Excursion 15 Great Cumbrae

Key details

Authors	D.S. Weedon (after W.G.E. Caldwell)
Themes	Old Red Sandstone and Calciferous Sandstone Measures sediments and dykes of three ages, Calciferous Sandstone, Carboniferous-Permian and Tertiary.
Features	Minor sedimentary structures, marls and concretionary cornstones, faults, upstanding dykes (notably cuinbraite), bostonites, flow-banding
Maps	O.S. 1: 50 000 Sheet 63 Firth of Clyde B.G.S. 1: 63 360 Sheet 29 Rothesay
Terrain	All exposures are accessible from the flat coastal road.
Distance and Time	Total distance around the island approximately 16–18 km: (10–11 miles); examination of main exposures (using car) half-day but better as a leisurely full day's outing.
Access	By vehicle/passenger ferry from Largs to Holm Bay (in 1991, approximately £10 for car). If travelling on foot, buses from the ferry terminal run to Millport where, if desired, bicycles are available for hire.

Introduction

The island and its neighbour, Little Cumbrae, lie in the Firth of Clyde midway between the mainland and South Bute. Little Cumbrae, composed largely of Carboniferous basalts, is privately owned and not easily accessible; it is not here described (for details of its geology, see Tyrrell, 1918). Great Cumbrae, however, is easily accessible from Largs, either on foot or by car. Its shores offer excellent exposures of sediments of the Upper Old Red Sandstone and the overlying Calciferous Sandstone Measures sediments, cut by suites of dykes of early Carboniferous, Permo-Carboniferous and Tertiary ages. Structurally the island is divided by the N–S trending Great Cumbrae Fault (Figure 15.1). Sedimentary rocks to the east of the fault are entirely of Upper Old Red Sandstone, whereas to the west they range from Upper Old Red Sandstone in the north into overlying Calciferous Sandstone Measures sediments in the south.

The Upper Old Red Sandstone, more than 600 m (2000 ft) thick, comprises mainly red sandstones and conglomerates in contrast with the Calciferous Sandstone Measures, about 300 m (1000 ft) thick, which are dominated by finer-grained red marls and grey sandstones. The latter are exposed by a southward-plunging syncline, present to the west of the Great Cumbrae Fault; the complementary southward-plunging anticline lies to the east of the fault. Examination of the relationships of recognisable dykes across the Great Cumbrae Fault shows that it has undergone at least two major movements: a sinistral tear movement of 1.6 km (1 mile) which is later than the Carboniferous / Permian dykes but earlier than the Tertiary dykes, and a dextral tear movement of 1.07 Km (0.67 ml) in post Tertiary dykes period (Patterson 1952). Great Cumbrae island is perhaps most notable geologically for the great number and variety of dykes that are easily accessible and magnificently exposed around its shores. Broad groupings into three categories can be made on directional trends, cross-cutting relationships and their individual distinctive petrological features. The accompanying map (Figure 15.1) indicates sufficient examples to show the major dyke trends; (1) Calciferous Sandstone Measures suite, trend approximately NE–SW: (2) Carboniferous-Permian suite, trend approximately E–W: (3) Tertiary suite, trend approximately NW–SE. Suite (1) is made up predominantly of dykes together with plugs and bosses representing old volcanic vents: these are generally of Jedburgh, Dunsapie and Markle basalts. The suite (1) dyke swarm is largely of bostoni tes and felsites, the main difference between them being the finer-grained texture of the latter. They often show well-developed fluxion structures, in the case of the bostonites by aligned phenocrysts. Both are characterised by a predominance of alkali feldspars (albite and orthoclase) and a paucity of ferro-magnesian minerals.

On Great Cumbrae albite is predominant in the dykes, the rocks being termed albite-bostonites. The felsites also show flow-banding, often due to streaked-out vesicles contained within a dense, cryptocrystalline matrix. (The dykes of Craignon Fitheach, Locality 7, are typical of these rocks). Suite (2) is exemplified by the E–W trending quartz-dolerite dyke which can be traced across the island from Bell Craig to Downcraig Ferry and is identical petrologically with other E–W dykes present in the Clyde area. It consists essentially of well-shaped plagioclase (labradorite) laths sub-ophitically enclosed by augite crystals, together with skeletal ilmenite and appreciable amounts of interstitial quartz. Suite (3) has dykes of both olivine-dolerite and tholeiite types, but the most striking are those named after the island, cumbraite. One forms the spectacular Lion Rock in the SE of the island, from whence it can be traced in a NW direction to Eerie Point at the NW end. It was here described by Tyrrell (1917, pp. 306–15) as the type rock. See Locality 9 for a full description.

