5 The Dalradian rocks of Lunga, Luing and Shuna

By C. T. Baldwin And H. D. Johnson

Maps

Ordnance Survey, 1:50,000 sheet 55.

Geological Survey, one inch to one mile: 36 (Kilmartin).

Introduction

General description of guide

This guide describes the rocks seen on a west to east traverse across the islands of Lunga, Luing and Shuna (Figure 1), as well as lateral facies changes recognized in Dalradian metasedimentary rocks along these and several other islands, including Belnahua, Insh Island and Kerrera. The rocks involved form part of the Argyll Group (Middle Dalradian) (Harris & Pitcher 1975) and consist of metasedimentary rocks which have suffered polyphase deformation in lowest greenschist facies. Despite the deformation the primary sedimentary features of these rocks have survived. Because the islands afford unusually good opportunities for a study of Dalradian deposition it is with this aspect of the geology that the guide is mainly concerned.

Previous work published on the geology of the islands consists of mapping by the Geological Survey (Peach et al. 1909) with a revision by Bailey (1913, 1917) who established the accepted stratigraphic succession of the South-West Highlands. Because this guide describes numerous relatively isolated islands the practical problems of transport, access and timing of visits are very important. Travel details

Permission

Both Lunga and Shuna are privately owned and, prior to landing, permission must be sought. For Lunga contact the owner, Major B. Johnson-Ferguson, and for Shuna, the Hon. Edward Gully. The whole of Luing and Torsa are farmed by the Cadzow family and it would be courteous to ask permission of the farm manager, Mr. Mackenzie, at Toberonochy. The other islands have complete freedom of access.

Transport

Due to the extreme complexity of the tidal rips and currents around all the islands discussed it is recommended that boat transport be left in the hands of two local boatmen. For all islands west of Luing (excluding Kerrera), Mr. Lachlan Maclachlan of Cullipool is highly experienced at landing geological parties and detailed arrangements should be discussed with him. For Torsa and Shuna, Mr. John Galbraith of Tobernochy will land parties.

The Isle of Luing is connected to the Isle of Seil at Cuan by service car ferry and thence by bridge to the mainland. However, the ferry is controlled by tidal state and an intermittent service is operated. As there is no accommodation on Luing, itineraries which involve embarkation at either Cullipool or Toberonochy should be prepared only after consulting the Cuan ferry timetable displayed at the head of the slipway on the Seil side. Alternatively, for any of the islands, arrangements may be made for embarkation on the Seil side of the Cuan ferry. For Shuna and Torsa, John Galbraith will pick up parties at the pier below Arduanie Post Office on the mainland.

Approximate duration of boat journeys:

Cullipool —Lunga/Belnahua 30–40 mins.

Cuan —Lunga/Belnahua 40–60 mins.

Toberonochy—Shuna/Torsa 20–30 mins.

Arduanie —Shuna/Torsa 30–40 mins.

Cuan —Shuna/Torsa 35–45 mins.

Landings

Winds and tides are the controlling factors for all excursions but particularly so for the islands west of Luing, where all landing and pick-up places should be discussed with the boatmen.

Lunga. It is best to arrange your excursion to coincide with a low tide at around midday. By landing at about 9.00–9.30 a.m. on the south coast of Lunga, the first section, the walk along the strike, and the second section on the north coast may be completed by just after midday, allowing a crossing to be made on foot from Lunga via Fiola an Droma and Eilean Iosal to all the other islands in the north Lunga group. Should an itinerary with low tide at midday be inconvenient a small dinghy could be left on the north coast of Lunga so that the party could ferry itself across the sheltered sound between Lunga and Fiola Meadhonach at any state of the tide. This must be discussed fully with the boatman on the day.

No hard and fast indications of landing places on the south coast of Lunga are given as these are controlled entirely by wind strength and direction and by the state of the tide. Ask the boatman for the place nearest Locality (1) (see (Figure 1)) on the particular day of the excursion.

Picking up at the disused quay south of the ruin on the south coast of Fiola Meadhonach is convenient at all tides and with most wind directions and strengths. Shuna. Land anywhere in the bay south of Shuna Cottage. Possible at most wind strengths, directions and states of the tide.

Pick up at the large landing stage below Shuna Castle on the north-east coast which is sheltered from most winds and convenient at all states of the tide.

Belnahua. Landing and picking up on the south or east coasts is controlled entirely by wind strength and direction.

