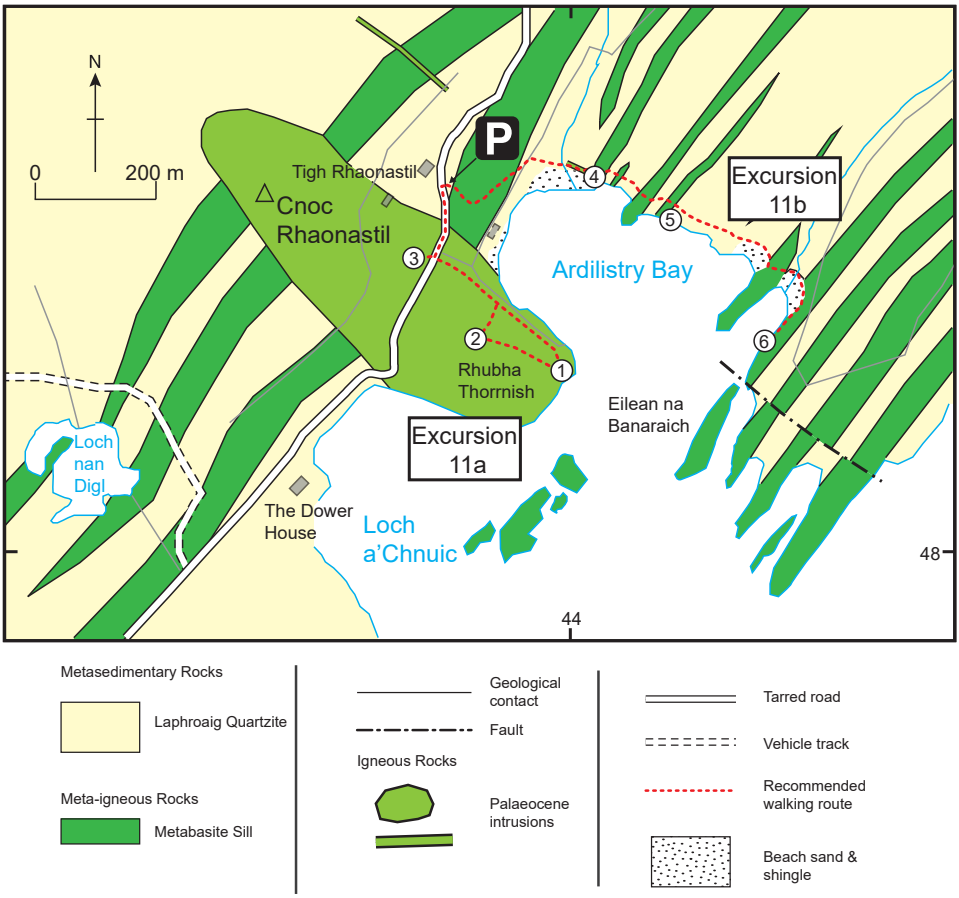


Fig. W11.1 Geological map of part of Islay after British Geological Survey (1997), Tanner (2013) and the author, showing the localities described in Excursions 11a and 11b.

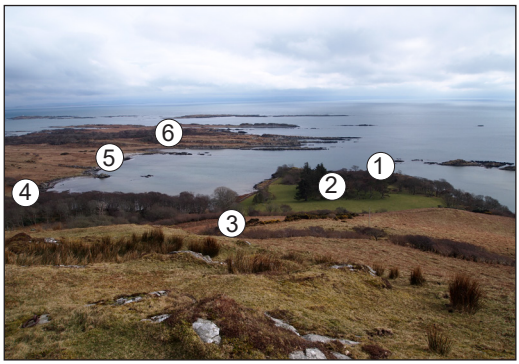


Fig. W11.2 View looking SE across Ardilistry Bay from the top of Cnoc Rhaonastil (the Fairy Hill) showing the positions of the localities.

Excursion 11: Ardilistry Bay

Unusual igneous rocks in a picturesque bay under the Fairy Hill.

Grade: **1+**.

Terrain: Muddy tracks, grassy fields, shorelines with some slippery rocks. Gates and stiles.

Duration: Allow 2 hours.

