FOGNAM QUARRY

OS Grid Reference: SU298800

Introduction

Fognam Quarry is a large abandoned chalk pit on the west side of the B4000 road, 3 km WNW of Lambourn (Figure 4.6). It is a key section through the Chalk Rock Member close to its type locality and area of maximum development. It is also the type locality for the (intra-Chalk Rock) Fognam Marl, and for the Fognam Farm Hardground, one of the component hardgrounds of the Chalk Rock. The succession below the Chalk Rock is crucial to resolving the continuing and contentious problem of the stratigraphical relationship between the Chalk Rock and the basinal Southern Province successions, and to determining the base level of sub-Chalk Rock erosion. It is also of importance to British Upper Cretaceous ammonite biostratigraphy because two of the international Middle Turonian zonal index ammonites,*Romaniceras* (*Yubariceras*) *ornatissimum* (Stoliczka) and *Collignoniceras woollgari* (Mantell), have both been collected *in situ*. The Fognam site has provided the lowest record in Britain of the ammonite genus *Subprionocyclus,* which has enabled the base of the international basal Upper Turonian *Subprionocyclus neptuni* ammonite Zone to be approximately identified in the lower part of the Chalk Rock standard succession.

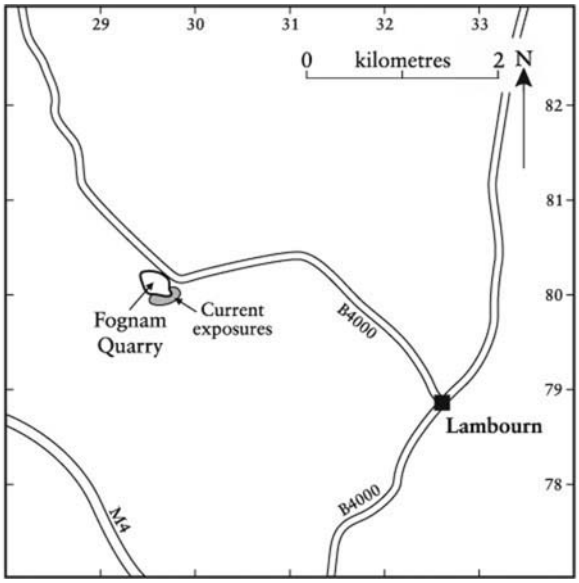

Figure 4.6: Location of Fognam Quarry (Fognam Farm), near Lambourn, Berkshire.

Description

The rapidly degrading faces of Fognam Quarry expose a section from 9 m below the Chalk Rock to some 3 m above the Chalk Rock. Details of the Chalk Rock succession were given by Bromley and Gale (1982). Mortimore (1987, fig. 5) correlated the section with geophysical downhole wireline logs of boreholes in the vicinity, and with other Chalk Rock localities including Beggar's Knoll Quarry and **Shillingstone Quarry** (see GCR site report, this volume). Wray and Gale (1993) described the clay mineral trace-element geochemistry of the Fognam Marl and the marl beneath the lowest hardground (Ogbourne) of the Chalk Rock, using this evidence to demonstrate a different interpretation of the correlation between the condensed Chalk Rock and expanded basinal successions from those ofBromley and Gale (1982) and Mortimore (1987). Wright and Kennedy (1981) gave a graphic log with macrofossil data down to the Ogbourne Hardground, and illustrations of Middle Turonian ammonites from the section beneath this hardground. Gale (1996) used the site as a key element in a sequence stratigraphical and cyclostratigraphical interpretation of the Turonian Stage, and discussed the significance of the ammonite biostratigraphy.