Torsa. Land and pick up from the southern tip of Ardinamar.

Accommodation

Hotel and guest house accommodation is available on the Isle of Seil, particularly at Easdale and a large motel is convenient at Arduanie on the mainland. Cottage accommodation suitable for small parties is available on the Isle of Shuna. For larger parties, Oban is approximately 1 hour's drive away from Cuan ferry.

Addresses Hon. Edward Gully, Shuna House, Isle of Shuna, by Oban, Argyllshire. Tel: Luing 244. Major Brian Johnson-Ferguson, Solwaybank, Canonbie, Dumfriesshire. Tel: Chapelknowe 209. Mr. John S. Galbraith, Toberonochy, Isle of Luing, by Oban, Argyllshire. Tel: Luing 272. Mr. Lachlan Maclachlan, Cullipool, Luing, by Oban, Argyllshire. Tel: Luing 282.

Summary of sedimentation and stratigraphy

The junction between the Scarba Conglomerate and the underlying Jura Quartzite is faulted on Lunga but a sedimentary contact occurs further south on the island of Jura.

The Scarba Conglomerate on Lunga, is a base-of-slope submarine fan-type deposit, in which mass flow sediments and turbidites were deposited from density currents flowing down a northerly dipping palaeoslope, whose origin can be traced further south on North Jura (Anderton 1974). The strike of the rocks on Lunga is roughly parallel to the original depositional dip, so that by studying east-west sections across the islands a composite picture of the sedimentary basin may be built up. It can be shown that the overall northward fining, lateral facies changes and varying sedimentary structures along a south&ndashnorth traverse on Lunga correspond to increasing distality within this ancient submarine fan. This gradational facies change can be traced northwards through Belnahua and Insh Island and eventually on to Kerrera, where the deposition is of a more distal character.

Superimposed on the lateral fining is a vertical fining, related to a gradual decrease in the influx of coarse sediment from density currents, together with a corresponding increase in the relative importance of mud deposition and the Scarba Congomerate passes upwards into the thick sequence of the Easdale Slates. The junction between the two formations is gradational. The contact, which is well displayed on the south coast of Lunga, is usually drawn where black slates and limestones dominate over sandstones. The Easdale Slates sensu stricto crop out along the east coast of Lunga but are most thickly developed on the islands of Seil and Luing. They are best seen on the west coasts of these islands, in particular at Easdale, Cullipool and Black Mill Bay. Easdale Slate sedimentation was dominated by relatively quiet deposition of carbonaceous muds and occasional limestones. The occurrence of turbidity currents is shown only by the intermittent occurrence of thin, graded and more massive non-graded sandstones. The muds on Luing and Seil are generally massive and do not display the features characteristic of distal turbidites as seen in the older Easdale Slates on Kerrera. With the gradual filling of this initially deep sedimentary basin, an overall decrease in water depth and an increase in circulation resulted in the deposition of the Degnish Limestone, which consists of a complex sequence of interbedded limestones, calcareous sandstones and mudstones, and which is most completely developed on Shuna and at Degnish Point (see Borradaile 1973). The upward passage from the Easdale Slates to the Degnish Limestone is gradational. The origin of the latter group is uncertain for, although some beds are graded, suggesting deposition from density currents, the majority are massive, parallel laminated, or cross-bedded with evidence of great variability in current direction. This, together with the complex vertical facies changes, suggests that deposition was, in part, under shallow marine conditions.

The limestones give way through a thin horizon of sandy and muddy impure limestones to a thin, clean quartzite and then to the thick, sandy Craignish Phyllites. The phyllites exhibit complex facies changes (cf. Knill 1963) which on Shuna retain the same dominant south to north facies control as seen in the units below. The phyllites exposed on the south coast of Shuna are noticeably sandier and more thinly bedded than those in the north. Vertically they become gradually more calcareous, again retaining the thinner laminated and discontinuous beds in the south, whilst thicker, sometimes cross-bedded impure limestones are present in the north. The calcareous phyllites grade imperceptibly into more sandy, sometimes rippled phyllites which exhibit no obvious systematic facies changes. The whole formation is strongly deformed but those sedimentary structures preserved, together with the complex facies changes, suggest deposition under relatively shallow water and occasionally emergent conditions (Anderton 1975).

