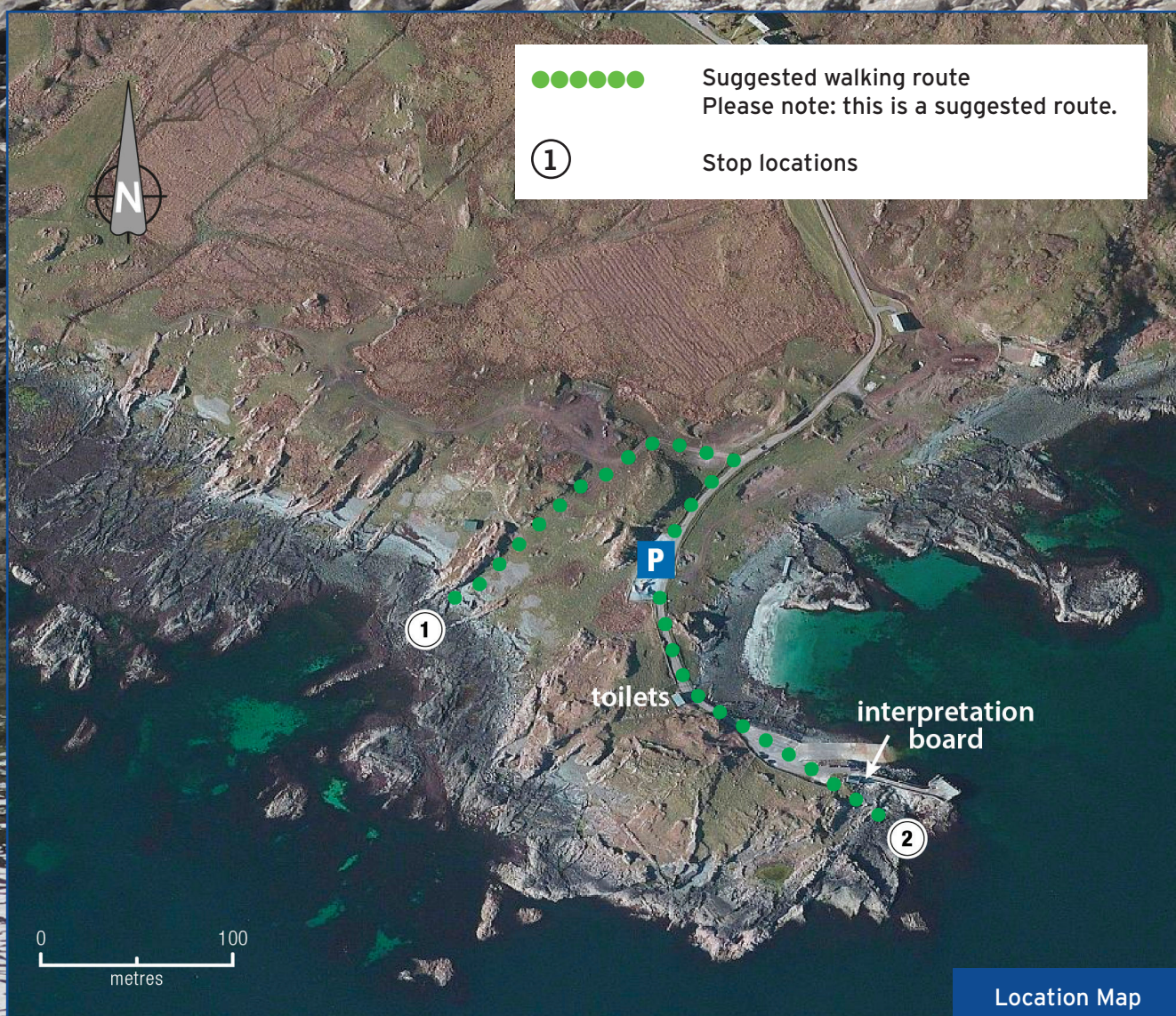


Kilchoan




Teacher's Sheet



Mingary Pier at Kilchoan is an ideal site to see exposures of cone-sheet swarms. Park in Mingary Ferry carpark by Mingary Pier at the end of the B8007 (Pier Road). From the carpark walk north 100m and enter the field to the left via the gate. Beware of cows in this field. Follow the farm track in the field toward the west for a few metres, then head south towards the shore. Here, you will see a well exposed example of a basalt cone-sheet (Stop Location 1). Explore along the coast line either side to see more cone sheets of varying thickness, and head toward Mingary Pier to see a Lochaber Geopark interpretation board. Behind the interpretation board there is a stile crossing the fence which provides access to more exposures of cone-sheets as well as dykes, when the tide is out (Stop Location 2).