Locality 1. The conspicuous promontory at Downcraig Ferry [NS 580 182]

The conspicuous promontory at Downcraig Ferry [NS 580 182] formed from a thick 23 m (75 ft) quartz-dolerite dyke of the Carboniferous-Permian Suite is well exposed on the shore. As mentioned above, this is the dyke which can be traced across the island to Bell Craig. In the intertidal zone some 230 m (250 yds) north of this locality, a small complex of felsite dykes (Suite 1) is cut by an olivine-dolerite Tertiary dyke. The felsite dykes show excellent flow banding.

Locality 2. The Lion Rock [NS 549 179] and the Deil's Dyke [NS 544 174]

Locality 2. The Lion Rock [NS 549 179] and the Deil's Dyke [NS 544 174] are spectacular upstanding parallel dykes composed of cumbraite, a rock type described by Tyrrell (1917). It is a porphyritic rock, with large yellowish-white phenocrysts of plagioclase feldspar in a black, vitreous groundmass. The type rock was described from Eerie Port Locality 9). Both dykes form sheer natural walls, with horizontal cooling joints well displayed. The Lion Rock (4.8 m, 16ft thick) is exposed on the shore near the roadside, where it cuts a bostonite dyke of Suite 1. The Deil's Dyke is 3–3.6 m (10–12 ft) wide on the shore, where it encloses a lens of bleached conglomeratic sandstone. Between the Deil's Dyke and Millport, the road swings northward and runs parallel with the Great Cumbrae Fault, crossing a series of Old Red Sandstone sediments. These are dominated by flaggy red sandstones and quartz conglomerates. Many macro-porphyritic dykes of Suite 1, average width 2–3 m (6–10 ft), are exposed along this shore line. The Great Cumbrae Fault lies to the seaward side of these exposures.

Locality 3. At Kames

Locality 3. At Kames Bay are exposed many isolated outcrops of rocks of Upper Calciferous Sandstone age. Although there are slight variants, the general dip is southerly. The rocks are sugary textured, white to greyish-white sandstones, with pink and purple horizons which are more silty. The latter become more prevalent in the higher horizons, exposed on the two offshore islands. A few olivine-dolerite dykes of the Tertiary suite (3) cut these rocks. At Millport Old Pier [NS 547 161] a sill of macro-porphyritic dolerite is well exposed at the roadside. Between Millport and Portachur Point two small faults emerge at Foul Port [NS 546 156] and bring Lower Calciferous Sandstone red marls to the west against grey sandstones of the Upper Measures to the east.

Locality 4. The rocks forming the region of Portachur Point [NS 538 152]

Locality 4. The rocks forming the region of Portachur Point [NS 538 152] comprise the upper unit of the Calciferous Sandstone Measures and are here well exposed. They form a continuous sequence of rocks of the same age as those described in isolated outcrops at the last locality, namely pale-grey to white thick sandstone beds, often strongly cross-bedded. These alternate with red, purple and green marls and fine-grained sandstones: the latter generally prove less resistant to weathering and hence produce lower erosional features. The marls are associated with concretionary cornstones; detrital cornstones are fairly common in thin lenses beneath more massive sandstone layers.

Locality 5. At Shell Hole [NS 540 150]

Locality 5. At Shell Hole [NS 540 150] the junction between Upper and Lower Calciferous Sandstone Measures has been placed: this is somewhat arbitrary and difficult to pinpoint. However, between here and Doughend Hole (Locality 6) the rocks are dominated by red-brown marls with associated calcareous and non-calcareous laminated sandstones and limestones (2.5–15 cm thick), many showing ripple-marks and desiccation cracks. Towards Locality 5 occur 'three thin clast-bearing limestones. The middle one (60 cm, 2 ft) thick is the most prominent and has a strongly ripple-marked surface. It is mid-grey in colour and shows undulating internal layering that suggests algal origin' (Quote Caldwell 1973).

