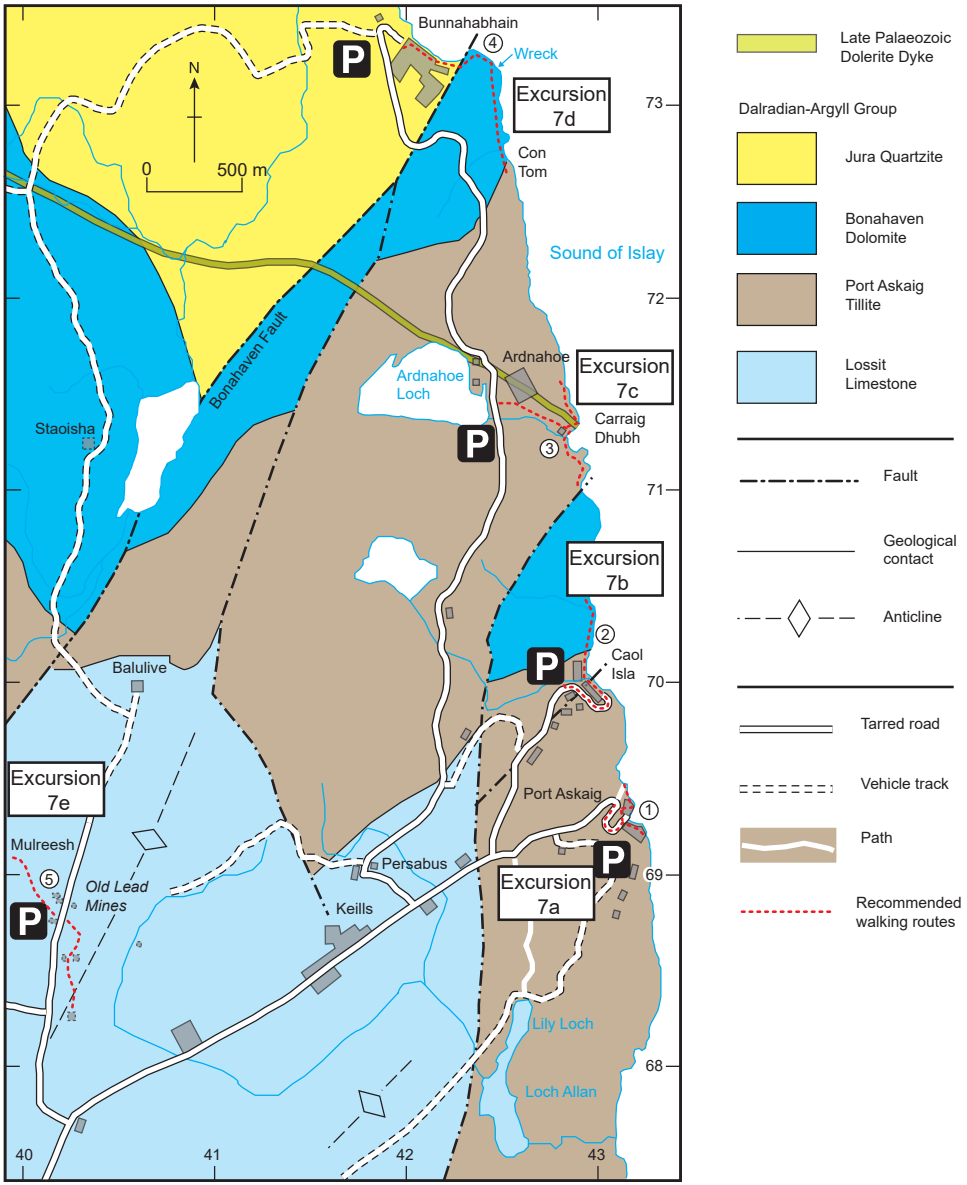

Fig. W7.1 Geological map of the area between Port Askaig and Bunnahabhain after British Geological Survey (1997), showing the localities described in Excursion 7a to 7e.

Excursion 7: Port Askaig to Bunnahabhain

The world-famous Port Askaig Tillite, the Bonahaven Dolomite with its stromatolites, plus old lead mines and three distilleries.

Grade: **1+**

Terrain: Tracks, sections of coastline, roadsides, and grassy fields. Excursion 7a is around the harbour at Port Askaig and good for those with limited mobility.

Facilities: Shop, toilets and pub at Port Askaig. Various visitor facilities at the distilleries.

Distances: Port Askaig - 1 km, Caol Isla - 1.8 km, Carraig Dhubh - 1.5 km, Bunnahabhain - 2.3 km and Mulreesh

Duration: Visiting all five localities should take around 6-7 hours.

