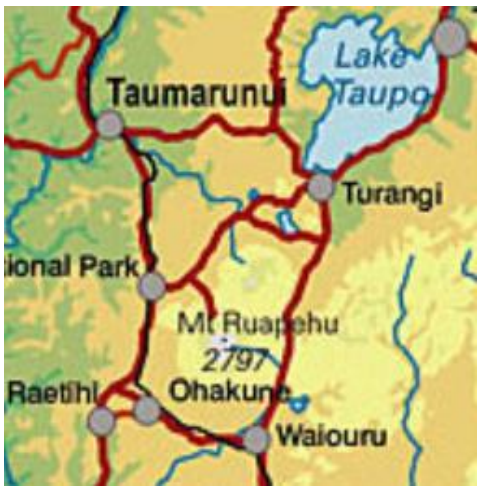
HOW TO GET AWAY WITH MORDOR*

Wes Gibbons 2018

There are many people who labour under the misapprehension that crime is more interesting than geology. As a direct result of this, any web search for Wes Gibbons will likely be confounded by the widespread fame of the fictional character Wes Gibbins, played by the English actor Alfred Enoch in the American legal drama *How to get away with Murder*. This Holiday Geology Guide therefore has been designed as a decoy to confuse Saint Google and Search Engine Optimisation, diverting clicks from the imaginary Wes Gibbins to the real Wes Gibbons. As a reward for the new visitor to the barcelonatimetraveller.com website, here we describe a 1-day circular drive around the three volcanoes of Tongariro, Ngauruhoe ("Mount Doom" in the film Lord of the Rings), and Ruapeho, in the heart of Mordor, halfway between the cities of Auckland and Wellington in North Island, New Zealand. In a change from the normally strictly scientific content of Holiday Geology Guides, in this case the reader is left alone to separate fact from fiction, in deference to Wes Gibbins and JRR Tolkien.

The 250km driving route described below runs anti-clockwise around the Tongariro-Ruapehu volcanoes via Ohakune and Waiouru (map below courtesy of the Land Information Department of New Zealand: http://www.nztourmaps.com/). It can be completed in one (long) day and needs clear, sunny weather to fully appreciate the volcanic landscape (something denied to us, so visit the web to search for more spectacular photos).



We recommend a preparatory evening in the Turangi Tavern, in the town of Turangi, located near the shores of the Sea of Rhûn (Moana o Rhûn in Maori) in eastern Middle Earth. The next morning drive south from Turangi on Highway 1 and turn right into H46 which runs west, passing Lake Rotoaira (right) and the steaming, sulphurous slopes of Tongariro volcano (left). Turn left into H47 which runs southwest, skirting the northwest slopes of Ngauruhoe/Mount Doom to a junction 45kms from Turangi where you turn left into H48 (Whakapapa Village), heading towards Ruapeho volcano summit ski area. In just over 1km from the junction, park on the roadside where the Mounds Walk path on the right leads southwest to a lookout over the hummocky terrain caused by a volcanic debris avalanche from Mount Ruapeho around 10,500 years ago.

This massive debris avalanche has been mapped on the ground as the "Murimotu Formation" and occurred when an estimated 200 million cubic metres of loosely consolidated fresh volcanic materials suddenly slid rapidly downslope then spread out over the lower ground to form a massive apron of rubble in places up to 12 metres thick. This wholesale collapse of the northern flank of the dangerously unstable, steep sided volcano occurred in hydrothermally altered volcanic debris partly held together by buttresses of glacial ice weakened by many years of deglaciation under a warming climate. The sudden failure of these northern slopes was perhaps triggered by an earthquake and/or eruption event after a long history of gradual destabilisation.

