Isle of Eigg

[NM 495 868]–[NM 497 877], [NM 465 905]–[NM 472 885], [NM 473 875]

B.M. Cox

Introduction

The Isle of Eigg was the original type locality of the 'Great Estuarine 'Series' (now Group) (Judd, 1878; Harris and Hudson, 1980). The GCR site known as 'Eigg' comprises two separate stretches of coast together with an inland exposure in the central part of the island (Figure 6.9).

1. The oldest strata are exposed along the east coast [NM 495 868]–[NM 497 877], about 2 km north of Kildonnan. The Lealt Shale Formation is well exposed here, and includes the best-known development and type section of its Kildonnan Member, as well as 'Hugh Miller's Reptile Bed'.
2. The coastal exposures [NM 465 905]–[NM 472 885] in the north-west of the island show an excellent section through the main part of the overlying Valtos Sandstone Formation, which, from Blair Mor to the Bay of Laig, forms sandstone cliffs up to 40 m high (Figure 6.10).
3. The inland exposure [NM 473 875] at Laig Gorge shows the top part of the Duntulm Formation and lower part of the overlying Kilmaluag Formation disconformably overlain by Cretaceous strata.

The sections are described in the recent British Geological Survey Memoir for Rum and the adjacent islands (Hudson in Emeleus, 1997) on which the following notes are largely based.

Description

(A) Coast north of Kildonnan

The lower part of the Lealt Shale Formation is well exposed between tidemarks and variably on the storm beach. There is an almost continuous section through *c.* 27 m of predominantly grey, silty shale or mudstone, including a thin bed of coarse calcareous sandstone and several beds of shelly limestone that form marker beds. This constitutes the type section of the Kildonnan Member ((Figure 6.11) and (Figure 6.12)). A detailed composite bed-by-bed description of the section is given by Hudson in Emeleus (1997, appendix 1) based, with amendments, on individual sections recorded by Hudson (1966). Wakefield (1994, 1995) and Hudson *et al.* (1995) also provided graphic sections.

The oldest beds, which are seen near the northern end of the -exposure, contain shelly layers including small mytilid bivalves (probably *Praemytilus strathairdensis* Cox), unionoid bivalves, small gastropods (*Valvata* and neritids) and conchostracans (*Euestheria* and *Neopolygrapta*). The overlying 'Reptile Bed' (Bed 2 of Hudson) is mainly a sideritic gastropod biosparite; siderite mudstone lenses within it contain well-preserved small neritid gastropods, *Valvata* and '*Cylindrobullina*' *; Unio* occurs less abundantly. There is limited in-situ exposure of this bed, which was discovered by Hugh Miller in 1845 (recorded posthumously in Miller, 1858), but it is readily recognizable as loose blocks that are weathered red. The bed has yielded disarticulated, black plesiosaur bones (Newman in Persson, 1963; Benton and Spencer, 1995), and fish teeth and scales are consistently present. In the overlying silty mudstone (Bed 3), there are shell layers and thin shell-beds with gastropods, as in Bed 2, together with *Viviparus* and small *Praemytilus;* the latter becomes increasingly abundant, though specimens remain small (probably juvenile), in the upper part of the bed, which includes, at its top, large articulated specimens of *Unio.* The most useful marker (Bed 4) in the lower part of the section comprises irregularly lenticular beds of coarse, calcite-cemented sandstone, some with rippled tops and mudcrack-fills at their bases, separated by shale lenses, overlain by a sandy molluscan biosparite composed mainly of small *Praemytilus.* The sandstones contain high proportions of worn phosphatic debris, and some of the shales contain small gastropods. Bed 5 is the thickest development (total *c.* 13.3 m) of silty shale in the section; it includes subordinate thin beds of siltstones, *Praemytilus* biosparites and fibrous 'beef' calcite. In the upper part, large *Praemytilus* cover entire bedding planes, and often show current lineation. The gastropod *Valvata* and ostracods are also present. The upper part of Bed 5 also contains ovoid septarian concretions, about 1 m across and 0.20 m thick with well-formed rhombic calcite crystals. A mixed assemblage of *Unio,* large *Viviparus* and *Praemytilus,* orientated at all angles with respect to the bedding, occurs in Bed 5f. Below the Shelter Stone (so-called because one can actually shelter within it), the overlying Fish Bed (Bed 5g), a thin shelly limestone crowded with hybodont shark teeth and fish scales, is exposed at the back of the beach resting directly on a concretion.