Start: Port Askaig Ferry car park for Locality 1, Caol Isla, Ardnahoe and Bunnahabhain distilleries for Localities 2, 3 and 4 respectively. Layby at Mulreesh for Locality 5.

Access: No restrictions.

Dogs: Livestock in fields around Mulreesh.

Note: Locality 1 probably best avoided during busy ferry times.

The Port Askaig Formation is an iconic Precambrian glacial deposit. It was deposited between 720 and 660 million years ago during the Sturtian 'Snowball Earth' glaciation. It is overlain by the Bonahaven Dolomite which has some of the best examples in Scotland of Precambrian fossils in the form of algal stromatolites. Lead was extensively mined in Islay in the past and this excursion also visits some of the old mines.

This excursion is divided into five separate short excursions at Port Askaig, (7a), Caol Isla (7b), Ardnahoe (7c), Bunnahabhain (7d) and Mulreesh (7e) respectively.

Excursion 7a – Port Askaig

Park in the Port Askaig ferry car park and walk uphill on the pavement on the western side of the road. Start at the rock faces before the new netting (Fig. W7.2). This locality extends from here uphill along the roadside for some 200 m to the main hairpin bend.

Locality 1a [NR 4301 6921] to NR [4307 6934]

Port Askaig ferry terminal.

The cliff around the ferry terminal is an extensive exposure of the Port Askaig Tillite, which at this end of the locality, consists of thick grey-brown rock with sparse but conspicuous clasts (also known as stones) of pink coarse-

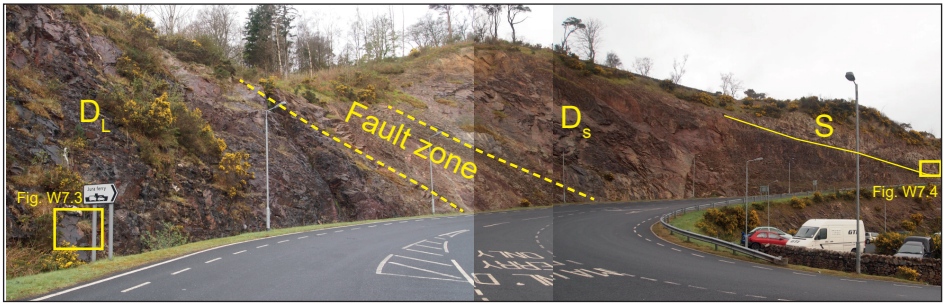

Fig. W7.2 The Port Askaig Formation at Locality 1a. Diamictites with large granite clasts (D_L) are exposed on the left with a wide fault zone of shattered rocks. On the upthrown side there are more diamictites with sparse clasts (D_s) with a sharp-based sandstone bed (S) above.

*grained **granite** (Fig. W7.3) in a fine-grained **matrix**. These rocks are called **diamictites** (a non-genetic term) in preference to the term **tillite** (which has a direct glacial connotation). These rocks do indeed have a glacial origin and were deposited by melting ice which had a lot of rock debris entrained within it. The diamictite bed here is very thick (about 70m) and no top or base is visible. The majority of the clasts are of granite, but although they are the same age (1,800 Ma) as the local Rhinns Complex, they are not like any rocks currently exposed and contain unusual minerals (such as chessboard albite). Their origin is still unclear, some studies suggest a derivation from Greenland or Labrador, others from Scandinavia or even South America – all of which were close to this area at the time.*

*Towards the middle of the bend a **fault** is crossed; this is a wide zone of fractured rock running SW-NE along the line of the upper part of the road. It is a **normal fault** where the rocks to the SE (i.e. in the area of the car park) have dropped down relative to those to the NW. Sections of rock within the fault zone have fallen onto the road; hence the new and extensive rock-bolting and netting to help prevent future slips.*

Fig. W7.3 Diamictite with large granite clasts, Locality 1a.

Fig. W7.4 Cross-bedding in laminated sandstone at the top of Locality 1a.

The cliffs on the left of the straight uphill section of the road expose (now under the netting) more massive diamictites, but with very sparse small stones. About 50 m before the big hairpin bend there is a 7-8 m thick bed of lighter-coloured ***sandstone*** *(Fig. W7.4), which has a sharp contact with the underlying diamictite and is overlain, again quite sharply with another diamictite with few stones. The sandstone is* ***laminated****, with some* ***cross-bedding****, and was probably deposited in shallow tidally-influenced water.*

The diamictites with the large clasts are thought to be part of Member 4 of the Port Askaig Formation and were originally interpreted to have been deposited by melting ice that was grounded (i.e. it was in contact with the sub-ice ground surface, however new evidence from other nearby localities suggest that deposition from floating ice is more plausible. The strata on the road after the fault are interpreted to be part of the underlying Member 3 of the Port Askaig Formation. The sandstones are thought to have formed in an interglacial period when the sea-level rose and reworked some of the older glacial deposits. This indicates that the ice must have been close to sea level and not in a mountain environment.