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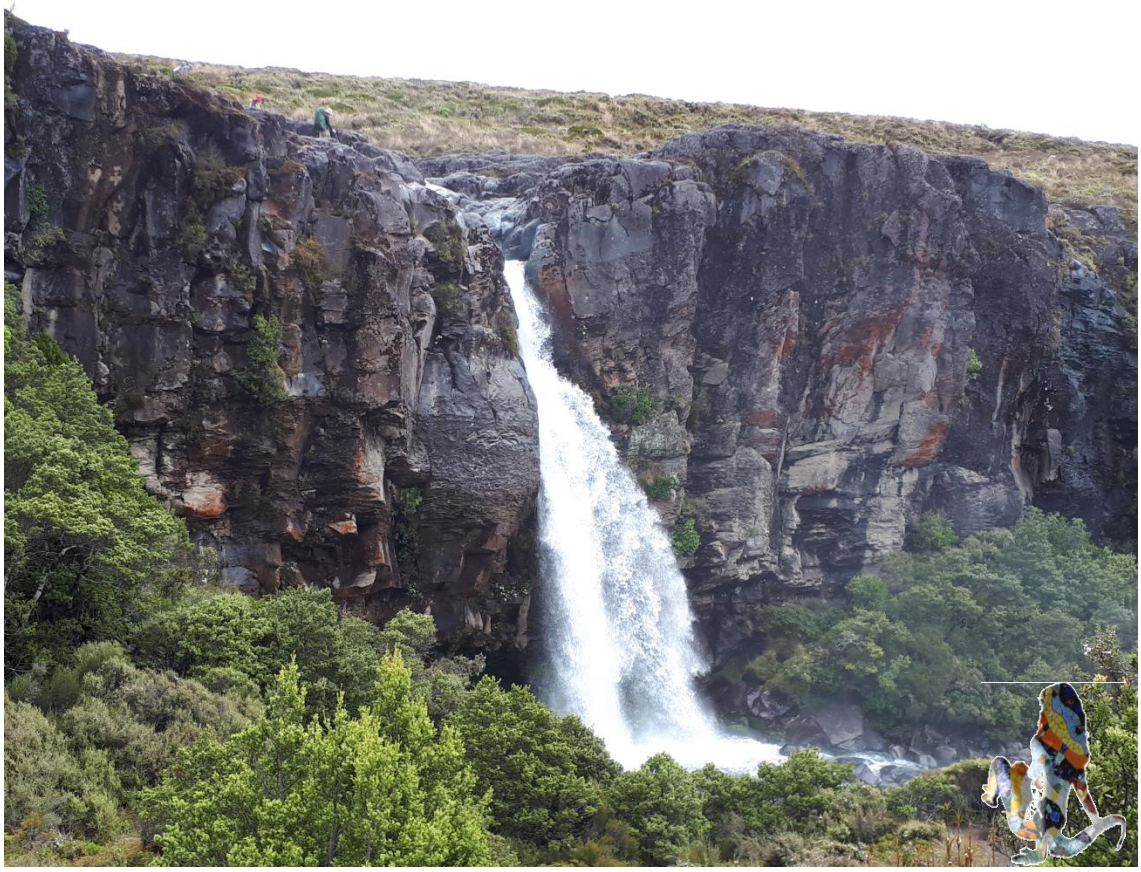
The Mounds of Mordor on the ring plain of Ruapehu volcano. The vegetated hillock in the foreground marks one of many large blocks of volcanic material that slid down from the slopes of Mount Ruapeho in a volcanic debris avalanche around 10,500 years ago. The symmetric peak of Ngauruhoe volcano ("Mount Doom") rises in the background.

Here, in the northwestern limits of the Black Land of Mordor, there are views across to the volcanic peak of Mount Doom, otherwise known as *Orodruin* in the language of Sinderin. It was within this volcano that the One Ring to Rule Them All was forged by the Dark Lord Sauron in the year of 1600SA (Second Age of the Sun), although such tales of Middle Earth have become legends, the truth behind them forgotten. As Boromir noted, the land around the volcano "is a barren wasteland, riddled with fire, and ash and dust; the very air you breathe is a poisonous fume". In the Age of Men, the volcano is thought to have been re-named by the Maori as *Nga-Uru-Hoe*, meaning 'throwing hot stones'. Eruptions from the volcano were regarded by the Maori as a sign of war.

Ngauruhoe is a classic andesitic stratovolcano that rises to 2,291m asl, the highest point in the Tongariro Volcanic Complex (TVC). It is not only the highest but also the youngest and most active eruption centre in the TVC which, like all the volcanoes in the Taupo Volcanic Zone, was produced by the subduction of the Pacific Plate below the Australian Plate. Whereas Ngauruhoe appeared only around 2,500 years ago, the TVC first erupted in Pleistocene times around 275,000 years ago, since when around a dozen volcanic cones have been produced in the volcanic centre. The most recent eruption from Tongariro occurred in 2012 and caused considerable disruption but no injuries.

Drive a further 1km down the road to locate the small car park on the left and the 20minute walk to Tawhai Falls (Gollum's Pool). This is the location where Faramir and his archers threaten to kill Gollum who is contentedly fishing without fishing rights: "Our only wish, to catch a fish, so juicy sweet!"

Return to the car park and continue southeast on H48 to park by the Whakapapa Visitor Centre and walk to Taranaki Falls (allow 1.5-2 hours for the return walk), which lies just 8km southwest of the summit of Mount Doom, where The One Ring was finally destroyed on 25 March 3019 TA (Third Age of the Sun).