Lithostratigraphy

The lower part of the section (Figure 4.4) exposes *c*. 8 m of chalk with flints and marl seams, the lowest 2 m of which can be assigned to the New Pit Chalk Formation of the Southern Province. Some of the flints have distinctively lilac-coloured cortices and grey-black cores. Above the highest flint band are found the two hardgrounds that constitute the bottom hardground suite (Bromley and Gale, 1982) of the Chalk Rock. Both of these hardgrounds are much less well cemented and mineralized, as well as showing a much lower relief, than the same hardgrounds in the Chalk Rock type section at Ogbourne Maizey (SU 180 716). The lower (Ogbourne) hardground is glauconitized and near-planar, and the subjacent chalkstone possesses a distinctive patchy orange coloration. It is overlain by weakly nodular, coarse-grained, highly fossiliferous, shelly chalk, which terminates in a poorly lithified thin, pink-coloured chalkstone and a near-planar pinkish-brown phosphatized surface. This higher (Pewsey) hardground is a poor development of the strongly phosphatized, highly convolute hardground of the type section. The chalk immediately above the hardground contains common brown phosphatized intraclasts, including small fossils such as internal moulds of inoceramid bivalves and ammonites.

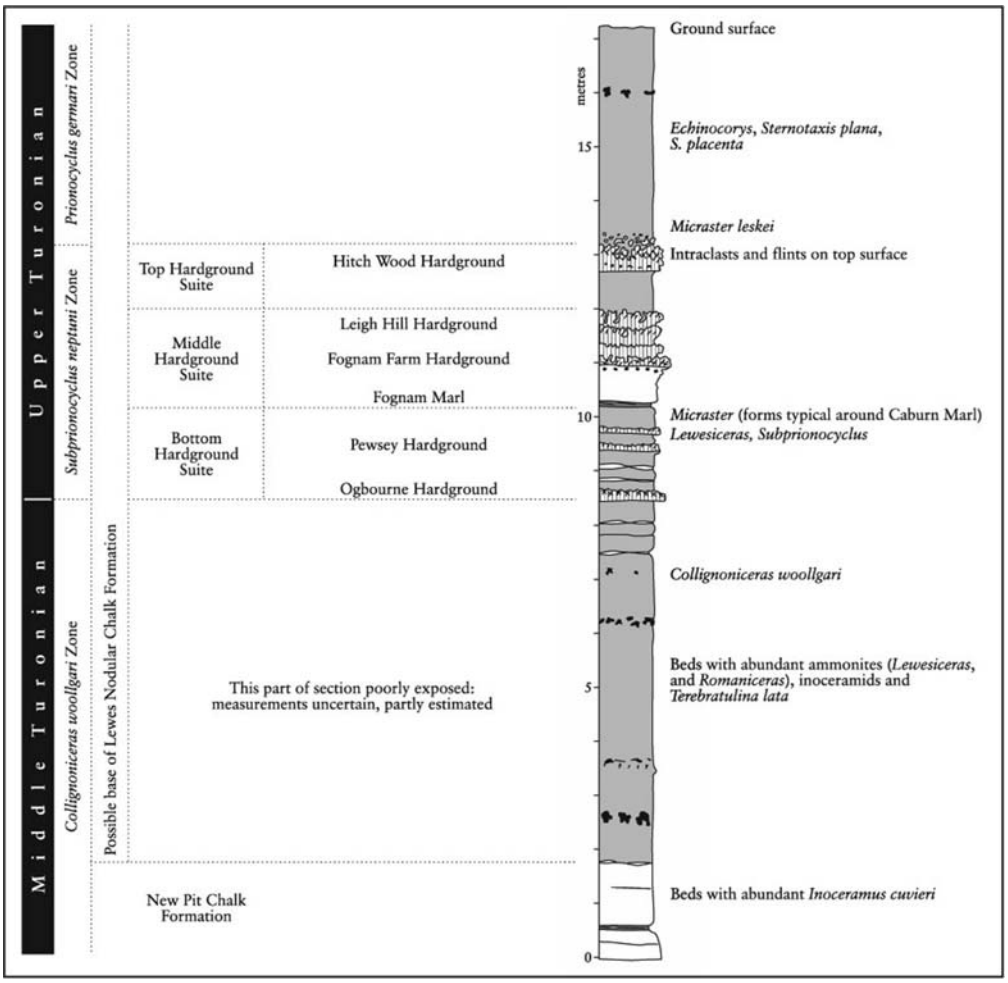

Figure 4.4: The Chalk succession exposed at Fognam Quarry, a key section for Chalk Rock stratigraphy. Compare with Charnage Down Chalk Pit (Figure 3.41, Chapter 3) and Kensworth Chalk Pit (Figure 4.21).