There are further exposures of diamictite and sandstone in the cliffs alongside the track and also behind the ferry office, around the hotel (look out for a lovely door stop at the main hotel entrance) and below the life boat station on the south side of the harbour (Locality 1b).

From here either follow the road back to the car park, or take the track that starts on the outside of the hairpin (across the safety barrier) and which goes steeply down to the houses in the bay to the immediate north of the harbour. There is then a path back to the ferry terminal along the shore. There is a small bay below the old cannon at the life boat station which can be accessed via the hotel garden and some steps.

Locality 1b [NR 4317 6922]

Lifeboat Station.

The small bay exposes more diamictites with granitic clasts but the diamictites have a pronounced ***foliation*** *on account of their*

Fig. W7.5 Granite clast in foliated diamictite, Locality 1b. This could be a dropstone but here the cleavage is being refracted around the clast and the foliation is not bedding.

clay content Fig. W7.5). On ***metamorphism****, the clay minerals change to micaceous minerals and align at right angles to the dominant pressure direction. This foliation superficially resembles bedding. It bends (refracted) around the hard granite clasts (which have no clay) and the end result looks superficially like a dropstone - i.e a rock that has dropped through water into the muddy sea bottom from melting floating ice.*

Excursion 7b – Caol Isla

The locality is at the Caol Isla distillery (Fig. W7.6). It extends north from the distillery along the pebbly shoreline for about 600 m. Park in the new car

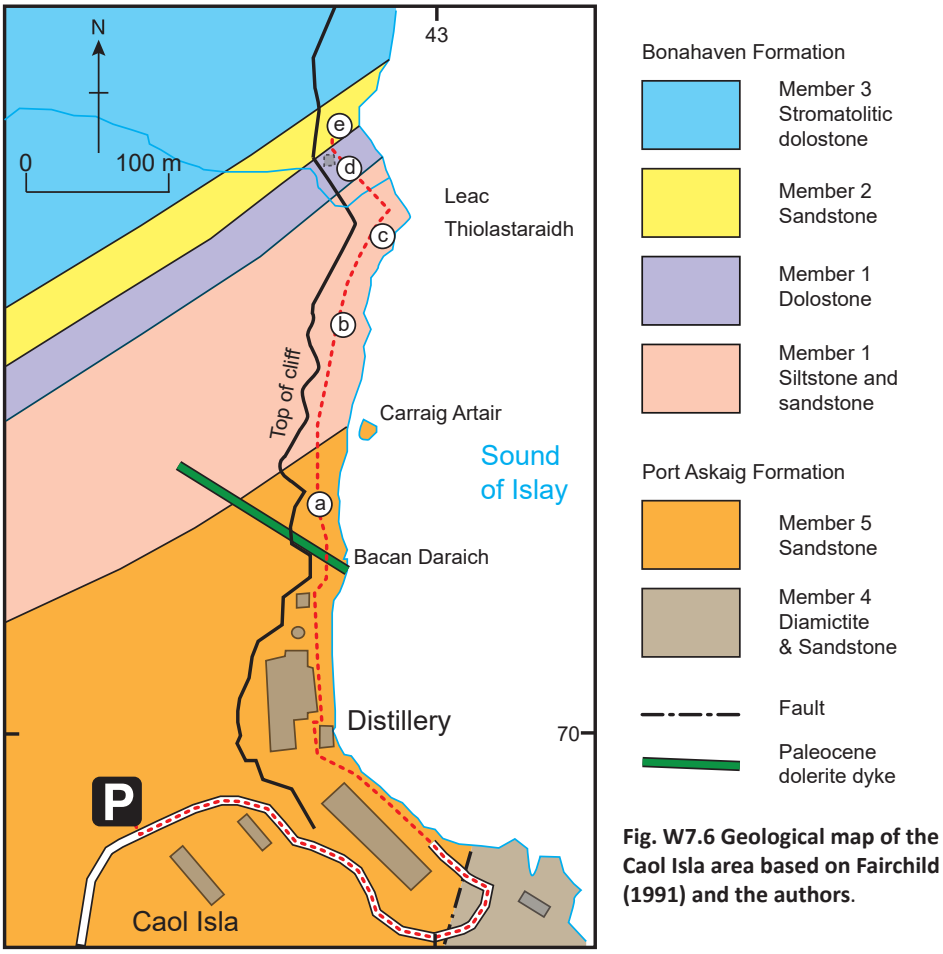

Fig. W7.6 Geological map of the Caol Isla area based on Fairchild (1991) and the authors.

