Robin's Wood Hill Quarry, Gloucestershire

[SO 835 148]

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Introduction

The Robin's Wood Hill Quarry GCR site comprises a large quarry, disused for several decades, excavated into the south-western flank of Robin's Wood Hill overlooking Tuffley, a suburb of Gloucester (Figure 4.10). The section exposes a more than 60 m-thick succession of Pliensbachian mudstones and siltstones, with subordinate sandstone and bioclastic limestone units, and represents the finest inland section in Britain of the Upper Pliensbachian Substage (Middle Lias), here exposed almost in its entirety, as well as a considerable thickness of the underlying Lower Pliensbachian succession. This is represented by a good section through the Dyrham Formation, designated as its type locality by Sumbler *et al.* (1999), part of the overlying Marlstone Rock Formation, and underlain by the top of the Charmouth Mudstone Formation. It is one of a series of key sites revealing lateral facies and thickness changes both within the Severn Basin and across the whole of the Lower Jurassic outcrop. Excavations in 2000 have re-exposed a formerly obscured section through part of the Dyrham Formation, while a small track-side excavation nearby (at [SO 8367 1468]) exposes the upper part of the Marlstone Rock Formation and the base of the Whitby Mudstone Formation (Toarcian) above. The succession, and its rich and diverse fauna, has been well documented.

Despite his extensive research into the geology of this area, Robin's Wood Hill received only passing mention in Richardson's field guide to the geology of Cheltenham (1904). The site formed the subject of an excursion report (Watts, 1928), in which a general account of the fossil fauna and its palaeoecology was given, but the lithological succession otherwise remained undescribed until an excursion report by Ager (1955). In this he estimated the ammonite zone ranges for the section. A general account of the site was published by Dreghorn (1967). The site formed part of a major investigation by Palmer (1971, 1973) who described the stratigraphical succession in detail and attempted correlation with the succession in another disused pit, at Stonehouse [SO 816 050], 10 km to the south, as well as with the successions recorded in the Stowell Park Borehole (Figure 4.1), and those on the Dorset coast. In the earlier paper, Palmer (1971) established the positions of the ammonite zonal and subzonal boundaries within the succession. He later (1973) listed the invertebrate fauna together with the lithostratigraphical distribution of each species and commented on the palaeoecology of parts of the succession on the basis of condusions drawn from the diversity and composition of the invertebrate fauna. In the latter paper he described two new species of bivalve, *Hippopodium tuffleyensis* and *Hettangia aperta:* a third species, *Cardinia tuffleyensis,* was described in a subsequent paper (Palmer, 1975). A new species of crinoid, *Balanocrinus solenotis,* was based in part on fragmentary material from the upper part of the Dyrham Formation at this site (Simms, 1989). Elements of the microfauna have been investigated by Lord (1972, 1974).

Further details of the Lower Pliensbachian stratigraphy at this site were published by Phelps (1985), and well-preserved crinoid material from near the base of the Upper Pliensbachian succession was figured by Simms (1989). The Upper Pliensbachian succession at Robin's Wood Hill Quarry also formed part of a broader investigation into Upper Pliensbachian sedimentation patterns of the Severn Basin (Simms, 1990a) during which some revisions of the biostratigraphy established by Palmer (1971) were made. The most recent investigation of the site was by Chidlaw (1987) who logged the succession in more detail than that of earlier accounts.

Description

Robin's Wood Hill Quarry has been excavated at two levels, described as the 'upper quarry' and 'lower quarry' (Figure 4.11), and exposes almost 60 m of the Lower Jurassic succession (Figure 4.12). Ager (1955) and Palmer (1971) reported about another 8 m exposed below the lowest beds currently visible. The Pliensbachian–Toarcian boundary section, described below, was exposed in a nearby track-side excavation [SO 8367 1468] and recorded by Chidlaw in October 2001.

	Thickness (m)
TOARCIAN STAGE	
Whitby Mudstone Formation	
Tenuicostatum Zone (presumed)	
D: Clay, fawn-brown, soft, sticky.	0.90 (seen)
C: Clay, mottled, pale-grey/orange, soft, sticky. This has a diffuse contact with Unit D above and mails, and overlies by a few cm, the irregular top of Unit B below.	0.30
UPPER PLIENSBACHIAN SUBSTAGE	
Marlstone Rock Formation	
Spinatum Zone (presumed)	
B: Clay, mottled, pale-grey/orange/red-brown, soft, sticky, containing weathered clasts of Unit A; some are up to 0.35 m across, angular and only slightly iron-stained; others are reddish-brown and friable, 3–4 cm across, subangular and of high sphericity. The contact with units above and below is irregular, with mammilated limonite nodules 2–5 cm across locally present on the upper surface.	0.45
A: Limestone, massive, well jointed, greenish-grey, bioclastic, with abundant ferruginous ooids. Belemnites and bivalves common, with some rhynchonellid brachiopods. This bed is lithologically identical to Bed 37 (= 16c of Palmer, 1971) of the main section reproduced below.	1.50 (seen)

The descriptions and bed numbers of the units within the main quarry section, as shown below, and depicted in Figure 4.12, are based largely on the work of Chidlaw (1987), but follow the lithostratigraphical divisions of Cox *et al.* (1999). The bed numbers of Palmer (1971) are given in parentheses.

