BRITISH GEOLOGICAL SURVEY

TECHNICAL REPORT WA/89/68

Onshore Geology Series

TECHNICAL REPORT WA/89/68

Geological notes and local details for 1:10 000 Sheet SP70NW (Thame and Haddenham)

Part of 1:50 000 Sheet 237 (Thame)

R D Lake

Geographical index
UK, Buckinghamshire, Oxfordshire

Subject index
Geology, Upper Jurassic,
Lower Cretaceous, Quaternary

Bibliographic reference
Lake, R D. 1989. Geological notes and local details for 1:10 000 Sheet SP70NW (Thame and Haddenham). *British Geological Survey Technical Report* WA/89/68.

 Keyworth, Nottingham British Geological Survey 1989

Preface

This report summarises the geology of 1:10 000 sheet SP70NW which forms part of the 1:50 000 Geological Sheet 237 (Thame).

The area was surveyed by R D Lake, with parts by K Ambrose and A J M Barron in 1987, as part of a geological survey supported by the Thames Water Authority, under the direction of R G Thurrell, Regional Geologist.

F G Larminie
Director
British Geological Survey
Keyworth
Nottingham NG12 5GG

Geological notes and local details for 1:10 000 Sheet SP70NW, Thame and Haddenham

Introduction

The area described is largely rural but includes the conurbations of Thame and Haddenham, together with the villages of Kingsey and Towersey. The drainage of the River Thame and its tributaries has influenced the pattern of main roads in the area, which generally run in an easterly or south-easterly direction along the major interfluves. The one remaining passenger railway runs across the grain of the country north-westwards through Haddenham.

The ground is generally broadly undulating although steeper slopes are present to the north-west of the Thame valley, where an altitude of 110 m is reached in the extreme north-west corner of the quarter-sheet.

Elsewhere, the interfluves have maximum elevations of between 77 and 90 m, whereas the valley-floors lie at between 63 and 70 m.

Geological sequence

The solid deposits and drift deposits represented on the 1:10 000 geological map are listed below.

	Typical thickness m
SUPERFICIAL DEPOSITS (Drift)	
Alluvium	up to 7
River terrace deposits	up to 4
Head	up to 3
SOLID FORMATIONS	
Cretaceous	
Gault	up to 25
Lower Greensand	?1.5
- UNCONFORMITY -	
Jurassic	
Whitchurch Sand Formation	up to 7

- DISCONFORMITY -	
Purbeck Formation	up to 3
Portland Formation	9 to 15
Kimmeridge Clay Formation	seen to 15

Solid formations

Kimmeridge Clay Formation

The oldest proved formation in this area is the Kimmeridge Clay which occurs at outcrop in the Thame valley and near Thame. This comprises alternating medium grey and dark grey bituminous mudstones which weather to firm medium grey clays. Impersistent nodular cementstones also occur.

The highest beds are of buff or greenish grey, locally clayey, fine-grained sands, up to 10 m thick (the 'Thame Sand' of earlier authors); a thickness of 5 m is more typical. There is also a less persistent bed of sands and clayey sands, up to 5 m thick and about 5 m below the 'Thame Sand', in the area to the north-west of the Thame valley.

In the nearby Hartwell Borehole [7926 1223] the sandy beds of the Upper Kimmeridge Clay ('Hartwell Clay') were found to lie in the Pallasioides Zone (Cox in MS).

Portland Formation

This formation occurs extensively in the area and, although it is characterised by marked vertical and lateral variations of lithology, has been divided as follows in descending order (Ballance, 1963; Bristow, 1968):

Creamy Limestone (Blake, 1880)
Crendon Sand (Buckman, 1926)
Glauconitic Beds and Rubbly Limestone (Blake, 1880)
Lydite Bed (Hudleston, 1887)

The Lydite Bed is typified by well rounded pebbles of black chert, together with quartz and Kimmeridgian phosphate, in a matrix variously of sand, clayey sand, silt or sandy limestone, up to 0.3 m thick.