The area described occupies a structural position on the easterly dipping, western limb of the Loch Awe Syncline. The minor structures are best seen on Shuna, where F_2 and F_3 folds and the relationship of the coeval and later cleavages are magnificently preserved in the Degnish Limestone and the Easdale Slates on the western side of the island.

A dyke and fault chronology can be worked out from the continuous coastal exposure and the stratigraphic relationships of the epidiorite and felsite sills (Caledonian) and basalt dykes (Tertiary) may be demonstrated on Shuna and Rubha Fiola (North Lunga).

Description of localities

The localities listed below are shown in (Figure 1) and (Figure 2)

Locality 1 : South coast of Lunga

This section begins at the most southerly point along the south coast of Lunga [NM 708 074] and lies immediately east of a felsite sill and due south of the highest hill in this region. It continues eastwards up the succession to just beyond Poll nan Carraig Ruaidhe and demonstrates some of the features characteristic of mass flow and turbidite deposits within a relatively proximal part of the submarine fan. It also illustrates the gradual upward transition into the Easdale Slates.

(1A) Here is exposed a thick mass flow deposit with a matrix of coarse sand and granule size grains of quartz and feldspar, supporting a random admixture of boulders of intrabasinal origin including slate, quartzite, limestone, sandy limestone and laminated siltstone fragments. Evidence of resedimentation from a previous mass flow deposit is seen within a 9 m long internally brecciated siltstone boulder. Note the indefinite nature of bed contacts, chaotic arrangement of boulders, (possible) large-scale channelling and occasional thin graded units.

A felsite sill is intruded at the top of this unit and is followed within the bay by a thinly bedded sequence of sandstones and some graded slates.

(1B) This includes the next headland immediately east of the previously mentioned bay. The most informative exposure is on a large, steep, southerly dipping joint surface, crossed by, numerous quartz-filled tension gashes. Here, turbidite features other than those seen at (iA) are displayed. The main points to note are the well-bedded nature of the quartzites, lateral persistency o£ inS.vid.ual beds, amalgamations, massive and graded beds, occasional load casts and flame structures, and quartzites charged with intrabasinal clasts, such as fragments of black slate. Internal brecciation within the flows is indicated by the in situ break-up of the clasts, together with their angular and streaked-out shapes. Note the dominant alignment of the fragments parallel to bedding.

(1C) The next headland, which is connected to a prominent island at low tide, displays a different feature associated with turbidites. Graded beds are again dominant, as seen at (1B), but now the upper parts of the individual beds are commonly parallel laminated, indicating the development o£ both A and B Bouma divisions, suggesting that the source is now becoming less active, allowing individual flows to be more completely developed.

(1D) This exposure forms the large bay, Poll nan Carraigh Ruandhe, and is composed of a sequence of black slates and occasional thin limestones, with intermittent sandstone beds. It marks a major break from turbidite deposition and represents the beginning of the transition into the Easdale Slates.

The remainder of this south coast section consists of alternating horizons of slates and limestones, with quartzites becoming less important upwards. Tectonic structures are occasionally well-developed.

Locality 2: North coast of Lunga

This section is reached by walking back to (/A), then northwards, following the east coast of Camas a' Mhor-Fhir and up the raised beach slope to the marked gap at the top. This topographic feature marks the position of the large, strike-slip Scarba Fault, which is intruded by a 30 m thick composite dolerite dyke. Follow the dyke down to the coast at (2A) [NM 703 090]. The walk from (1D) to (2A) is approximately 30 minutes.

(2A) This consists of 25 m of laminated siltstones and sandstones, occurring immediately east of the dyke, and may represent in situ slope sediments, with identical lithologies being found in blocks within some boulder horizons further up the succession. (See 2B, 3A and 4C).

(2B) The beginning of the turbidites with occasional mass flow deposits occurs on the prominent NW–SE. trending headland. Many of the features seen at locality 1 are again present, although there are marked differences (e.g. decrease in both grain and clast size). Mass flow deposits are relatively thin and uncommon. Graded beds frequently contain mud clasts at their base and small-scale channelling is occasionally present.

The most easterly side of the headland is marked by a 4 m thick mass flow deposit in which blocks of laminated quartzite are chaotically distributed. Several small faults and intrusions break up the succession on this headland.