Teacher's Notes

SUGGESTED STOPS	POINTS TO NOTE
<p>Access:</p>	<p>Park in Mingary Ferry carpark, by Mingary Pier at the end of the B8007 (Pier Road). From the carpark there are two suggested routes. Walk north-east on the B8007 for 50m and enter the field to the left via the gate (beware of livestock) and follow the farm track south towards the shore for the first well-exposed example of a basalt cone-sheet (Stop Location 1). Explore along the coast line either side to see more examples of cone-sheets.</p> <p>For Stop Location 2 head south from the carpark toward Mingary Pier to see Lochaber Geopark's interpretation board. There is a stile behind the buildings situated behind the interpretation board. Use this stile to cross the fence to see more exposed cone-sheets and dykes when the tide is out. The nearest toilet facilities are visible from the car park for the Kilchoan ferry terminal.</p>
<p>1</p>	<div data-bbox="392 555 1038 992">  </div> <p>Image 1: An oblique aerial view of the geological map looking across the Ardnamurchan peninsula, showing how the different types of rock, each shown with a different colour, are arranged in overlapping rings. The width across the map halfway up is 10 km.</p> <p>Stop Location 1</p> <p>'Ardnamurchan' means 'Headland of the Great Seas'. The peninsula is composed largely of igneous rocks that together form the Ardnamurchan Ring Complex. The 'ring' character is obvious on a geological map (Image 1) but it is equally obvious from the air because the harder rocks produce distinctive rings of low hills (Image 2). It became world famous in the 1930s because of early black-and-white aerial photographs. It is also very conspicuous on satellite images (Image 3). It was mapped in great detail by the British Geological Survey in the early 20th century and a new map has recently been issued (British Geological Survey Ardnamurchan Central Complex 1:25000). It is the structure at the base of what was probably a conical volcano, that existed 58.6 million years ago, in the early Palaeogene, when the North Atlantic was just beginning to open.</p> <div data-bbox="392 1469 798 1910">  </div> <p>Image 2: Ardnamurchan Centre 3</p> <div data-bbox="837 1469 1485 1910">  </div> <p>Image 3: Ardnamurchan from Google Earth</p>

The volcano formed on land that was mainly composed of Moine schists (see Am Muidhe excursion), on top of which have been deposited thin layers of Triassic and Jurassic sedimentary rocks. On top of these were layers of basalt which had flowed across the land from a very large volcano on Island of Mull, which was active between 60.6 and 58.3 million years ago.



Image 4: Thick cone-sheets inclined towards the left, north of the Pier.

On the eastern flank of the central complex on Ben Hiant (Image 5) there are 'debris flows'; conglomerates and breccias that slid down the flanks of the conical volcano that stood above. They are interbedded with sandstones that were formed by streams running down the flanks of the volcano, eroding the Moine schists that had been domed up by the rising magma chamber. These 60-million-year-

old sandstones contain spores from giant conifers, believed to be extinct until in 1944, the dawn redwood was discovered in China.



Image 5: Ben Hiant from the Pier, with cone-sheets in the foreground.

The ring complex is 10 km at the widest point and is mostly composed of overlapping thick circular dykes with steep edges ('ring-dykes') of a coarse-grained igneous rock called gabbro which define three intrusive centres (the blue and light brown rings in Image 1). The last centre to form (Centre 3) is a thick, funnel-shaped intrusion. There are also hundreds of funnel-shaped basalt 'cone-sheets' (the narrow, curved areas of rock mainly at the bottom of the map) each typically less than 5 m thick, which are inclined towards three common focus points beneath the surface (Image 6). Added together they have lifted the roof of the magma chamber by about 1 km. Cone sheets are shown in photos 4 and 5.

