British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

# Macrofossil palaeontology and stratigraphical interpretation of the Chalk Group in the Bradfield Southend Borehole (SU57SE229)

Geology & Landscape England Programme

Open Report OR/13/005

BRITISH GEOLOGICAL SURVEY

GEOLOGY & LANDSCAPE ENGLAND PROGRAMME

OPEN REPORT OR/13/005

# Macrofossil palaeontology and stratigraphical interpretation of the Chalk Group in the Bradfield Southend Borehole (SU57SE229)

M A Woods



*Keywords*

Chalk Group, Macrofossils, Santonian, Lithostratigraphy, Biostratigraphy, Chronostratigraphy.

*Map*

Sheet 268, 1:50 000 scale, Reading

*Bibliographical reference*

WOODS, M A. 2013. Macrofossil palaeontology and stratigraphical interpretation of the Chalk Group in the Bradfield Southend Borehole (SU57SE29). *British Geological Survey Open Report*, OR/13/005. 11pp.



Keyworth, Nottingham British Geological Survey 2013

## BRITISH GEOLOGICAL SURVEY

The full range of our publications is available from BGS shops at Nottingham, Edinburgh, London and Cardiff (Welsh publications only) see contact details below or shop online at www.geologyshop.com

The London Information Office also maintains a reference collection of BGS publications, including maps, for consultation.

We publish an annual catalogue of our maps and other publications; this catalogue is available online or from any of the BGS shops.

*The British Geological Survey carries out the geological survey of Great Britain and Northern Ireland (the latter as an agency service for the government of Northern Ireland), and of the surrounding continental shelf, as well as basic research projects. It also undertakes programmes of technical aid in geology in developing countries.*

*The British Geological Survey is a component body of the Natural Environment Research Council.*

*British Geological Survey offices*

**BGS Central Enquiries Desk**

Tel 0115 936 3143 Fax 0115 936 3276

email enquiries@bgs.ac.uk

**Environmental Science Centre, Keyworth, Nottingham NG12 5GG**

Tel 0115 936 3241 Fax 0115 936 3488

email sales@bgs.ac.uk

**Murchison House, West Mains Road, Edinburgh EH9 3LA**

Tel 0131 667 1000 Fax 0131 668 2683

email scotsales@bgs.ac.uk

**Natural History Museum, Cromwell Road, London SW7 5BD**

Tel 020 7589 4090 Fax 020 7584 8270

Tel 020 7942 5344/45 email bgslondon@bgs.ac.uk

**Columbus House, Greenmeadow Springs, Tongwynlais, Cardiff CF15 7NE**

Tel 029 2052 1962 Fax 029 2052 1963

**Maclean Building, Crowmarsh Gifford, Wallingford OX10 8BB**

Tel 01491 838800 Fax 01491 692345

**Geological Survey of Northern Ireland, Colby House, Stranmillis Court, Belfast BT9 5BF**

Tel 028 9038 8462 Fax 028 9038 8461

www.bgs.ac.uk/gsni/

*Parent Body*

**Natural Environment Research Council, Polaris House, North Star Avenue, Swindon SN2 1EU**

Tel 01793 411500 Fax 01793 411501

www.nerc.ac.uk

Website www.bgs.ac.uk

Shop online at www.geologyshop.com

# Foreword

This report describes macrofossils collected by P M Hopson from the Chalk Group of the Bradfield Southend Borehole (SU57SE229), and their significance for interpretation of formational stratigraphy.

# Acknowledgements

The Bradfield Southend Borehole (SU57SE229) was logged and sampled by P M Hopson. This log forms the basis of Figure 1 and the lithological data it contains is referred to herein.

# Contents



**FIGURES**

# Summary

Macrofossils from the Chalk Group of the Bradfield Southend Borehole indicate assignment of the topmost interval (58.83 – 67.83 m depth), below the contact with Paleogene strata, to the *Uintacrinus socialis* and uppermost *Micraster cornguinum* zones; the boundary between these zones is tentatively placed at a depth of 67.6 m. The lithology of the chalk assigned to the *U. socialis* Zone corresponds with the typically marl-rich Newhaven Chalk Formation. The remainder of the chalk in the borehole, below 67.6 m to the base of the borehole at 89.6 m, is assigned to the upper (Santonian) part of the *M. coranguinum* Zone. This interval contains tentative evidence for Rowe's Echinoid Band and the Barrois Sponge Bed, both indicative of levels near the top of the *M. coranguinum* Zone in the North Downs. There is no macrofossil evidence for the succession ranging below the base of the Santonian into the lower (Coniacian) part of the *M. coranguinum* Zone.