(2C) By moving up the succession a second headland is reached, on which a wide variety of sedimentary structures typical of turbidites may be seen. One locality shows spectacular slump folds. The sense of overturning of these can be used to demonstrate a north-westerly dipping palaeoslope. Both massive and graded quartzite beds are present, with the latter displaying both A and B Bouma divisions. Other sedimentary structures include load casts, ball and pillow structures, convolute lamination, rippledrift cross-lamination and small channels filled by slate clasts. Interbedded slate horizons are much more common than at locality 1. This, together with the change in sedimentary structures and overall decrease in grain and clast size from localities 1 and 2B, relates to increasing distality within the submarine fan.

Locality 3: Eilean Iosal [NM 708 097]

Outcrops on the west coast of this island demonstrate the nature of channelling within the submarine fan and allow a study of one of the four boulder horizons which occur on the island.

(3A) This is the lowest boulder horizon and can be followed laterally along the coast section. It consists of chaotically arranged boulders of laminated siltstone and sandstone, ranging up to 10 m in length, several of which are flaser bedded and occasionally internally folded. The boulders may have been derived from the outer shelf and margins of a submarine canyon.

(3B) Graded quartzite beds are cut by several channels, up to 2 m deep, and infilled by clasts of slate and siltstone. Note the increase in grain size in the channel-fill quartzites, orientation of the channels and shape of the channel margins.

Locality 4: Rubha Fiola [NM 709 102]

This locality is reached within 15 minutes from (3B) by crossing to Fiola Meadhonach and across to Rubha Fiola near (4A); these islands are readily accessible at all states of the tide. The section allows study of the more distal part of the deposit and certain volcanic features.

(4A) Two volcanic vents of Old Red Sandstone age are exposed; one contains angular, the other more rounded fragments. The rounding probably results from diatremic abrasive action.

(4B) This short section demonstrates large-scale load-casting and sedimentary dyke intrusion, both resulting from relatively rapid deposition of a thick graded quartzite bed over a slate unit. Differential subsidence of the quartzite has caused upwelling and internal deformation of the slate. At the northern end of the exposure this has resulted in the slate breaking through the quartzite.

(4C) A spectacular boulder horizon can be studied here. Note the chaotic arrangement of the blocks and compare their lithology to those seen in a similar deposit at (3A).

(4D) A series of felsite sills (Caledonian) are cut by a suite of basalt dykes (Tertiary), the latter related to the nearby igneous complex on Mull.

(4E) The remainder of this coast section shows several sedimentary features seen earlier but important facies changes should be noted, in particular the overall decrease in grain size (medium to coarse sand), marked decrease in size and number of clasts, increase in the proportion of slates and the sharp differentiation between slate and quartzite horizons.

Locality 5: Belnahua [NM 714 127]

This further demonstrates the continued northward fining seen on Lunga. The west coast consists of a series of thickly bedded, massive and graded quartzites, displaying some of the features seen on Rubha Fiola. This passes with a rapid transition into slates and siltstones with interbedded thick, laterally persistent, limestones. Carbonaceous slates gradually become more conspicuous from west to east.

Locality 6: Black Mill Bay, Luing [NM 733 085]

This section begins just south of a small bay due east of Fiola an Dromha and north of Black Mill Bay, and shows the different sediment types to be found in the Easdale Slates. Black slates are always the dominant lithology with subordinate calcareous slates, black limestones and sandstones. Tracing the section around to the south-east, discrete beds of laminated and thinner massive sandstones increase in number until on the north side of Black Mill Bay they appear as distinct groupings of sandstone beds. In the eastern corner of the bay, medium bedded, laterally continuous limestones are associated with graded sandstones and brown micritic siltstones. A weak association o£ muds separating silts and sands from the limestones is developed at this eastern end of the traverse.

Locality 7: Torsa

Commence the section on the south coast north of Ardinamar House. This section demonstrates the beginning of the transition from the Easdale Slates through into the sandy base of the Degnish Limestone.

Variations in the sandstone bed thickness and the abrupt increase to laterally persistent, medium bedded limestones and sandstones on the east coast can be traced on this short traverse. Black slates persist throughout the whole section.

Locality 8: South coast of Shuna

The gradual transition from deep sea euxinic mud deposition to sedimentary facies of more shallow water aspect may be seen on two traverses across Shuna. Lateral variation within facies seen on the north and south coasts should be noted. The Degnish Limestone, most thickly developed down the west side of Shuna, is a continuation of the development seen in the upper Easdale Slates as traced across Torsa, and the junction between these two groups is always transitional. Minor variations in sediment type, along with the overall increase in carbonate content may be studied on the first part of this section, just south of Shuna Cottage.