In the overlying beds, a heterodont bivalve (*Tancredia?*) replaces *Praemytilus* as the predominant bivalve, and fine-grained shales with *Neomiodon,* conchostracans and numerous ostracods also occur. Three marker beds (the Bivalve–Septarian Bed (6e), the Unio Bed (7a) and Bed 8b (a hard, blue-grey, unfossiliferous calcilutite)) in the upper part of the section help to correlate exposures. The last-named is the highest consistently exposed marker bed in this type section. The boundary with the overlying Lonfearn Member and the widespread algal stromatolite that usually occurs at the top of the Kildonnan Member are not continuously exposed here.

The GCR site covers a little under a kilometre of coastline, of which the type section of the Kildonnan Member described above occupies about 200 m. The remainder of the section includes other exposures of the Lealt Shale and of the overlying Valtos Sandstone formations but these are less well developed than elsewhere on the Isle of Eigg.

(B) Bogha na Bricenis to Bay of Laig

According to Hudson (in Emeleus, 1997), the most conspicuous Mesozoic outcrops in the Small Isles are the cliffs of the Valtos Sandstone Formation in this part of the GCR site in northwest Eigg (Figure 6.10). The pale sandstone gives rise to pure white beach sands, the famous 'singing sands' of Camas Sgiotaig. The formation here has been divided into six informal divisions (A–F from below). Each of the divisions, except F, contains a sand body, generally coarsening-upwards, and usually capped by a coarse-grained, shelly, cemented unit representing reworking. A map showing the distribution of these divisions within the GCR site is shown in (Figure 6.13). A cross-section of their lateral distribution is shown by Harris (1992, fig. 4) and Hudson (in Emeleus, 1997, fig. 15), and these also show the distribution of the five facies recognized within the formation by Harris (1992). These facies are (1) *Neomiodon* mudstone–siltstone; (2) coarsening-upwards sandstone, (3) coarse-pebbly sandstone including (3a) pebbly and (3b) thin-bedded, trough cross-stratified and coarse-grained; (4) wave-formed sandstone; and (5) *Neomiodon*-debris limestone. Graphic logs of six sections at intervals along the coastal exposure are given by Harris (1992).

At the northern end of the GCR site, the gradational contact of the Valtos Sandstone Formation and the underlying Lonfearn Member of the Lealt Shale Formation is exposed. Thin beds of strongly bioturbated sandstone appear intercalated with dark shales, which are intruded by thin and somewhat irregular sills. The proportion of sandstone beds increases, and sills decreases, upwards. On the shore platform south-east of Bogha na Brice-nis, prominent calcareous concretions in the upper part of Division A are well exposed on the shore, and north of Camas Sgiotaig, sandstones of Division B contain large masses of rafted logs. The massive, pebbly sandstone of Division C, intersected by several, deeply eroded dykes, is exposed in the lower cliff of the complex headland between Camas Sgiotaig and the Bay of Laig. The sandstone shows prominent south-dipping foresets hereabouts, and where it overlies thin beds of greenish argillaceous sandstone at the base of the cliff, differential erosion has created prominent overhangs and a natural arch. Division E is well exposed on the north side of the Bay of Laig and the calcareous concretions that characterize the formation are well displayed. In the lower part of Division E they are relatively isolated but are often coalesced into botryoidal masses. The top of Division E is more-or-less completely cemented. In the cliff above the shore, shales of Division F give rise to a grassy interval. Within this division, there is a biosparite with the bivalve *Neomiodon,* associated with fibrous 'beef' calcite.

