Duntulm (Cairidh Ghlumaig and Lon Ostatoin) Isle of Skye

[NG 411 740]–[NG 406 733], [NG 406 729]–[NG 408 727]

B.M. Cox

Introduction

The GCR site at Duntulm, on the west coast of northern Skye, includes the type section of the Duntulm Formation as well as exposures of parts of the underlying Valtos Sandstone and overlying Kilmaluag formations. The main section comprises two nearly continuous exposures in the bay (Cairidh Ghlumaig) south of the headland on which Duntulm Castle stands, but a section exposed in the Lon Ostatoin stream, about 1 km south of the headland, is also included (Figure 6.27). The stream section is separated from the coastal section by unexposed ground and by a fault. The sections have been described by Anderson (1948), Anderson and Dunham (1966), Hudson and Morton (1969), Hudson (1970), Harris and Hudson (1980), Bell and Harris (1986), Andrews (1985), Andrews and Walton (1990) and Morton and Hudson (1995).

Description

Cairidh Ghlumaig foreshore

The following section and observations are largely taken from Morton and Hudson (1995); their section is itself based on Hudson (1970) and Harris and Hudson (1980) with additions by J.E. Andrews. The section starts immediately south of the headland. Beds 1–7 (4.1 m thick), which are strongly metamorphosed, are exposed in an 'apron' between the dolerite intrusion that forms the craggy headland, and an offshoot dyke that crosses the foreshore. From there, the succession up to Bed 39 (7.68 m thick), and dipping gently to the south, continues southwards within the bay (Figure 6.28); Bed 39 is conspicuous in the low cliff at the back of the storm beach. There is then a gap in the exposure for about 400 m until beds 40–55 (12.18 m thick) are exposed in another low cliff and the adjacent foreshore. The highest well-exposed bed is a conspicuous nodular algal limestone (Bed 54). The most striking feature of the Duntulm Formation is the monotypic shell beds, either limestones or shales, composed of the oyster *Praeexogyra hebridica* (Forbes). Graphic logs showing lithofacies and palynolog-ical data are given by Andrews and Walton (1990), which form the basis of (Figure 6.29), Riding *et al.* (1991) and Wakefield (1994).

	Thickness (m)
Duntulm Formation	
55: Shale, silty, green-grey with three *c.* 10 mm-thick pale bands at 1.0 m, 1.2 m and 1.4 m below top; *Corbula* common; *Cuspidaria, Myopholas, Procerithium,* and plant fragments	3.40
54: Limestone, nodular, algal with various horizons of cryptalgal pelletal laminations; some pale micritic horizons of pelletal limestone	0.60
53: Shale with abundant *Praeexogyra;* harder limestone in middle	0.60
52: Limestone, wavy laminated, cryptalgal with some nodular algal pods	0.15
51: Shale and siltstone; undulose lamination with a few cryptalgal laminations	0.15
50: Shale and shaly limestone; abundant *Praeexogyra*	1.05
49: Shale, dark; no fossils	0.15
48: Shale, calcareous; abundant *Praeexogyra*	0.60

