Below: a more complete crinoid, showing the feathery arms



How a crinoid may have looked when it was alive on the sea floor. It may look like a plant but it is an animal.

Fossils - Plants

Lepidodendron, stigmaria, mariopteris

The most common plants come from the Carboniferous rocks in the Central Belt. This was when Scotland was near the equator and the corals were growing in warm seas. On land, the trees and other plants were growing in swamps. Many of the dead trees and plants were buried below ground where they eventually formed coal.

There are different parts of the plants that you can find.

Lepidodendron

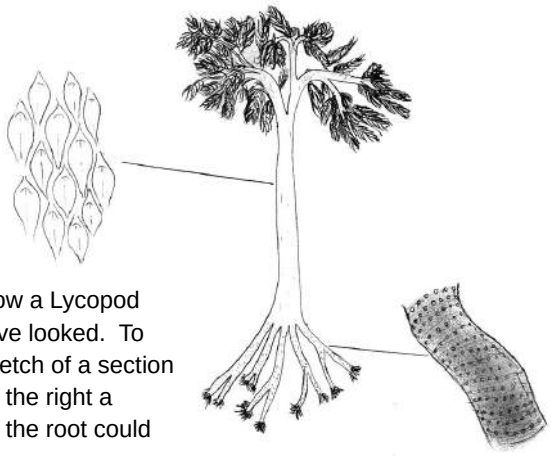
This is the fossil of the bark that covered the trunk and branches of a plant known as a lycopod. Sometimes they are called scale trees because if you look at the bark it has diamond shaped marks that look like the scales of a fish.

Top: a small piece of *Lepidodendron*

Below: a piece of *Stigmaria*

Stigmaria

Stigmaria is the fossil root of the same tree. It has dimples where small rootlets would have grown out of the main root.

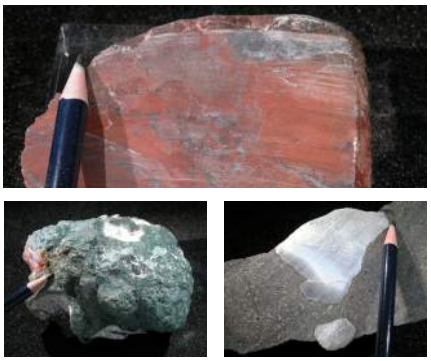


A picture of how a Lycopod tree would have looked. To the left is a sketch of a section of bark and to the right a sketch of how the root could have looked.

Mariopteris

Mariopteris is part of a fossil plant called a seed fern. You can usually find this fossil in the same sort of rocks that you find the *Stigmaria* and *Lepidodendron*.

Left: clear quartz cluster (rock crystal)
Top right: milky quartz
Bottom right: amethyst cluster



Top: jasper
Bottom left: agate nodule (rough)
Bottom right: cut slice of rock with two agates in it

Minerals

Quartz

Quartz is one of the commonest minerals in Scotland. Small impurities in it can make it look very different. Quartz can also be called the names below, depending on what it looks like.

Quartz/rock crystal is clear and very hard. This is pure quartz.

Milky quartz is hard and white and you can't see through it, unlike some other types of quartz. This is the most common type you'll find in Scotland - maybe even in your garden.

Amethyst is a lovely clear (you can see through it) quartz that has a purple colour.

Smoky quartz is similar to ordinary quartz but has a grey or brown colour. It is also called cairngorm, which can be red/brown in colour.

Jasper is an opaque quartz that is usually a reddish colour. This colour comes from another mineral in it called haematite, which contains iron.

Agates are usually found in basalt. If you cut or break one open you can sometimes see bands of different coloured agate in it.

Calcite

Calcite can look like milky or clear quartz, but it is easy to tell the difference. Quartz is very hard, whereas calcite is quite soft. Quartz will scratch a two pence piece as the coin is softer than the quartz. If you do the same to a piece of calcite, the coin will scratch the calcite because it is softer than the coin.

Barite

Barite is a white/beige or pink mineral that is usually found with other minerals such as galena. The best way of identifying barite is to hold it in your hand, as it is heavy. It is heavy as it contains barium which is a very heavy chemical element.