UPPER PLIENSBACHIAN SUBSTAGE	Thickness (m)
Marlstone Rock Formation	
Spinatum Zone	
37 (= 16c): Limestone, massive, rubbly weathering, brownish-grey, bioclastic, with abundant ferruginous ooids. Scattered shelly fauna including belemnites, rhynchonellids and bivalves. *Pleuroceras spinatum* and *Amaltheus* cf. *subnodosus* recorded by Palmer (1971).	0.33
Dyrham Formation	
Margaritatus Zone, Subnodosus to ?Gibbosus subzones	
36 (= 16b): Sandstone, yellow-buff weathering, ferruginous, friable, micaceous, fine, silty. Locally between 1.8 m and 3.3 m above the base of the unit are hard, calcite-cemented, irregular 'doggers' up to about 1.5 m thick and 3 m across, with smaller ellipsoidal calcite concretions below the Jogger horizon and more laterally extensive, though discontinuous, bands of calcite-cemented sand above the doggers. Abundant bioturbation, although trough cross-lamination and dish structures locally present. Fossils scattered and only well-preserved in cemented units, but including belemnites, bivalves and debris of the crinoid *Balanocrinus solenotis.* Simms (1990a) recorded *Amaltheus subnodosus* up to 2.6 m above the base of the unit.	4.87

35 (= 16a): Conglomerate, irregular, pebble-to cobble-grade. Clasts mostly flat-lying discoidal or ellipsoidal, of pale-grey siltstone. Matrix of yellow-brown mudstone within abundant fine bioclastic debris. Ager (1954) recorded *Gibbirhynchia micra* from the clasts.	0.18
34 (= 15 part): Siltstone, yellow-brown, sandy, micaceous. Local indistinct and bioturbated planar laminations.	0.20
33 (= 15 part): Silt, pale greenish-grey, sandy, micaceous. Mostly planar laminated with some cross-laminations near base.	1.80
32 (= 15 part): Silt, pale greenish-grey, micaceous. Planar laminated. Grades up into Bed 33 above.	3.33
31 (= 15 part): Mudstone, dark blue-grey, clayey, micaceous, silty. Grades up into Bed 32 above.	3.00
30 (= 14 part): Congomerate, flat pebble- to cobble-grade, with siltstone clasts set in a green-grey, sandy micaceous silt matrix.	0.12
29 (= 14 part): Limestone, hard, pale-grey, bioclastic, with occasional ferruginous ooids in top 0.02 m. Undulating base and top.	0.24
28 (= 14 part): Conglomerate, pebble- to cobble-grade. Discoidal clasts of hard blue-grey siltstone with ferruginous rind in a matrix of green-grey mudstone with abundant bioclastic debris. Irregular base.	0.22
Stokesi Subzone	
27 (= 13 part): Silt, pale greenish-grey, locally cemented, sandy, micaceous. Bioturbated in top 0.25 m; cross-laminated below.	0.36
26 (= 13 part): Silt, pale greenish-grey, sandy, micaceous. Cross-laminated in top 0.04 m; planar laminated below.	1.64
25 (= 13 part): Silt, greenish-grey, clayey, micaceous, planar laminated in parts. Grades up into Bed 26 above.	4.33
24 (= 12): Siltstone, hard, shelly, micaceous. *Amaltheus stokesi* and *Lytoceras fimbriatum* recorded by Palmer (1971).	0.56
23 (= 11): Clay, blue-grey, silty, passing up into dark greenish-grey, planar-laminated, clayey micaceous silt. Floor of upper quarry lies 0.2 m above the base of this unit on the south side of the quarry	3.27
22 (= 10): Conglomerate, pebble-grade, with hard, discoidal/ellipsoidal, blue-grey siltstone clasts in a matrix of grey-green mudstone with abundant coarse bioclastic debris and large thick-ribbed bivalves. The upper 0.15 m is deeply weathered, with friable clasts and a 0.05 m-thick reddish-orange layer at the top. Erosion surface contact with Bed 21. *Amaltheus wertheri* and *Pagophylloceras* recorded by Phelps (1985).	0.35
21 (= 9g part): Silt, blue-grey, sandy, micaceous. Planar laminated but streaked with fine yellow sand in places. Occasional scattered siderite nodules up to 0.25 m across and 0.06 m thick.	0.25

