Staffin, Isle of Skye

[NG 472 697]–[NG 471 710]

K.N. Page

Introduction

Callovian strata exposed at Staffin Bay, on the east coast of the Trotternish peninsula in northern Skye, form part of a classic Sub-Boreal–Boreal, Middle–Upper Jurassic sequence. Exposures are primarily on the foreshore between [NG 471 710] and [NG 472 697], and are accessible only at low tides; in addition, boulders and seaweed can affect the degree of exposure, at least seasonally. Despite these difficulties, the similarity between the argillaceous beds exposed here and the Oxford Clay Formation of England (see Peterborough Brickpits GCR site report, this volume) has been recognized since the mid 19th century (Forbes, 1851). Anderson and Dunham (1966) recorded the sections and provided maps of the foreshore; the main Callovian exposures are between their points 3 [NG 473 698] and 5 [NG 472 708], although now that the Upper Ostrea Member is considered to be of probable Callovian rather than Bathonian age, Callovian strata are also exposed at and south of their Point 1 [NG 474 694] (see Staffin Bay GCR site report, this volume) and at Point 6 [NG 470 712]. These numbered points (small headlands or features) have been used by all subsequent authors as a means of locating their position on the outcrop (Figure 6.33). The lithostratigraphy was revised by Sykes (1975) whose results were summarized by Duff (1980). Most recently, the sections were reviewed by Morton and Hudson (1995). The GCR site includes the type section of the Staffin Bay Formation (Point 5 [NG 472 208] of Anderson and Dunham, 1966; Hudson, 1962) and the southern part of the type locality of the Staffin Shale Formation that is taken as the foreshore on the western side of Staffin Bay (Turner, 1966; Sykes, 1975). Point 5¯of Anderson and Dunham (1966) is also the type section of the Upper Ostrea Member (Anderson and Cox, 1948). Another exposure, south of Point 1 of Anderson and Dunham (1966), showing the Upper Ostrea Member and the underlying Skudiburgh Formation, is included in the GCR Bathonian Block (see Staffin Bay GCR site report, this volume), and the overlying Belemnite Sand Member also has Staffin Bay as its type locality (Anderson and Cox, 1948). The Dunans Shale Member, at the base of the Staffin Shale Formation, was proposed by Sykes (1975) with, again, a type section at Point 5 of Anderson and Dunham (1966). The Dunans Clay Member was proposed by Sykes (1975) with a type section on the foreshore midway [NG 473 699] between points 3 and 4 of Anderson and Dunham (1966).

Description

The following section of the Callovian succession is based mainly on Morton and Hudson (1995); bed numbers for the Staffin Shale Formation are those of Sykes and Callomon (1979).

	Thickness (m)
Staffin Shale Formation	
Dunans Clay Member(part)	
SS6 (part): Clay, silty, grey-green; highly bioturbated by *Thalassinoides* and *Chondrites;* layers of lignite debris; phosphatic nodules; *Bositra buchii* (Roemer) at base only; sporadic nuculacean bivalves, belemnites and ammonites (*Kosmoceras* and *Quenstedtoceras*) above	2.20
SS5c: Siltstone, carbonate-cemented ('cementstone') with ammonites (*Kosmoceras* and *Quenstedtoceras*)	0.25
SS5b: Clay, silty; *Bositra buchii* common; ammonites (*Kosmoceras and Quenstedtoceras*)	0.45
SS5a: Siltstone, carbonate cemented ('cementstone')	0.25