47: Limestone composed of *Praeexogyra* shells	0.23
46: Sandstone, fine grained, calcareous; *Praeexogyra, Placunopsis, Camptonectes, Corbula, Modiolus, Procerithium,* serpulids encrusting *Praeexogyra* shells, abraded shark teeth, echinoid spines, reworked *Pycnoporidium* colonies; some surfaces intensely bioturbated; *Thalassinoides*	0.30
45: Limestone, hard, laminated with partings; *Placunopsis, Modiolus, Corbula,* a few rare small *Praeexogyra,* some serpulids attached to *Praeexogyra* shells but not as commonly as in Bed 46; intensely bioturbated with *Pelecypodichnus;* some reworked, nodular, algal material; worm burrows	0.23
44: Shale, dark, abundant *Corbula, Placunopsis* and *Cuspidaria,* fish fragments	0.20
43: Limestone, grey, pelletal, small nodular algal heads on top surface; ?mudcracks	0.10
42: Shale, calcareous; *Praeexogyra* and small indeterminate bivalves	0.12
41: Mudstone, structureless, blue-grey, rusty-weathering; carbonaceous fragments and lignite abundant, otherwise no fossils	0.90
40: Shale, carbonaceous, laminated	seen to 0.90
Break in exposure; at most, only 1.0 m missing	
39: Shale, dark, abundant *Praeexogyra*	seen to 2.50
38: Shale, dark	0.30
37: Limestone, hard; *Praeexogyra*	0.20
36: Shale, dark; abundant *Praeexogyra*	0.30
35: Sandstone, hard, calcareous, very bioturbated with *Thalassinoides* and *Diplocraterion*; *Praeexogyra*	0.30
34: Limestone, sandy; *Praeexogyra*, shark-fin spines	0.15
33: Shale parting	
32: Sandstone, coarse grained; *Praeexogyra*	0.06
31: Sandstone, dark, argillaceous, ripple laminated; Praeexogyra; layer with *Praeexogyra* and *Kallirhynchia* at base	0.10
30: Limestone, nodular, algal, grey, with massive fabric	0.20
29: Shale parting	
28: Sandstone, hard, calcareous	0.15
27: Sandstone, soft, argillaceous, intensely bioturbated; *Praeexogyra* in patches only; *Kallirhynchia*, wood fragments	0.75
26: Sandstone, hard, calcareous; *Praeexogyra*	0.20
25: Shale parting	
24: Sandstone, hard, calcareous; abundant *Praeexogyra* and *Kallirhynchia;* reworked fragments of *Pycnoporidium*	0.15
23: Siltstone, ripple laminated; *Praeexogyra*, *Kallirhynchia*, *Myopholas*, *Corbula*, *Modiolus*, *Anisocardia* and fish fragments	0.15
22: Shale, dark; *Myopholas* and *Corbula* abundant; *Cuspidaria,* heterodont bivalves, *Procerithium?,* other gastropods crushed, *Praeexogyra* fragment, shark tooth and fish scales	0.60

21: Shale; *Praeexogyra* abundant	0.15
20: Limestone, nodular, algal, dark-grey, quite soft with irregular domes on top surface; well-preserved *Cayeuxia nodosa* Anderson and thin organic-walled tubes similar to modern *Schizothrix* (this bed often hidden by beach sand)	0.15
19: Shale with lenticular sand horizons; *Praeexogyra*	0.06
18: Sandstone, harder and softer beds, ripple marked; *Praeexogyra*, shark-fin spines, wood fragments	0.30
17: Sandstone, medium grained, in part calcareous; shale partings, 10 mm quartz pebbles; bioturbated with *Diplocraterion*	0.30
16: Sandstone, hard, medium-grained, better sorted than beds above	0.15
15: Shale and siltstone, dark; 20–40 mm-thick, calcareous sandstone layers; ripple laminated	0.70
14: Shale, silty; *Praeexogyra*	0.08
13: Sandstone, argillaceous and calcareous, shelly	0.15
12: Shale, silty	0.15
11: Sandstone, fine-grained; *Praeexogyra*	0.15
10: Shale, dark, silty, bioturbated with *Thalassinoides; Praeexogyra?* and hybodont sharks' teeth	0.45
9c: Shale, silty, not obviously fossiliferous	0.18
9b: Sandstone; *Praeexogyra* fragments	0.20
9a: Shale, dark, shelly, pyritic, ?baked by dyke; *Placunopsis, Modiolus, Cuspidaria?,* fish fragments	0.30
8: Shale, dark, discontinuously exposed; no obvious fossils	0.60
Section interrupted by dyke crossing foreshore Valtos Sandstone Formation	
1–7: Siltstones and mudstones with thin calcareous horizons baked by intrusion; *Neomiodon, Unio;* large mudcracks in upper part	4.10