20 (= 9g part): Siltstone, blue-grey, sandy, micaceous, massive, with pea-sized siderite nodules. Broken thin-shelled bivalves.	0.04
19 (= 9g part): Silt, pale blue-grey, sandy, micaceous, with planar laminations locally disturbed by horizontal burrows. Occasional pea-sized siderite nodules and discontinous row of larger siderite nodules at 1.7 m above the base. Small limonitic casts of amaltheid ammonitcs arc common. *Amaltheus stokesi* and A. sp. recorded by Phelps (1985) from about this level.	3.52
18 (= 9f part): Siltstone, discontinuous, pale grey, commonly with abundant remains of *Balanocrinus gracilis.* Bivalves common and specimens of *Amaltheus bifurcus* and *A. wertheri.*	0–0.08
LOWER PLIENSBACHIAN SUBSTAGE	
Davoei Zone, Figulinum Subzone	
17 (= 9f part): Silt, green-grey, sandy, micaceous. Mostly planar laminated but cross-laminated towards base.	0.66
16 (= 9e): Siltstone, pale blue-grey, indurated, planar- and cross-laminated, micaceous, with broken shell debris and small siderite concretions. *Oistoceras? angulatum* recorded by Phelps (1985).	0.10
15 (= 9d): Silt, blue-grey, micaceous, planar laminated and locally bioturbated.	5.49
14 (= 9c): Siltstone, blue-grey, indurated, wavy laminated, micaceous, with burrow mottling.	0.08
Capricornus Subzone	
13 (= 9b part): Silt, blue-grey, planar laminated, micaceous.	6.62
12 (= 9b part): Silt, dark blue-grey, indistinctly laminated, muddy, micaceous. *Aegoceras crescens* transitional to *Oistoceras angulatum* recorded by Phelps (1985).	1.14
11 (= ?): Iron-stained pebble conglomerate, with siltstone clasts in a siltstone matrix.	0.08
10 (= ?): Silt, blue-grey, indistinctly laminated, sandy, micaceous.	0.80
9 (= ?): Iron-stained pebble-grade conglomerate, with siltstone clasts in a siltstone matrix.	0.04
8 (= ?7): Silt, blue-grey, indistinctly laminated, sandy, micaceous, with bivalve moulds.	0.80
7 (= ?): Pebble conglomerate, with siltstone clasts in a siltstone matrix. *Aegoceras capricornus* recorded by Phelps (1985).	0.05
6 (= 6): Siltstone, pale grey, indurated, clayey, micaceous, forming prominent hard band. Together with beds 7 and 8 this represents the 'Capricornus Sandstone' of Palmer (1971).	1.65
Maculatum Subzone	
5 (= 5 part): Siltstone, pale grey, indistinctly laminated, clayey, micaceous.	1.14
4 (= 5 part): Silt, pale grey, planar laminated, clayey, micaceous. Moulds of small thin-ribbed bivalves near base.	5.37

3 (= 4): Siltstone, pale grey, planar laminated, clayey, micaceous.	0.19
2 (= 3c part): Silt, pale grey, planar laminated, clayey, micaceous. Siderite nodule bands at 8 m and 9.2 m above base.	10.5
1 (= 3c part): Silt, blue-grey, planar laminated, micaceous, with moulds of small thin-ribbed bivalves. Strata below this level were recorded by Palmer (1971, 1973) but are no longer visible (bed numbers are those of Palmer, 1971).	1 (seen)
Charmouth Mudstone Formation	
3c: (part): Shales, grey, silty, with ferruginous nodules.	*c.* 2
3b: Clay, blue, sticky, with ironstone nodules. *Androgynoceras sparsicosta* recorded by Phelps (1985) and *Aegoceras maculatum* recorded by Palmer (1971).	1.82
Ibex Zone, Luridum Subzone	
3a: Shales, grey, silty, grading up to dark-grey clay.	1.23
2: Shales, hard, grey, sandy *?Beaniceras luridum* recorded by Phelps (1985) and Palmer (1971).	0.30
1: Shales, grey, with nodules.	*c.* 3

The floor of the lower quarry lies in a series of grey mudstones and silty mudstones of the Charmouth Mudstone Formation, which form beds 1 to 3 of Palmer (1971), corresponding to the Luridum Subzone and lower part of the Maculatum Subzone. This part of the succession is now rarely exposed. The mudstones of Palmer's Bed 2 contain thin shell beds that yield *Beaniceras* cf. *luridum* and are similar to shell beds in the correlative strata of the Charmouth Mudstone Formation at the Blockley Station Quarry GCR site that lies 40 km to the north-east.

Grey silty mudstones with several indurated units and siltstone clast conglomerate bands form the near-vertical face of the lower quarry, more than 20 m high. This encompasses Bed 2 to the lower part of Bed 23 of this account (Palmer's Bed 4 to the lower part of Bed 11), corresponding to much of the Dyrham Formation, in which the upper part of the Maculatum, the Capricornus, and the lower part of the Stokesi subzones were identified. Bed 6 forms the most prominent unit in the lower quarry and, together with beds 7 and 8 of Palmer (1971), was correlated with the 'Capricornus Sandstone', a fossiliferous flaggy, micaceous sandstone, in the Stonehouse section, 10 km to the south (Palmer, 1971, 1973). Bed 8 of Palmer (1971) has yielded the brachiopod *Tetrarhyrnchia dunrobinensis* (Palmer, 1973), a predominantly northern species (Ager, 1956–1967).

The lowest 8 m or so of the Stokesi Subzone is exposed at the top of the lower quarry, with the upper quarry exposing the remainder of the Dyrham Formation and the overlying Marlstone Rock Formation (Figure 4.11). Together the two formations attain a thickness of approximately 29 in at this site (Figure 4.12). The Upper Pliensbachian succession is dominated by grey silty mudstones but, like the Lower Pliensbachian succession immediately beneath, includes siltstone cast conglomerates. Palmer (1973) noted a general paucity of benthic fauna in the mudstones and muddy siltstones in contrast to the limestones and conglomerates, which often are abundantly fossiliferous with many large filter-feeding bivalves. In the mid-1970s an impersistent siltstone unit (Bed 18 of this account; about 1 m above the base of Bed 9f of Palmer, 1971) yielded abundant articulated specimens of the crinoid *Balanocrinus gracilis* together with large specimens of the ophiuroid *Palaeocoma milleri* and two intact examples of the small ophiuroid *Hemieuryale lunaris,* known previously only from dissociated ossicles (Hess, 1962). Some of the crinoid material was figured by Simms (1986, 1989).