SS4: Silts and silty clays, pale grey-green; profuse *Bositra buchii* at several horizons; several rows of phosphatic nodules; ammonites (*Kosmoceras*)*;* base burrowed by *Chondrites*	1.90
Dunans Shale Member	
SS3: Shale, dark grey, bituminous, barren except for occasional belemnites	3.45
SS2: Shale, laminated, black, bituminous; *Lingula* and belemnites	0.45
SS1: Clay, shaly, medium- to dark-grey with layers of glauconitic silt burrowed by *Chondrites*; *Kosmoceras* at sharp base and at 0.85 m and 1.20 m above	?2.45
Staffin Bay Formation	
Belemnite Sand Member	
BS7: Limestone, red-weathering, hard, sandy, glauconitic and sideritic; white nodules in lower part; abundant belemnites (*Cylindroteuthis*)	0.25
BS6: Sandstone, soft, argillaceous; belemnites	0.30
BS5: Sandstone, hard, calcareous, glauconitic, pebbly; rubbly weathering with nodular *Spongeliomorpha suevica* (Reith); belemnites	0.20
BS4: Sandstone, massive, hard, calcareous; apparently unfossiliferous; sharp base	0.20
BS3: Soft, carbonaceous, shelly siltstones and fine-grained sandstones; top marked by hardground; ripple cross-lamination mostly disturbed by bioturbation; burrows outlined by carbonaceous laminae; bivalves including *Astarte* and *Camptonectes,* as well as '*Liostrea*'and *Neomiodon*	0.20
BS2: Limestone, hard, sandy with fine-grained matrix and carbonaceous fragments; bivalves (mostly disarticulated) and ammonites (*Cadoceras* and *Kepplerites*)	3.00
BS1: Soft, carbonaceous, shelly siltstones and fine-grained sandstones; small-scale ripple-bedding outlined by carbonaceous laminae; bivalves including '*Liostrea*', *Oxytoma, Pleuromya* and *Trigonia*	0.60
Upper Ostrea Member	
U05: Shale, dark, very shelly with layers of mainly articulated bivalves; prominent shell-bed at top; bivalve fauna dominated by *Neomiodon* with occasional *Staffinella*	2.90
U04: Siltstone, soft, shelly with carbonaceous streaks and ripple cross-lamination; *Neomiodon*?	1.20
UO3: Shale, dark, very shelly with shell beds some including *Praeexogyra hebridica* (Forbes); other bivalves including Isocyprina, Isognomon?, *Neomiodon*, *Staffinella* and *Vaugonia staffinensis* (Anderson and Cox)	4.55
UO2: Limestone, massive, hard, shelly with '*Liostrea*' and other bivalves	0.75
U01: Shale, dark with harder pyritic layers including 0.08 m-thick basal shell-bed; fauna dominated by *Isognomon* and *Neomiodon*	1.80
Great Estuarine Group	

Interpretation

The molluscan fauna of the Upper Ostrea Member, dominated by bivalves, is of low diversity and indicative of brackish salinity conditions (Anderson and Cox, 1948; Hudson, 1963a,b). Palynofloras recovered by Riding (1992) from this section are dominated by miospores with lesser proportions of marine microplankton. The florules are of relatively low species-diversity with the dominance of just one or few taxa; this is typical of marginal marine environments subject to salinity fluctuations. The presence of the dinoflagellate cyst *Rhynchodiniopsis cladophora* (Deflandre 1938) Below 1981 amongst the marine microplankton was considered by Riding (1992) to be conclusive evidence that the Upper Ostrea Member is Early Callovian rather than Late Bathonian in age (Riding and Thomas, 1997); all other taxa recovered could be either Late Bathonian or Early Callovian in age. No ammonites are known from the member. The Belemnite Sand Member includes a more varied and marine bivalve fauna than the Upper Ostrea Member, and ammonites, albeit very rare, are also present. These include *Kepplerites* (*Gowericeras*) *galilaeii* (Oppel) and *Cadoceras* aff. *sublaeve* (J. Sowerby) in Bed BS2 indicating the Galilaeii Subzone (Koenigi Zone, Lower Callovian) (Figure 6.34). The incoming of abundant cylindroteuthid belemnites at the top of the member is comparable with their appearance at the base of the Calloviense Zone in southern England. A plesiosaur found in a loose boulder on the foreshore hereabouts is believed to have come from this member (Clark *et al.,* 1993).

The Dunans Shale Member is poorly fossiliferous except for *Chondrites*-type burrows and *Lingula* in the more silty beds. Belemnites may also occur in the silty beds but ammonites are common only near the base of the member. These include abundant *Kosmoceras* (*Gulielmiceras*) *medea* Callomon (macroconch and microconch) in Bed SS1 (indicative of the Middle Callovian Medea Subzone, Jason Zone), and *K.* (*G.*) *jason* auctt. a little higher (Jason Zone and Subzone; Sykes, 1975; Morton and Hudson, 1995). The only ammonite evidence from the upper and greater part of the member is a specimen of *Erymnoceras* cf. *coronatum* (Bruguière) collected loose from a concretion (ex Bed SS3) indicating the Middle Callovian Coronatum Zone (possibly Obductum Subzone; Morton and Hudson, 1995). Ostracods and foraminifera also appear to be virtually absent (Sykes, 1975; Whatley, 1970).