Locality 6. At Doughend Hole [NS 546 149]

Locality 6. At Doughend Hole [NS 546 149] a series of Old Red Sandstone sediments, mainly sandstones and silty sandstones, are in juxtaposition with the red-brown marls which form the basal unit of the Calciferous Sandstone Measures on Great Cumbrae. The junction is inferred to be faulted but little movement appears to have occurred, judging from field evidence. A vertical macro-porphyritic dyke 3.6 m (12 ft) thick of Suite 1 is present to the NE of this locality. Between here and Locality 7 the highest beds of the Upper Old Red Sandstone are continuously exposed on the intertidal foreshore. These include coarse-grained sandstones with cross-bedding, finer grained sandstones and spectacular lenses of conglomerate with pure-white quartz pebbles. The sedimentary sequence from Doughend Hole to Craignon Fitheach (Locality 7) is cut by many non-porphyritic dolerite dykes of the Calciferous Sandstone Measures suite.

Locality 7. Old sea cliffs form Craignon Fitheach

Locality 7. Old sea cliffs form Craignon Fitheach, a marked feature striking NE–SW and extending across the road to the sea. Parking of cars is relatively easy at this locality, but it is a rather popular picnic stop! The cliffs and seaward extension are formed from two thick dykes of porphyritic bostonite, with an intervening thinner dyke of porphyritic dolerite, in all some 39 m (130 ft) thick. On the shore the bostonite is seen in contact with quartz-conglomerate and pebbly sandstone. Tyrrell (1918, fig.3) described the bostonite as chilled against baked conglomerate, which is in turn in contact with blue porphyritic dolerite. Lenses of pebbly sandstone, 15 cm thick, in places separate the dolerite from the more southern bostonite. All these dykes are cut by yet another, a thin dyke of olivine-dolerite of the Tertiary suite (3). From here to Locality 8 the shore section shows little variation, as the dip is generally SE at low angles. The Upper Old Red Sandstone sediments which are exposed are of red and purple sandstones, some more massive beds, and some flaggy with sparse conglomerates.

Locality 8. To the south of Bell Bay [NS 576 162]

Locality 8. To the south of Bell Bay [NS 576 162] is a circular, flat-topped sheer-sided crag situated at the end of the old sea-cliff. This is formed from a basaltic volcanic plug, which contains large phenocrysts of augite and occasional xenoliths of country rock: agglomerate is plastered against the side of the plug. Somewhat to the south of the plug, a thick (30 m, 100 ft) dyke is exposed on the shore. This is a quartz-dolerite dyke of the Carboniferous–Permian suite (2) and although displaced by two faults, can be traced across the northern part of the island and equated with the dyke of similar characteristics present at Locality 1.

Locality 9. At Eerie Port, alongside the building indicated on the OS map [NS 588 168]

Locality 9. At Eerie Port, alongside the building indicated on the OS map [NS 588 168], is exposed the 9 m (30 ft) wide dyke selected by Tyrrell (1917, p. 307) as the type locality for the rock he named cumbraite. It is conspicuous on the shore by the road-side, where it is seen to dip at 70 degrees to the WSW. It is directly comparable with the rock of the Lion Rock and the Deil's Dyke, being dense, hard and flinty, black or dark grey in colour and with a vitreous lustre from its hemi-hyaline groundmass; large well-shaped phenocrysts of plagioclase feldspar are prominent. The groundmass of the central part of the dyke has a more vitreous lustre than the rest, a feature common in dykes of this nature. Microscope examination shows that the euhedral plagioclase crystals are calcium-rich, average composition mid-bytownite, usually with a narrow outer zone of labradorite, a composition comparable with that of the laths in the groundmass. The

remainder of the groundmass is made of enstatite, augite and abundant dark glass. The freshness or degree of alteration of the glassy groundmass accounts for variations in colour of the overall weathered appearance of these rocks.

Locality 10. From White Bay [NS 592 178]

Locality 10. From White Bay [NS 592 178] where the Great Cumbrae Fault emerges at the northern end of the island, to the Ferry Terminal, the Suite 1 dyke swarm is particularly dense, with more than sixty dykes cutting the Upper Old Red sandstones of the shore section. Most are of the macroporphyritic feldspar type, but two microporphyritic varieties form prominent exceptions, 4.5 m (15 ft) and 7 m (23 ft) in thickness. Also recorded from this shore section have been a 12 m (40 ft) dyke of porphyritic bostonite, a 10 m (34 ft) quartz keratophyre and two NW-trending dykes of the Tertiary suite.

The car queue for the return ferry to Largs forms to the south of the jetty, on the seaward side of the road.