The bottom hardground suite of the Chalk Rock is separated from the middle and top suites by an interval of flintless chalk containing a conspicuous 0.02–0.1 m thick silty greyish marl seam, the Fognam Marl, for which this is the type locality. The marl contains scattered glauconite grains and small phosphatized and glauconitized intraclasts, which also occur in the chalk immediately above and below. The hardgrounds and associated chalkstones that comprise the middle and top hardground suites are moderately well exposed. The lowest (Fognam Farm)

hardground is strongly glauconitized, distinctively dark bottle-green in colour and overlain by a 0.1 m lag of even darker green pebbles. The hardground succession is essentially similar to that at Ogbourne Maizey, but the top hardground (Leigh Hill) of the middle suite is overlain here by a minor hardground, and the Hitch Wood Hardground is single rather than double, with a hummocky, instead of convolute, relief (see Bromley and Gale, 1982, fig. 12). There are also several unnamed glauconitized hardgrounds. The chalk immediately above the Hitch Wood Hardground contains glauconitized pebbles and small irregular carious burrow-form flints. The Chalk Rock is overlain by *c*. 3 m of white chalk containing a single flint band near the top of the section.

Biostratigraphy

The section extends from a level in the *Terebratulina lata* Zone to high in the *Sternotaxis plana* Zone. The diminutive zonal index brachiopod, *Terebratulina lata* R. Etheridge, occurs above the lowest conspicuous flint band and, together with the terebratulid brachiopod *Gibbithyris* sp. in the interval between the Ogbourne and Pewsey hardgrounds, where it is common. It is also common at the level of the Fognam Marl.

The inoceramid bivalve *Inoceramus cuvieri* J. Sowerby is particularly common below the marl seams at the base of the succession. The overlying flinty succession has yielded several in-situ specimens of the international Middle Turonian zonal index ammonite *Romaniceras* (*Yubariceras*) *ornatissimum* (e.g. Wright and Kennedy, 1981, pl. 15, fig. 1). The 2 m interval below the Ogbourne Hardground contains ammonites, including the Middle Turonian zonal index species *Collignoniceras woollgari*, as well as *Lewesiceras peramplum* (Mantell) and *Scaphites* sp.. Well-preserved inoceramid bivalves (some with the valves articulated), including *I. cuvieri*, are common at this level. In addition to indeterminate inoceramids, the phosphatized internal moulds above the Pewsey Hardground include the heteromorph ammonite *Sciponoceras bohemicum* (Fritsch) and a *Subprionocyclus* intermediate between *S. neptuni* (Geinitz) and *S. branneri* (Anderson) (Gale, 1996). Of particular interest is the occurrence of primitive forms of the echinoid *Micraster* in the interval from immediately below the Fognam Marl and the Fognam Farm Hardground. These have plate structures similar to those of *Micraster* from the Caburn Marl in Sussex.

The *reussianum* fauna of the terminal (Hitch Wood) hardground of the Chalk Rock at this locality is not particularly noteworthy, in comparison to its richness at **Kensworth Chalk Pit** (see GCR site report, this volume) and at the type locality, the Hill End Pit in Hertfordshire. The beds above the Chalk Rock contain the zonal index echinoid, *Sternotaxis plana* (Mantell) as well as *Sternotaxis placenta* (Agassiz), *Echinocorys* hexactinellid sponges, brachiopods, the spinose bivalve *Spondylus spinosus* (J. Sowerby) and *Micraster* sp. (Wright and Kennedy, 1981, fig. 6).