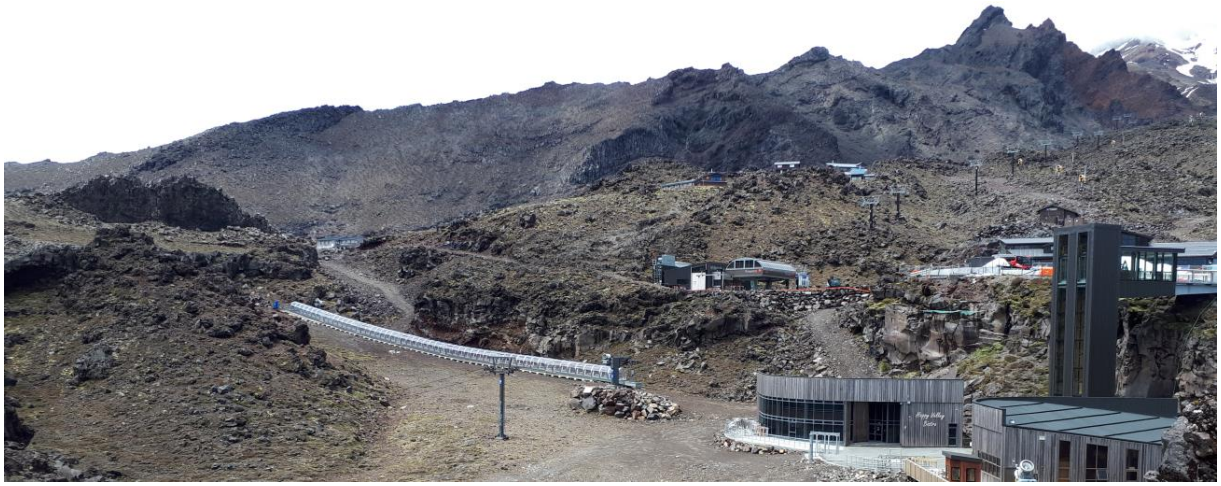
The Taranaki Falls andesite lava flow (Whakapapa Formation) has been dated as having erupted around 9,000 years ago from a cone currently hidden beneath the Ruapehu summit area ice field. Lavas emanating from this cone flowed NNW down the volcanic slopes for up to around 10 kilometres.

Return to Whakapapa Tourist centre car park and continue the drive up H48 (Bruce Road) towards Ruapehu summit, climbing through spectacular volcanic landscapes to the car park in the skiing area at the end of the road (toilets and cafeteria available). The Whakapapa ski area is where Isildur cut off the finger of Sauron in the opening scenes of *The Fellowship of the Ring*. It was also used in the unforgettable scene where the armies of Mordor leave Minas Morgul in *The Return of the King*.

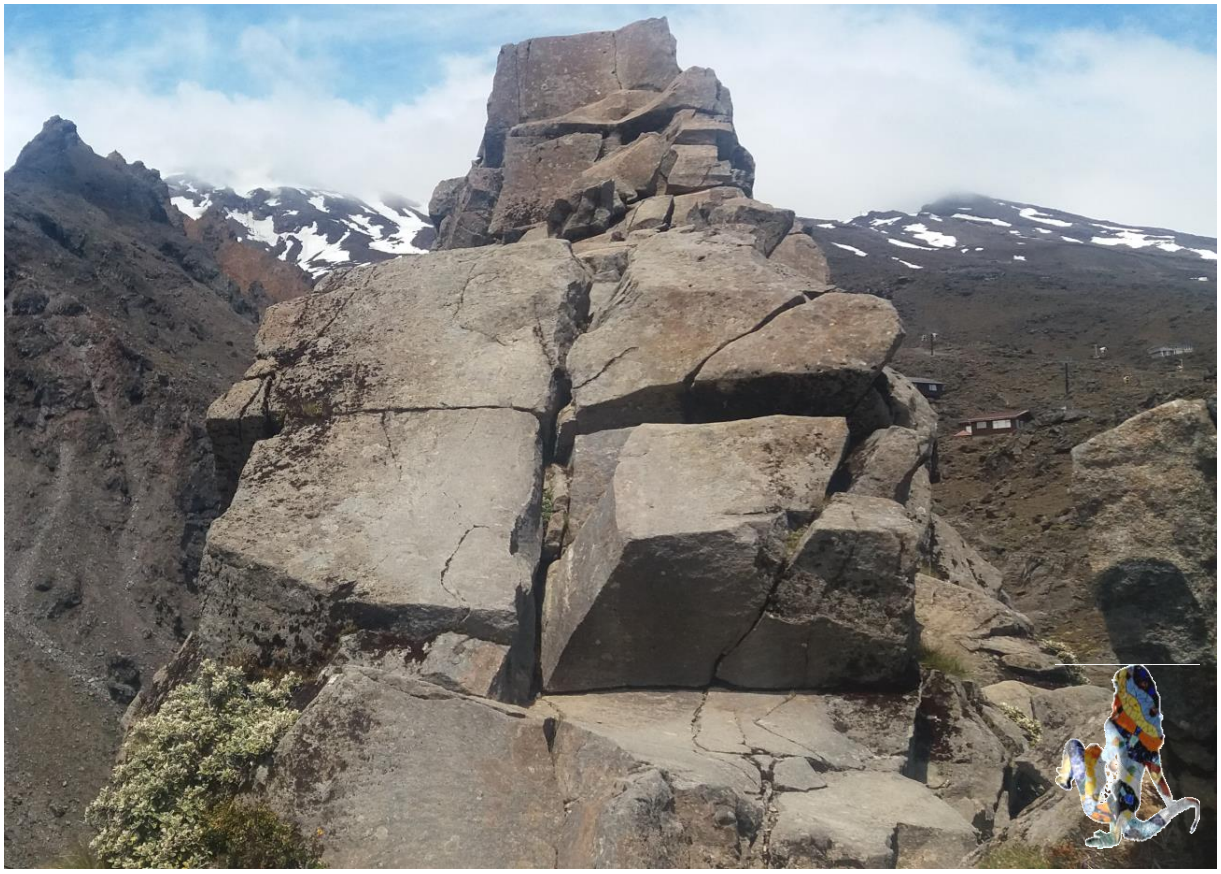
Walk east past the ski lift area towards the linear rock ridge of Mead's Wall ahead, locating the line of sticks with yellow paint that leads northwards up the side of the wall to a viewpoint looking south towards the snowy volcanic summit. The "Wall" here was named after William Perrett Mead, the story of whom can be found at: https://teara.govt.nz/en/biographies/4m49/mead-william-perrett