Fig. W7.7 Fine-grained sandstones at the top of the Port Askaig Formation with wave-ripples indicating a shallow water origin, Locality 2a.

Fig. W7.8 Metamudstones at the base of the Bonahaven Formation dipping to the NE with several foliations, Locality 2a.

park and walk down the road and walk through the distillery area to the far end which gives access to the shoreline via a gate and a short grassy section over a low headland (Bacan Dairaich) before reaching the pebbly beach.

Locality 2a [NR 42931 7014]

Bacan Daraich

The strata here dip gently N at about 20-30° so the excursion encounters successively younger rocks. The first rocks seen are the uppermost ***sandstones*** *of Member 5 of the Port Askaig Formation with some good examples of wave-ripples (Fig. W7.7). In addition a thin dolerite dyke can be seen. About 50 m north at [NR 42947021] an exposure of mudstone marks the base of the Bonahaven Formation (Fig. W7.8). This whole section is generally very weakly* ***metamorphosed*** *except for this one exposure (of metamudstone) which has undergone more severe deformation. It has several foliations and some* ***biotite mica,*** *probably related to fluid flow up a local* ***fault.***

Continue walking N for about 80m until close to an old fishing shelter with a small skerry (Carriag Artair) just offshore.

Locality 2b [NR 4294 7029]

Carraig Artair

The rocks in the cliff line between here and the previous locality lie above the metamudstone bed and are siltstones of the lower part (Member 1) of the Bonahaven Formation. They are well-bedded and were deposited in a very shallow nearshore wave-dominated area. At this locality a thin ***conglomerate*** *containing mainly quartz and granite pebbles can sometimes be found amongst the seaweed and it probably represents a tidal channel fill.*

Fig. W7.10 Wave-ripples on the bedding surfaces, Locality 2c.

Fig. W7.11 Laminated siltstones with a small scour channel, Locality 2c, Caol Isla.

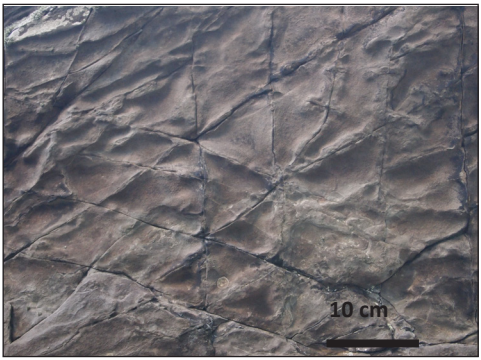

Fig. W7.12 Desiccation cracks on the underside of a bed of siltstone, Locality 2c.

Continue walking N for a further 150 m to the headland with a few easy rocky steps.

Locality 2c [NR 4297 7035]

Leac Thiolastarairdh

At this headland some spectacular rippled surfaces are exposed in fine grained, well sorted coarse siltstones (Fig. W7.10). There are also examples of small scour channels (Fig. W7.11) and alternating sand, mud and heavy mineral layers with some cross-bedding indicating intermittent and changing current flows, probably caused by storms. Polygonal cracks on the bedding surfaces can be found (Fig. W7.12), which are interpreted as desiccation cracks. Overall deposition is believed to have been in a very shallow marine environment; probably in a lagoonal area behind a series of low-relief barrier islands. The channels are thought to have resulted from storm currents washing over the barrier.

Follow the shoreline N into the small bay to the rocks on the immediate north side of the burn.

Locality 2d [NR 4294 7038]

Burn north of Leac Thiolastarairdh

Immediately adjacent to the burn, there are some honeycomb-weathered yellow, bedded ***dolostones*** *(Fig. W7.13) with some beds of dolomitic sandstone. There is some* ***cross-bedding*** *and an overall tidal sandflat environment is envisaged. This dolomitic unit is characteristic of the top of Member 1. There was some excitement in 1998 when a paper was published describing trace fossils (animal tracks) from this locality but this has since been retracted by the authors.*

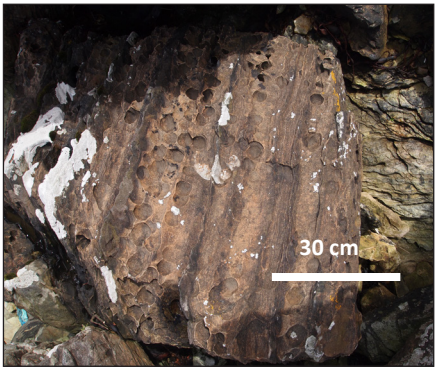

Fig. W7.13 Honeycomb weathering at the top of Member 1, Locality 2d.