The Marlstone Rock Formation forms the uppermost 0.5 m of the Upper Pliensbachian succession exposed in the upper quarry. It is a rather calcareous, flaggy, sometimes poorly oolitic, limestone, and has yielded *Pleuroceras spinatum.* Formerly (Palmer, 1971) the formation was taken to include the indurated, brown, micaceous sandstone of Bed 36 below, from which weather large spheroidal 'doggers', but Sumbler *et al.* (2000) have assigned these sandy beds to the Dyrham Formation. Specimens of *Amaltheus subnodosus* have been found up to 2.6 m above the base of this sandy unit, while a pebble bed at the base (Bed 35) yielded the brachiopod *Gibbirhynchia micra* (Ager, 1955; Palmer, 1971).

Interpretation

Palmer (1971) was the first to establish a detailed lithostratigraphy for the Robin's Wood Hill Quarry GCR site and succeeded in identifying the principal biostratigraphical boundaries. Where ammonites could not be found in the succession these boundaries were based partly on lithostratigraphical cross-correlation with the Stonehouse Brick and Tile Quarry, 10 km farther to the south [SO 816 050], and with the succession in the Stowell Park Borehole (Green and Melville, 1956).

Palmer (1971) assigned 7.7 m of silty mudstones of the Dyrham Formation in his beds 9b–c (beds 12–14 of this account) to the Figulinum Subzone on the basis of such correlation. Phelps (1985) recovered a specimen of *Aegoceras crescens transitional to Oistoceras angulatum* from Bed 12 (low in Bed 9b of Palmer, 1971) at Robin's Wood Hill Quarry, indicating the uppermost zonule of the Capricornus Subzone, and *Oistoceras? angulatum* from Bed 16 (Bed 9e of Palmer, 1971). Accordingly, he placed the two nodule bands of the Dyrham Formation, beds 9c and 9e (beds 14 and 16 of this account), and the intervening 2.74 m of silty mudstones, in the Figulinum Subzone. *Amaltheus bifurcus,* indicating the lowest zonule of the Stokesi Subzone (Phelps, 1985), has been found in Bed 18 (M.J. Simms, unpublished observations), and hence the Lower–Upper Pliensbachian boundary can be placed with some confidence below Bed 18.

Higher in the succession, Ager (1955) and Palmer (1971) interpreted the presence of *Gibbirhynchia micra* in Bed 35 as evidence for the Spinatum Zone. Palmer (1971) failed to find evidence for the Gibbosus Subzone below Bed 35 at Robin's Wood Hill Quarry. However, *Amaltheus subnodosus* occurs up to 2.6 m above the base of Bed 35 (Simms, 1990a) and hence the Gibbosus Subzone must lie above this level. Its presence has yet to be proven at this site, although it is known elsewhere in the northern Cotswolds. The Spinatum Zone is, therefore, probably confined to Bed 37 at the very top of the quarry, and Cox *et al.* (1999) included beds 35 and 36 within the Dyrham Formation. The most recent detailed log of the succession (Figure 4.12) can largely be correlated with the earlier accounts of Palmer (1971, 1973), but Chidlaw (1987, and this account) was unable to reconcile his own observations with part of the succession recorded by Palmer (beds 7, 8 and 9a of Palmer, 1971, broadly corresponding to beds 7–11 of this account).

As the most extensive inland exposure of the Pliensbachian Stage, incorporating the type section of the Dyrham Formation, the overlying Marlstone Rock Formation, and part of the underlying Charmouth Mudstone Formation, in the Severn Basin, the succession at Robin's Wood Hill Quarry has played an important role in inter- and intra-basinal correlation and interpretation. Palmer (1971) demonstrated a striking lithostratigraphical continuity between the quarries at Robin's Wood Hill and Stonehouse. He concluded, on lithostratigraphical and biostratigraphical grounds, that a sandy limestone and more than 6 m of silts immediately below the Marlstone Rock Formation at Stonehouse since considered to represent the Subnodosus Sandstone Member — were absent from the section at Robin's Wood Hill Quarry. This he attributed to differential erosion prior to deposition of the highest part (beds 35–37) of the Robin's Wood Hill Quarry section.

Palmer (1971) also attempted correlation of the Robin's Wood Hill Quarry succession with those in the Stowell Park Borehole (Green and Melville, 1956). More recent work has helped to define formation boundaries within the succession. Sumbler *et al.* (1999) designated this as the type section of the Dyrham Formation and suggested its lower boundary, with the underlying Charmouth Mudstone Formation, be placed at the base of the Capricornus Sandstone (base of Bed 6 of this account) although we have placed it a little lower at the first appearance of silts. Palmer (1971, 1973) assigned all of his Bed 16 (beds 35–37 of this account), to the Marlstone Rock Formation, but here it is restricted only to Bed 37 at the top of the main quarry section, and beds A and B of the trackside section.

Overall similarities between the Robin's Wood Hill Quarry, Stowell Park Borehole and the Dorset coast successions, particularly in the general coarsening upwards through the sequence, reflect a regional (western Europe) shallowing that is evident in many Pliensbachian sequences (Hallam, 1981; Hesselbo and Jenkyns, 1998). More detailed lithostratigraphical correlation of marker bands between Robin's Wood Hill Quarry and the Dorset coast, located as they are in separate basins, must be regarded as tentative at best. For example, the Capricornus Sandstone, the most distinctive marker band in the Lower Pliensbachian successions of the Severn Basin has no lithostratigraphical correlative in the Green Ammonite Mudstone Member of the Wessex Basin (Hesselbo and Jenkyns, 1995), nor at Napton-on-the-Hill on the East Midlands Shelf (Callomon in Hallam, 1968a). The Subnodosus Sandstone Member

(Simms, 1990a) in the upper part of the Dyrham Formation can be traced over an area similar to that of the Capricornus Sandstone in the Severn Basin. Limestone beds of comparable thickness and depth in the upper part of the Dyrham Formation, are known beyond the Severn Basin at both the Neithrop Fields Cutting and the Napton Hill Quarry GCR sites and, in the case of the latter at least, are of proven Subnodosus Subzone age. However, correlation of these widely separated occurrences must be considered highly tentative at best.