Galena

Galena is also a heavy mineral. It is easy to identify as it has a dark grey colour and is shiny if scratched or unweathered. It also can be found in cubes or similar shapes. It is heavy as it contains lead which is a very heavy chemical element.

Pyrite

Pyrite is also known as ‘fools gold’ because it is a gold colour and looks metallic. Pyrite doesn't contain any gold but contains iron and sulphur and is a lot harder than gold. When you find pyrite in Scotland, you will almost always find it as specks or small cubes in rocks.

Chalcopyrite

Chalcopyrite can look very similar to pyrite, as it also contains iron and sulphur. Sometimes chalcopyrite can look shiny and multicoloured, but usually it doesn't. The easiest way to tell which you have is to try and scratch a piece of steel (such as a penny washer). Chalcopyrite will not scratch the washer but pyrite will as it is harder than the chalcopyrite.

Garnet

Garnets can be found on their own or as part of a metamorphic or igneous rock. They are usually dark red in colour, can grow to large sizes and are sometimes used in jewellery - though in Scotland few are good enough to be cut into gems. Usually though, they grow up to 1cm in size. They are very hard and so when they are found on their own, it has been because the softer rock around them has been worn away, and the garnets have been left behind.

Zeolites

Zeolites are white minerals that are found in holes in the cooled lavas on some of the Hebridean Islands such as Skye and Mull. The crystals come in different shapes, including ‘hair-like’. Look for the holes that are not completely filled with minerals as that is where you will find the nicest crystals.

Rocks

What are rocks? Rocks are a collection of minerals of different types (or sometimes the same type) grouped together to make a solid piece.

Granite

Granite is common in the Highlands and Grampian region. Aberdeen is the 'Granite City' as it sits on a large body of granite which has been used in many of the buildings. Granite is a type of **igneous rock** - this means it formed when molten rock cooled and formed crystals of different minerals. Granites tend to be made of crystals of quartz, feldspar, biotite and/or hornblende. In the photographs you can see the different crystals (colours) that make up the rocks. The feldspars in the rock can usually be found in two different colours (white or pink).

Basalt

Basalt is another **igneous** rock - it is cooled lava. It does contain different minerals, but the crystals are tiny and difficult to see because the lava cooled quickly. Basalt does not contain quartz, but contains feldspar and pyroxenes as well as magnetite and sometimes olivine. Basalt contains a lot of iron, which makes it heavier than granite.

Garnet-Mica Schist

Garnet-mica schist contains garnets (usually red) and mica (usually brown or black and very shiny) as well as other minerals. Schist is not named after the minerals in the rock, but after how the minerals have been stretched out. This is because schist forms deep in the ground and the minerals get squashed - just like when you squeeze a tube of stripy toothpaste and the stripes line up on your toothbrush.

Folded Metamorphic Rocks

Metamorphic rocks have been changed by heat and/or pressure. Any rock can be changed by this happening. If the heat and pressure are strong enough, the rocks can get bent or folded into different layers. In the photograph you can see different coloured layers. They are the different minerals that make up the rock, and have been bent and twisted almost like layers of modelling clay.

Geological Timescale

Eon	Era	Period	Years ago in millions of years (Ma)	Age of	Events
Phanerozoic	Cenozoic	Quaternary	0 - 2	Mammals	Humans / Ice Ages
		Tertiary	2 - 5		
			5 - 24		
			24 - 37		
			37 - 58		
			58 - 65		Extinction of Dinosaurs
	Mesozoic	Cretaceous	65 - 145	Reptiles	Flowering Plants
		Jurassic	145 - 200		1st Birds/Mammals
		Triassic	200 - 251		1st Dinosaurs
	Palaeozoic	Permian	251 - 299	Amphibians	Extinction of Trilobites
		Carboniferous	299 - 359		1st Reptiles
					Large Primitive Trees
		Devonian	359 - 416	Fish	1st Amphibians
		Silurian	416 - 443		1st Land Plants
		Ordovician	443 - 488	Invertebrates	1st Fish
		Cambrian	488 - 542		1st Shells, Trilobites
Proterozoic	Precambrian		542 - 2,500		1st Multicelled Organisms
Archaean			2,500 - 3,800		1st Single-celled Organisms
Hadean			3,800 - 4,600		Origin of the Earth

Dates after Gradstein, Ogg and Smith 2004