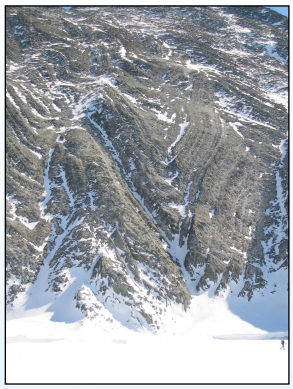
Antarctic Rocks

More than ninety eight percent of the rock in Antarctica is hidden by ice, while the remainder provides a record of the remarkably varied conditions that have existed on the continent over the last 3.9 billion years.

This record also extends to the landscape itself, which shows evidence of erosion by both running water and wind. Together the rocks and landscape of Antarctica have provided strong evidence that:

- plate tectonics occurs.
- life evolves.
- the circulation of the ocean changes.
- processes in the atmosphere change.
- Earth's climate changes.



Folds in sedimentary rock. The person in the lower left gives scale. Image: Andrill.

The three main types of rock

1. Sedimentary rocks

Sediments are the eroded fragments of rocks. If sediments accumulate, thicken and are compressed they eventually form *sedimentary rock*. Within a sedimentary rock, the size and shape of the fragments records the story of its formation, for example:

- sandstone is composed of small grains of sand which have been rounded by knocking against each other in fast moving water, such as in a river or on a beach.
- mudstone is composed of smaller, finer sediments that are able to be carried in slower moving water.

Fossils may also be found in sedimentary rocks, and provide strong clues as to the environment in which they lived. For example identifying the species of a fossilised fish in a mudstone may show whether it formed in marine or fresh water.

Likewise some rocks, such as limestones, are composed entirely of microscopic shells. The lack of any other sediments in these rocks suggests that they were no rivers nearby, with any land being very distant.

At times sedimentary rocks can be formed by minerals being precipitated directly from a watery solution, as with the formation of *rock salt* which may be mined and sold as common table salt.

2. Igneous Rocks

Igneous rocks are formed when molten rock cools. There are two types of igneous rock

- *Plutonic rocks*. These form when molten rock cools slowly, such as when it is trapped beneath the surface. The slow cooling provides sufficient time for large crystals to form, such as those in granite and diorite.
- *Volcanic rocks*. These form when molten rock cools quickly, such as when flying through the air or plunging into water. The rapid cooling only allows microscopic crystals to form, such as those in scoria or volcanic glass (obsidian)

The chemistry of igneous rocks varies and depends on where and how the rock was formed. For example, as molten magma rises up through a volcano it may be contaminated by surrounding rocks and water. In part this is why the volcanoes formed where tectonic plates spread apart have a different chemistry (and therefore behaviour) to those where tectonic plates collide.

3. Metamorphic Rocks

Metamorphic rocks are formed when rock is altered by heat and pressure - conditions which often occur when rocks are pushed down into the Earth. How long the heat and pressure are applied for, along with the chemistry of the original rock, determines the type of metamorphic rock that results, for example:

- mudstones may be metamorphosed to schist
- limestones may be metamorphosed to marble

New tools, new discoveries

A hundred years ago the first studies of Antarctica's rocks were made using the transport of the time, namely dog sledge, ski or simply on foot. Today motor toboggans and small planes are widely used, and are essential for quickly visiting remote rock outcrops, in a manner the early geologists would barely believe.

Other advance include studying rocks using 'remote sensing 'techniques such as:

- flying equipment above thick ice to measure the magnetic or gravitational properties of the rocks below.
- bouncing the sound waves from explosions of different layers of rock and recording the results with seismic recorders.

One of the most spectacular discoveries using remote sensing, has been the detection of the Gamburtsev Mountains. Although this mountain range is larger than the European Alps, it lies completely hidden beneath the Antarctic ice cap.

Even traditional drilling for rock samples has changed, with one recent international project (ANDRILL) using high-tech' methods on moving sea ice and ice shelves, to retrieve 1170 metres of rock. This impressive core of rock provided a remarkably detailed record of how Antarctica's climate has changed over the last 40 million years.

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Curricula: Science L4 - 8, Social Studies L3 - 4, Geography L6 - 8.