The last locality comprises the cliff behind the old fishing shack a few meters to the north (Fig. W7.14).

Locality 2e [NR 4292 7041]

Fishing shack north of Leac Thiolastarairdh

Fig. W7.14 Laminated bedded sandstones of Member 2, Locality 2e.

The cliffs to the north of the fishing shack expose bedded and laminated sandstones of Member 2 of the Bonahaven Formation. It was deposited on a very shallow tidal shelf and some beds are probably beach sands. It is about 15 m thick, quite distinctive, and widespread across northern Islay; making it a useful marker for geological mapping purposes. Above the sandstones are dolostones of Member 3. These are not well exposed in the cliff, but there are large boulders of dolostone along the shore which severely hamper progress further north. They are best observed at Bunnahabhain (Locality 4).

Retrace the outward route back to the distillery.

Excursion 7c – Carraig Dubh

Locality 3 is reached by driving back to the main road, heading W towards Keils. Before the village take the right turn towards the Bunnahabhain distillery, passing through Persabus farm. Some 3 km north of Persabus there is a new distillery at Ardnahoe. There is a gate on the SE side of the car park onto a track which heads east. Some 200 m later a zig-zag grassy path branches off right, leading down to Carriag Dubh (Blackrock) cottage.

Locality 3 [NR 4287 7134]

Carraig Dhubh.

To the immediate NE of the cottage, on the headland of Carraig Dhubh, there is an extensive exposure of a dark brown ***igneous*** *rock (Fig. W7.15). This is a thick (c.20 m)* ***quartz-dolerite dyke*** *believed to be of* ***Carboniferous*** *age (about 300* ***Ma****) which has been mapped trending SE to NW across northern Islay and Jura.*

Fig. W7.15 Looking north from the Carboniferous quartz dolerite dyke at Carraig Dhubh, Locality 3.

To the north of the dyke and also to the south of the cottage there are low cliffs with intermittent exposures of diamictite and some sandstones of the Port Askaig Formation, somewhat similar to those seen at Locality 1.

Excursion 7d – Bunnahabhain

Park just outside the distillery (or in its carpark) and go through the buildings and past the cottages at the southern end. See map Fig. W7.16. There is a gate at the end of the cottages leading to a rough path which skirts the shoreline towards Rubha a'Mhill. The first locality is some 50 m after the gate.

Locality 4a [NR 4227 7320]

Bunnahabhain Bay.

The rocks exposed on the north side of the distillery are the Jura Quartzite. A major fault line (the Bonahaven Fault) runs from here SW towards Bridgend. Underling the Jura Quartzite is the Bonahaven Formation which outcrops extensively on the upthrown (SE) side of the fault in the cliffs and shoreline at Rubha a'Mhill and southwards to the Con Tom peninsula.