(C) Laig Gorge

The upper part of the Duntulm Formation is exposed on the left bank of the Abhainn a' Chaim Loin in the lower part of the Laig Gorge [NM 873 875] where the stream cuts through Tertiary lavas into Cretaceous and Jurassic sedimentary rocks that have been slightly metamorphosed by a quartz porphyry on the north bank of the stream. A graphic log of the section is shown in (Figure 6.14); another, showing ostracod data, is given by Wakefield (1994). Near the base of the section, a prominent nodular 'algal' bed is interbedded with typical oyster-rich shale–limestone alternations. The upper 5 m of the section are mainly shale with fine-grained, partly nodular, limestones and rare oysters. The boundary with the overlying Kilmaluag Formation is gradational but the top of the Duntulm Formation is taken at the last thin oyster-bearing limestone.

The Kilmaluag Formation comprises 6 m of shale–limestone alternations with an abundant ostracod and conchostracan (*Antronestheria*) fauna. The top limestone is dolomitic, and beneath the disconformable base of the Cretaceous Laig Gorge Sandstone, there is a shale. The outcrop of these beds above the south bank of the stream is sometimes obscured by vegetation, but can be easily exposed.

Interpretation

The Lealt Shale Formation is deduced to have been deposited in shallow waters of low but fluctuating salinity in near-coastal lagoons (Hudson, 1983; Chen and Hudson, 1991). The depositional conditions of the Kildonnan Member at its type section (A above) have been investigated in detail, culminating in the case study presented by Hudson *et al.* (1995) based on macrofaunal, ostracod, conchostracan, palynofloral and stable isotope data. These authors concluded that sedimentation was 'mildly episodic' with relatively frequent, not very intense storms rapidly burying shells on the floor of the generally tranquil lagoons. The mixed and jumbled faunal assemblage of Bed 5f (see above) was perhaps transported by an influx of coarse sediment (Hudson in Emeleus, 1997). Salinity appears to have been always brackish, fluctuating between oligohaline and low polyhaline. There are no stenohaline marine forms nor evidence of long-term emergence. The 'Reptile Bed' is only 0.15 m thick but it extends laterally for at least 3 km (Hudson, 1966). Its general lithology indicates that it could have originated, like the other limestones, as a winnowed shell- and bone-concentrate on the lagoon floor. According to Hudson (1966), the abundant and well-preserved *Unio* shells cannot have travelled far and they suggest that the water was sometimes almost fresh. The great abundance and dispersal of reptile bones and fish remains may be accounted for by slow deposition and high organic productivity. Hudson (1966) draws an analogy here with the present-day Whitewater Bay in the Florida Everglades, USA.

The sediments of the Valtos Sandstone Formation have been interpreted by Hudson and Harris (1979) and Harris (1992) as representing a series of delta lobes built into the lagoons in which the Lealt Shale Formation had accumulated. As elsewhere in the Inner Hebrides Basin (see Elgol–Glen Scaladal GCR site report, this volume), heavy-mineral assemblages in the sandstones are garnet-poor, staurolite-rich and rutile-rich, which may indicate a significant though indirect input of sediment from the Dalradian rocks of the southern and eastern Highlands (possibly via the Old Red Sandstone, which may have extended into the hinterland of the basin). The coarsening-upwards sandstone facies, which is well displayed in the Bay of Laig section, is interpreted by Harris (1992) as indicating progradation of delta shoreline and interdeltaic lagoon shoreline systems. The wave-formed sandstone facies, which is also well developed here, represents wave reworking of fluvially supplied sand at the delta shoreline; the thicker, more complex sand-bodies of this facies are interpreted as the upper shoreface–foreshore of prograding delta shoreline systems (Harris, 1992). The shell-debris limestones, which, in places, cap divisions D, E and F (see B above), either indicate brackish-water transgressions of the lagoon shoreline or, where intercalated with the *Neomiodon* mudstone–sandstone facies, shell-debris sheets and shoals (Harris, 1992). Calcite concretions from the Bay of Laig section have been studied by Wilkinson (1992) who concluded that they grew at burial depths of 200–300 m, at temperatures of 31–46°C in pore waters of meteoric origin. The average concretion (*c.* 0.12 m diameter) grew in approximately 0.36–0.84 Ma, and their most likely nucleus was detrital *Neomiodon* shells.