The lithology of the chalk interval assigned to the *M. coranguinum* Zone in the Bradfield Southend Borehole is marl-rich, and unlike the typically marl-free upper Seaford Chalk that elsewhere in southern England generally corresponds with the upper *M. coranguinum* Zone. Similar, but less prolifically marly chalk occurs in the upper *M. coranguinum* Zone of the Faircross Borehole south of Reading. Provisionally, this atypical marly facies is designated the Bradfield Southend Member of the Seaford Chalk Formation. Regional gravity data suggest that local basin architecture may have influenced the successions found in the Bradfield Southend and Faircross boreholes.

# 1 Introduction

The Bradfield Southend Borehole [SU 58204 70713; BGS SOBI index number: SU57SE229), about 6.5 km ENE of Thatcham, Berkshire, penetrated Superficial Deposits (2.72 m), Paleogene strata (56.11 m), and Chalk Group (30.77 m), terminating in the latter at a total depth (TD) of 89.6 m. This report describes macrofossil samples from the Chalk Group in this borehole (58.83 m – 89.6 m depth), and their significance for biozonal and lithostratigraphical interpretation of the succession.

Author citations for fossil species are given in Appendix 1.

# 2 Biostratigraphy

Below a flint pebble bed marking the contact with Paleogene strata at 56.11 m, the Chalk Group of the Bradfield Southend Borehole is characterised by thin wispy marls, nodular flints, and very conspicuous and abundant bioturbation. The marls are particularly common in the highest 10 m of the succession, but regularly persist downwards, with a further concentration between 85.5 m and 87.5 m depth. The bioturbation is picked out by darker-grey, marly chalk infilling burrows.

The macrofossils are dominated by bivalves, echinoids and crinoids, and are predominantly concentrated in the highest 9 m of the succession, at and above 67.83 m.

## 2.1 58.83 m – 67.83 m

The macrofauna of this interval is as follows (see Fig. 1):

| | |
|---|---|
| Bivalvia: | *Acutostrea incurva* |
| | inoceramid shell fragments (indeterminate) |
| | *Mimachlamys cretosa* |
| | ?oyster |
| | *Platyceramus* |
| | *Pseudoperna boucheroni* |
| | *Pycnodonte* |
| | *Spondylus?* |
| Crinoidea: | *Bourgueticrinus* (columnals) |
| | ?*Uintacrinus socialis* (brachial) |
| Asteroidea: | isolated skeletal plates |
| Echinoidea: | *Conulus* |
| | ?*Echinocorys* |
| | cidarid spine |

The relatively common oysters, particularly the record of *Pseudoperna boucheroni*, associated with possible *Uintacrinus socialis*, suggests that at least part of this interval is likely to include the *U. socialis* Zone. The base of the *U. socialis* Zone is typically coincident with the base of the Newhaven Chalk Formation, characterised by regularly developed marl seams.

Macrofossils from 67.83 m comprise a concentration of echinoid remains (*Conulus*, ?*Echinocorys*, cidarid spine), that might compare with the echinoid abundance locally recorded in the uppermost *M. coranguinum* Zone (immediately below the *U. socialis* Zone) in the North Downs (Rowe's Echinoid Band; Robinson, 1986). In the Bradfield Southend Borehole, the echinoid fauna at 67.83 m appears to mark the boundary between frequent oyster and crinoid remains (above), and more widely scattered macrofossil records below. On this basis, the marl partings around 67.6 m are tentatively selected as marking the base of the *U. socialis* Zone. The underlying upper *M. coranguinum* Zone, elsewhere in southern England typically represented by marl-poor upper Seaford Chalk Formation, appears to be developed in chalk with marl seams (see **3** below).

### 2.2 67.83 m – 89.6 m

Below the echinoid fauna seen at 67.8 m, inferred to occur within the highest *M. coranguinum* Zone (**2.1** above), there are widely scattered records of macrofossils, with local concentrations at 69 – 71 m depth.

