The Point Lookout area is situated within the New England National National Park on the northern tablelands of New South Wales. Point Lookout lies between Armidale, Guyra and Dorrigo at a relatively high altitude of 1550 metres. This site is well known for the spectacular views over a very wide area, a range of varied bushwalks and beautiful native bushland. Point Lookout mainly occurs on the eastern edge of the Great Escarpment (Map 1) which is locally capped by dominantly basaltic rocks derived from the extinct Ebor Volcano.

This guide provides a description of some of the rocks and landforms at Point Lookout and the nearby Wrights Lookout. The guide commences at the Point Lookout parking area, then continues from the start of the track to Wrights Lookout (Map 2). Localities described herein are defined by grid references using MGA94 datum. The descriptions focus on sites along the walking tracks. Visitors to this area should be aware that weather conditions can vary rapidly, and subzero temperatures are common from autumn to spring.

LOCAL AND REGIONAL GEOLOGY AND LANDFORMS

The Point Lookout area occurs on the edge of the Great Escarpment (Maps 1 and 3). This is an abrupt steepening in slope, commonly associated with cliff lines and abruptly rising ranges, that runs east of the Great Divide throughout the length of eastern Australia. It separates two regions of vastly different geomorphology: the tablelands and the coastal zone.

The Great Escarpment originated after the opening of the Tasman Sea by plate movements 80 to 100 million years ago during the break up of Gondwana (Table 1). This event caused the coast of the Australian continent to uplift and warp. As the ocean widened the uplifted block subsided along the present coastline and river systems developed that eroded back toward the inland flexure along the warp. Rapid headward erosion of these streams formed the Great Escarpment and cut deep gorges back into the plateau areas of the adjacent New England Tablelands.

The rocks of the Point Lookout area (Map 4) comprise an older series of folded and metamorphosed sedimentary rocks which are overlain and intruded by younger volcanic rocks of the Ebor Volcano. The oldest rocks present in the local region are Car...
Map 2. Topographic map and access road into Point Lookout. The Eagles Nest loop track and track to Wrights Lookout are shown.

Map 3. Satellite image of the Point Lookout region showing the Great Escarpment.
From Bob and Nancy’s Geological Tour Site: http://ozgeotours.110mb.com

boniferous to early Permian mudstones, siltstones, sandstones and cherts (Map 4). These were formed in a very deep ocean many kilometres from land. They were transported to the edge of the continent by movement of the underlying crust toward a subduction zone which existed along the margin of the Australian landmass. The sediments were scraped off against the edge of the continent as their crust sank downwards into the subduction zone, forming a mass of compressed and deformed rocks known as an accretionary wedge.

During this time Australia was moving about the surface of the earth by continental drift, becoming part of the supercontinent Pangaea in the early Permian. When Pangaea broke apart during the end of the Permian, Australia was part of Gondwana, which itself began to break apart in the Jurassic (Table 1).

Melting of subducted crustal material during the Permian and into the earliest Triassic formed magmas which travelled upward through the crust. The oldest of these magmas were primarily melted from sedimentary rocks. These rose high into the crust where they cooled to form S-type granites (S = sedimentary origin). S-type granites are characterised by distinctive minerals and chemical compositions. The youngest, and most common granites were formed from the melting of igneous rocks or sedimentary or metamorphic rocks which were rich in igneous material. These are referred to as I-type granites. Although no granite outcrops at Point