(8A) The section commences on the extreme southwesterly point, due west of Shuna Cottage. [NM 757 076].

In the limestones and interbedded black slates, immediately above the wave cut notch, problematical solution structures with cross cutting pyrite laminae are preserved. These are everywhere associated with thin layers of cone-in-cone black calcite, which are folded. At this first locality the solution structures may be seen to pass laterally into a form of calcareous net veining: this may give some guide to the origin of the netveined appearance of most of the thick, laterally continuous limestones seen higher up the succession. Thin impure sandy limestones and black graphitic and pyritic slates are the dominant lithologies, and small scale cross-lamination, occasionally with mud drapes, are the only sedimentary structures preserved.

Following the coast eastwards towards the bay, the first dark micrites appear above the thickest limestones (8B). The micrites are associated with phyllitic fine sandstones, thin limestones and slates. In places small isolate ripple cosets are preserved in calcareous silt lenses in the centre of the thicker micrite beds. Load-casts and associated flamestructures are present in some of the thicker sandy lithologies, (8C). This thinly bedded facies then alternates with thickly bedded limestones.

Where limestones and silts are interbedded, very spectacular minor F_1 folds, mostly overturned westwards, are developed, (8D). Fairly thick slate units are still present but after the thick felsite sill these give way to a fairly continuous section of limestones with subordinate slates. Near to the cow shed on the point (8E), slates again reappear, the tectonic style being chaotic in comparison with that preserved in the more competent limestones.

On the west side of the bay (8F) thin, discontinuous micrites appear in which flat lying, almost sideways closing F_1 folds are preserved. Just north of these, pseudo crossbedding, which is in fact the "ghosting out" of the second cleavage, is preserved in the last limestone outcrop before the wide sandy bay.

(8G) The first outcrop of trough cross-laminated limestones on the eastern side of the bay marks the base of the first markedly laterally continuous group of veined, thickly bedded limestones. This horizon may be traced along the strike from south to north with no appreciable change in thickness or lithology. Moving southwards along the coast, successively lower beds are brought in by a series of minor normal faults, so that just north of the east-west trending wall (8H), a group of channelled and cross-bedded calcareous sandstones crop out on the coast. These probably represent a transition facies from the underlying sandy and muddy beds.

For some distance further south the coast is formed of black graphitic and pyritic slates, with subordinate sandy limestones. An overall increase in sand content southwards eventually causes the almost complete replacement of the black slates by flaggy sands and silts, grey phyllites and sandy limestones. A worm burrow (*Planolites* sp.) has been found at this stratigraphic level (8I). This sandy lithology is maintained continuously on to Shuna Point, where some medium bedded fine sandstone beds are present. The full transition from sandy lower facies up into the thick limestones and through into the phyllites may be studied on the west to east traverse on the south coast. Many of the limestones contain cream micrite clasts of coarse sand or granule-size, as well as abundant sand-size blue quartz, (8J). Beds have sharp planar bases and are occasionally graded.

The actual top surface of the limestone is not exposed, but in the first deep bay (8K), south of the raised beach cliff, a laterally continuous quartzite horizon is exposed just inland. This separates the limestone from the first outcrop of pinkish sandy phyllite and marks the change from the Degnish Limestone into the more sandy Craignish Phyllites.

Because the phyllites contain few macroscopic features and the upward facies variations are so indistinct, it is recommended that after reaching the first felsite sill in the phyllites (8L), the party move northwards to the prominent raised beach cliff just south of the east-west wall (8M).

(8M) In the cliff a very strong near horizontal S_3 crenulation cleavage, which in places is axial planar to small open folds is developed. Up on the cliff side a dip-slip fault has caused the rotation of platy phyllite fragments in the narrow, brecciated fault zone.

Follow the base of the cliff back to the north and eventually to the eastern corner of South Bay, where a substantial path is cut through the thick limestone and passes up the eastern side of a low limestone ridge. Quartzites crop out on the right hand side of the path. Keeping to the path, cross the small stream just before a gateway and turn right up the hill. Below the trees on the left hand side, above the raised beach slope (8N), calcareous muddy sandstones, transitional to the Degnish Limestone and the Quartzite, crop out.

Locality 9: North coast of Shuna [NM 764 098]

This section is reached by following the path as far as the white cottage next to a cattle grid. (Walking time approximately 45 mins.). Through the first gate on the left, move northwestwards to the eastern side of the long shallow bay (9A).