Interpretation

The succession at this site is critical to the understanding of the stratigraphical position of the Chalk Rock in relation to the expanded basinal successions of the Southern Province. Using a combination of flint band correlation and cyclostratigraphy (the succession of inferred precession-controlled marl–chalk couplets), Gale (1996, fig. 5) correlated the short section below the Ogbourne Hardground with the key section at Beggars Knoll Quarry, Wiltshire (ST 890 506) and with sections on the south coast, ranging from Ballard Head (part of the **Handfast Point to Ballard Point** GCR site) in Dorset, through the Isle of Wight **Compton Bay** GCR site and Culver Cliff, to the expanded section at Beachy Head, Eastbourne and the condensed section at Dover (part of the **Folkestone to Kingsdown** GCR site). All of these sections span the complete interval from the top of the Holywell Nodular Chalk Formation to the lithified erosion surface forming the Ogbourne Hardground and its inferred lateral correlative in the basinal succession. It should be noted that use, in the older literature, of the term 'Spurious Chalk Rock' (Rowe, 1901, 1908) for intra-*Terebratulina lata* Zone hardgrounds in the Dorset and Isle of Wight sections refers mainly (but not exclusively) to the glauconitized Ogbourne Hardground (see Bromley and Gale, 1982).

In Gale's interpretation, the marl seam *c*. 1 m below the Ogbourne Hardground at Fognam Quarry is the Round Down Marl (Robinson, 1986: Malling Street Marl of Mortimore 1983,

1986a) of the condensed section at Dover and the marl component of couplet F20 of the expanded successions. On this basis, he demonstrated (Gale, 1996, fig. 5) that pre-Ogbourne Hardground erosion had cut down more deeply into the New Pit Chalk Formation at Fognam Quarry than elsewhere. For example, an additional 16 couplets above F20 can be identified beneath the Ogbourne Hardground at Ballard Head, the hardground itself representing the lithification of the chalk component of couplet F36. Extending this interpretation to the expanded basinal section at Beachy Head, Eastbourne, Gale (1996, figs 2, 5) identified the Ogbourne surface at a level of weakly nodular chalk in the New Pit Chalk Formation, some 5 m below New Pit Marl 1. He also correlated (his fig. 6) the distinctively pink-coloured phosphatized Pewsey Hardground with a level of pink-coloured phosphates high in the interval between the Glynde Marls and Southerham Marl 1 and, consequently, equated the overlying Fognam Marl with Southerham Marl 1.

The corollary of Gale's interpretation is that an interval (20–40 m thick) in the basinal succession, from just above the Round Down Marl (Malling Street Marl) in the New Pit Chalk, to a level at or above the base of the Lewes Nodular Chalk Formation, may be missing at the Ogbourne Hardground surface at Fognam and correlative localities.

Gale (1996, fig. 8) additionally applied a sequence stratigraphical interpretation to the succession of hardgrounds that comprises the Chalk Rock in and adjacent to the type area. In his model, the two most strongly glauconitized hardgrounds, the Ogbourne Hardground at the base of the bottom suite, and the Fognam Farm Hardground at the base of the middle suite, represent major sequence boundaries. The variable position of the surface in the basinal succession that corresponds to the Ogbourne sequence boundary has been discussed above. Given that the Fognam Marl in the type area is the equivalent of Southerham Marl 1, the overlying Fognam Farm sequence boundary must relate to a surface in the interval of relatively nodular chalks between Southerham Marl 1 and the Caburn Marl. Erosion associated with both of the sequence boundaries has proceeded to a varying extent according to the depositional and/or structural position. Although the greater degree of erosion is associated with the Ogbourne sequence boundary, Gale (1996) noted that pre-Fognam Farm erosion had locally (e.g. at some localities in the Chiltern Hills) cut down to a level beneath the equivalent of Southerham Marl 1; at such localities, the sub-Chalk Rock ‘Fognam Marl' was a Glynde Marl (cf. Wray and Gale, 1993) and not the correlative of the Fognam Marl of the type area. In contrast to the main glauconitized hardgrounds, the two main phosphatized (Pewsey and Hitch Wood) hardgrounds of the Chalk Rock are inferred (Gale, 1996, fig. 8) to represent transgressive (onlap) surfaces belonging to Turonian sequences 3 and 4 respectively.