"I impressed on all parties asking for particulars of the route that the rock wall was their important landmark both going up and coming down, and after a while I found them calling it Mead's Wall." W M Mead, *Memories of a Mountain and a River*.

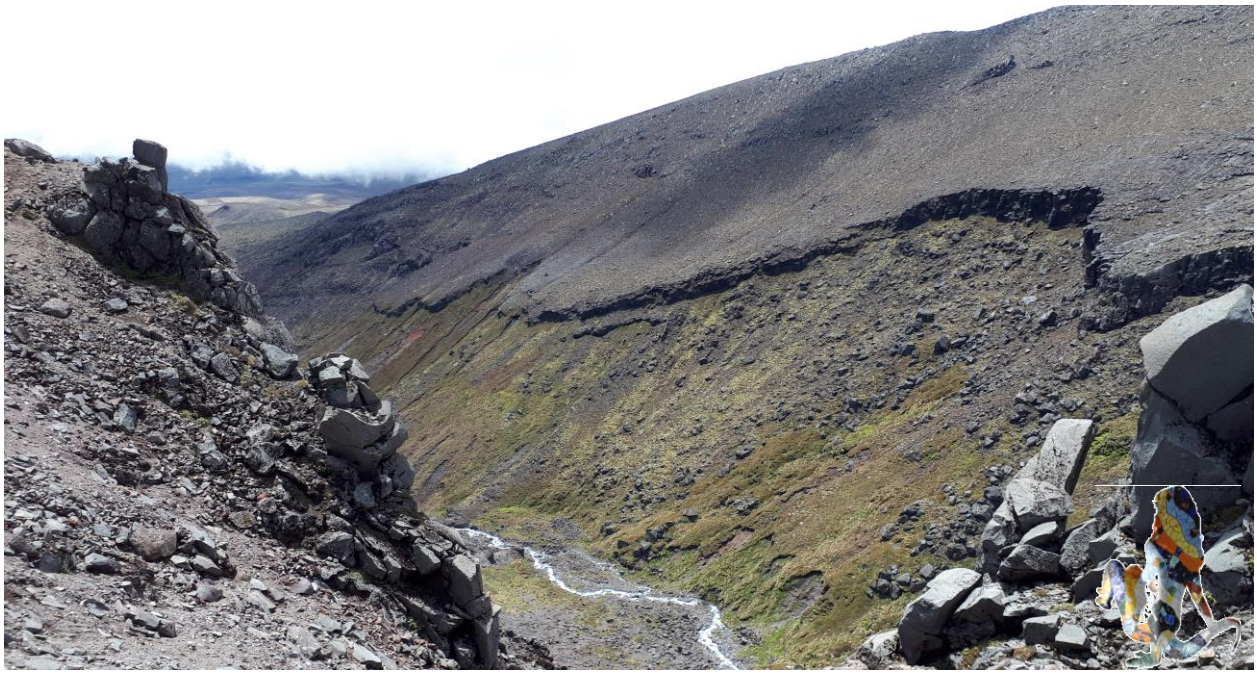
The Mead's Wall area was used in some of the Lord of the Ring scenes depicting Emyn Muil, the barren, rocky landscape in which Frodo and Sam had a difficult time crossing before they meet Gollum.