Facilities: None, but the distillery at Ardbeg has a cafe and toilets.

Access: No known restrictions.

Distance: 11a - 1km, 11b 1.8 km return.

Dogs: No specific problem areas.

Start: Park just before the house 'Tigh Rhaonastil' on the right (east) side of the minor road at [NR 4378 4863] some 3.5 km (2.2 miles) northeast of Ardbeg and about 600 m (0.4 miles) after The Dower House.

Notes: The crossing of the burn near Locality 4 usually presents no problems. A low tide makes access easier at Locality 6.

Along the coast of Islay to the east of Port Ellen metamorphosed sills account for up to half of the succession. One of the sills, exposed along the southeast shoreline of Ardilistry Bay, is quite rare in the British Isles. This sill is around 12–14 m thick and, towards the base, there is a 3 m thick layer that consists almost entirely of actinolite, an amphibole mineral.

Cnoc Rhaonastil (Fig. W11.2) is the only Paleocene-age (60 Ma) igneous intrusion of any significant volume in these islands. In places it has some unusual minerals and rock types.

This excursion is in two halves on either side of Ardilistry Bay.

Excursion 11a - Rhubha Thòrrnish

From the parking place walk S for 150 m back down the road to a stile (comprising a small gate and ladder) over the wall (Fig. W11.3). Cross the stile into the field and head SE to the tip of the peninsula which lies about 200 m to the SE.

Fig. W11.3 The gate in the wall leading to Locality 1.

Locality 1 [NR 4399 4830]

Rhubha Thòrrnish

The rocks and boulders exposed on the shoreline (Fig. W11.4) are coarse-grained ***dolerite****, containing* ***olivine*** *and* ***pyroxene****. Its light-grey colour is*

Fig. W11.4 Leucodolerite outcrop, Locality 1.

Fig. W11.5 Hand specimen of leucodolerite from Locality 1. The light areas are plagioclase feldspar.

*due to its high **plagioclase feldspar** content (c. 70%) and based on this it is called a **leucodolerite**. An exposed fresh surface shows the coarse grain-size of the rock with light areas of plagioclase and darker areas of pyroxene (Fig. 1.5). Some areas show alternating light and dark bands about 5 cm wide which generally dip SE. Because of the orientation of the various cooling joints (seen mainly on the summit of the hill), it is thought that the intrusion had a rounded upper surface not far above the current erosion surface. The overall elongate shape of the intrusion suggests it should be termed a **boss** (which is a small circular or sub-circular **stock**). The differences between stocks, **dykes** and **sills** are shown in Fig. W11.6. The intrusion is of Paleocene-age (c. 60 Ma) and part of the extensive suite of **dyke swarms** and other intrusions in the Hebridean area. These were intruded during the initial extensional phase of a thermal dome over the newly-forming Icelandic **mantle plume** which eventually lead to the creation of the North Atlantic Ocean.*

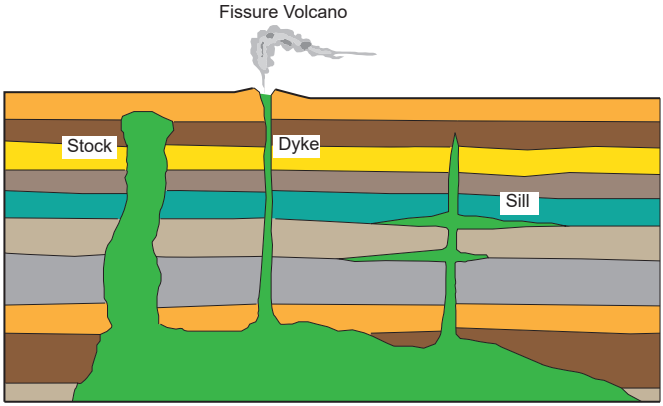


Fig. W11.6. Diagram showing the differences between sills, dykes and stocks.

The leucodolerite seen here is typical of over 90% of the intrusion, however, there are two old and overgrown small quarries in the intrusion where there are some unusual rock types and minerals.

To get to the next locality, head NW for about 100 m into an area of large pine trees. There are a number of low quarry faces in this area (Fig. W11.7).