The succeeding beds comprise glauconitic calcareous sands and sandy clays with a patchy development of sandy, shelly or pelletal limestones, whereas the 'Crendon Sand' above consists of locally calcareous, fine-grained sands. The highest unit, the 'Creamy Limestone', includes shelly, crystalline, micritic limestones, locally sandy, pelletal or with oyster-encrustations and with thin sands and marls. Ammonites and the bivalve *Protocardia* are locally common in the limestones; serpulid horizons also occur, particularly near the top of the formation.

It is doubtful if the above subdivisions have real correlative value, except on a local scale, and in the recent survey it was found practicable to distinguish an upper limestone unit (Portland Stone Member or 'Creamy Limestone') and a lower division of variable lithologies (Portland Sand Member); locally an intervening sand (the 'Crendon Sand') could be mapped. Typically these units are 4 to 10 m, 2 to 5 m and 1 to 2 m thick, respectively.

The sand bed was delineated to the south-west of Haddenham; near Scotsgrove House [712 076] a glauconitic sandy clay was augered at a comparable stratigraphical level. In the railway cutting [c 728 088] near Haddenham, Jukes-Browne (in MS) recorded the following section:

	Thickness m
[Portland Formation]	
Decomposed marly and clayey beds	[2.4 or 3.0]
Portland fossil bed [?limestone]	[1.5 or 1.8]
Strong lydite bed at base	
[Sand in Kimmeridge Clay]	
Bluish and brown shaly sands passing down into bluish sands or slightly clayey sands	

Further to the north-west [c 7250 0915] Davies (1904) recorded beneath 0.46 m of topsoil:

	Thickness m
[Portland Formation, partly decalcified]	
Buff sands with some rubbly limestone in places	[0.76]
Very glauconitic sand	[0.30]
Buff sand	[0.71]
Wet sand with limestone nodules	[0.36]
Pebble bed [Lydite Bed]	[0.23]
[Sand in Kimmeridge Clay]	
Buff, dry sands	[1.98]
Black, wet sands more clayey towards the base, not bottomed	[1.30]

These two sections suggest that the sands above the Lydite Bed in Davies' section represented the decalcified Portland Stone Member.

Details

Although the lower beds in this area appear variable, in the vicinity of Manor Farm [702 092], rubbly glauconitic sandstones dominate this part of the sequence. Hence a clear distinction can be made hereabouts between a lower sandstone and an upper limestone unit. Elsewhere a lower unit of mixed lithologies and an upper limestone unit are separated generally by a bed of sand, the 'Crendon Sand'. Exceptionally, near Scotsgrove House [712 076] a glauconitic sandy clay occurs, apparently at the level of the sand bed, and this has been taken to mark the top of the lower subdivision.

The following section [7430 0845] in Haddenham is an abridged and metricated version of that seen in a temporary exposure by Ballance (1963, p.402):

	Thickness m
Sandy soil	0.3
Clayey sand, brown with much clay ironstone. Base piped into bed below [regolith]	up to 0.6

Purbeck Formation	
Limestone, white, sandy, rubbly	up to 1.4
Limestone, white, very sandy, fissile, hard	0.1
Limestone, white, very fine-grained with pipes and pockets of green clay	0.3
Portland Formation	
Limestone, grey, crystalline, hard with oysters	0.1
Sand, fine-grained, grey, lenticular	0.03
Limestone, as before	0.1
Limestone, marly, shelly, 'gritty', yellowish	0.15
Limestone, grey, alternating soft and hard, locally shelly	0.8
Clay, grey and orange	0.08
Limestone, grey, shelly	0.4
Marl, brown, laminated	0.1
Limestone, grey, very fossiliferous, with oysters encrusting top surface	seen to 0.6

He also recorded the section in Haddenham railway-cutting [732 085]:

	Thickness m
Purbeck Formation	
Marl	0.15
Portland Formation	
Limestone, crystalline, hard, grey, with abundant shell debris	about 0.9
Gap in exposure	2.4
Limestone, sparsely oolitic, slightly sandy, shelly, cream	0.6
Sand	1.2