Gale's interpretation of the Fognam Marl and the underlying weakly developed Pewsey Hardground at Fognam as the Southerham Marl 1 and pink phosphate horizon respectively of the Beachy Head succession appears to be well supported by the evidence. However, there are potentially serious problems with his interpretation of the Ogbourne Hardground and the underlying succession. In particular, the available biostratigraphical evidence from the site itself, taken in combination with the geophysical logs of water wells in the vicinity (Mortimore, 1987; Tate *et al*., 1971), suggests that there is a considerable thickness of Chalk between the Ogbourne Hardground and the Plenus Marls Member in the immediate area. This thickness is far greater than is allowed for in Gale's (1996, fig. 5) inferred correlation between Fognam Quarry and the key Beggars Knoll Quarry succession. The abundance of *Inoceramus cuvieri*, rather than *Mytiloides* ex gr. *subhercynicus* (Seitz) beneath the supposed correlative of the Round Down Marl at both localities fits better with a level nearer the top than the base of the New Pit Chalk Formation.

The site is of key importance because of the occurrence of the ammonite *Romaniceras* (*Yubariceras*) *ornatissimum* in the succession below the Ogbourne Hardground. This occurrence, at two horizons beneath the inferred Round Down Marl (Gale, 1996, fig. 8) provides additional evidence for the existence in England of the international *R. ornatissimum* ammonite Zone/Subzone, which is recognized in France, Spain and North Africa (Wiese, 1997). Hitherto the only in-situ record of the index taxon was a specimen from the New Pit Marl 2–Glynde Marls interval in Sussex (Mortimore, 1986a; Lake *et al*., 1987, fig. 19). The occurrence of the Middle Turonian index fossil *Collignoniceras woollgari* between the inferred Round Down Marl and the Ogbourne Hardground, and of definite *Subprionocyclus*, including forms between the basal Upper Turonian zonal index fossil, *S. neptuni* and the coarser-ribbed

S. branneri, in the phosphates over the Pewsey Hardground, suggests that the boundary between the *woollgari* and *neptuni* zones should be placed either in the interval between the Ogbourne and Pewsey hardgrounds or at the Pewsey Hardground itself.

Fognam Quarry is hence the one locality where the Pewsey Hardground can be placed unequivocally at or immediately above the base of the Upper Turonian Substage. *Subprionocyclus* (*S. hitchinensis* (Billinghurst)) is also known from just above Southerham Marl 1 at Dover (Gale, 1996). The identification by Gale of the Pewsey Hardground phosphates and their associated pink-coloured chalkstone with a similar bed high in the Glynde Marls–Southerham Marl 1 interval at Eastbourne has therefore necessitated a downward revision of the base of the Upper Turonian succession to at least this level in the basinal succession. This latter datum may thus correspond to the transgressive surface of Gale's Turonian sequence 3. Wiese (1999) recommended that the Pewsey Hardground and its corresponding 'spike' in $*^{13}C$ curves could well serve as a marker for the base of the Upper Turonian Substage.

Conclusions

Fognam Quarry is a critical locality for the definition, correlation and interpretation of the Chalk Rock. This succession of hardgrounds and nodular chalk beds is the condensed equivalent of much of the lower Lewes Nodular Chalk Formation. Condensation has led to the loss of the key tephro-event marker marl seams of the more expanded basinal successions and in turn this has meant that correlations are difficult to prove and can be controversial. The fossils from the quarry, particularly Middle and Upper Turonian ammonites associated with inoceramid bivalve assemblages, provide the evidence for dating the Chalk Rock as a whole and the individual surfaces within the rock. This dating is essential to the various sedimentary models proposed for the origin of the Chalk Rock, the Lewes Nodular Chalk Formation, and interpretations of sequence- and cyclo-stratigraphy more widely in the Chalk.

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