



Volcanoes

Geology

Volcanic activity has created many of the iconic features that we instantly associate with the North Island such as large volcanic cones, lakes and geothermal areas. The South Island too has had its share of volcanism in the past, leaving behind places like Bank's Peninsula and the Otago Peninsula as reminders.

Volcanoes are the landforms produced when magma (molten rock) escapes to the earth's surface. There are different kinds of volcanoes depending on the type of magma and style of eruptions. The New Zealand area is characterised by both a high density of active volcanoes and a high frequency of eruptions. Most New Zealand volcanism in the last 1.6 million years has occurred in the Taupo Volcanic Zone, an area that extends from White Island south to Mount Ruapehu. The Taupo Volcanic Zone is extremely active on a world scale and includes three frequently active cone volcanoes: Ruapehu, Tongariro-Ngauruhoe, and White Island, plus recently active centres at Tarawera and longer ago at Taupo.

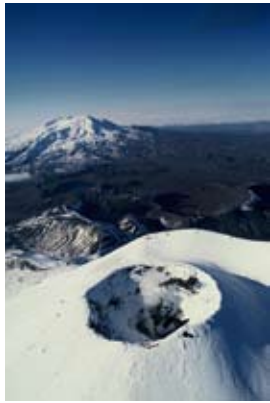
How do volcanoes form?

Tectonic plates are huge slabs of the Earth's crust that float on the hot, partially molten rock of the underlying mantle. As these plates move around, they split apart at mid-ocean ridges, creating new crust, and collide in other areas. Almost all of the world's volcanic activity occurs near these tectonic plate boundaries.

Our North Island volcanoes are formed because magma is produced when the Pacific plate is forced under the Australian plate, a process that geologists call 'subduction'. As the ocean crust capping the Pacific plate is forced deeper it carries water down with it. Fractional melting and reaction between the water, crust and mantle forms pockets of gas-rich molten magma at depths of 70–100 km. This magma is less dense than the surrounding material and begins to rise to the surface. If or when it reaches the surface it creates volcanic activity.

Ruapehu in eruption
Harry J. R. Keys





Ngauruhoe's crater

Plate tectonics explain why the New Zealand volcanoes are part of a long chain of active volcanoes known as the 'Pacific Ring of Fire'. This chain stretches north to Tonga and the through the Philippines, Japan and eastern Russia, around through the Aleutian Islands in the North Pacific Ocean and down the west coasts of both North and South America. All of these volcanoes lie in the subduction zone, where the Pacific plate is diving below another less dense continental plate.

Types of volcanoes

Magma can be erupted either passively, through lava flows, or explosively. The degree of explosiveness depends on the type of magma that is being released, and this also determines the shape of the volcano that subsequently forms.

Rhyolite magma is thought to be formed by fractional melting of crust of andesitic composition. Rhyolite magma is rich in silica and gas-rich, so it is thick, viscous and highly explosive. It produces two distinct types of volcanoes: dome-shaped volcanoes such as Mount Tarawera or huge craters, known as calderas. Eruptions of such volcanoes can sometimes be powerful enough to blast volcanic dust across the country and even around the world. Large amounts of material are erupted out so that the surrounding land collapses into the hole left forming a caldera. These are often filled by water forming lakes, such as Lakes Taupo and Rotorua.

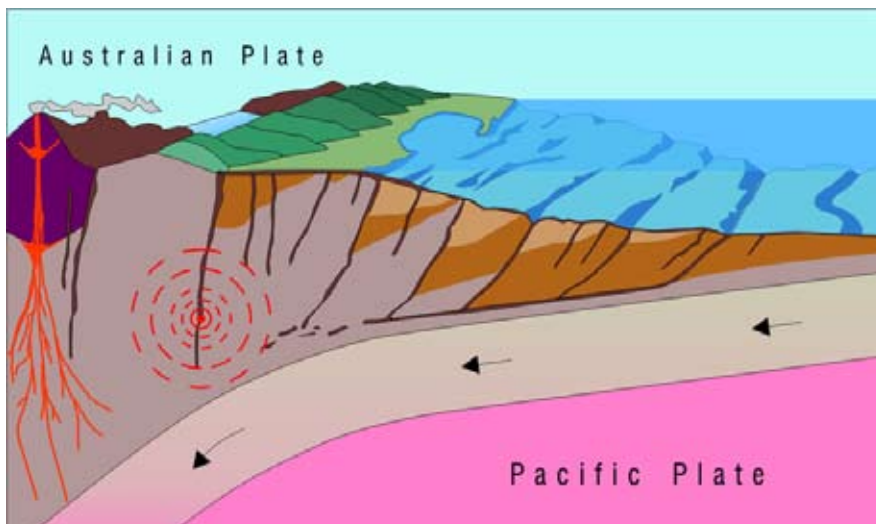
A different type of volcano is formed when basaltic magma is formed by fractional melting in the mantle. This type of magma is more fluid, hotter and usually gas-poor. This means it is generally less explosive, because there is less gas dissolved in the magma and it can be released more easily. Generally smaller volcanoes are formed made up of layers of scoria and rock from lava during these less violent eruptions.