A more recent temporary exposure nearby [7308 0854] at a similar stratigraphical level showed:

	Thickness m
Portland Formation	
Limestone, sandy, shell-detrital, dark brownish grey, with serpulids	1.0
Marl, sandy, grey-green	0.5
Limestone, sandy, shell-detrital, buff	about 0.1
Marl, largely obscured; oyster-bed at base (at track level)	about 1.5

Purbeck Formation

These beds comprise pinkish grey, subporcellanous micrites, pale grey sandy micrites, ?algal laminites and pelmicrites together with marls and grey or green clays. Ostracods and small gastropods occur locally. The sequence is generally thinly preserved near Haddenham and Towersey and possibly disturbed by solution effects. The base of this formation has been taken at the lowest porcellanous limestone and/or above the highest serpulid/oyster-bearing limestone of the Portland Formation.

Details

This formation is thinly represented by faulted outcrops of porcellanous limestone and grey-brown silty clays to the north and west of Notley Abbey [7145 0925].

In the larger outcrops near Haddenham and Towersey there are few described sections apart from those referred to in the details of the Portland Formation. A former pit [c 7351 0591] on the east side of the road from Towersey to Kingsey (Davies, 1899, p.39) exposed the following metricated sequence:

	Thickness m
Soil	0.3
[Purbeck Formation]	
Band of nodular calcareous chert	0.05
Limestone, thin-bedded	0.1

Marl, with nodules at base	0.2
Limestone, thin-bedded	0.15
Marl, with *'Paludina'*	0.2
Limestone, thin-bedded	0.4
Sand, ferruginous, slightly clayey	0.1
Marl	0.2
[Portland Formation]	
Limestone, more massive [than above]	0.3
Limestone, thin-bedded	0.3
Limestone, more massive (*Protocardia dissimile*)	0.3

The field brash presently shows both porcellanous and laminated limestones, marl and green clay from the Purbeck Formation.

Whitchurch Sand Formation

Various patches of sand between Swindon, Wiltshire and Whitchurch, Bucks which contain a Purbeck fauna were assigned by Casey and Bristow (1964) to the 'Whitchurch Sands'. Two faunas were distinguished, an 'unusually saline facies' and a brackish water type. These were both assigned to horizons near to the top of the 'Lower Purbeck' by Morter (1984, p.231).

In this area buff, fine to medium-grained sands with thin clays occur as two outliers: on the Aylesbury Road [720 085] to the west of Haddenham and in the area [750 096] to the north-east of the village. At the latter locality up to 5 m of buff and pale grey clays with ironstone occur at the base of the formation. These occurrences together with two others in Haddenham village were mapped by Ballance (1963) as 'Wealden Beds' on very limited evidence. Indeed some or parts of his outcrops as delineated appear to consist of a superficial wash of brown clayey silts and sands with ironstone fragments derived in part at least from the clays mentioned above. One fragment of ironstone found by Ballance just to the east of this area [7512 0924] contained the gastropod *?Viviparus*, which is not diagnostic of age.

From a comparison with other occurrences in the Oxford area, these two outliers are provisionally assigned to the Whitchurch Sand Formation. In the eastern locality these deposits rest disconformably on the Purbeck Formation, and at the other, they overlie the Portland Formation.

Lower Greensand

With the exception of one small outcrop [710 051] in Thame and a probable borehole proving [7376 0519] at Towersey, the occurrences of Lower Greensand are apparently restricted to small disturbed pockets which apparently occupy shallow solution cavities in the Portland Formation, perhaps comparable to that described as 'reddish sands with ironstone' by Davies (1904), in the Haddenham railway-cutting. Relict Whitchurch Sand lithologies may also occur in this situation, however.

In this area the typical lithology which is thought to represent the Lower Greensand is that of a ferruginous fine- to medium-grained sand with scattered quartz and chert pebbles up to 5 mm in diameter. Iron-cemented examples of this type have been obtained from gravelly Head deposits, on an interfluve [747 059] near Grange Farm, Towersey. This Drift is likely to be degraded terrace material and the pebbles probably originally derived from outcrops in the Aylesbury area.