The succession exposed at Robin's Wood Hill Quarry has proven invaluable in understanding patterns and controls on sedimentation in the Severn Basin during early and mid Jurassic times. The apparent absence of the Subnodosus Sandstone Member at Robin's Wood Hill Quarry (Palmer, 1971), was interpreted as a manifestation of uplift along a WNW–ESE axis, probably associated with movement on a basement fault close to Robin's Wood Hill late in Subnodosus Subzone times. Evidence of intermittent uplift on this axis imparting a gentle northward dip of the strata below the Marlstone Rock Formation has been recorded over an area extending at least 20 km to the north (Simms, 1990a). Although this pattern is fairly clear to the north of Cheltenham, extrapolation farther southwards to Robin's Wood Hill and Stonehouse is less certain. Simms (1990a) suggested that the Dyrham Formation at the Robins Wood Hill Quarry GCR site was deposited in a separate half-graben from that of sites farther north (Bredon Hill to Cleeve Hill).

Chidlaw (1987) disagreed with this interpretation, suggesting that lithological marker bands used by Palmer (1971) and Simms (1990a) for correlation within the Severn Basin were confined to individual sub-basins. Another possibility is that the Subnodosus Sandstone Member, far from being absent at Robin's Wood Hill Quarry, may in fact be represented in part by the thick silty sandstone of Bed 36. Sumbler *et al.* (2000) suggested that differential subsidence and intermittent truncation across sedimentary highs at times of eustatic lowstand, rather then any uplift, was the principal control on sedimentation erosion.

Conglomeratic horizons are developed at several levels throughout the succession at this site. Typically the clasts are of siltstone, evidently derived from the sediments beneath, and commonly are of a flattened discoidal shape. Palmer (1971) correlated some of these beds across the Severn Basin and possibly beyond, indicating widespread episodes of erosion and reduced sedimentation, which he (Palmer, 1973) attributed to periods of shallowing. The relative abundance of these episodes, represented by the conglomeratic horizons, at Robin's Wood Hill Quarry may indicate proximity to an area of uplift, and hence some may be of local distribution. Chidlaw (unpublished observations) has noted evidence for prolonged weathering, with leaching and concentration of iron oxide, at the top of Bed 22 in the Dyrham Formation and at the top of the Marlstone Rock Formation (Bed B) exposed in the track-side section. These horizons are developed at the top of upward-shallowing cycles and they may represent the lower horizons of lateritic palaeosols developed during brief periods of emergence.