In the Dunans Clay Member, beds SS5a–c form a prominent marker horizon. Several layers are packed with the supposed hemipelagic bivalve *Bositra buchii.* The ammonite fauna is often abundant but typically crushed in the clays. Bed SS4, at the base of the member, has yielded *K.* (*Lobokosmokeras*) ex gr. *phaeinum* S.S. Buckman indicating the Phaeinum Subzone (Athleta Zone, Upper Callovian), although records by Turner (1966) suggest that *K.* cf. *grossouvrei* R. Douvillé of the topmost Middle Callovian Grossouvrei Subzone may also occur in this bed and hence, the Coronatum Athleta zonal boundary. Higher levels have yielded species of *Quenstedtoceras* and *Kosmoceras* ex gr. *spinosum* (J. Sowerby) from Bed SS5b–c, indicative of the ?Henrici Subzone (Upper Callovian Lamberti Zone), and *Quenstedtoceras* ex gr. *lamberti* (J. Sowerby) (including *Q. grande* Arkell; Callomon and Wright, 1989), *K.* ex gr. *spinosum* and *Longaeviceras holtedabli* Salfeld (Callomon and Wright, 1989) in the lower 2.2 m of Bed SS6 (Lamberti Subzone and Zone). The base of the Oxfordian Stage appears to lie towards the top of Bed SS6 (*c.* 5.05 m above the base of the Dunans Clay Member) as *Cardioceras* (*Scarburgiceras*) is present in the top 0.35 m of that bed (Morton and Hudson, 1995).

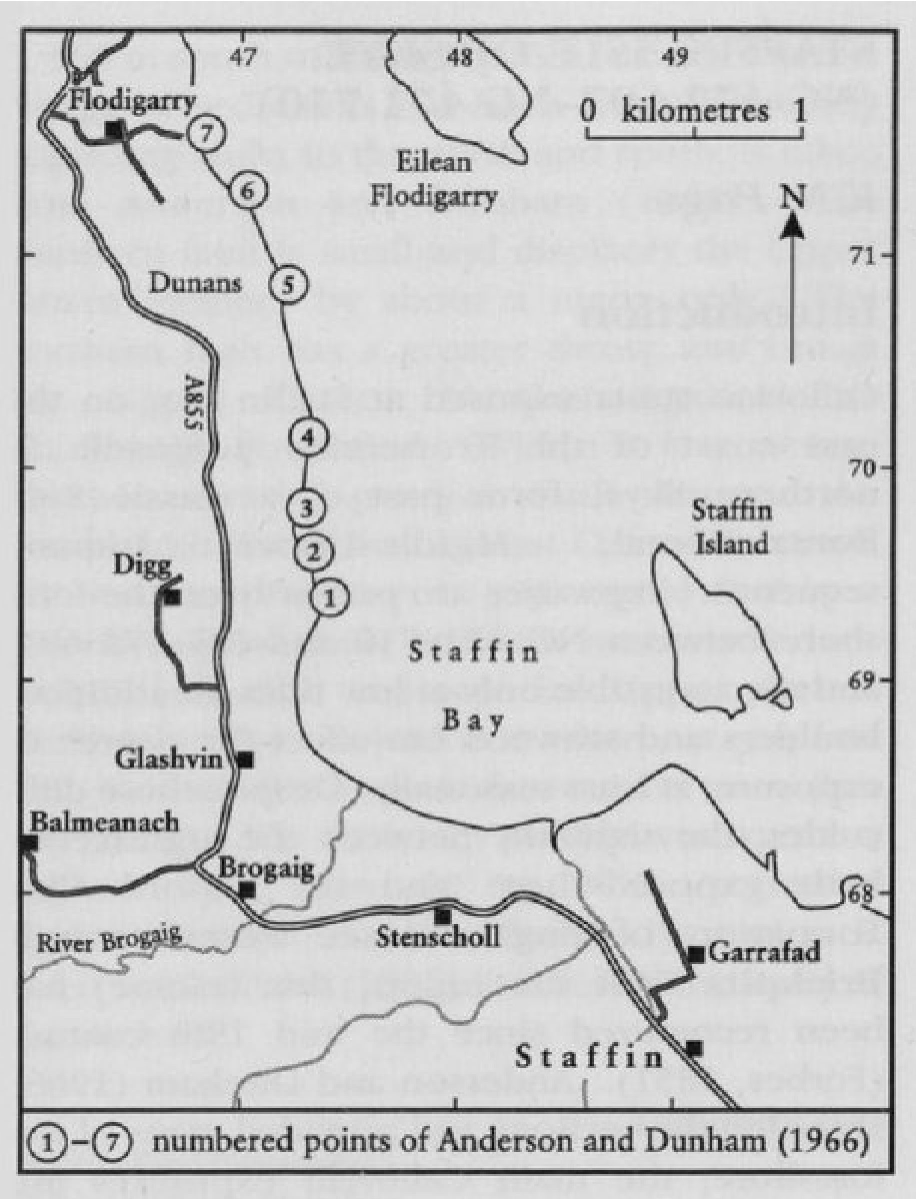
The facies and faunas of the Callovian succession at Staffin Bay indicate a progressive environmental change from restricted to open marine conditions. The Upper Ostrea Member was probably deposited in a coastal lagoon that was then transgressed possibly by an offshore sand-bar represented by the Belemnite Sand Member. The general lack of benthos in the Dunans Shale Member suggests that the sea floor was anoxic for much of the time, with only occasional, brief, more oxygenated phases indicated by bioturbated silts. The Dunans Clay Member indicates an amelioration of seabed conditions, and mainly well-oxygenated conditions favouring infaunal benthos (Morton and Hudson, 1995).