Details

In the former railway-cutting [7082 0527] at Thame about 0.5 m of brown, poorly sorted sand with small pebbles was proved by augering beneath about 0.5 m of grey silty clay (Gault) and some 3 m of terrace deposits.

Gault

The Gault comprises buff and pale grey micaceous mudstones and these occur extensively in the Towersey and Kingsey areas. Both the Upper and Lower Gault are thought to be represented in this area; sandy clays with phosphatic nodules ('coprolites') occur at the base of and within each division. A small faulted outlier of Lower Gault occurs on the ridge [712 094] near Notley Abbey.

The base of the Lower Gault was taken by Ballance (1963, p.41) as 'a bed of pebbly, ferruginous sandy clay several feet thick' in a railway-cutting [709 053] at Thame. Ferruginous sandy clays have been located at the base of the Gault to the north of Towersey; ironstone pebbles occur in a similar lithology at a point [7421 0729] north of Kingsey. Phosphatic nodules are reported to have been dug at the former brickyard [728 055] to the west of Towersey but their precise stratigraphical position is uncertain because of the nearby presence of a fault, and its associated terminal bending.

Structure

Within this particular area, the effects of the sub-Cretaceous unconformity are not particularly marked. In the Kingsey, Towersey and Notley Abbey [713 092] areas, the Gault rests with gentle discordance on Purbeck and Portland beds. To the west of Thame, however, the Gault steps down on to beds in the Kimmeridge Clay (see sheet SP60NE). There is no direct evidence of intra-Cretaceous faulting. The strata dip generally to the south-east at values of less than ½ to 1°. The unconformable nature of the base of the Cretaceous sediments is reflected by increased, perhaps doubled, dip-values for these beds within these limits.

Locally, higher average dip values (of 2°) are apparent, for example on the flanks of the Thame valley, due to cambering. It is also probable that dips increase in the proximity to faults where terminal bending of the adjacent strata is present. This effect is apparent to the north of Towersey where the strike swings abruptly from NNE to an easterly sense, near a fault with the latter trend. Some other faults also influence the direction of strike.

Superficial structures: cambers

Cambering is generally best developed where permeable, moderately hard sandstones or limestones overlie clays and cap the higher ground. Valleyward attenuation of the argillaceous beds has caused the harder beds to arch over the summit and to drape downslope. The associated fracturing of these beds resulted in 'dip-and-fault structure' and intermixing of lithologies; fissures or 'gulls' may also have formed between fault-blocks.

It is probable that the higher ground to the north-west of the Thame valley is affected by cambering and, as a consequence, the apparent thicknesses of the mapped sandstones and limestones may be disproportionately large. To the south-east of the valley the effects of cambering are possibly much reduced.

Drift deposits

Head

Heterogeneous deposits of brown stony sandy clays and clayey sands form thin cappings to the interfluves in the south-eastern part of the area. The stony pockets contain flint, sandstone and limestone clasts; the deposits generally have a markedly cryoturbated base, particularly where they overlie the Gault. These occurrences lie at levels above 70 m OD. The sediments are probably the dissected remnants of a formerly more extensive solifluction sheet which may have been contiguous with the higher terrace deposits. Locally the presence of ironstone and sandstone gravels suggests that this body incorporated patches of river terrace material.

Head deposits also occur on the lower parts of the valley-sides. These predominantly buff silty loams and soft brown clays were derived by solifluction and other processes, such as spring-sapping and hillwash, from parent materials upslope.

Details

A ditch section [7235 0513] near Cotmore Wells Farm exposed up to 1.5 m of cryoturbated Head deposits overlying Gault. The former comprised clayey sand with scattered pebbles; at the base, and occupying involution hollows, lenticular masses of marl with limestone rubble were present. Possibly the limestone material was derived from the terrace deposits upslope to the west.