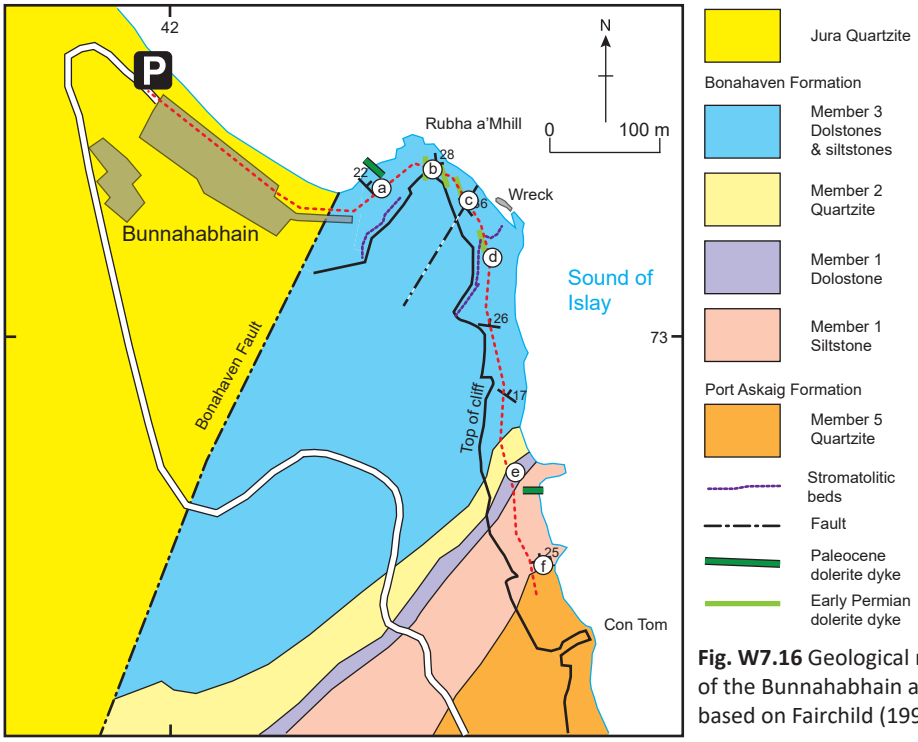

Fig. W7.16 Geological map of the Bunnahabhain area based on Fairchild (1991).

At this locality the shoreline below the path exposes beds of fine-grained dolomitic sandstone dipping gently to the NE. They are cut by a narrow and sinuous Paleocene-age (60 Ma) dolerite dyke (F. 7.17). In the cliff above the path there are some excellent exposures of stromatolitic dolostones. There is, however, quite a steep and overgrown scramble up to the base of the exposure, and they are more accessible at Locality 4d.

Continue to follow the narrow path NE for a further 50 m to the tip of the peninsula where the path essentially dies out and it is best to walk along the shoreline near the high-tide mark.

Locality 4b [NR 4232 7322]

Rubha a'Mhill.

There are extensive exposures of bedded dolomitic sandstones and siltstones around the headland. Clean surfaces show centimetre-scale laminations (Fig. W7.18) and there are beds with ripples, grading, some cross-bedding and also wavy bedding. Some of the beds have 1-2 cm long sub-vertical cracks, which are deformed shrinkage cracks. Overall the beds were deposited in a shallow-water tidal-flat depositional environment which was

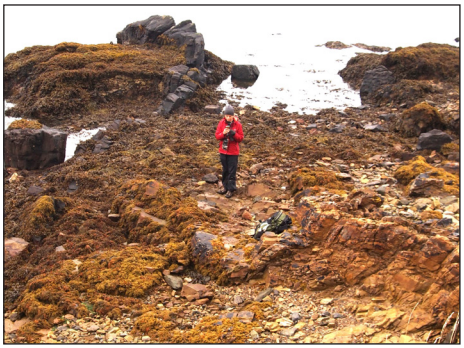

Fig. W7.17 A thin dolerite dyke (D) cuts across dolomitic sandstones, Locality 4a.

Fig. W7.18 Laminated dolomitic siltstones and fine grained sandstones with shrinkage cracks, cross-bedding and wavy bedding, Locality 4b.

subjected to periodic storms which stirred up the sediment.

There are also several dykes of dolerite trending NNW, cutting through the strata (Fig. W7.20). These are believed to be early Permian in age (about 285 Ma) and likely to be feeder dykes to lavas of this age which outcrop on Glas Eilean in the Sound of Islay, some 8 km to the SSE.

The path heading SE at the edge of the rock outcrops becomes narrower and it is preferable to continue on the rocky shore. The next locality is about 100 m to the SE near the remnants of the wreck of the Wyre Majestic trawler (most of which has now disappeared).

Locality 4c [NR 4239 7318]

Site of wreck of the Wyre Majestic.

There are several Permian-age dolerite dyke at this locality. They have abundant amygdales which are former gas bubbles frozen into the rock and filled with white zeolite minerals precipitated from late-stage hot hydrous fluids. These show some signs of copper mineralisation, now weathered into green stained areas, and some have small rusty-coloured patches, which are thought to be ***xenoliths*** *from the Earth's mantle (Fig. W7.19). There are also some poor exposures*

Fig. W7.19 Dolerite dyke at Locality 4c with white zeolite-filled amygdales and rusty-brown xenoliths of mantle peridotite.

Fig. W7.20 Boulder of dolomitic siltstone with nodules of calcite which were previously anhydrite, Locality 4c.

*but numerous fallen blocks of yellow-weathering dolostone with small stromatolitic **bioherms** and some boulders of dolomitic siltstone with patches of white and pink **calcite** which are replacing (pseudomorphing) previous aggregates of **anhydrite** crystals. These probably indicate warm and arid conditions similar to modern sabkhas in tropical arid places like the Persian Gulf.*

Follow the shoreline SSE for a further 60m to a prominent NE-SW trending ridge with the wreck at its NE end. The ridge can be circumnavigated to the east over the rocks or crossed via a short scramble through an obvious cleft in the crest. Locality 4 is at the base of the cleft on the south side of the ridge.