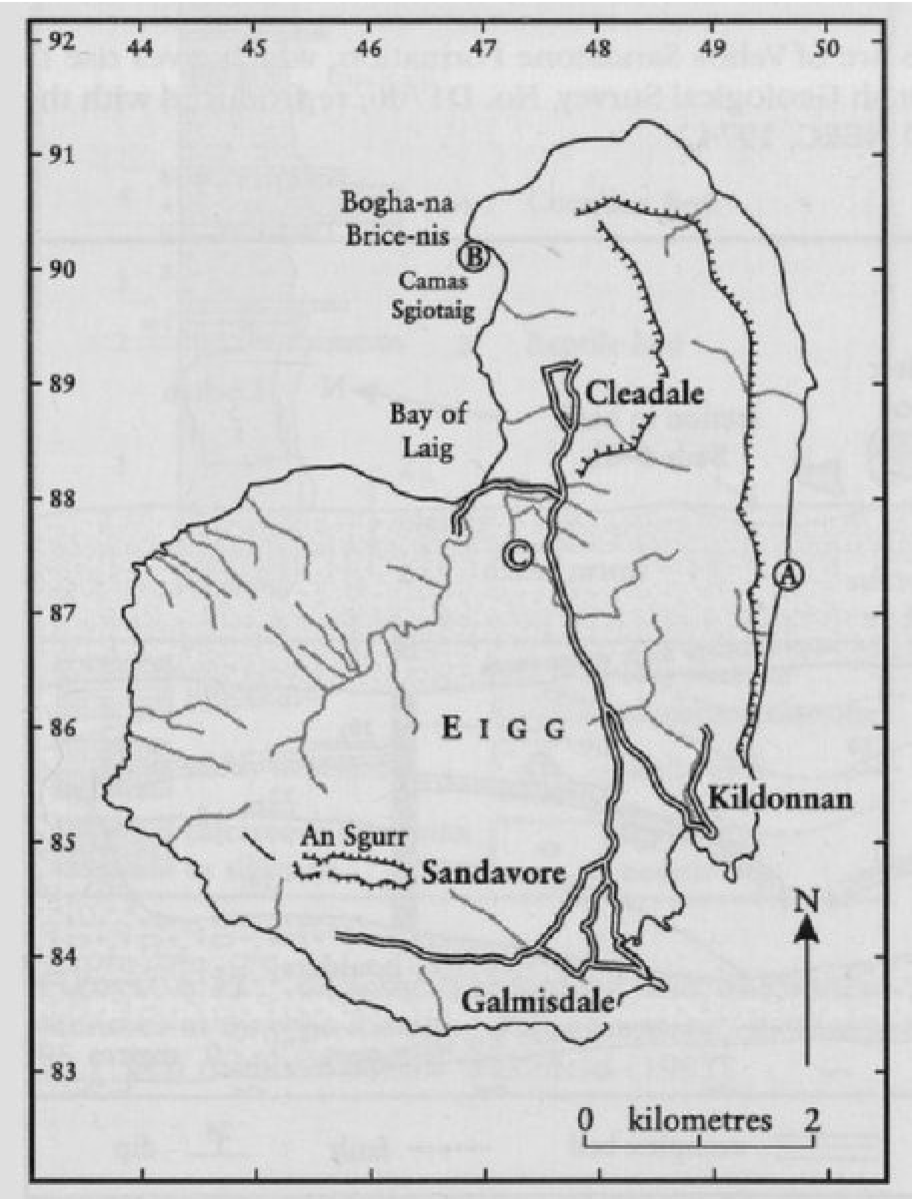
The Duntulm Formation at Laig Gorge is dominated by *Praeexogyra* limestones (facies 1 of Andrews and Walton, 1990) and argillaceous limestones (facies 2 of Andrews and Walton, 1990). These are interpreted, respectively, as former shell-banks that have fallen apart, probably agitated by weak, wind-driven tides in shallow water, and shallow littoral carbonate–siliciclastic mud deposition probably in quiet water, leeward of the oyster-shell banks (Andrews and Walton, 1990). An algal bed (facies 3a of Andrews and Walton, 1990) occurs near the base of the exposure and correlates with Bed 31 in Straithaird (see Elgol–Glen Scaladal GCR site report, this volume). This is interpreted by Andrews (1986) as representing a supralittoral algal marsh to a shallow littoral algal stromatolite. Facies 2 limestones at the boundary of the Duntulm and Kilmaluag formations record the change from open, marine, brackish-water lagoons to closed, shallow,