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>YEARS AGO</th>
<th>LIFE FORMS</th>
<th>GEOLOGICAL EVENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holocene</td>
<td>0 - 10,000</td>
<td>Human Beings</td>
<td>Continued erosion of Great Divide, and westerly retreat of Great Escarpment.</td>
</tr>
<tr>
<td>Pleistocene</td>
<td>10,000 - 1,800,000</td>
<td>Grazing and carnivorous Mammals</td>
<td>Last Ice Age reached greatest intensity 20,000 years ago, and had ceased in Australia by about 11,700.</td>
</tr>
<tr>
<td>Pliocene</td>
<td>1,800,000 - 5,300,000</td>
<td>Modern mammals</td>
<td>Continued uplift of Great Divide and erosion along east to form Great Escarpment.</td>
</tr>
<tr>
<td>Miocene</td>
<td>5,300,000 - 23,000,000</td>
<td>Placental animals</td>
<td>Eruption of Ebor Volcano above mantle hotspot 19.6-19.2 million years ago.</td>
</tr>
<tr>
<td>Oligocene</td>
<td>23,000,000 - 33,900,000</td>
<td></td>
<td>Continued uplift of Great Divide and erosion along east to form Great Escarpment.</td>
</tr>
<tr>
<td>Eocene</td>
<td>33,900,000 - 55,800,000</td>
<td>Placental animals</td>
<td>Australia separated from Antarctica 55 million years ago and began moving rapidly northward.</td>
</tr>
<tr>
<td>Paleocene</td>
<td>55,800,000 - 66,500,000</td>
<td>Placental animals</td>
<td>Beginning of uplift of the Great Dividing Range - continues to Pliocene</td>
</tr>
<tr>
<td>Cretaceous</td>
<td>66,500,000 - 145,500,000</td>
<td>Last dinosaurs. First flowering plants</td>
<td></td>
</tr>
<tr>
<td>Jurassic</td>
<td>145,500,000-200,000,000</td>
<td>First birds. Reptiles and ammonites abundant.</td>
<td>Gondwana begins to break apart.</td>
</tr>
<tr>
<td>Triassic</td>
<td>200,000,000-250,000,000</td>
<td>First dinosaurs, ammonites and primitive mammals</td>
<td>Formation of Gondwana. I-type granites intrude.</td>
</tr>
<tr>
<td>Permian</td>
<td>250,000,000-299,000,000</td>
<td>Mammal-like reptiles. Last trilobites.</td>
<td>I-type granites intrude.</td>
</tr>
<tr>
<td>Carboniferous</td>
<td>299,000,000-359,000,000</td>
<td>First reptiles, fern forests</td>
<td>Formation of new supercontinent, Pangaea. S-type granites intrude. Deep water marine sedimentary rocks form part of accretionary wedge.</td>
</tr>
<tr>
<td>Devonian</td>
<td>359,000,000-416,000,000</td>
<td>First amphibians and insects</td>
<td>Deep water marine sedimentary rocks form part of accretionary wedge.</td>
</tr>
<tr>
<td>Silurian</td>
<td>416,000,000-443,000,000</td>
<td>Vascular land plants</td>
<td>No rocks from this time in local area.</td>
</tr>
<tr>
<td>Ordovician</td>
<td>444,000,000-488,000,000</td>
<td>First corals, fish with vertebrae</td>
<td>Supercontinent Rodinia breaking apart.</td>
</tr>
<tr>
<td>Cambrian</td>
<td>488,000,000-542,000,000</td>
<td>Shellfish, trilobites</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Simplified geological history of northeastern New South Wales.
Lookout, there are large areas of I-type granite outcropping a little further west in the Cathedral Rock area (see our Cathedral Rock tour).

Following emplacement of the granites in the Jurassic, Gondwana began to break apart. Australia was still attached to Antarctica and New Zealand. During the Cretaceous large parts of eastern and central Australia sagged below sea level, and large sedimentary basins resulted. Then from the Paleocene the present eastern coastline began to uplift through a process of rifting and Antarctica and subsequently New Zealand were split from Australia. Eastern Australian uplift formed the great dividing range, with its associated deep gorges and retreating escarpment.

During the Eocene, tensional stresses within the eastern Australian continent resulted in a period of intraplate volcanic activity (which accompanied uplift of the Great Divide) and locally formed extensive lava fields throughout eastern Australia. Some of these lavas are present to the west of here in the Cathedral Rock area (see our Cathedral Rock tour). From the Paleocene to present, the Australian plate has moved northward across a mantle hotspot. Mantle hotspots occur above fixed convection cells, where outward directed heat is focused in the top of the mantle and lower crust, resulting in melting of the rocks near the top of the cell (Figure 2). The hotspot has resulted in the formation of a long, broad track of extinct central volcanoes extending from the oldest in north Queensland, to the youngest in Victoria (Figure 1). The hotspot is presently believed to be beneath Bass Strait, where seismic activity first detected in 2002 suggests that magma is beginning to rise again. The hotspot has formed magmas of tholeiitic basaltic composition, which in some places are accompanied by volumetrically less dacite, trachyte and rhyolite (e.g. The Nandewar and Ebor Volcanoes). Large volumes of very hot and fluid basalt erupting from the volcano commonly travel large distances from the vent, forming a volcano with a broad, gently curved profile resembling an ancient Roman or Greek shield. As a result, these volcanoes are termed shield volcanoes.

