



ANTARCTICA NEW ZEALAND INFORMATION SHEET

ICE AND ROCK

A Continent of Ice & Rock

Antarctica is a vast continent of rocky islands covered with ice and surrounded by ocean. It is totally different from the Arctic, which is an expanse of frozen ocean surrounded by continents. Antarctica is almost as large as the US and Australia.

Ice, Ice and More Ice

Ice is the major feature of Antarctica. Even though little precipitation falls, the ice formed from compacted snow accumulates because none is lost due to the extreme cold.

It covers 98% of the continent and is partly responsible, along with Antarctica's position at the pole, for the extremes of wind and cold.

Only about two percent of Antarctica is ice-free. One of these areas is called the Dry Valleys in the Ross Dependency. It is the driest place on earth - no rain has fallen for at least two million years! In the Dry Valleys, however, there are lakes filled by melt streams that flow during the brief summer.

Over most of the continent, though, the icecap is so thick that it has pushed down the underlying rock. The icecap covers 13.72 million square kilometres and contains 90 percent of the world's ice and 70 percent of the world's fresh water. The highest elevation of the icecap is 4100 metres, and in places it covers entire mountain ranges. The ice flows downhill from the highest points in the icecap towards the coast.

Ice has filled most of the valleys between the mountains to form glaciers. The largest Antarctic glacier is the Lambert Glacier, 40 km wide and 400 km long. It is also the largest glacier in the world.

Floating ice shelves form about one third of the coastline - the largest is the Ross Ice Shelf near Scott Base. It is twice the size of New Zealand. Its thickness ranges from 900 metres at the base of the TransAntarctic Mountains to 200 metres at its northern edge. Huge outlet glaciers and three main ice streams feed it as well as snowfall.

Huge flat-topped icebergs are formed when pieces "calve" off the floating ice shelves. One of the biggest ones recorded was the size of the Canterbury Plains! Remember, too, that 80 percent of the iceberg is below the water line.

In winter, the ocean around the coast also freezes. This more than doubles the size of Antarctica. The sea ice reaches its maximum in September. This huge area of frozen ocean strongly influences the circulation of the Southern Ocean, which in turn

affects the atmosphere and thus the weather of the entire Southern Hemisphere. The sea ice is strong enough that in spring an aeroplane runway can be built on it in McMurdo Sound.

The South Pole, the point where the lines of longitude meet at the bottom of the Earth, is as high as Mount Cook because of the thickness of the icecap. The United States has established a base there where people undertake research year-round.

One of the reasons why Antarctica is so cold is that the permanent ice cover reflects about 80 percent of the incoming sunshine - this means that only 20 percent of the energy from the sun is absorbed. In oceans, because of their darker colour, 95 percent of radiation is absorbed and five percent reflected, so they are warmer.

In the Dry Valley region, where the ice-free surfaces are dark and absorb most of the incoming radiation, the summer temperatures are 6-8°C higher than at Scott Base. In winter, though, the Scott Base area is warmer because of the effect of the ocean.

The accumulating ice is a good record of the past climate. Ice can be drilled - the deeper cores reveal the oldest ice. The ice can reveal volcanic ash, pollen and bubbles of air, which clearly show past atmospheric concentrations of greenhouse gasses. This provides a benchmark for research into changing atmosphere and weather conditions.

Weather

As well as being the iciest continent on Earth, Antarctica is also the driest, windiest and coldest. Antarctica receives a similar amount of precipitation in the form of snow as the hot deserts receive as rain - an average of about 50 mm a year.

The lowest temperature ever recorded on Earth (-89.2°C) was recorded at the Russian Base Vostok in Antarctica in 1983. At Scott Base, New Zealand's scientific base in the Ross Dependency, the mean temperature is -20.2°C and the maximum ever reached was 7°C. In summer it usually remains below 0°C. The lowest temperature ever recorded at Scott Base is -57°C.

The wind in Antarctica is partly due to the icecap. Katabatic (down-flowing) wind results from the sliding of dense cold air down to the sea from the higher elevations in the interior. These winds can reach 320 kilometres per hour. Blizzards are frequent in Antarctica. These are a combination of strong winds with blowing or falling snow. Visibility can be reduced to only a few metres.

Winters are severe in Antarctica, not only because of the low temperatures, but also because of the long period of darkness. At Scott Base, the sun sets at the end of April and is only seen rising again at the end of August. For two of these four months, there is complete darkness. At the South Pole, the darkness lasts another month. In mid-summer though there are 24 hours a day of sunlight.

Ancient Rocks

Some of the rocks forming the Antarctic continent are amongst the oldest in the world - the ancient rocks of East Antarctica are at least 3000 million years old. The rocks of West Antarctica are more recent - only about 700 million years old! The oldest are metamorphic rocks - sediments and granite that have been subjected to extremes of

heat and pressure while buried in the Earth's crust.

The TransAntarctic Mountains are a 3000-kilometre-long mountain chain running almost the whole length of Antarctica. It is partly made up of unaltered sediments about 500-600 million years old, which contain fossils of plants and animals that have also been found on other continents.

This gives us the clue that Antarctica was once joined to other continents. Africa, South America, India, Australia, Antarctica and New Zealand were all once part of the super-continent called Gondwana.

The greatest similarities between the now-separate parts of Gondwana are seen in deposits laid down about 350 million years ago during an ice age. Ice covered the land and the glaciers left sediments as the ice sheets retreated. Identical sediments are found in Antarctica, Australia, India, South Africa and South America.

A temperate phase occurred after the ice age, causing the glaciers to retreat. Plants, principally the fern-like *Glossopteris*, covered Gondwana. Enough plant material accumulated to form thick layers of peat, which changed to coal deposits.

Different plants dominated in the following drier period. The fern *Dicroidium* was eaten by herds of primitive amphibians and reptiles such as the one metre high *Lystrosaurus* which were widely distributed throughout Gondwana.

About 190 million years ago the huge continental plates (like the pieces of a jigsaw puzzle) that made up Gondwana began to break up and move. During this time there was also a lot of volcanic activity with huge lava flows, which may have been caused by the break up. It can be deduced from fossils that this landscape was wooded and the climate mild and well watered. New Zealand was the last to break off from Antarctica about 80 million years ago. The TransAntarctic Mountains began to be uplifted about 45 million years ago and glaciers developed on the rising high ground of the mountains. These eventually merged to form a miniature icecap. By 15 million years ago, a larger and more extensive icecap developed.

Volcanic activity continued sporadically, and there is evidence a few volcanoes may have erupted under the ice. Others may have grown up from the ocean floor as large volcanic islands. Volcanic cones formed along the TransAntarctic Mountains and the Antarctic Peninsula. Mount Erebus is still active and is one of the few volcanoes in the world to have a lava lake in its crater. Mount Melbourne has steam vents but most of the others are now extinct.

Fossils show that as recently as 3 million years ago, the climate may have again been mild and forests of trees like New Zealand's beech grew. These are similar to species growing in South America and Tasmania.

Further Reading

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