(9A) Limestones crop out on the western wall of the bay and quartzites on the southern side. Keeping to the coast all the way eastwards, the vertical fades variations in the phyllites may be studied. The bedded sandy phyllites pass up into more calcareous lithologies which, north east of Shuna House, become thickly bedded and, in places, graded, (9B).

(9C) Small F_3 conjugate folds and a vertical NW–SE. S_4 fracture cleavage are developed on Rubha Salach. At the end of the section south of the pier, a wide Tertiary dolerite dyke with horizontal columnar cooling joints (gD) cuts through the small headland of Sceir Creagag, on the southern side of which a narrow basalt dyke (gE) is displaced by a dextral strike-slip fault.

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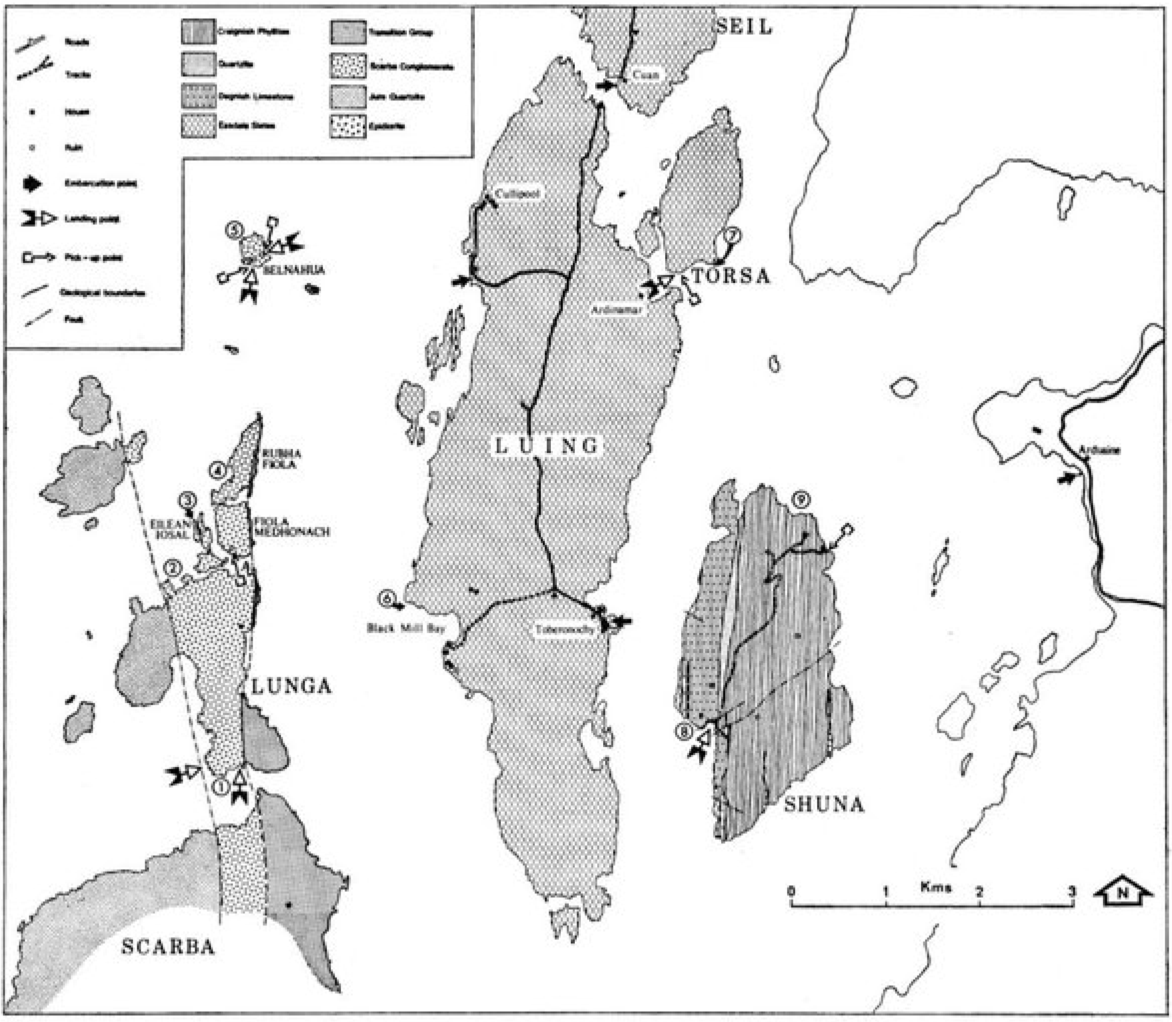
Figures

(Figure 1) General map of the area described in this article.