As the continental plate moved across the hotspot, the line of volcanoes progressed through Queensland.
toward New South Wales. The first of these volcanoes to form in northern New South Wales was the Tweed Volcano, which erupted between 23 and 20 million years ago. It is estimated that this volcano reached a height of 2000 m and a diameter of about 100 km (Ferrett, 2005). At almost the same time, between 21 and 17 million years ago, the Nandewar Volcano was erupting to the east of Narrabri. The continuous northward drift of the continent removed the Tweed Volcano from its source of magma, and a new vent erupted between 19.6 and 19.2 million years ago, forming the Ebor volcano.

The Ebor Volcano erupted onto an uplifted and incised terrain with a relief of over 100 m. The land surface comprised Permian to Triassic granites, Carboniferous to Permian metasedimentary rocks, and Eocene lava field basaltic rocks (Figure 3). The volcano erupted mainly tholeiitic basaltic lavas as flows to 60 m thick, with minor areas of fragmental rocks and local sedimentary rocks (Ashley, Duncan & Feebrey 1995). Late in the history of the volcano, several intrusions of trachyte, dacite and rhyolite were emplaced, probably erupting at the surface. The volcano was at least 45 km across and rose to a height of more than 800 m above the land surface. More than 90% of the volcano has been removed by erosion and retreat of the Great Escarpment.
The eruptive throat of the Ebor Volcano is partially preserved as the Crescent Complex (Map 4), a mixture of intrusive gabbro and subsequent plugs and dykes of rocks ranging in composition from monzodiorite to monzogranite. The complex is now exposed at a level about 1500 m beneath the top of the original volcano (Ashley, Duncan & Feebrey 1995) in an area known as The Crescent (Map 3).

THE EXCURSION

The excursion includes two bushwalks: the Eagles Nest loop walk, and the Wrights Lookout walk. The Eagles Nest walk includes some steep staircases on its northern end, and descends to the base of a major cliff line where various aspects of the products of the Ebor Volcano can be observed. The walk and observations can be undertaken in several hours by a reasonably fit person. The Wrights Lookout walk is a gentle grade with a short, steep scramble towards its eastern end. This can be completed in several hours by a relatively fit person.

Both walks are open to the extremes of this high altitude environment. Rapid and severe changes in weather conditions can prevail, with strong winds and snow in winter. Frosty and wet conditions may result in slippery conditions under foot. Appropriate clothing and footwear should be worn, and water carried.

Eagles Nest Loop Walk (Map 5)

From the eastern end of the car park area, take the sign posted track to Eagle Nest Lookout. After walking for 170 metres the first lookout is reached.

If the weather is clear, this site provides an excellent view of the escarpment and gorges, with the coastline visible in the far distance (Photo 1). Most of the rocks forming this landscape are Permian metamorphosed sedimentary rocks which formed the base beneath the Ebor Volcano. The Crescent, within which the core of the volcano is preserved, is visible in the near distance.

Continue along the track for about 80 metres to the next lookout.

Stop 2. Lookout. Grid reference: 443437 6626974

This lookout provides an excellent view of the Great Escarpment, the eastern fall towards the
Continue along the track, descending a number of stair cases until the cliff base is reached. This is a distance of about 200 m.

**Stop 3. Cliff base** - base of lava flow.

Grid reference: 443410 6627039.

The cliff line above is a thick basaltic lava flow which originated from the Ebor Volcano. Blocks of the basalt have fallen and in places can be found along the edge of the track. Fresh surfaces of the rock show that it is black, fine-grained basalt with large, scattered, glossy feldspar phenocrysts (Photo 4). The rock is very hard, and fractures with a conchoidal pattern. Note the very large, lath-like crystals of colourless plagioclase.