A third group of volcanoes, called andesitic volcanoes, contain magma that is intermediate in viscosity and explosiveness. These volcanoes usually erupt both volcanic ash (fragmented magma and rock) and lava, forming composite (layered) cone-shaped mountains such as Mount Taranaki, Ruapehu, Tongariro and Ngauruhoe.

A world record eruption

New Zealand is home to the world's most violent eruption in the last 5000 years – the Taupo eruption of 181AD. Flows of hot ash, mud and gas moving at estimated speeds of 600–900 km/h destroyed 20,000 square kilometres of the central North Island. In total 50 cubic km of material was erupted, which is equivalent to a block with dimensions of 3.7 km across x 3.7 km wide x 3.7 km high!

Pacific Plate being subducted under the Australian Plate producing volcanoes and earthquakes Diagram: GNS Science /www.gns.cri.nz



New Zealand's volcanoes

The large volcanoes in the central North Island and offshore north of the Bay of Plenty have been erupting for many thousands of years over the last million or so years. In contrast, the Auckland volcanoes were formed during single eruptions or a relatively short sequence of eruptions over the last 160,000 years. Eroded, long extinct volcanoes are located in many places including Northland, Waikato Banks Peninsula, Timaru, Dundedin and the Subantarctic islands. The study of these volcanoes is important for the understanding of volcanic processes and hazards. Volcanism plays an important role in Earth's systems including climate, atmosphere, water and biodiversity. By studying past eruption deposits, geologists derive information about the history of past eruptions and the nature of future eruptions and the risk they create for people. Detailed monitoring of volcanic activity may further reduce the risks to people and property from major eruptions.

- Mt Ruapehu, now the highest point in the North Island, first became volcanically active at least 250,000 years ago. It has hazardous eruptions every 10 years on average. The active vent is occupied by Crater Lake, a hot, acidic lake near the summit. The latest eruptions were in 1995–98. During 1945, water in Crater Lake was expelled by a rising dome of lava. This was then destroyed by violent explosions, generating ash that fell as far away as Wellington (250 km). Within seven years, water had refilled the crater. On 24 December 1953, a debris dam near the lake outlet collapsed, sending an ash-laden lahar (volcanic debris mud flow) down the Whangaehu Valley. The lahar swept away the Tangiwai rail bridge, causing a train to plunge into the swollen river, killing 151 people. In 1969 and 1975 eruptions of Ruapehu generated lahars that damaged parts of the Whakapapa ski field and again in 1995 lahars ran through part of the ski area. Because Ruapehu has the potential to eject Crater Lake water down the slopes of the volcano at any time, two lahar warning systems have been put in place on the volcano, and other alarm systems installed further downstream.
- The oldest dated rocks of the Tongariro complex (which includes Ngauruhoe) were erupted about 270,000 years ago. Eruptions from the twelve or more composite cones making up the complex have continued intermittently since. The youngest vent on the Tongariro volcano is Ngauruhoe, which first erupted about 2,500 years ago. It is so young that it shows few signs of erosion and forms a near perfect cone, unlike Ruapehu and Tongariro. Last century Ngauruhoe was the most active volcano in New Zealand with frequent eruptions no more nine years apart. However its last eruption was in 1975. Other than Ngauruhoe, Mt Tongariro's last eruption was in 1896 from the active Te Maari Crater.
- The oldest known ash deposits from Mt Taranaki are dated at about 120,000 years ago. Its most recent eruption is thought to have occurred in about 1755 AD although some people think a small eruption took place about 100 years ago. Taranaki is the youngest member of a chain of volcanic structures stretching to the Sugar Loaves, the oldest near New Plymouth.