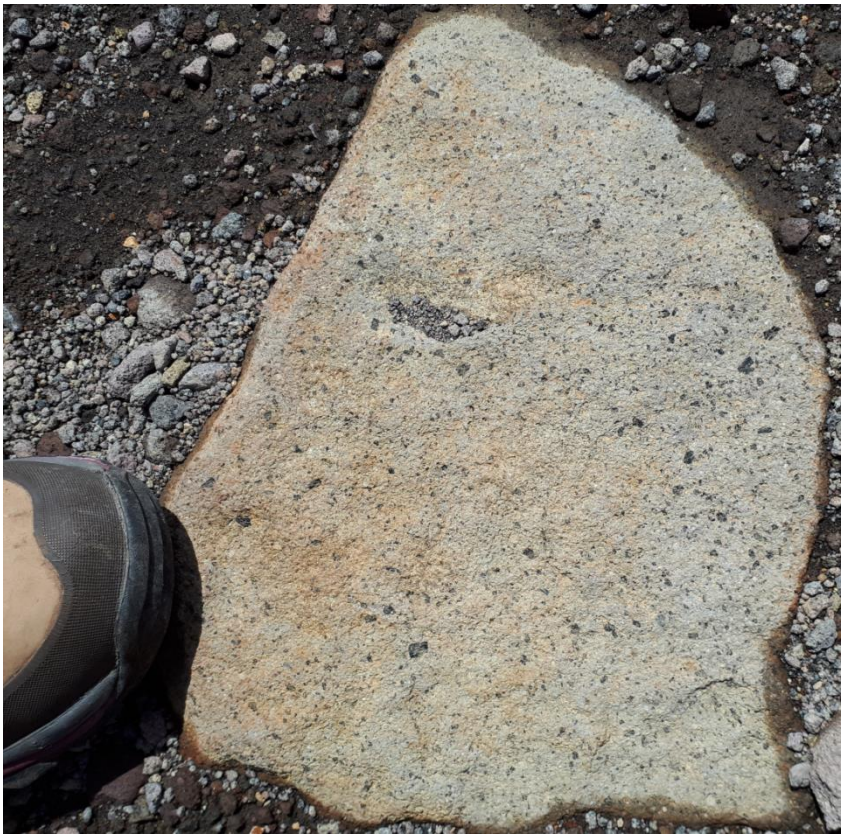
Happy Valley/Whakapapa ski area in summer, with Mead's Wall (middle ground left) and Pinnacle Ridge (background right: mostly brecciated lavas) both belonging to the Te Herenga Formation (200-150,000 years old: the oldest dated eruptions of the volcano). In the foreground are young (c. 6,000 year old) lavas of the Whakapapa Formation (Iwikau unit).



Close-up of the vertical andesite dyke forming Mead's Wall (1650m asl) on the northern slopes of Ruapehu volcano, looking south with views to Pinnacle Ridge and the Te Herenga Formation (left) and the snowy summit area beyond. Such dykes acted as vertical feeder channels for the andesitic magma on the way to eruption. Deep erosion of the Pleistocene volcano exposed the dyke cutting Te Herenga lavas and breccias before the eruption of the young Whakapapa lavas (right) in Holocene times.



View from Mead's Wall dyke across to the lower slopes of Pinnacle Ridge which are draped by a distinctive andesitic air fall deposit erupted from a nearby vent around 10,000 years ago.

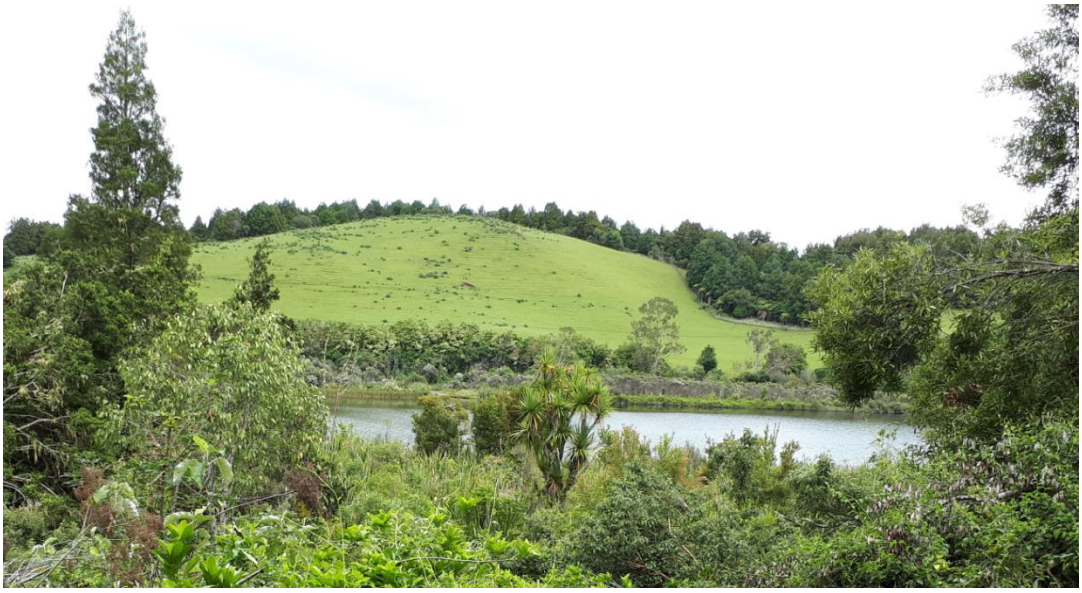


Porphyritic andesite erupted from Ruapehu volcano. Such rocks have a long and complex history that begins with melting in the deep mantle (c. 100km depth) above the subducting plate slab to produce basalt magma which rises to the base of the crust at a depth of around 30-40km. Here the basaltic magma cools and partially crystallises to produce dark solid rock full of minerals rich in iron and magnesium, leaving a residual liquid richer in silica and of andesitic composition, some of which rises to erupt at the surface. This is a simplification of a complex process, but the idea is that magma compositions can change on their journey from the mantle and through the crust before they eventually erupt as lava. So in this case the original parent magma was basaltic in chemistry but this changed as crystals were left behind, producing a residual liquid richer in SiO_2. This process is called fractional crystallisation (or crystal fractionation) and is of fundamental importance to explain how magmas can change from basaltic through andesitic, dacitic and rhyolitic compositions.