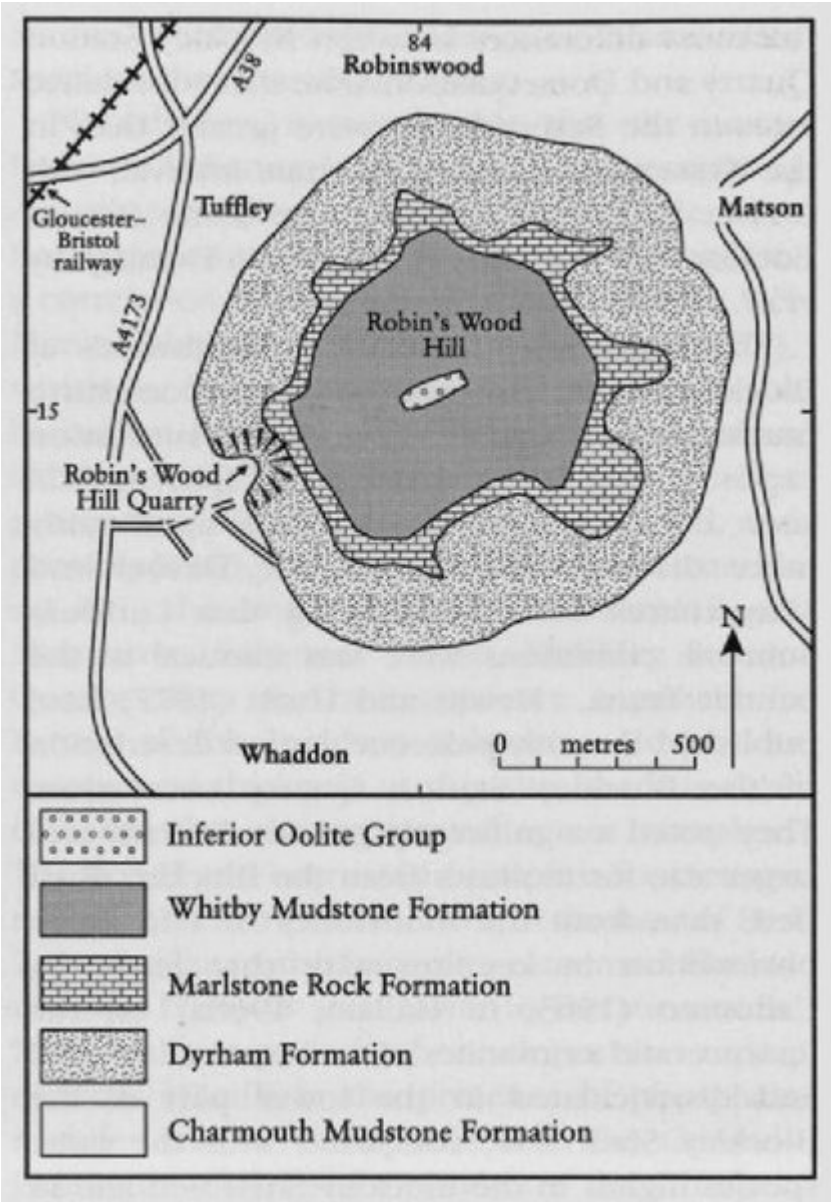
Robin's Wood Hill Quarry has been the site of a number of significant palaeontological discoveries. The discovery of *Amaltheus subnodosus* up to 2.6 m above examples of *Gibbirhynchia micra* in Bed 35 extends the known range of this brachiopod, which formerly was recorded only from the uppermost Gibbosus Subzone and lower Spinatum Zone (Alter, 1954). The occurrence of *Tetrarhynchia dunrobinensis* in Bed 8 of Palmer (1971, 1973) extends its geographical range from its previously known distribution in Yorkshire and Scotland. Palmer (1973) interpreted the abundance of large filter-feeding bivalves in the coarser units of the Dyrham Formation and the Marlstone Rock Formation as evidence of well-oxygenated water and abundant 'plankton rain' and conduded, from the occurrence of trochid gastropods, that water depths did not exceed 100 in. The occurrence of articulated crinoids and ophiuroids in an impersistent siltstone in the Dyrham Formation in Bed 18 represents an example of an obrution deposit (Seilacher *et al.,* 1985) in which the crinoids and ophiuroids were killed and preserved as a result of catastrophic burial, perhaps associated with storm re-suspension of sediment. Similar occurrences of *B. gracilis* and *P. milleri,* preserved in siltstone lenticles by obrution, are found at a comparable stratigraphical level in the Stokesi Subzone on the Dorset coast. Such deposits indicate that the sea floor was above storm wave-base at this time, and the sea was much shallower, perhaps as little as 20 m or less (Hallam, 1997). Still further support for this comes from the investigations of Lord (1972, 1974) and Malz and Lord (1976), who found a higher incidence of ornamented and heavily calcified ostracods in the Charmouth Mudstone and Dyrham formations at Robin's Wood Hill Quarry than in the broadly coeval beds at the Blockley Station Quarry GCR site, indicating a rather shallower, higher-energy palaeoenvironment at Robin's Wood Hill Quarry. Lord (1972, 1974) also noted a strong similarity between the ostracod faunas of Robin's Wood Hill and the Dorset coast and concluded that an open seaway connection existed between the two areas. In contrast, the connection with the East Midlands Shelf was

much poorer. This equates broadly with the recognition by Ager (1956a) and Howarth (1958) of distinct faunal provinces for the south-west and the Midlands.