Lon Ostatoin stream section

The stream exposes a good but discontinuous section of the Duntulm Formation, as well as part of the overlying Kilmaluag Formation. The beds are exposed in the south-eastern bank of the stream above and below the road bridge. According to Harris and Hudson (1980) and subsequent authors, the exposures immediately below the bridge on the seaward side include a probable correlative of Bed 54 of the coastal sections (Figure 6.29). Above the bridge, the succession mainly comprises mudstones and silt-stones but a *Praeexogyra*-rich limestone (Bed 19) forms a small waterfall. The graphic log given by Andrews and Walton (1990) forms the basis of (Figure 6.29); graphic logs showing respectively ostracod and palynological data were given by Wakefield (1994) and Riding *et al.* (1991). Farther up the stream, in what is described by Hudson and Morton (1969) and Morton and Hudson (1995) as the 'upper gorge' [NG 408 727], and after a gap in the succession of *c.* 25 m, an exposure shows *c.* 6 m of the upper part of the Kilmaluag Formation. The beds are predominantly shales, which are unusually rich in smectite, with some shaly limestones (Andrews, 1985). The freshwater gastropod *Viviparus,* conchostrachans and ostracods have been recorded (Hudson and Morton, 1969). Bed 4 of Andrews (1985) is a conspicuous 50 mm-thick, pale, grey-buff coloured, soft clay intercalated within otherwise dark-grey shales that are locally baked by the overlying dolerite sill.

Interpretation

Beds 1–7 of the foreshore section are assigned to the Valtos Sandstone Formation whose sediments are interpreted as being deposited in lagoonal deltas (Harris, 1992). According to this latter author, the mudcracks (desiccation cracks) recorded at Duntulm bear witness to a reduction in clastic supply and probably indicate reduced fluvial runoff. This reduction in clastic supply is associated with the incoming of marine bivalves (first *Placunopsis, Cuspidaria* and *Modiolus,* then *Praeexogyra*) which defines the base of the overlying Duntulm Formation (Morton and Hudson, 1995). The Duntulm Formation has the most diverse faunas of all of the formations in the Great Estuarine Group, and the effects of substrate can be most clearly recognized therein (Hudson, 1980; Andrews, 1987). It includes a number of features, such as the sandy beds 9b-19 with conspicuous burrows including *Thalassinoides* and wave-ripple marks, and the algal (cyanobacterial) nodular limestones (beds 20, 30 and 54), which together indicate marine brackish-water salinities (Hudson, 1963a,b). Above Bed 41, the faunas are as marine as any in the Great Estuarine Group, and include abundant dinoflagellate cysts (Andrews and Walton, 1990). In the Lon Ostatoin stream section, the beds yield a low-salinity fauna and flora including *Unio, Neomiodon,* conchostracans and *Botryococcus,* but just below Bed 19, in which *Praeexogyra* is abundant, the fossils, including dinoflagellate cysts, indicate a return to marine conditions. Above this, in beds 22–23, the fossil assemblage again indicates low-salinity conditions.