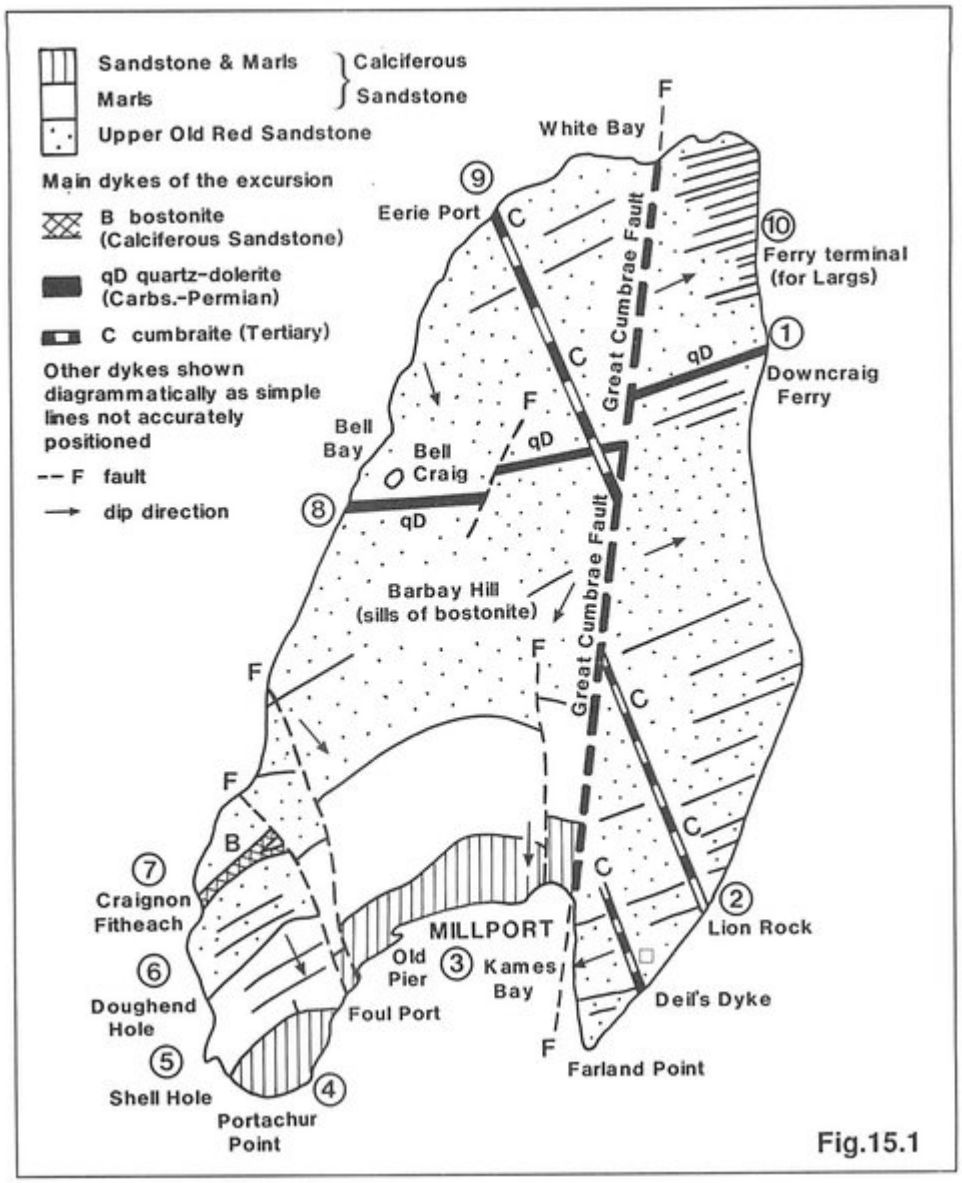
References

GUNN, W. and others. 1903. The geology of North Arran, South Bute, and the Cumbraes, with parts of Ayrshire and Kintyre. Mem. Geol. Surv. U.K.

PATTERSON, E.M. 1952. Notes on the tectonics of the Greenock-Largs uplands and the Cumbraes. Trans. geol. Soc. Glasg., 21, 430–435.

TYRRELL, G.W. 1917. Some Tertiary dykes of the Clyde area. Geol. Mag., 6, 305–315, 350–356.

TYRRELL, G.W. 1918. The igneous geology of the Cumbrae Islands. Trans. geol. Soc. Glasg., 16, 244–274.



(Figure 15.1) Simplified geological map of Great Cumbrae.