When thick bodies of lava or shallow intrusions (sills or dykes) cool slowly and evenly they crystallise and decrease in volume. Cracks develop perpendicularly to the tops and bottoms of the flow or the walls of the intrusion. The cracking forms 5 or 6 sided, straight to curved columns. These are referred to as *columnar joints* or *cooling columns*. Lavas which cool quickly or unevenly don’t form columnar jointing. In places where the lava flow was crystallising on a slope or was subjected to outside pressures the columns...
may be curved, demonstrating that the lava had cracked whilst still in a non-solid form. The cliff above this site shows poorly developed columnar joints. Many of the lavas from the Ebor Volcano cooled to form such joints. Lavas with an abundance of gas bubbles (vesicles) are present in some localities, with concentrations of the vesicles mainly toward the tops of each flow. The flows range in thickness from 10 to 60 m.

Continue along the track for a further 200 m to a point where a jagged bank of rock borders and overhangs the track (Photo 5).


This stop is located at about the same topographic level as the previous site, close to the base of the thick, columnar jointed lava. The rock exposed here is a breccia, a rock composed of angular fragments (unlike a conglomerate, which is made up of rounded fragments). Both the fragments, and the material between them is basalt, so this rock has formed from the breaking up of a basaltic lava. When a lava flows across relatively cold ground, the base of the lava chills rapidly and in some cases breaks apart into blocks. The spaces between the blocks are then infilled with molten lava. The resulting rock is a breccia, such as outcrops here, and the process which forms the breccia is known as autobrecciation (which implies that the lava brecciated itself). The same process takes place at the top of the lava, where the molten rock cools rapidly by contact with the atmosphere. Commonly, where a basaltic lava brecciates along its upper surface, the interaction with the atmosphere causes oxidation of some minerals which results in a red colouration of the rock due to the formation of iron oxide. This feature is evident further along the track.

Note the angular form of the fragments, and their dimensions, which range up to about 1 m across. Also note how all the fragments are compositionally identical, and are randomly orientated as would be expected in an autobreccia.

Continue along the track, noting the appearance of the cliff face above. Also note that the track mainly follows the relatively low slopes associated with the interval between lava flows. The slope becomes steep to near-vertical below the track, where the underlying lava flow is exposed. Stop 5 is reached after a walk of about 110 metres.

**Stop 5. View of cliff face. Grid reference 443445 6626891.**

This site offers the first uninterrupted view of the thick lava flow which is developed above the breccia examined at the previous stop. The lava is relatively massive, with large diameter, poorly-formed columnar jointing. The flow is between 30 to 40 m thick, and represents a major outpouring of lava down the flanks of the Ebor Volcano about 19 million years ago.
The track continues along the same contour for another 50 m before coming to Eagles Nest Lookout.

**Stop 6.** Eagles Nest Lookout. Grid reference: 443438 6626842.

This site offers another view of the spectacular, incised country to the east. It also presents another view of the thick, columnar jointed lava flow above, and the red weathering surface beneath that flow.

The lookout is sited on the top of the next major lava flow beneath the cliff-forming one above here. Note the colour of the rocks at ground level at the lookout. The red colouring is due to oxidation in the weathering environment active during the time the Ebor Volcano was active. As would be expected, there was some interval in time between lava eruptions from the volcano. This interval could be days or tens or hundreds of years, as is the case in modern volcanoes. During the longer intervals there would be time for the rocks on the ground surface to begin weathering and forming soils. These ancient soils are known as palaeosols, meaning fossil soils. Iron-rich rocks such as the basalts can form red soils, as are presently developing in the local area, and are common about Dorrigo to the northeast. The red soil horizon was preserved as a thick lava flow was produced in a subsequent eruption. Lava flows will commonly be separated by layers of autobrecia (representing the top or bottom of a lava) and red palaeosol.

Continue along the track for about 220 m. The track drops downward through the underlying lava flow before levelling out on the top of the underlying flow (Map 5 and Figure 4). Stop 7 is a vertical bank of breccia (Photo 8).

**Stop 7.** Volcanic breccia. Grid reference: 443269 6626739.

This is a similar breccia to that examined at Stop 4. The breccia is composed of dark, angular blocks of volcanic rock with intervening black lava. It probably represents the base of the lava flow examined at Weeping Rock (Stop 8).