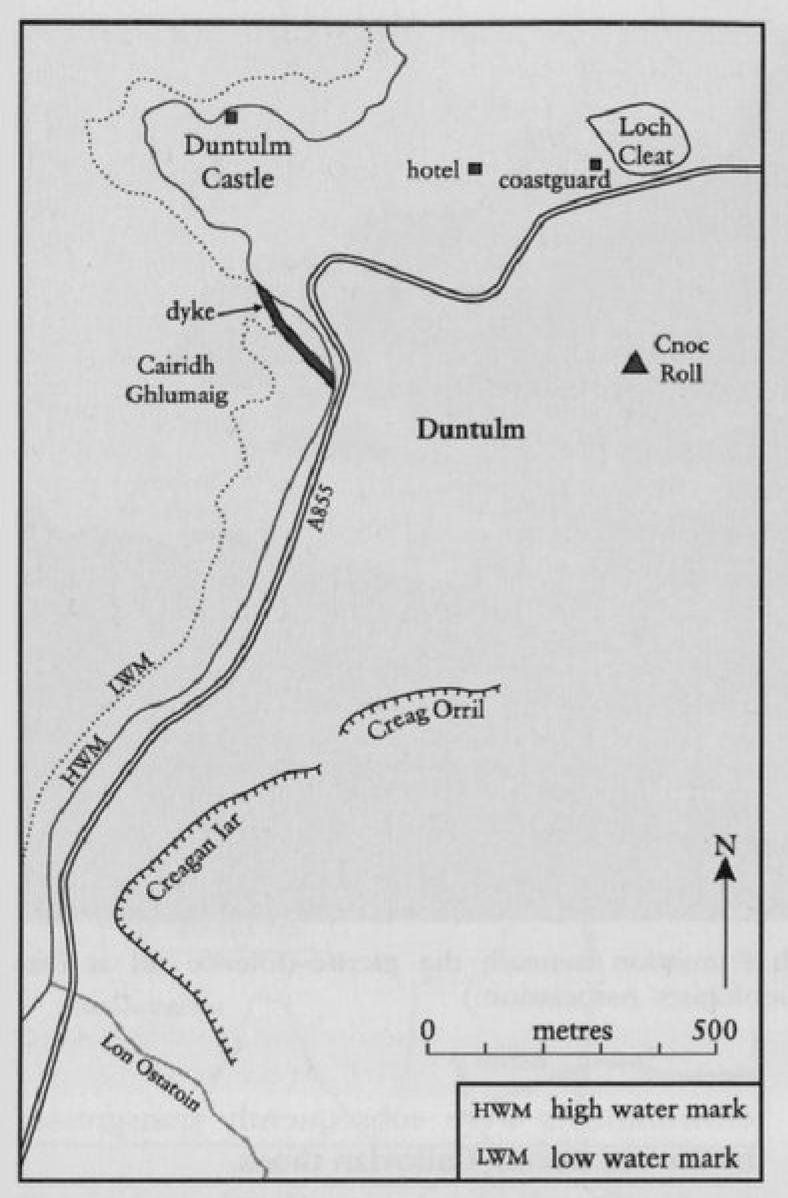
Detailed facies analysis suggests that the limestones, shales and siltstones of the Duntulm Formation were deposited as shallow lagoonal sediments (Hudson and Harris, 1979; Andrews and Walton, 1990). The sandstones probably represent small deltaic deposits (Andrews, 1987). Features such as mudcracks, algal limestones and lignite-rich mudstones have been interpreted as indicative of lagoon–marginal mudflat palaeoenvironments but the presence of the bivalves *Unio* and *Neomiodon* suggest that at times the lagoons temporarily became freshwater (Andrews, 1987 and references therein). Most of the succession at the GCR site belongs to lithofacies 1 ('*Praeexogyra* limestone–shales') of Andrews and Walton (1990), although the lowest beds constitute lithofacies 4 ('sandstones') and the algal limestones constitute lithofacies 3a. Lithofacies 1 is interpreted as probably representing former shell-banks that have 'fallen apart'. According to Andrews and Walton (1990), the preservation of articulated valves, and the mudstone matrix, militate against strong current reworking; they were probably agitated by weak wind-driven tides in shallow water. The argillaceous beds intercalated between the oyster beds are interpreted as inter-shell-bank muds. The clay minerals and silts were probably deposited in the lagoons as distal suspension detritus from small rivers. The sandstones of lithofacies 4 were possibly formed by the redistribution of fine sand from the delta-front environments. These more distal delta sands were mainly deposited in 'marine' open lagoonal settings where brachiopods, calcareous algae and serpulid worms were able to survive. The petrography and palaeoecology of the algal limestones of lithofacies 3a have been studied in great detail (Hudson, 1970; Andrews, 1986). The latter author interpreted them as supra-littoral algal marsh deposits to shallow littoral algal stromatolites. The micritic horizons of pelletal limestone recorded in Bed 54 probably represent storm-washed carbonate sediments between algal heads (Morton and Hudson, 1995).

The distinctive buff clay (Bed 4) recorded by Andrews (1985) in the Kilmaluag Formation seen in the 'upper gorge' of Lon Ostatoin is surprisingly unbaked and retains a soapy texture; preliminary X-ray diffraction work led Andrews (1985) to interpret it as a bentonite. According to Andrews (1987), it has a mineralogy of more than 85% smectite and vermiculite and is interpreted as a secondary bentonite, the alteration product of a redeposited volcanic ash. The source of this pyroclastic material may have been to the west of the depositional basin, and possibly associated with initial North Atlantic rifting.