Fig. W11.7 Teschenite in the quarry, Locality 2.

Locality 2 [NR 4387 4834]

Old quarries on Rhubha Thòrrnish

These old quarries are quite overgrown but some rock is still visible. It has a similar mineralogy as the leucodolerite, although when a fresh surface is exposed it can be seen to be finer-grained (Fig. W11.8) and darker. It also contains ***analcime*** *(a sodium-rich silicate mineral) and on this basis is classified as* ***teschenite.*** *Its outcrop seems to be restricted to the wooded knoll area and it may be a separate, and slightly later, intrusion. There are some exposures of a coarser-grained* ***pegmatite*** *in these quarries but careful searching is required!*

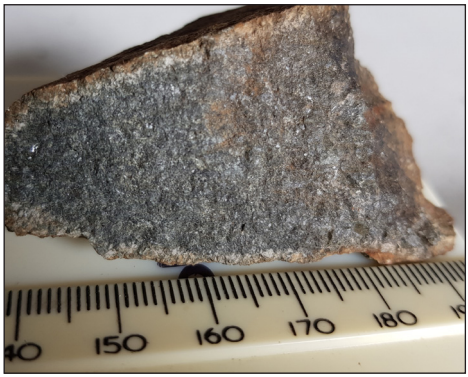


Fig. W11.8 Hand-specimen of fine-grained teschenite from Locality 2.

Return to the road at the ladder stile and look for the old quarry adjacent to the road opposite the stile. It is behind a wire fence and is quite overgrown, but the main face remains visible (Fig. W11.9).

Fig. W11.9 The overgrown quarry at Locality 3 behind the fence.

Locality 3 [NR 4375 4849]

Roadside quarry

Fig. W11.10 Exposure of weathered syenite in the quarry, Locality 3.

The main rock type here is a much lighter colour than those seen at the previous localities (Fig. W11.10). It is classified as a ***nepheline syenite*** *as it is comprised predominantly of sub-parallel elongate crystals of* ***potassium feldspar*** *with some* ***nepheline*** *and* ***biotite*** *(black mica). There are conspicuous black needles of* ***kaersutite*** *- a titanium-rich* ***amphibole*** *(Fig. W11.11). The syenite occurs as discrete 'pods' (sometimes referred to as 'nests') within the main leucodolerite body, which are the result of localised trapping of residual liquids in the cooling magma. There are also some alternating light and dark bands, known as schlieren, which are flow structures caused by the squeezing-out of these liquids during the late stages of intrusion. Recently, some very small (microscopic size) and uncommon crystals of zirconium-aegerine (a pyroxene mineral) and calcium-catapleiite (also a zirconium mineral) have been described here.*

The unusual occurrence of teschenite and nepheline-syenite in association with the leucodolerite are suggestive of ***differentiation*** *(i.e. segregation of minerals) taking place during cooling and intrusion. The main process operating here was* ***fractional crystallization****, which involves the segregation and removal of newly-formed crystals of the remaining* ***magma****, which changes the composition of the magma. This is one of the most important geochemical and physical processes operating within the Earth's crust and mantle.*

Fig. W11.11 Hand-specimen of syenite from Locality 3, with prominent 5 mm-sized crystals of kaersutite.

Return to the Parking Place.

Excursion 11b – Ardilistry Bay (East)

From the parking place follow the narrow path S into the woods, which after 50 m or so turns SE and continues for a further 100 m sloping downwards towards the shore. Follow it to an iron gate through the old stone wall at [NR 4392 4864] and cross the stony beach (Fig. W11.12) and then the burn carefully at an appropriate place (usually best nearest the sea).

Some 50 m after the burn, Locality 4 is at the foot of the first of several promontories jutting out into the bay (Fig. W11.13).