Continue for about 130 m along the track, stopping at the signposted Weeping Rock.

**Stop 8.** Weeping Rock. Grid reference 443180 6626722.

This very interesting locality displays two lava flows, and an intervening red palaeosol breccia. (Photo 9).

The higher part of the cliff face is composed of columnar jointed basalt. The columns are very wide, about 2 to 3 m (Photo 9). Beneath this very thick flow is a change in slope which is common-
ly vegetated. Where it is not covered in vegetation the red, brecciated character of the rock can be seen. This suggests that the rock is a flow top autobreccia associated with the underlying lava which has been subjected to weathering prior to the overlying lava erupting. The breccia has to some degree been part of a soil profile.

The underlying, massive lava which is exposed at track level, is a dacite. This rock type is quite different to the basalts which comprise much of the Ebor Volcano’s lavas. Basalts contain no quartz and are dominantly made up of the minerals feldspar, pyroxene and in some cases olivine. Dacite contains quartz, feldspar, biotite, hornblende and pyroxene, and are erupted as cooler, more viscous lavas. Some boulders and blocks of this lava by the track show evidence of flow in the form of irregular laminae (Photo 10). The laminae represent inhomogeneities in the lava which result from different rates of cooling in the lava sheet or by increased viscosity during cooling. Flow within the lava extends out the viscous, treacle-like material, resulting in the formation of discontinuous planes within the lava. These planes are the laminae preserved in the solidified lava.

The track continues along a similar contour level before commencing a gradual ascent towards the top of the escarpment. Over the next 400 m the track passes through some interesting scenery of basalt cliffs and
boulders, and passes through a cleft between two huge, fallen blocks. The next lookout offers an opportunity to review the scenery below in light of the path taken on this walk.


This lookout gives a view across the escarpment, beneath which the track passes (see Map 5). Considering this, it is appropriate to heed the sign posted advice not to throw rocks from here, as the track is immediately below at the foot of the cliff!

Continue along the track for 170 m to Platypus Lookout.


The ascent from the previous lookout has climbed about 30 m, crossing one or more thinner lava flows. Platypus lookout is renowned for no platypus ever having been seen here despite many thousands of visitors relentlessly scanning the bush and cliff line. It is likely that the sign is a relic from Gondwana times.

Return to the parking area, passing through bushland developed on poorly outcropping lavas. To travel to Wrights Lookout, return along the access road for about 3 km to the sign posted intersection on the left. You can park about 80 m down this road, after which an easy walk of about 1.9 km finishes at Wrights Lookout (see Maps 2 and 6).

**Wrights Lookout Walk (Map 5)**

The walk follows a fire trail, passing a branch walking track to Point Lookout, and eventually leaving the trail close to the lookout. This walk is useful for demonstrating the characteristics of some of the oldest rocks in the Ebor Volcano, as well as an interesting intrusive into the base of the volcano. For most of the walk the outcrop is very sparse, with excellent outcrops at Wrights Lookout. The first 320 metres of the walk are through an area of no outcrop, after which exposures of layered pyroclastic rocks appear in the road, gullies and gutters. Pyroclastic rocks are volcanic rocks formed by the accumulation of volcanic debris, including ash, pumice, scoria and exploded rock and crystal material.

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**Map 6. Topographic map of the area about the Wrights Lookout track.**

From Bob and Nancy's Geological Tour Site: http://ozgeotours.110mb.com

This locality is a small rock face exposed in the gutter on the northern side of the track (Photo 11). The outcrop comprises interfingering coarse ash and finer grained, pale ash. The coarser rock is composed of angular fragments of lava and white pumice, confirming that these are products of explosive activity within the volcano’s crater. The abundant layering, possible cross-bedding (top of photo) and interfingering suggests that these rocks have been reworked by alluvial processes, such as watercourses on the flanks of the volcano.

Research by Ashley, Duncan and Feebrey (1995) has confirmed that these pyroclastics are of rhyolitic composition (see Glossary). They represent some of the earliest products of the Ebor Volcano. Being rhyolitic, and therefore relatively cool and viscous, they were prone to erupting explosively, producing volumes of ash rather than lava. The ash was spread by explosive processes including ignimbrite flows and airfalls. Being uncompact-ed after eruption they were prone to reworking by wind and water, resulting in rocks similar to those exposed here.