Conclusions

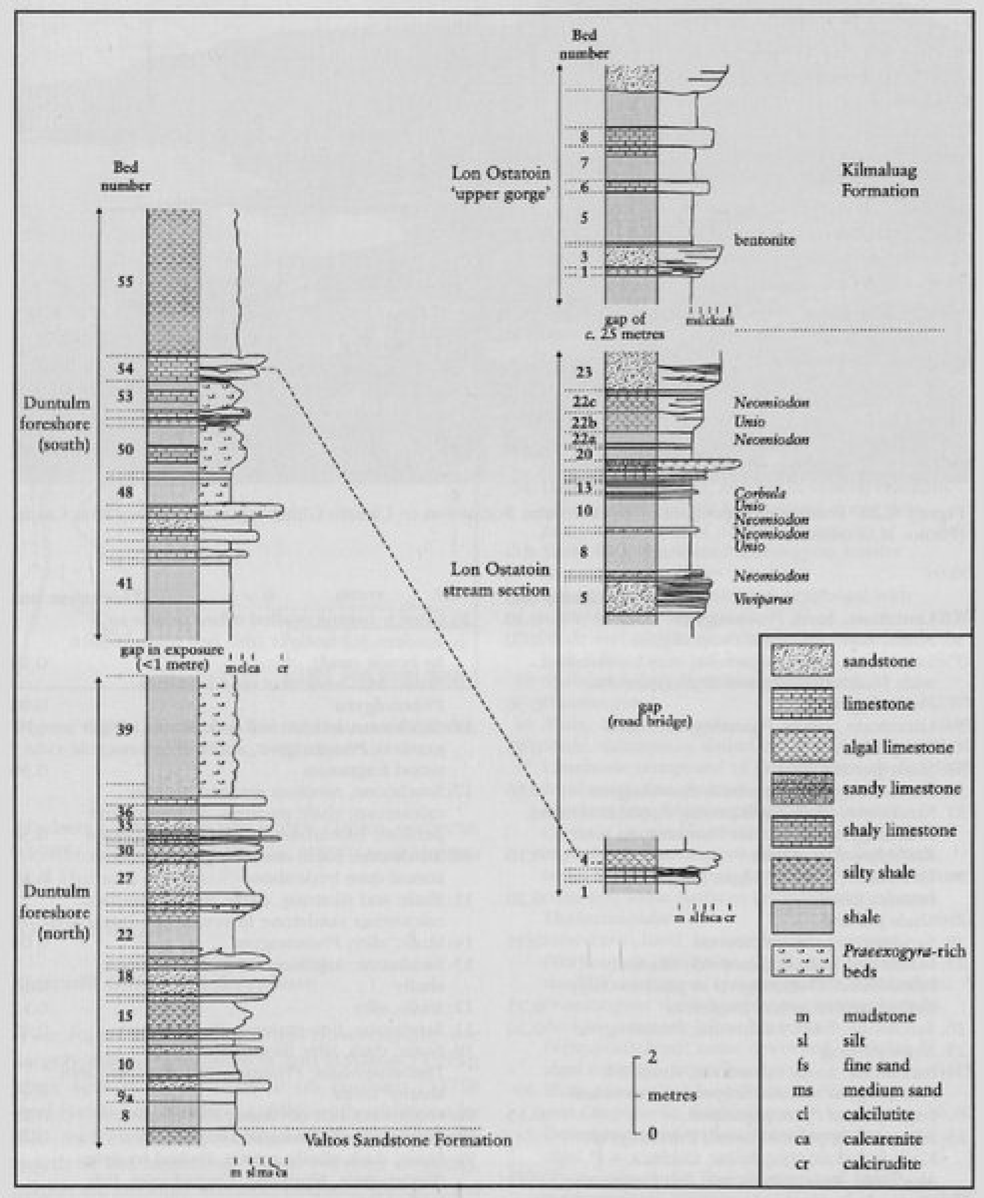
This site includes the most important exposure and type section of the Duntulm Formation. The sections are the most fossiliferous, litholo- gically varied and accessible in that formation, which itself represents the most marine interval in the Great Estuarine Group of the Hebrides. The sections are amongst the best for studying the alternation of marine and freshwater facies in that group.

References



(Figure 6.27) Locality map for the Duntulm GCR site. (After Morton and Hudson, 1995, fig. 35.))

(Figure 6.28) Foreshore exposures of the Duntuim Formation in Cairidh Ghlumaig south of Duntulm Castle. (Photo: M.G. Sumbler.))



(Figure 6.29) Graphic sections of the Duntulm and Kilmaluag formations exposed at the Duntulm GCR site. (After Andrews, 1985, fig. 3; and Morton and Hudson, 1995, fig. 36.) Bed numbers follow Andrews (1984, 1985).)