The fauna is as follows (Fig. 1):

| | |
|---|---|
| Brachiopoda: | *Kingena* sp. |
| | *Orbirhynchia* sp. |
| Bivalvia: | *?Acutostrea incurva* |
| | *Platyceramus* |
| | oyster |
| Crinoidea: | *Bourgueticrinus* (columnal) |
| Echinoidea: | *Conulus* sp. |
| | *Micraster* sp. |

The above fauna, whilst not biozonally diagnostic, is consistent with assignment to the upper (Santonian) part of the *M. coranguinum* Zone. Typically, hard, nodular, sponge-bearing chalk, associated with the echinoid *Conulus*, occurs towards the top of the *M. coranguinum* Zone; broadly equivalent to the Barrois Sponge Bed that underlies Rowe's Echinoid Band in the North Downs succession (Bailey et al., 1983; Robinson, 1986). In the Bradfield Southend Borehole, a slightly harder, nodular chalk surface was observed in a sample at 70.46 m, with a record of *Conulus* a short distance above, and might represent an expanded equivalent of the Barrois Sponge Bed. On this basis, as well as the evidence for the *U. socialis* Zone higher in the succession, the remainder of the cored chalk in the Bradfield Southend Borehole is assigned to the higher part of the *M. coranguinum* Zone. There is no evidence for the lower (Coniacian) part of the *M. coranguinum* Zone in the borehole, which is typically capped by an abundance of the inoceramid bivalve *Cladoceramus undulatoplicatus*, marking the base of the Santonian.

# 3 Lithostratigraphy

The chalk assigned to the *U. socialis* Zone in the Bradfield Southend Borehole has the typical marl-bearing character of the Newhaven Chalk, consistent with the lithostratigraphical correlation of this biozone elsewhere in southern England. However, the downward persistence of these marl seams into the inferred upper part of the *M. coranguinum* Zone is not typical; this biozonal interval normally equates with the upper Seaford Chalk which lacks marl seams,

although marls are present in the basal and lower parts of the formation. The presence of marl in the upper *M. coranguinum* Zone, and the abundance of bioturbation, suggests an unusual depositional setting with a localised source of detrital material, perhaps controlled by local basin architecture. If correct, and acknowledging that marls are a component of part of the Seaford Chalk Formation, and that the concept of this formation covers both rock and fossil content, it is suggested that this marly interval of the upper *M. coranguinum* Zone is provisionally regarded as a new member of the Seaford Chalk; the name Bradfield Southend Member is proposed. Given the sparse and tentative nature of the macrofossil evidence, this interpretation should be confirmed with follow-up analysis of the calcareous micropalaeontology of the Chalk in the borehole succession.

## 3.1 GRAVITY ANOMALY DATA

Examination of gravity anomaly data (Fig. 2) shows that the borehole site is at the edge of a discrete gravity low centred on an area south of Reading. Whilst the gravity data are likely responding to deep-seated contrasts in rock density, a negative gravity anomaly may indicate the presence of structures at depth that could have influenced local deposition of the Chalk, or highlight regions underlain by thicker low density rock successions that may have permitted greater compactional subsidence during Chalk deposition.

Regions north, south and west of the borehole site show the presence of ‘ridge-like’ features in the gravity anomaly data, with significantly less negative gravity values. The Faircross Borehole [SU 69720 163220; SU66SE21] is located on the edge of a gravity ‘ridge’ at the southern margin of the gravity low (Fig. 2), and a detailed log of the succession (by R N Mortimore) in BGS archives shows the unusual development of glauconitic surfaces in the *U. socialis* Zone, with only 16 m of chalk separating the lowest record of *U. socialis* and the basal Santonian index fossil *C. undulatoplicatus* (compared with about 30 m in both the North Downs and South Downs; Mortimore, 1986; Robinson, 1986); thin marls also occur in the interval between these biomarkers. These observations suggest that there may have been increased erosional winnowing of sediment during accumulation of the Chalk succession at Faircross, and that this is reflective of a relatively more prone structural situation within the depositional basin. However, the persistent record of marl seams in the inferred upper part of the *M. coranguinum* Zone at Faircross suggests that this feature may relate to the influence of a larger-scale structural or basin architecture feature, perhaps proximity to the edge of the London Platform further to the north-east (Fig. 2).

# Appendix 1 – Author citations for fossil species

*Acutostrea incurva* (Nilsson, 1827)

*Cladoceramus undulatoplicatus* (Röemer, 1855)

*Mimachlamys cretosa* (Defrance *in* Brongniart 1822)

*Orbirhynchia pisiformis* Pettitt, 1954

*Pseudoperna boucheroni* (Woods *non* Coquand, 1859)

*Uintacrinus socialis* Grinnell, 1876

# References

British Geological Survey holds most of the references listed below, and copies may be obtained via the library service subject to copyright legislation (contact libuser@bgs.ac.uk for details). The library catalogue is available at: http://geolib.bgs.ac.uk.