Locality 4d [NR 4243 7313]

Rock ridge south of Rubha a'Mhill

*The cleft in the ridge is the result of the erosion of a dolerite dyke - probably a continuation of the one observed at the previous locality. The main feature here is the cliff face on the right (E) side of the cleft, where there is a 2 m thick stromatolitic bed near the top of the rock face (Fig. W7.21). Stromatolites are formed by the trapping, binding and cementation of sedimentary grains by biofilms (microbial mats) of micro-organisms, especially cyanobacteria. Here they form **biostromes** which are layers made from coalesced columns of the microbial colonies.*

*These are rare examples of Precambrian life and probably indicate that not long after the Port Askaig glacial episode, warmer conditions followed. The Bonahaven Formation has been interpreted as a **cap carbonate** to the underlying Port Askaig Tillite. These unusual rocks occur immediately above many Precambrian glaciations. Increasing CO_2 levels led to global warming with increased rainfall*

Fig. W7.21 Exposure of stromatolitic dolostone, Locality 4d.

resulting in enhanced weathering of the bedrock, and delivering more dissolved carbonate into seawater. This led to precipitation of carbonate generally in deeper water as sea levels rose rapidly. However, on Islay, the presence of large amounts of clastic sediments between the last glacial deposit and the first carbonate beds coupled with the shallow water environment indicates that if the Bonahaven Formation is a cap carbonate, then it is very atypical.

Continue S for about 300 m, mainly following the edge of the rocky shore to where a low rocky ridge protrudes into the sea.

Locality 4e [NR 4246 7280]

Shore south of Rubha a'Mhill

Fig. W7.22 Siltstones and thin breccias in Member 1. Locality 4e.

The dolostone-dominated rock succession seen at localities a to d is assigned to Member 3 of the Bonahaven Formation. The shoreline has further exposures and fallen blocks of these strata. Their dip is about 25^{O} N to the NE, so this southerly traverse encounters progressively older rocks.

The cliff at this locality expose about 20 m of distinctive grey siltstones interbedded with light-brown fine-grained sandstones and thin breccias (Fig. W7.22). Some microfossils (now mineralised into very small spheres) have been found in the thin grey siltstone beds.

There are some dolostone beds lying immediately above these and all these strata have been assigned to the topmost part of Member 1 of the Bonahaven Formation. Some of the dolomite is in the form of diagenetic concretions and probable formed in very shallow water which may have been sub-aerially exposed. There are also two thin Paleocene-age dolerite dykes trending E-W cutting across the strata.

Continue S for a further 100m along the rocky shore line.

Fig. W7.23 Bedded fine-grained sandstones with ripple marks at the top of the Port Askaig Formation Locality 4f.

Fig. W7.24 Mudstones dipping gently north with steeper cleavage at the base of the Bonahaven Formation, Locality 4f.

Locality 4f [NR 4249 7269] to NR [42536 72608]

Shore north of ConTom

Below the distinctive unit at the top of Member 1 the strata are dominated by grey siltstones with some mudstones and beds of fine-grained sandstones with ripple marks (Fig. W7.23). The latter indicate that they were deposited in shallow marine wave-dominated environments. These in turn overlie some mudstones with a pronounced cleavage. These mudstones mark the base of the Bonahaven Formation and below them lie a thick series of sandstones which extend from here to the Con Tom peninsula (and for another 500 m or so beyond it). These sandstones are assigned to Member 5 of the Port Askaig Formation and are not considered to be glacial deposits but were likely deposited very rapidly, possibly in moderately deep water. At the peninsula itself some folding and deformation can be observed, which is probably caused by water-escape (Fig. W7.25). Recent work in the local area and inland has revealed the presence of a thin diamictite virtually at the top of the Port Askaig Formation - and it is thought that this bed (now termed D48) was deposited by iceberg melting and probably marks the final event in the Port Askaig glaciation here.

It is possible to get around Con Tom with a favourable tide to view more of Member 5 sandstones, however a return via the outward route from here is strongly recommended.

Fig. W7.25 Sandstones at Con Tom with folding and deformation caused by water escape.

Excursion 7e – Mulreesh

The last locality is the lead mine at Mulreesh (Fig. W7.26). Return to Keils and head SW towards Bridgend. After 2 km take the right hand turn signposted to Finglaggan and follow it N for 1 km to a large passing place next to a ruined building (the Engine House) on the left.