low-salinity coastal marginal lagoons with mud-dominated sedimentation and a restricted low-salinity biota of ostracods, conchostracans and gastropods (Andrews, 1985).

Conclusions

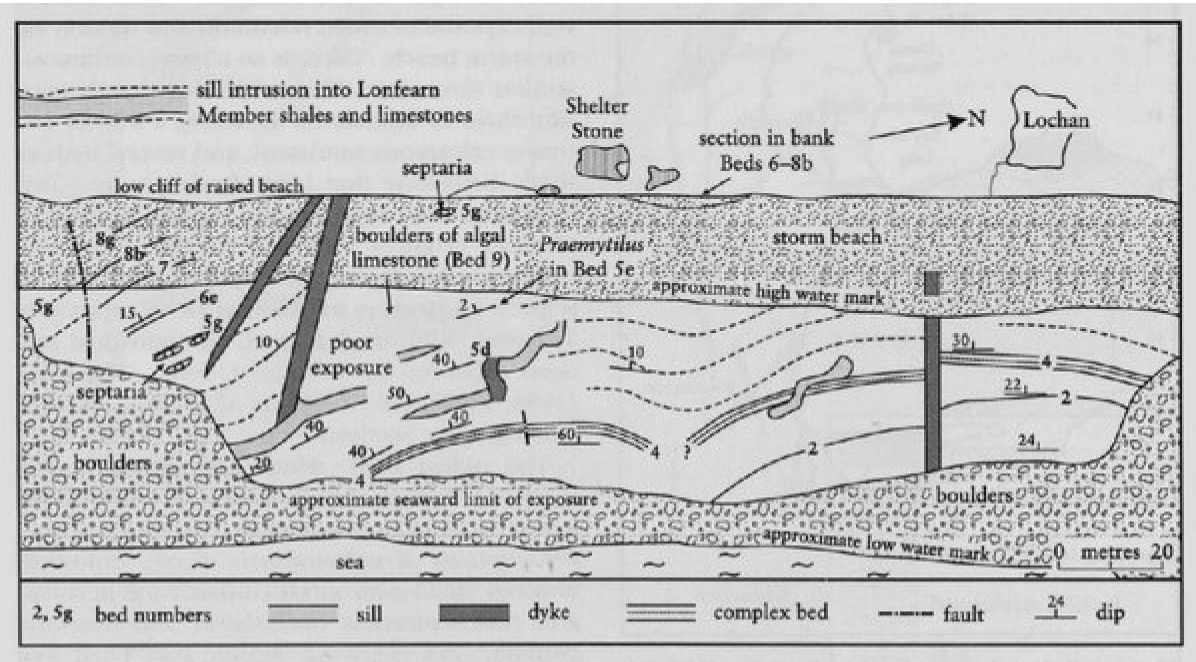
The Isle of Eigg GCR site includes the highly fossiliferous type section of the Kildonnan Member of the Lealt Shale Formation. This member records palaeoenvironments of low but fluctuating salinity and includes 'Hugh Miller's Reptile Bed', which features in the fossil reptile GCR networks (Benton and Spencer, 1995). The site also includes excellent exposures of the overlying Valtos Sandstone Formation, which represent the most conspicuous outcrop of Mesozoic rocks in the Small Isles, and a section across the boundary of the Duntulm and Kilmaluag formations. These formations represent a range of coastal lagoonal and deltaic depositional palaeoenvironments. The site is therefore an important one for stratigraphy, sedimentology, palaeontology, palaeoecology and palaeogeography.