River terrace deposits

Four terraces have been distinguished in the Thame valley downstream from this area, at general levels of 0 to 5, 5 to 12, 15 to 16 and 25 to 27 m above the present-day alluvium; these are designated Second, Third, Fourth and Fifth terraces respectively.

In this area only the lower three are present, but in Thame, terraces 3 and 4 cannot be distinguished as separate entities. It is likely that the latter units originally merged laterally with high level solifluction deposits; in the eastern part of Thame, sandy gravels are overlain by pebbly clayey sands and sandy clays, the latter probably of solifluction origin. Elsewhere the terrace deposits consist largely of pebbly sands; the pebbles are commonly of rounded sandstone, ironstone, chert, quartz and angular flint.

Alluvium

The alluvium present at the surface in the major floodplains comprises soft to firm, grey-brown, silty and sandy clays. At the base, fine- to coarse-grained gravel in a silty sand matrix is present. This lower unit is up to 5 m thick and is markedly variable in thickness, on a local scale. A thickness of 2 to 3 m is probably more typical. It is possible that, near Thame, the gravels are laterally contiguous with the flanking (Second) terrace deposits.

Made ground

Apart from railway embankments and other earthworks, areas of made ground include back-filled pits, landscaped urban sites and a tip for domestic waste [712 068] near Thame Sewage Works. Such examples are small and isolated. One area of hummocky made ground [738 064] near Kingsey constricts the floodplain of a tributary stream to the River Thame.

Economic geology

Supplies of potable domestic water have been obtained from shallow wells sunk in the Portland Formation in the Haddenham and Towersey areas. A public works [7281 0605], east of Thame, extracts water from wells sunk in this formation and the underlying 'Thame Sand'. One domestic well [7376 0519] at Towersey obtained water from a thin development of Lower Greensand, beneath the Gault.

The lowest terrace (2) deposits have been dug in the past for sandy gravels, near Thame. None is thought to be economically important now. Building stone and 'hoggin' was worked from shallow pits in the Purbeck Formation and the

Portland Formation (mainly in the upper beds). Sand was also extracted locally, for example from a pit [7131 0743] in the 'Thame Sand' near Scotsgrove House.

References

Ballance, P F. 1963. The beds between the Kimeridge and Gault clays in the Thame-Aylesbury neighbourhood. *Proc. Geol. Assoc.*, Vol. 74, pp.393-418.

Blake, J F. 1880. The Portland rocks of England. *Q. J. Geol. Soc. London*, Vol. 36, pp.189-236.

Bristow, C R. 1968. Portland and Purbeck beds. Pp.300-311 in *The Geology of the East Midlands*. Sylvester-Bradley, P C and Ford, T D (Eds). (Leicester Univ. Press).

Buckman, S S. 1926. *Type Ammonites*, VI. London.

Casey, R and Bristow, C R. 1964. Notes on some ferruginous strata in Buckinghamshire and Wiltshire. *Geol. Mag.*, Vol. 101, pp.116-128.

Davies, A M. 1899. Contributions to the geology of the Thame valley. *Proc. Geol. Assoc.*, Vol. 16, pp.15-57.

--------- 1904. Excursion to the new railway at Haddenham. *Proc. Geol. Assoc.*, Vol. 18, pp.385-87.

Hudleston, W H. 1887. Excursion to Aylesbury. *Proc. Geol. Assoc.*, Vol. 10, pp.166-172.

Morter, A A. 1984. Purbeck-Wealden mollusca and their relationship to ostracod biostratigraphy, stratigraphical correlation and palaeoecology in the Weald and adjacent areas. *Proc. Geol. Assoc.*, Vol. 95, pp.217-234.

Memorandum

British Geological Survey

Keyworth
Nottingham NG12 5GG

Plumtree (06 077) 6111
Telex 378173 BGSKEY G

From A Horton

To David Bate

Your reference

Our reference

Technical Report HA/89/6 8

Please publish this as soon as possible.

Please provide RD Lake 2d myself with a copy

Many thanks

Albert

Rec'd 5/7/89