Locality 4 [NR 4404 4864]

Ardilistry Bay (N)

This small promontory, in common with others along this coast, is made of more resistant rock than that in the low-lying areas in-between. The rock exposed here is a ***metabasite.*** *This term is used to describe a metamorphosed igneous rock that originally was a* ***basalt*** *(or a coarser-grained dolerite****)*** *made of plagioclase and pyroxene. The rock in the lower part of the exposure is the basal part of an intrusive sill. The originally molten rock was intruded horizontally between beds of mudstone and sandstone about 600 Ma ago during the initial phase of the opening of the Iapetus Ocean in the later part of the Precambrian. The sills and the surrounding sedimentary rocks were all deeply buried (to about 25 km) under an extensive mountain chain that developed about 470 Ma ago in the Grampian phase of the Caledonian Orogeny.*

Fig. W11.12 Looking back along the route north-westwards from Locality 4 across the beach towards the gate (G) at the edge of the woods. The crossing of the burn is usually relatively easy. Boulders of dolerite in the right foreground are an exposure of a Paleocene-age dyke.

Fig. W11.13 Foliated metabasite in the lower part of a sill at Locality 4. A spheroidally-weathered dolerite dyke (D) can be seen at the left.

The rocks were folded in this process and they are now part of the south-eastern limb of a large-scale ***anticline*** *that dominates the geology of Islay. All the strata in this area dip at about 30^{o} to the south-east. The Orogeny was also responsible for the metamorphism of the sedimentary succession and its sills. The pressure and temperature changed the main minerals in the basalt (calcic-plagioclase and pyroxene) to sodic-plagioclase, amphibole and* ***epidote****.*

In addition to all this deformation, hot fluids (mainly water with dissolved carbon dioxide) liberated from the clay minerals in the enclosing mudstones during their metamorphism were moving upwards through the deforming strata and infiltrating the igneous rocks. Although the sills were less permeable than the mudstones, some of these fluids did manage to penetrate the sills and cause further mineralogical changes. The dip angle of the sill caused an asymmetry to develop, with the basal part being more affected

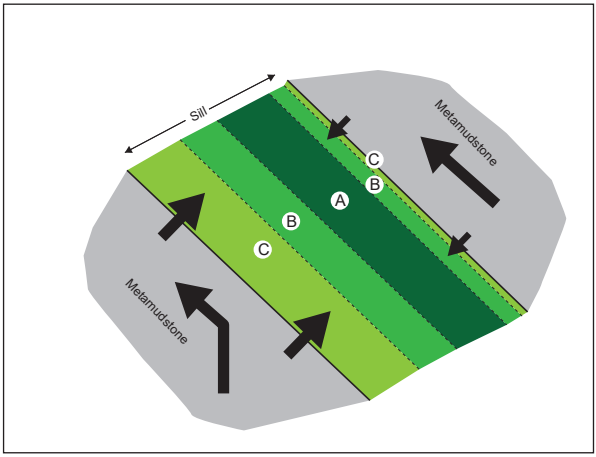


Fig. W11.14 Diagram showing the upward flow of fluids from metamudstones into a tilted sill. The central portion (Zone A) is unaffected by fluids, whereas the edges of the sill (Zone C) have a fully altered mineralogy with a transition (Zone B) between them. Note the asymmetry of the zonation.

than the top. In the thicker sills the central portions were unaffected (Fig. W11.14).

In the marginal areas of the sill the amphibole and epidote have been changed by the fluids into a mixture of ***chlorite****,* ***quartz*** *and* ***calcite****. As carbon dioxide is the main reagent in these reactions the process is known as carbonation. The development of the chlorite (a platy mineral) also gives the rock a characteristic* ***foliation****. These foliated sill margins can look very similar to the surrounding metasediments.*

Fig. W11.15 The beach area at Locality 5 is reached by crossing over the ridge via a narrow path.

There is a line of dark boulders on the beach (see Fig. W11.12) and some spheroidally-weathered brownish rocks at the base of the exposure; these are part of a dolerite dyke (of about the same age as the Cnoc Rhaonastil intrusion).

Go round the promontory on the shore (if the tide is low) or divert inland and in a further 70 m another promontory is encountered. Cross over this via a narrow path to reach the next section of beach (Fig. W11.15).

Locality 5 [NR 4416 4857]

Ardilistry Bay (NE)

The ridge comprises a further metabasite sill and on its eastern side the rocks exposed along the high tide line are representative of the strata into which the sills were intruded. Close to the sill the metasandstones are quite foliated and the foliated top-most rocks of the sill can also be seen (Fig. W11.16). Along the high-tide line heading SE there are several exposures of bedded metasandstones of the Laphroaig Quartzite Formation (Fig. W11.17).