References

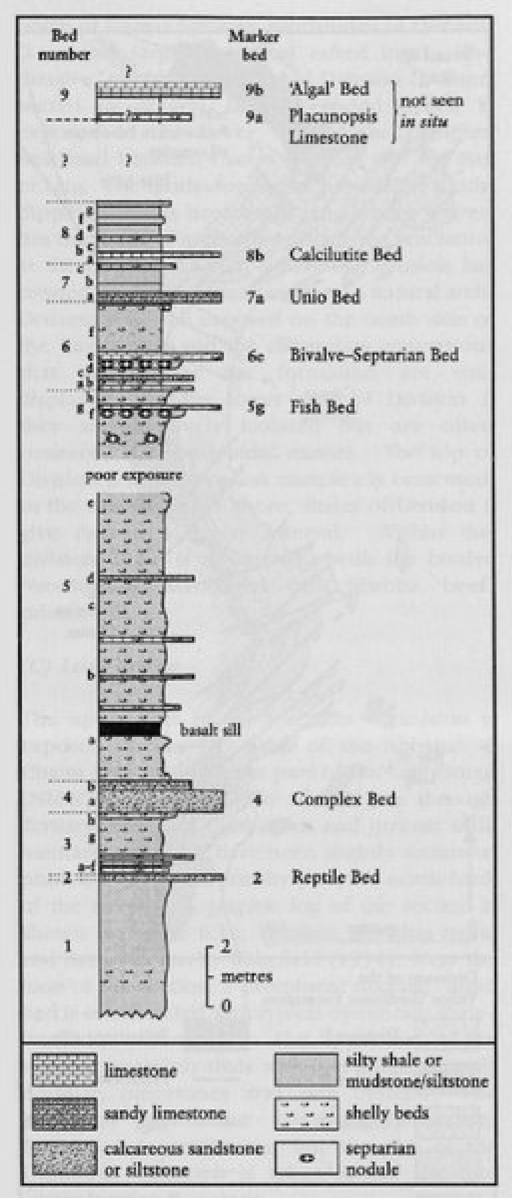


(Figure 6.9) Locality map for the Isle of Eigg GCR site, which comprises three separate localities. (A) Coast north of Kildonnan; (B) Bogha na Brice-nis to Bay of Laig; (C) Laig Gorge.)