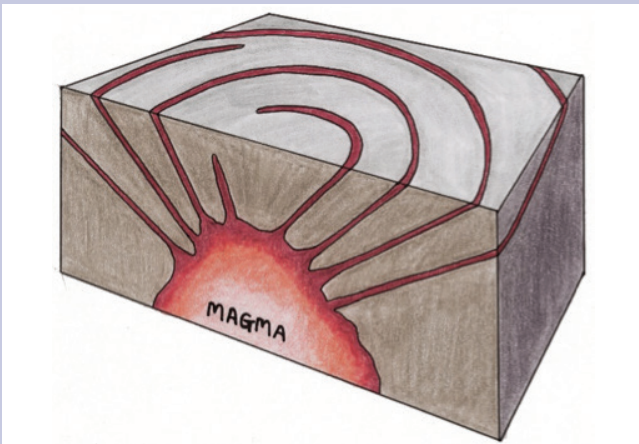


Image 6: Funnel-shaped cone sheets focused on a magma chamber.

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At Stop Location 1 (Image 4) students are looking at a thick cone-sheet which was probably intruded in two pulses. Thinner cone sheets lie below. These are not continuous and in some places, can be seen to cut across earlier sheets. Students will get a strong impression of the conical form of the sheets and if they look to the NW along the coastline (see map) they will see many more sheets. These are clearly seen on the aerial photograph/location map.

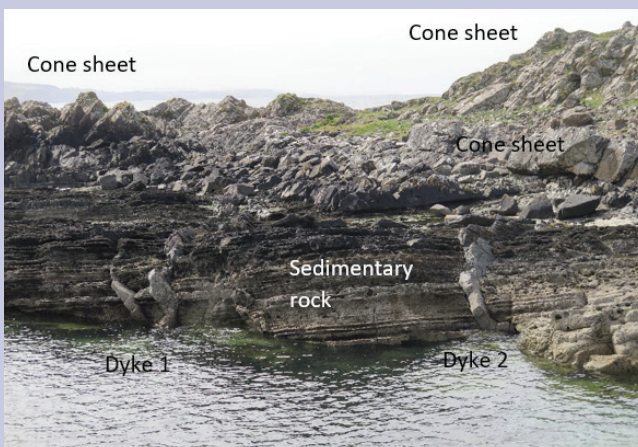


Image 7: Triassic sedimentary rocks cut by cone-sheets and two narrow dykes

This is a good locality to see the relationship between cone-sheets and the sedimentary rocks which they cut through. A Lochaber Geopark interpretative panel is beside the small hut at the landward end of the pier. Looking NE from the pier there are good views of more cone-sheets just in front of the pier. In the distance Mingary castle stands on a sill of granophyre (a quickly-cooled form of granite), which in turn rests on a sill of dolerite (the medium grained equivalent of basalt). Sills are horizontal sheets of rock intruded parallel to the bedding of sedimentary rocks. They, in turn, rest on Jurassic shales. The summit of Ben Hiant, behind, is a thick dolerite sill.

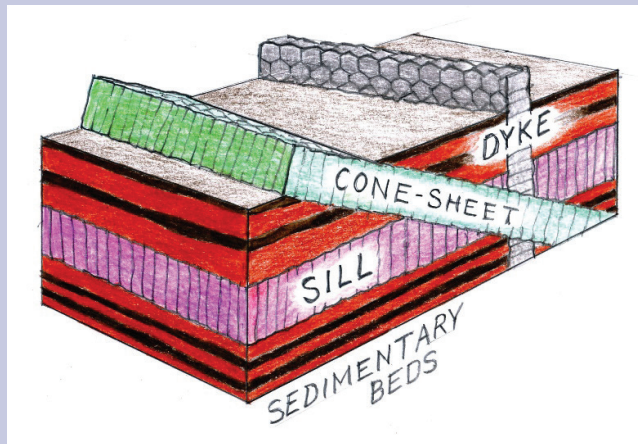


Image 8: Bedded sedimentary rocks (in red) intruded by a sill, a cone-sheet and a dyke.

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Image 9: Cross cutting dykes.

West of the pier (Image 7) there is a large cone-sheet that cuts through bedded sedimentary rocks which are Triassic in age. The inclined character of the cone-sheet is very clear. Also visible are much steeper, thin inclined dykes (Image 7). It is possible to reach the shoreline here by crossing the fence beside the hut. Students can move around to investigate the age relationships of the sediments, dykes and cone sheets. A diagrammatic explanation of how this can be done is shown in Image 8. An example of cross cutting dykes is shown in Image 9.