Continue around the bay for a further 300 m or so, crossing a low promontory and a sandy beach with a small burn in its north-eastern corner, before reaching an extensive rocky promontory trending SW towards Eilean na Banariach. Follow the promontory at sea level heading SW for 100 m. Locality 6 is the low cliff extending along this promontory (Fig. W11.18). It can either be accessed along the shore if the tide is low or via narrow tracks along the crest of the ridge.

Fig. W11.16 The foliated top of a metabasite sill (grey rocks, left) and metasandstones of the Laphroaig Quartzite Formation (red-brown rocks), Locality 5.

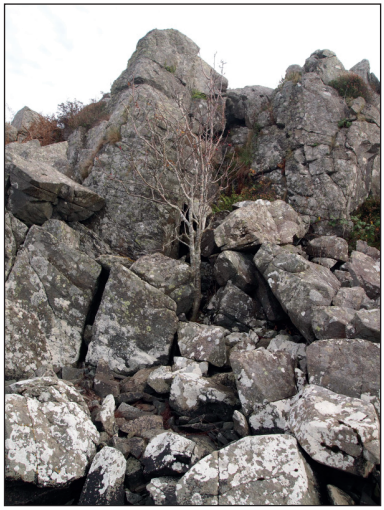
Fig. W11.17 Bedded metasandstones of the Laphroaig Quartzite Formation, Locality 5.

Locality 6 [NR 4432 4833]

Ardilistry Bay (SE)

The cliff is formed from a sill which is about 12–14 m thick (Fig. W11.19) and, towards the base, there is a 3 m thick layer that consists almost entirely of amphibole, here a dark-green magnesium and calcium-rich variety called actinolite. Crystals are 2-3 mm in size. This rock was originally a ***cumulate*** *formed by the early crystallisation and gravity-driven settling of pyroxene crystals. They were subsequently replaced by the actinolite during metamorphism. Although the mineralogy has changed, the original cumulate texture is retained. It is now a* ***metapyroxenite*** *and it is overlain*

Fig. W11.18 View looking south across to Locality 6 on the promontory to the left.



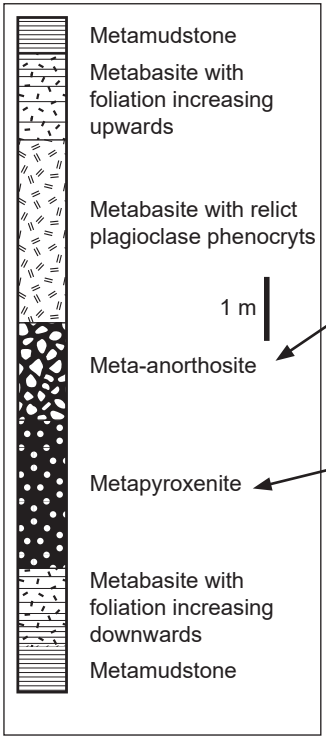


Fig. W11.19 Above and right: Photograph and vertical section of the sill at Locality 6 showing the various layers present. Far right: representative fallen blocks of the two key rock types.

*by a metamorphosed plagioclase layer approximately 1 m thick, with large 1-3 cm sized crystals. These also accumulated by settling and the original rock (the **protolith**) was an **anorthosite** (a relatively rare rock-type on the Earth but common on the Moon). It is now a meta-anorthosite. Like the sill at Locality 4, the top and base have been carbonated, and have a foliation which increases in intensity upwards towards the top and downwards towards the base. It is one of the best examples of a metapyroxenite preserved and exposed in the British Isles.*

Retrace the outward route along the shoreline back to the gate into the wooded area, and follow the paths through the woods to the parking place.

WHISKY RECOMMENDATION

Ardbeg Distillery is the obvious place to enjoy a whisky after this excursion. The cafe is good too. Their Ten Years Old is an excellent, well balanced, peaty, smoky and complex single malt. It takes its soft water from the Solum Loch above the distillery.