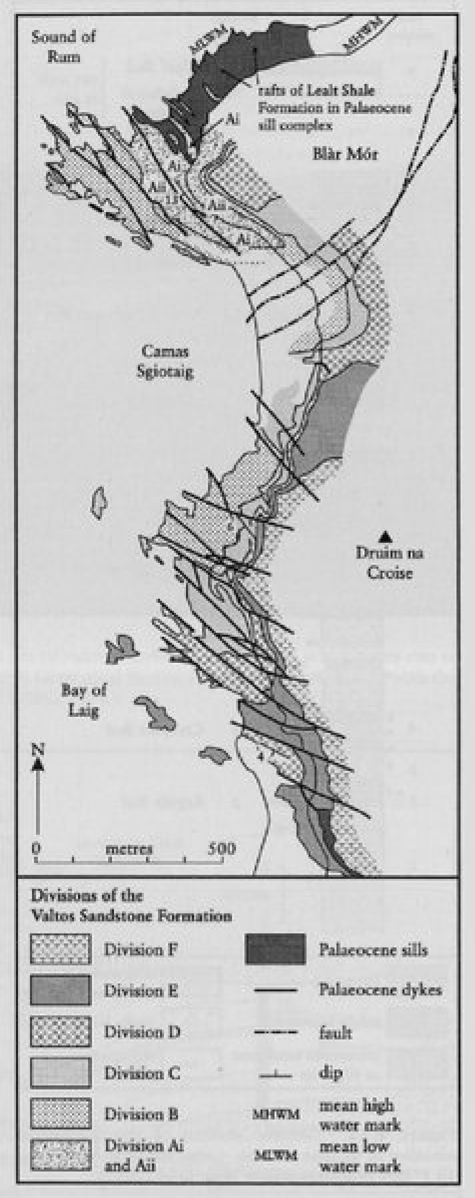
(Figure 6.10) Camas Sgiotaig, Isle of Eigg. The sea cliffs are of Valtos Sandstone Formation, which gives rise to the pure white 'singing sands' of the beach. (Photo: British Geological Survey, No. D1706; reproduced with the permission of the Director, British Geological Survey, © NERC, 1974.))



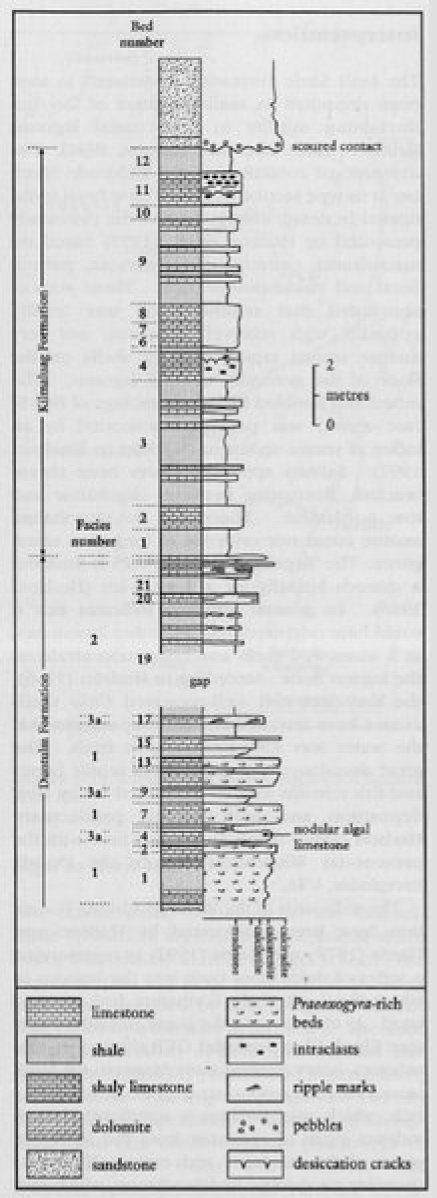
(Figure 6.11) Geological sketch map of the type locality of the Kildonnan Member (Lealt Shale Formation) on the coast north of Kildonnan, Isle of Eigg (for bed numbers, see (Figure 6.12)). (After Emeleus, 1997, fig. 12.))



(Figure 6.12) Graphic section of the Kildonnan Member at its type locality (After Emeleus, 1997, fig. 13.) Bed numbers follow Wakefield (1991).)



(Figure 6.13) Outcrop map of the Valtos Sandstone Formation between Bogha na Brice-nis and Bay of Laig, Isle of Eigg. (After Emeleus, 1997, fig. 14.) Division letters follow Harris (1984).)



(Figure 6.14) Graphic section of the Duntulm and Kilmaluag formations at Laig Gorge, Isle of Eigg. (After Emeleus, 1997, figs 17, 18). Bed and facies numbers follow Andrews (1984, 1985).)