Overall, Morton and Hudson (1995) interpreted the Staffin Bay Formation as a thin sequence or stratigraphical package (their 'Sequence F') representing a phase of basin stabilization. They interpreted the abrupt change of lithology at the base of the overlying Staffin Shale Formation as marking a sequence boundary and a minor hiatus in sedimentation. They suggested that the relatively thin Callovian part of the overlying sequence indicated a continued phase of basin stabilization, followed by a renewed phase of subsidence in Oxfordian and Early Kimmeridgian times; sediment thicknesses of that age are much greater.

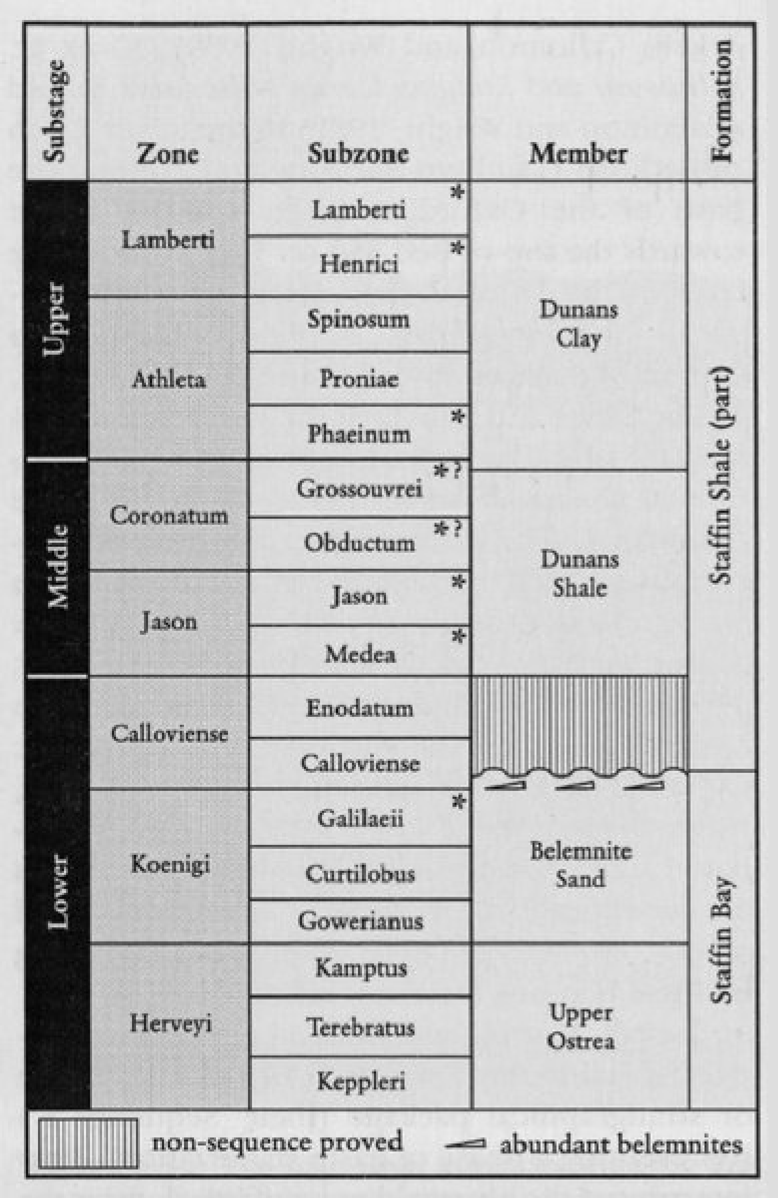
Conclusions

The Staffin GCR site includes the type sections of the Staffin Bay and Staffin Shale formations and of their Callovian component members. The sections are crucial to the understanding of the development of the Hebrides Basin during Mid to Late Jurassic times, and good overall age controls on the succession make close comparisons with other regions possible. Of note is the significant development of bituminous shale deposition in the Middle Callovian succession, especially in the Coronatum Zone, as elsewhere in Britain (see Peterborough Brickpits GCR site report, this volume).

References



(Figure 6.33) Locality map for the Staffin GCR site.)



(Figure 6.34) Main stratal divisions of the Callovian succession at Staffin. Not to scale. (= presence of subzone indicated by ammonites.))*