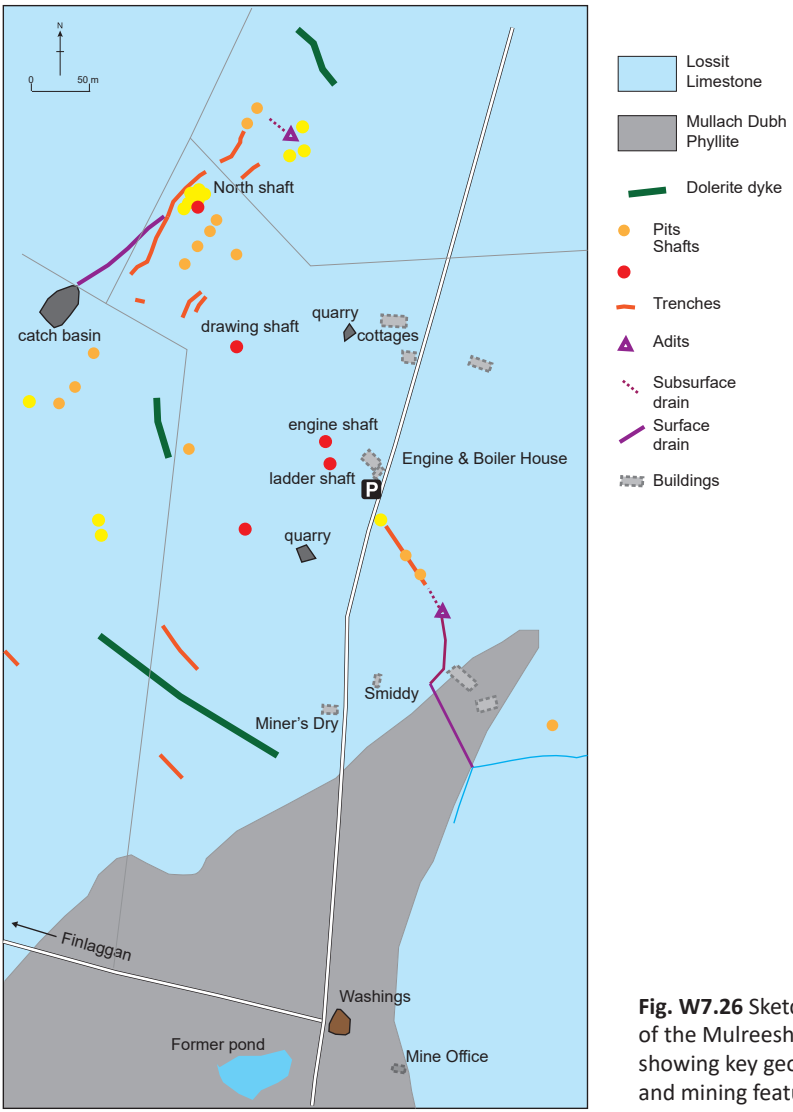

Fig. W7.26 Sketch map of the Mulreesh area, showing key geological and mining features.

Locality 5 [NR 4017 6872]

Mulreesh lead mines.

This area was the most important lead mining area on Islay – records go back to the 1770s and mining was finally abandoned in 1906. The Engine House (Fig. W7.27) dates to the latest period. There are two shafts in the field immediately to the W of the Engine House and a line of diggings, filled-in shafts and adits heading NW for 500 m to the North or 'New' shaft (Fig. W7.28), which was the last working of the mine.

Fig. W7.27 The engine house at Mulreesh.

Through the gate on the left (E) of the Engine House there are more old shafts near the road (now mainly filled in) with small piles of mine tailings and a water-filled adit 50 m to the SE. A washings reservoir remains next to the road some 500 m to the south, and remains of other buildings such as offices, miners 'dry', and a smiddy, dot the landscape.

Most of the mine waste is grey brecciated limestone (Lossit Formation) with white calcite and quartz veins. Occasionally small crystals of grey galena (lead ore) and yellow iridescent chalcopyrite (copper ore) can be found. The ore occurs in linear veins which mostly trend NW-SE.

Fig. W7.28 The north shaft at Mulreesh.

The mineralisation occurred in the Carboniferous Period about 300 Ma, (based on lead-isotope studies) when hot sulphur-rich fluids carrying metals from deep in the crust rose up along NW-SE fractures focussing on areas of pre-existing weaknesses. These fluids were quite acidic and dissolved and brecciated the limestone.

Return to the parking place.

WHISKY RECOMMENDATION

The new distillery at Ardnahoe is worth a visit. The views from the balcony over the Sound of Islay to Jura are wonderful. They draw their soft water from nearby Ardnahoe Loch and produce a range of characteristic Islay malts; fruity and moderately peated.