(Figure 2) Guide to localities described in the text



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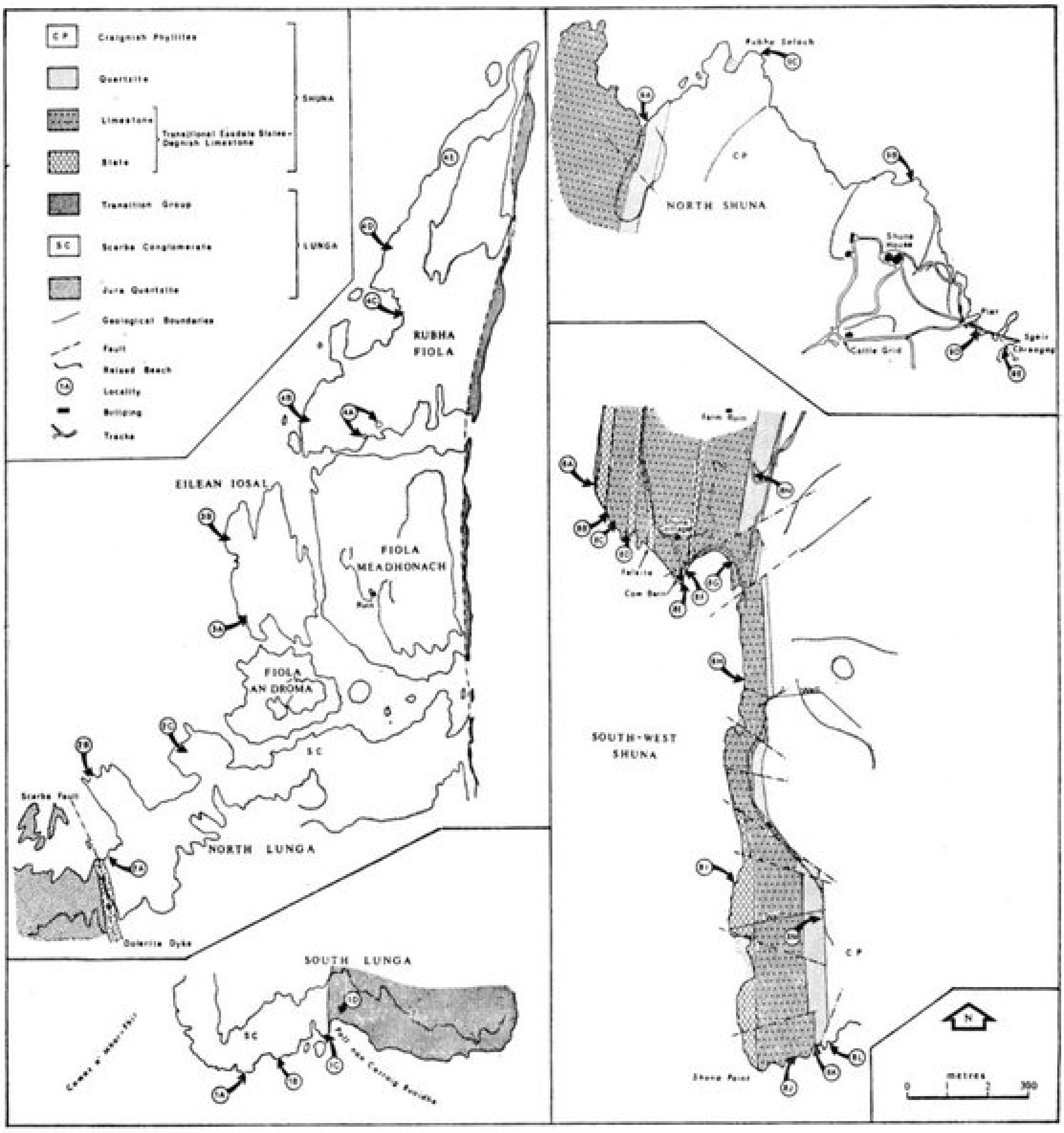

(Figure 2) Guide to localities described in localities 1–9