These rocks can be found sparsely from this point onwards.

After reaching the marked track to Wrights Lookout off the fire trail, the track begins ascending the plateau formed by an intrusive body of trachyte. After 50 m the first outcrops of this rock are encountered, and after 120 m the ascent onto the plateau through this rock takes place.

The rock type forming Wrights Lookout is a trachyte which has intruded through the metasedimentary rocks underlying the Ebor Volcano. The intrusion takes the form of a dyke, being a steeply orientated, tabular-shaped mass which cuts across the folded older rocks. The dyke apparently does not continue much further eastward beyond the outcrop at the lookout. Volcanoes are always associated with intrusive bodies (in addition to the main magmatic feeder into the crater), many of which are dykes. It is hardly surprising that volcanoes have this association, considering that they are focal points for upwelling magma, and that the crust in their vicinity is frequently undergoing significant expansion and contraction as magma enters and vacates the magma reservoir beneath the volcano. The resulting fracturing of the crust is a perfect structural environment for dykes to be formed.

All outcrops of the trachyte show a steeply dipping lamination. The lamination is defined by thin layers of different colour, along which the rock cleaves or fractures. This evident in Photo 12 as fracturing with the outcrops angling toward the top left of the photo. The lamination dips steeply to the northeast, suggesting that the dyke also has this dip. The lamination is probably formed by viscous flow within the magma as it cooled, which may indicate that this site is close to the top of the intrusion.

![Photo 12. Typical outcrop at Wrights Lookout, with the Point Lookout cliffs in background.](image)

Note the cliffs towards Point Lookout (Photo 12). An alternating terrace-cliff geometry confirms the presence of at least 5 major lava flows with the intervening breccias and palaeosols examined at previous sites. The less-steep landforms below the cliffs comprise the layered pyroclastics examined previously, and beneath them, the metasedimentary rocks forming the foundations of the Ebor Volcano.

This geological guide was inspired by the knowledge and enthusiasm of Professor Paul Ashley. We hope you have enjoyed exploring the Point Lookout area and have gained something from examining the geology of this location. We welcome any constructive criticism or comments.
BIBLIOGRAPHY


GLOSSARY

Basalt is a black volcanic rock characterized by the presence of pyroxenes and plagioclase. Olivine is present in some varieties of basalt.

Cross-bedding refers to inclined layering in a horizontal bed of rock. The inclined layers were formed by moving ripples or dunes and they indicate deposition by moving water or wind.

Dacite is a grey lava intermediate in composition between rhyolite and andesite. It consists mostly of plagioclase feldspar with biotite, hornblende, and pyroxene (augite and/or enstatite). It has quartz as phenocrysts, or as an element of the groundmass with plagioclase.

Dyke: a sheet-like body of igneous rock which has intruded into another rock across the boundaries of that body or across its internal layering. Dykes are often very steeply dipping.

Granite is a coarse-grained, light-colored igneous rock consisting chiefly of quartz, orthoclase or microcline, and biotite or muscovite mica.

Ignimbrites (or pyroclastic flows) are a hot suspension of ash and gases that flow rapidly away from a volcano, forming sheets of ash over very large areas.

Olivine is a magnesium-iron silicate common in igneous rocks from the upper mantle.

Plagioclase feldspar is an important series of silicate minerals common in igneous rocks. They range in composition from sodium-rich in granitic and rhyolitic rocks, to calcium-rich in basalt.

Pyroxenes are a group of important rock-forming silicate minerals with significant calcium, sodium, iron, magnesium, chromium and aluminium. They commonly form in igneous rocks derived from the Earth’s upper mantle.

Rhyolite is a pale-coloured lava of felsic (silica-rich) composition (typically > 69% SiO₂) comprising quartz, alkali feldspar and plagioclase. Biotite and hornblende are common accessory minerals. Rhyolite is the extrusive equivalent of granite.

Trachyte is an igneous rock comprising potassium feldspar and pyroxene, minor plagioclase and rare quartz.