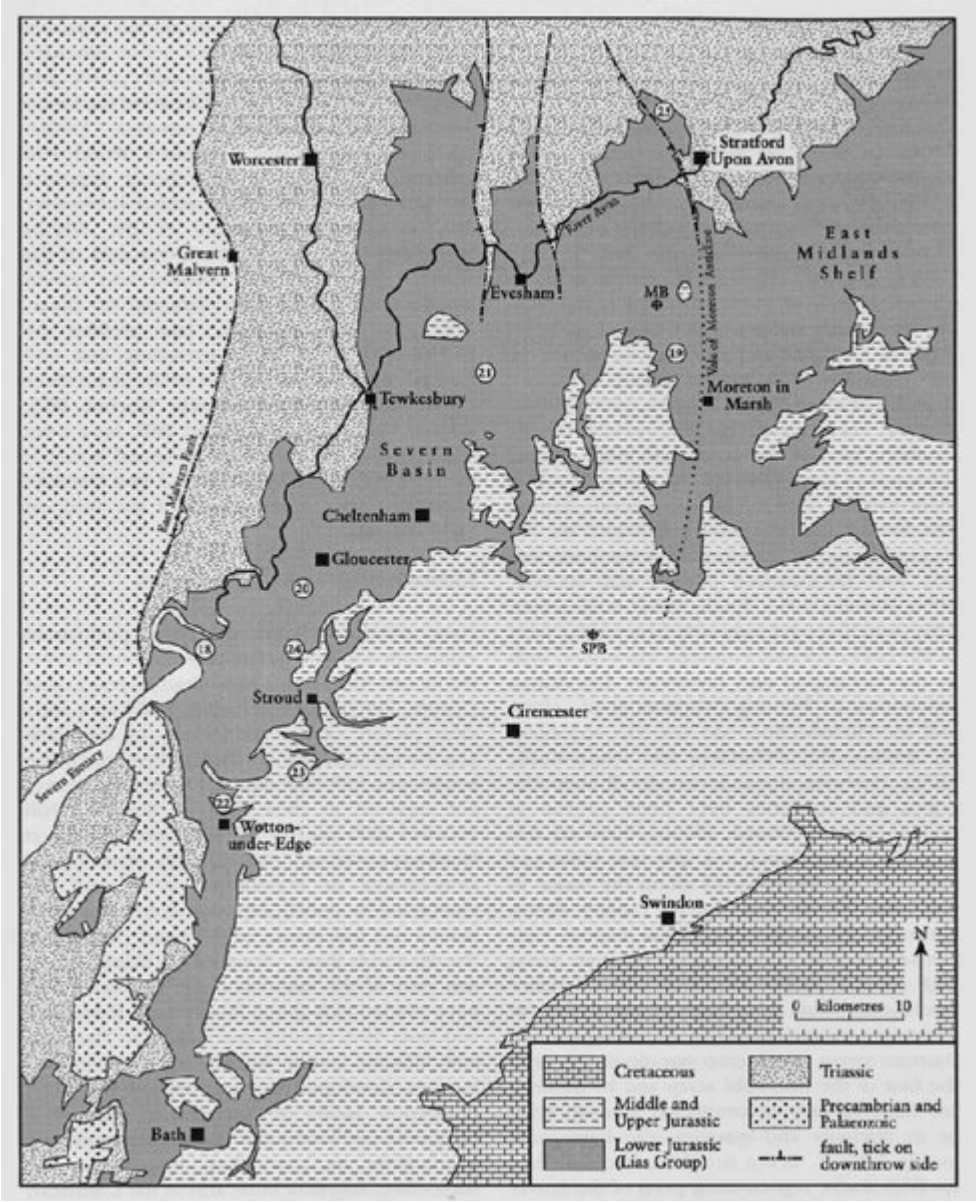
Conclusions

Robin's Wood Hill Quarry provides the finest section through the Pliensbachian Stage, in particular the Dyrham Formation for which it has been designated type locality, of any site between the Dorset and Yorkshire coasts. The succession exposed here has proven critical to understanding the underlying controls on facies distribution in the Severn Basin from the Upper Pliensbachian Substage into the Middle Jurassic Series. As one of only a small number of inland sites to still expose this part of the Lower Jurassic succession, Robin's Wood Hill Quarry is a key site for any investigations of early Jurassic palaeogeography, basin development and eustasy in southern Britain.