Ruapehu has erupted on repeated occasions since it first emerged in late Middle Pleistocene times around 200,000 years ago, frequently through a cover of glacial ice and snow. The chemical composition of the lavas has ranged from basaltic andesite through andesite to dacite: like Ngauruhoe it is a classic example of a plate subduction-generated stratovolcano.

Return past Whakapapa Village to turn left into H47 and travel around the northwest side of Ruapehu via the H4 and H49 to Ohakune where you turn right on the road to Raetihi. In 2km turn left into the narrow Lakes Road and in 200m park on the right (signposted Scenic Reserve). Walk for 10 minutes along the forest track then turn left at a junction to reach a view over an explosion crater lake. Compared to the volcanic peaks seen earlier, this is not the most dramatic geological feature, but it is nevertheless interesting because this is as far southwest as the Taupo Volcanic Zone has managed to penetrate in the New Zealand crust.

The phreatomagmatic eruptions that produced the Ohakune Volcanic Complex here took place around 30,000 years ago. The eruptions combined violent phreatomagmatic activity with the build-up of Strombolian scoriaceous spatter cones both here at Ohakune Lakes and adjacent to Ohakune town, 3km further northeast. It has been estimated that the magma rose from a depth of around 17km over a period of a couple of days, before interacting with groundwater to produce the phreatomagmatic explosions.



30,000-year old explosion crater lake and adjacent volcanic scoria cone belonging to the Ohakune Volcanic Complex at the southwest end of the Taupo Volcanic Zone.

“Suddenly events spin out of control and there is a paroxysmal explosion…. The eruption cloud resulting from this hydromagmatic detonation is initially full of white steam but quickly fills with ash and flying rock debris as it billows upwards to a height of several thousand metres and outwards to form a classic mushroom shape. A basal surge, like that first observed in the Bikini Atoll nuclear bomb tests during the 1940’s, radiates out from the explosion site. Broken rock is blasted horizontally at speeds exceeding one hundred and fifty kilometres per hour, ripping up mature trees for several kilometres in all directions. Chunks of rock falling back into the newly excavated crater become recycled and mixed in a series of further repeated explosions, ground surges and crater wall collapses.

After repeated explosions so much of the groundwater has been evaporated that the rocks have simply dried up. Now the basalt magma is free to reach the surface without being frustrated by encounters with water underground, and relative calm can reign over the scene of volcanic devastation. But the calm is definitely only relative as the lava erupts exuberantly from a fissure inside the crater to form a magnificent incandescent liquid fire fountain that spurts hundreds of metres into the air. The glowing, spattering lava fragments freeze as they shower over the surrounding ground where they accumulate as black pumice-like bombs and smaller stones ("lapilli")."

From: *Volcanoes in Girona*, *Barcelona Time Traveller*, Bimón Press 2016.

Walk clockwise around the crater lake (15 minutes), return to the vehicle, and drive back to the junction with H49 at Ohakune.

Turn left on the H49 then right into Goldfinch Street which runs northeast towards the Turoa ski field. After passing beneath the Wellington-Auckland railway line, the road becomes the Okahune Mountain Road which ascends through forests and out on to the open southwestern slopes of Ruapehu volcano. 16km from Ohakune park on the right to follow the short walk to Mangawhero Falls, which is another LOTR location used in the scenes where Gollum is catching fish.

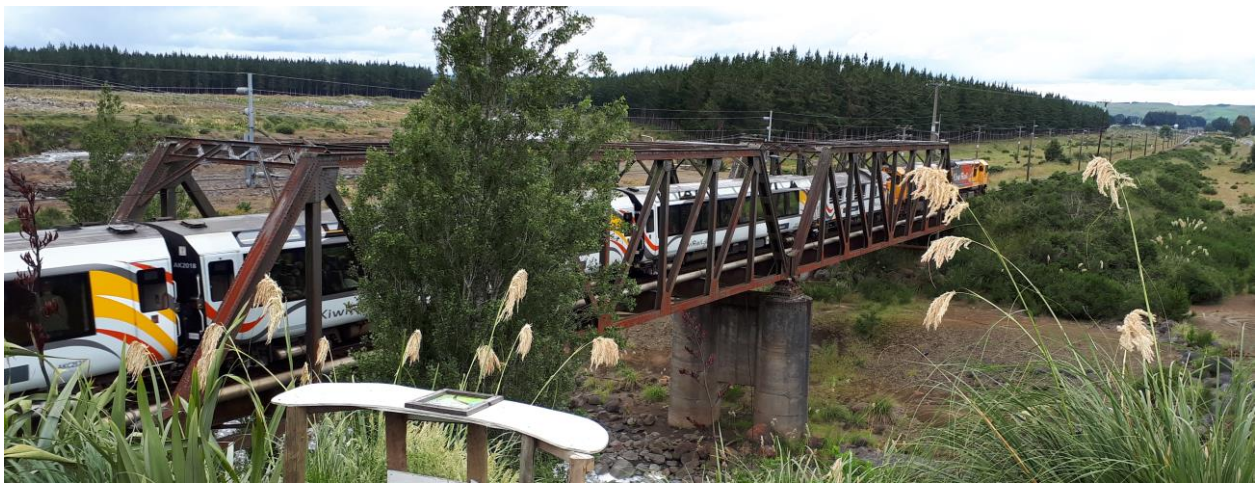
Return to Ohakune, turn left back into the H49 and follow it for 18km to the Tangiwai Memorial (signposted on left), where the Wellington-Auckland rail line crosses the Whangaehu River. On the late evening of December 24th 1953 a huge amount of water (by some estimates >1.5 million cubic metres) was released suddenly from the crater lake on the summit of Mount Ruapehu. The crater lake had been slowly refilling after an eruption in 1945, becoming progressively unstable with the weight of water held by a weakening barrier of ice and volcanic debris. The direct cause of the catastrophic release of water has been attributed to the collapse of an ice cave. Following the collapse, a wave of water and rock debris poured down the mountainside as a lahar, entrained by the drainage channel of the Whangaehu river. The lahar was reaching its peak velocity at Tangiwai, tens of kilometres below the volcanic peak, just as the Wellington to Auckland express train was approaching the bridge crossing at 22.21, packed with 285 people travelling north for the Christmas holidays. The bridge, built in 1906, had been damaged and repaired after previous lahar events (especially by one in 1925), and its central pillars were unable to withstand the force of the 1953 flow.

