Glaciers

Geology

A glacier is a large body of ice that is moving slowly downhill. Glaciers form in places where snowfall during winter is greater than snow melt during summer, typically high in the mountains or at lower latitudes near the poles. As the snow accumulates year to year, it is compacted under the increasing pressure, eventually forming very dense, bluish glacial ice.

New Zealand has about 3,150 glaciers, the majority of which are in the high mountains of the Southern Alps from Arthur's Pass to Fiordland. These glaciers occur here because of the weather pattern created by the high peaks of the Southern Alps, which lie across the path of the westerly airstreams that sweep onto New Zealand from the Tasman Sea. As this moisture-laden air is forced up over the mountains, the air cools and huge volumes of rain and snow are released in the upper reaches of the Southern Alps. This large amount of precipitation enables the glaciers to form.

Two of the largest and best known glaciers in New Zealand are the Fox and Franz Josef glaciers in Westland/Tai Poutini National Park. These glaciers are unusual as their tongues extend down through temperate rainforest, a phenomenon that is globally uncommon. This happens because of the large amounts of snow that accumulate at the glaciers' névé and the steep and narrow nature of the valleys down which they flow. Ice on the Fox and Franz glaciers descends at rates of up to seven metres per day, which is extremely fast by world standards.

Fox Glacier B. Postill

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A river of ice

Glaciers flow downhill in a similar way to a river flowing downstream, only much slower. The top part of a glacier where snow falls, accumulates and compacts is called the névé. From here, the ice begins to move slowly downhill, sliding over the underlying bedrock on a thin layer of water. The area directly downhill from the névé is the fastest moving area of ice. Lower down, the ice flows more slowly, eventually melting at the glacier terminus. The glacier also moves faster in the centre than along its edges, similar to a river.

Variations in a glacier's speed as well as its passage over uneven bedrock cause the surface ice to crack, forming deep fissures or crevasses. Where the glacier falls over a steep drop, these crevasses combine in a jumble called an icefall, which contains towering ice pinnacles called seracs.

Advance and retreat

Glaciers grow or shrink depending on the difference between how much snow is deposited at the névé versus how much ice melts at the glacier terminus. If more snow is deposited than melts, the glacier will grow and the terminus will move farther down the valley. When this happens, the glacier is said to be advancing. If the terminus ice melts more quickly than snow is deposited at the névé, then the terminus will recede back up valley as the glacier shrinks, and the glacier is said to be in retreat.

These responses to changes in snowfall and melting ice are not instantaneous. It can take about 5-6 years for an increase or decrease in snowfall to bring about a glacial advance or retreat.

New Zealand's glaciers are only a shadow of their size during the Ice Ages, when they would have covered about a third of the country's land area. During the last Ice Age, the glaciers of South Westland extended about 10 kilometres past the current shoreline.

Dart Glacier N. Peat

Since the end of the period known as the 'Little Ice Age' in the mid-nineteenth century, the world's glaciers have generally been retreating quite rapidly. Today there are theories that global climate change induced by human activities may be speeding up the melting of our glaciers. This is significant because more than three-quarters of the world's fresh water is currently locked up in glacial ice. If this ice melts, sea levels could rise dramatically, flooding many coastal areas where most of the world's population lives.

New Zealand's glaciers have on average receded by about 1.3 kilometres since the end of the last century. New Zealand's largest glacier, the 29 kilometre long Tasman Glacier, has been significantly reduced in length and depth and a large lake is growing at the glacier's terminus. However, for the Fox and Franz Josef glaciers, this trend has been punctuated by several minor advances because of huge snowfalls in their upper reaches during several periods.

Glacial features

Many of the landforms that we see around New Zealand today (particularly in the South Island) are the result of past glacial activity. Glaciers have immense power in sculpting and carving the landscape. As glaciers move down valley, they scrape rock away, acting as huge conveyer belts for debris from the high mountains to low valleys.

When the ice melts, the debris carried by the glacier is deposited along the sides of the glacier and at the terminus, resulting in mounds called moraines. Some of the material is also carried in the glacial river that flows out of the terminus. Glacial rivers are usually milky because they carry a large amount of glacial flour or till (finely ground and suspended rock sediment). The erosion process created by glaciers eventually creates U-shaped valleys, in contrast to the V-shaped valleys formed by rivers.

Hazards

The terminal face is generally the most dynamic and subsequently often the most hazardous place of a glacier. As the toe of the glacier reaches its furthest extent, it is still moving; but there is no longer ice in front to support it. As a result, ice and rock regularly falls from the terminal face, scattering the area with blocks that may weigh several tonnes. It requires considerable experience to know what features to look for and where the least hazardous places are to access the ice.

The greatest hazard at the glacier terminus is the ice cave, where the emerging river effectively undercuts the glacier toe. Occasionally, and with no warning, the entire ice cave area collapses in awe-inspiring fashion, leaving a considerable area in and around the river scattered with large ice blocks.

Rangers from the Department of Conservation inspect the Fox and Franz Josef Glaciers every morning, looking for hazards and determining where the visiting public can safely go. Rope barriers and signs are positioned to provide guidance on safe viewpoints.

Further information

For more information about the Fox or Franz Josef Glaciers, contact the Franz Josef Area Office, phone 03 752 0796