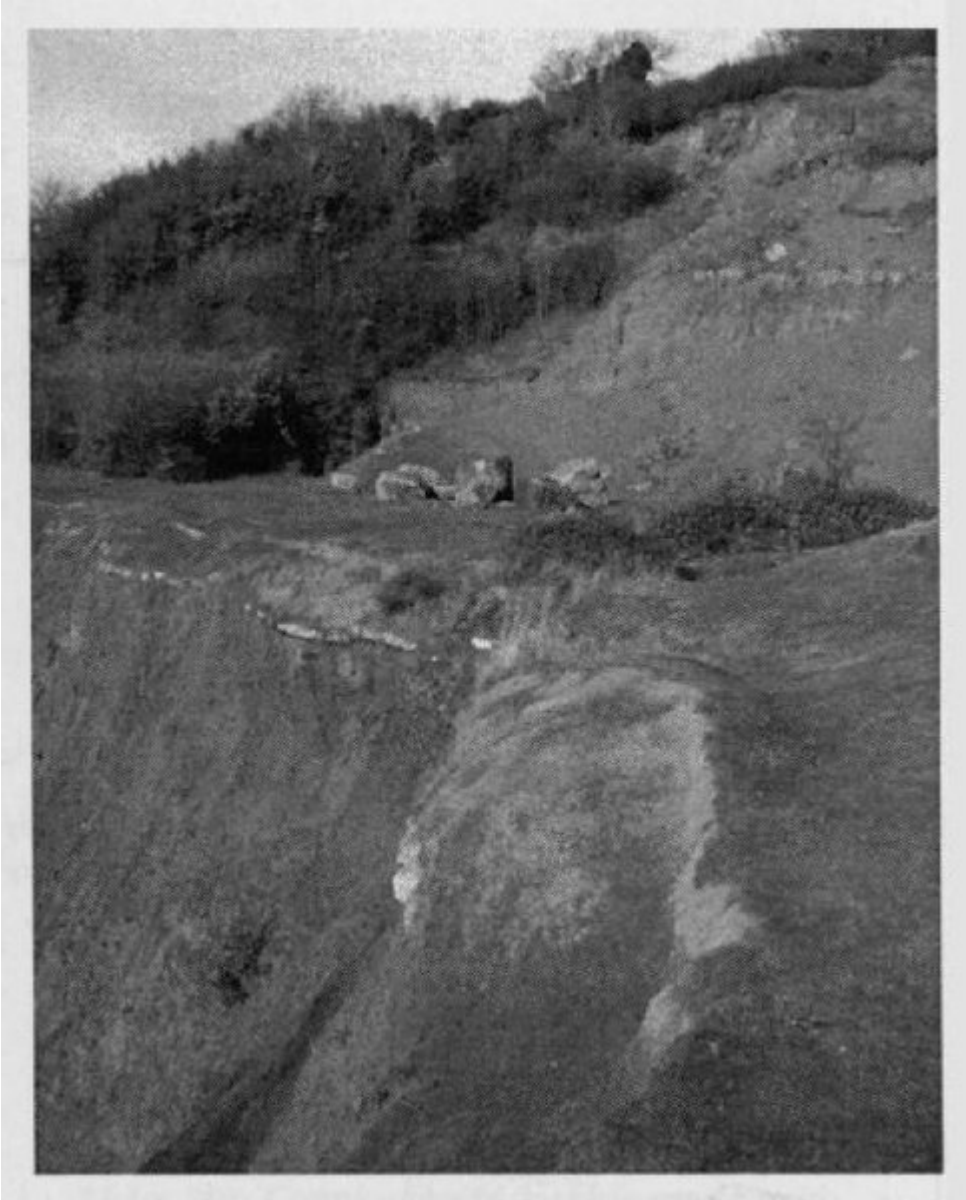
References



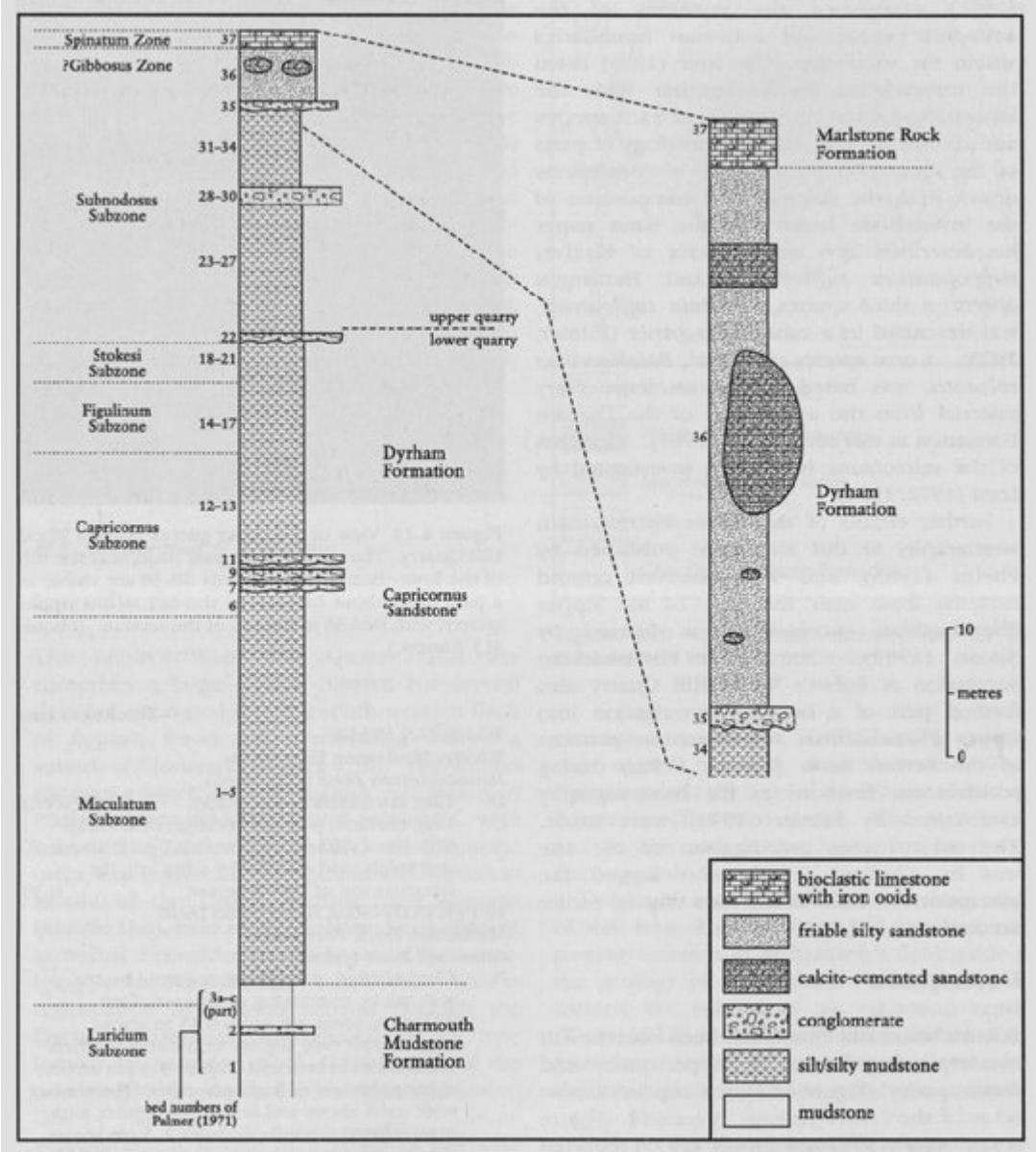
(Figure 4.10) Geology and location map for the Robin's Wood Hill Quarry GCR site.



(Figure 4.1) Generalized geology of the Severn Basin and western edge of the East Midlands Shelf. Only the main basin-bounding faults are indicated. Numbers correspond to the locations of the GCR sites: 18 — Hock Cliff; 19 — Blockley Station Quarry; 20 — Robin's Wood Hill Quarry; 21 — Alderton Hill Quarry; 22 — Wotton Hill; 23 — Coaley Wood; 24 — Haresfield Hill; 25 — Newnham (Wilmcote) Quarry (Chapter 5); MB — Mickleton Borehole; SPB — Stowell Park Borehole.



(Figure 4.11) View of the upper part of Robin's Wood Hill Quarry. The conspicuous pale band near the top of the lower face is Bed 22; beds 28–30 are visible as a pale band about halfway up the face of the upper quarry; with Bed 35 at the top of the section. (Photo: M.J. Simms.)



(Figure 4.12) Simplified graphic log of the Pliensbachian succession exposed at Robin's Wood Hill Quarry. After Chidlaw (1987).