The train driver, Charles Parker, realised something was wrong (either because he saw the raging flood and/or he was alerted by a local man named Arthur Cyril Ellis waving a torch) and hit the brakes 180m from the bridge. The momentum of the slowing train however still took it on to the damaged bridge which collapsed, unable to sustain the weight of the train and the damage caused by the lateral force of the lahar. The engine and front carriage nosedived across the river channel, hitting the opposite riverbank as the four carriages behind them fell into the swollen waters and were carried downstream. A sixth carriage (the leading first class coach) was left dangling over the river bank but, as Ellis and the train guard William Inglis tried to get people out, the coupling snapped and the carriage fell into the water, rolling before finally coming to rest with water pouring through it. Ellis then smashed several windows and, aided by a passenger named John Holman, began helping people to escape to the outside of the carriage where they remained as the waters subsided enough to enable a human chain to form and get people to the bank. The rear carriages, all first class (second class carriages were towards the smoky front of the train), remained on the track with no casualties.

Ellis and Holman were awarded the George Medal in 1954, the citation for Ellis reading: "*At Tangiwai on the night of 24 December 1953 Arthur Cyril Ellis was witness to a railway disaster he had endeavoured to avert by waving his torch ahead of the approaching express. After the engine and five carriages had crashed into the flooded Whangaehu River, Arthur Ellis entered the train and, with the Guard, went forward to the sixth carriage, which was balancing on the brink of the torrent. As he was beginning the movement of the passengers from the carriage it toppled forward into the river and was swept downstream. When it came to rest on its side, Arthur Ellis, who throughout displayed much calm and continued to allay panic, broke a window by means of his torch and, with the aid of another passenger, John Warren Holman, assisted to safety all surviving passengers from the partially submerged carriage. Through his present of mind and his courageous actions, in circumstances of extreme danger, Arthur Ellis assisted in the saving of twenty-one lives.*"

A total of 151 people died as a result of the disaster, with 60 bodies being recovered 24km downstream and 20 never having been found, presumably washed out to sea 120km away. One entire train carriage was found over 2km down the river. The tragedy led to the establishment of a lahar monitoring and early warning system, and bridges have been strengthened. Another crater-lake lahar at the same locality occurred in March 2007 but, even though it was larger than the 1953 event, caused no casualties. The railway authorities were absolved of any blame in the 1954 enquiry, although a dissenting voice was raised by a mountaineer named Jim Mason who claimed that he had recognised the geological threat posed by rising lake levels in the crater and had written to warn the Railways Department before the event.

http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=11175376



The Auckland-Wellington train crossing the rebuilt and now geological hazard-monitored Tangiwai Bridge in 2018.

Compared to Taranaki volcano, lahars emanating from Ruapehu tend to be relatively small, but even "small" lahars pose a serious threat to life, as demonstrated by those who died at Tangiwai as a result of a combination of poor geological hazard awareness and incredibly bad luck.

Continue east for 10km on the H49 and turn left into H1 at Waiouru to cross the remote, high and inhospitable "Rangipo Desert", with splendid views of the other side of the Ruapeho-Ngauruhoe-Tongariro volcanic trio on the left. This "Desert Road", the highest part of Highway 1, is used as a

training ground by the New Zealand army and is commonly closed by snowfalls during winter. The desert-like aspect of the area is due less to a lack of water and more to the combined drying effects of frequent strong winds, summer sun, and the porosity of the volcanic debris covering the area.

The volcanic wastelands of the Rangipo Desert provided the scenic background location for the final, desperate storming of the Black Gate of Mordor: “We must push Sauron to his last throw. We must call out his hidden strength, so that he shall empty his land. We must march out to meet him at once. We must make ourselves the bait, though his jaws should close on us. … We must walk open-eyed into that trap, with courage, but small hope for ourselves."

Gandalf the White in *The Return of the King*

The Rangipo Desert is essentially a coalescence of ring plain lahars and airfall deposits of the adjacent andesitic volcanoes, including in places Taupo ignimbrite (TI) erupted from the supervolcano of Lake Taupo. Roadside exposures of brown-weathered TI become more numerous as the H1 nears the Taupo Lake area: for example just after the H1 crosses the Waihohonu Stream where TI deposits (left) rest on andesitic debris thought to have been generated during the growth of the Ngauruhoe cone. Stopping on this busy highway is not recommended, but the many continuing exposures of TI, lahar breccias and ash fall deposits in road cuts (for example after crossing the Oturere Stream) can be enjoyed as H1 descends to pass the junction with H46 and finally back to arrive in trout capital Turangi, perhaps in time to catch a juicy, sweet fish in the Tongariro River.

Further Reading

For more details about North Island volcanoes, including reference sources, see:

http://barcelonatimetraveller.com/wp-content/uploads/2018/05/New-Zealand-Volcanoes.pdf

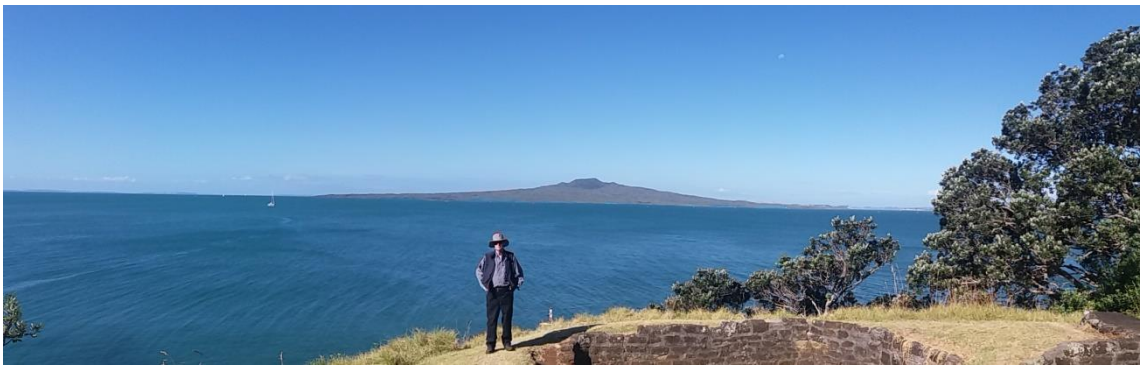
Background to Holiday Geology Guides

The author and geologist Wes Gibbons has always had an interest in writing short geoguides aimed at inquisitive tourists, offering them the opportunity to learn about the landscapes and rocks of scenically attractive places. His argument is that there is so much more to know about rocks and Earth history than the superficial descriptions offered by tourist guidebooks, which rarely even scratch the surface of Deep Time.

His first attempt in this direction produced *The Rocks of Sark* (1975), published jointly with John Renouf of Manche Technical Supplies in Jersey, a venture that taught a youthful Wes to always be the one responsible for the final proof reading. In 1976 Wes moved from Sark to begin a PhD supervised by Greg Power (Portsmouth University) and Tony Reedman (British Geological Survey). Living in a former Post Office in the village of Greatham on the Hampshire-West Sussex border, Wes decided to pass his spare time preparing a guide to the geology of the Weald in southeast England. He sold the idea to the publishers Allen and Unwin who commissioned other authors to develop a mini-series: *The Weald* (1981), *Snowdonia* (1981), *Lake District* (1982), and *Peak District* (1982).

His next field-based guidebook surfaced in 1985, fruit of several years research work in Corsica (*Corsican Geology: a field guidebook* by Gibbons and Horák). Two years later Wes launched the Holiday Geology series, using a simple, inexpensive format later described as "a single A3 laminated sheet …. folded into three and (with).. six portrait panels … filled with a lively mix of colour photos, maps, sections and text" (review by Nigel Woodcock in Geological Magazine, 2000). The first two Holiday Geology guides were *Scenery and Geology around Beer and Seaton* (1987) and *Rocks and Fossils around Lyme Regis* (1988). The Holiday Geology concept attracted the attention of the British Geological Survey who went on to expand the series to over 20 titles.

Following his retirement in 2004 to live in Barcelona with Teresa Moreno, Wes maintained his interest in publishing field guides by writing the text to *Field Excursion from Central Chile to the Atacama Desert* (Gibbons and Moreno 2007), *The Geology of Barcelona: an Urban Excursion Guide* (Gibbons and Moreno 2012), and *Field Geotraverse, Geoparks and Geomuseums* (in central and southwest Japan: Gibbons, Moreno and Kojima 2016). His most recent publishing project, the most ambitious so far aimed at a general readership, has produced the book *Barcelona Time Traveller: Twelve Tales* (2016, Spanish translation 2017: Bimón Press Barcelona) and the resurgence of the Holiday Geology concept, although this time in virtual format linked to the *Barcelona Time Traveller* webpage.



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