BAILEY, H W, GALE, A S, MORTIMORE, R N, SWIECICKI, A, and WOOD, C J. 1983. The Coniacian-Maastrichtian stages of the United Kingdom, with particular reference to southern England. *Newsletters on stratigraphy*, Vol. 12, 29 – 42.

MORTIMORE, R N. 1986. Stratigraphy of the Upper Cretaceous White Chalk of Sussex. *Proceedings of the Geologists' Association*, Vol. 97, 97 – 139.

PHARAOH, T C, VINCENT, C J, BENTHAM, M S, HULBERT, A G, WATERS, C N, and SMITH, N J P. 2011. Structure and evolution of the East Midlands region of the Pennine Basin. *Subsurface memoir of the British Geological Survey*.

ROBINSON, N D. 1986. Lithostratigraphy of the Chalk Group of the North Downs, southeast England. *Proceedings of the Geologists' Association*, Vol. 97, 141-170.

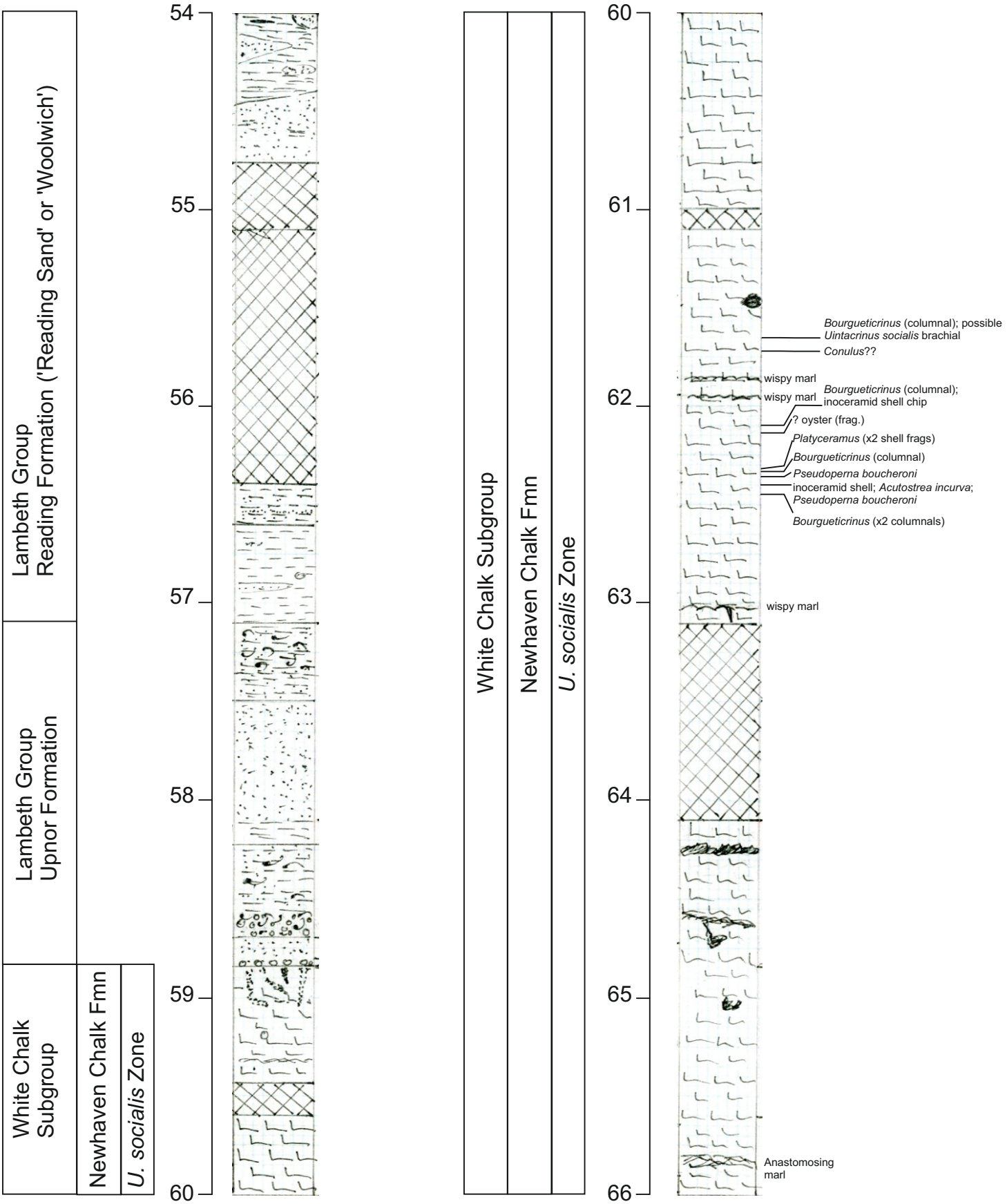
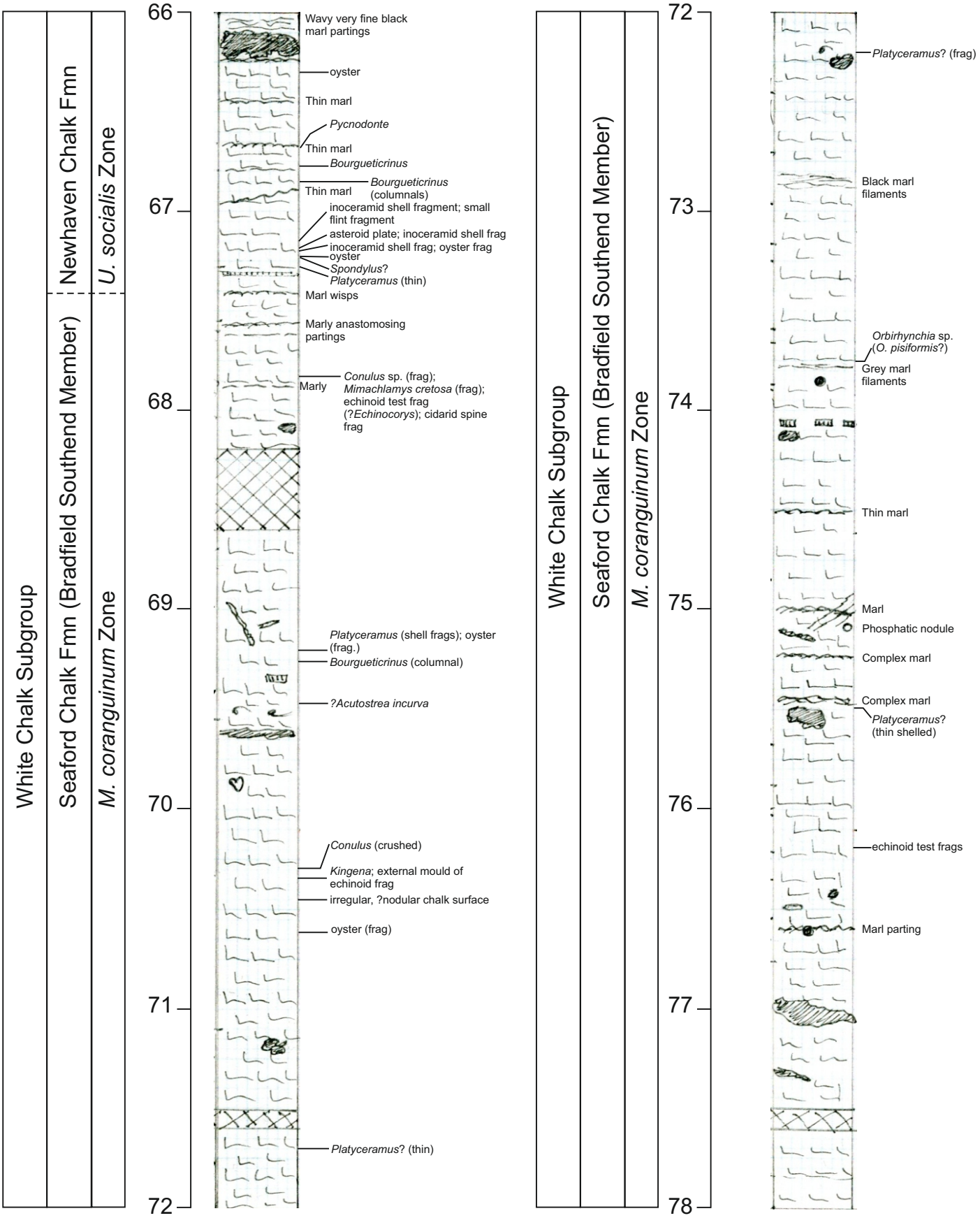
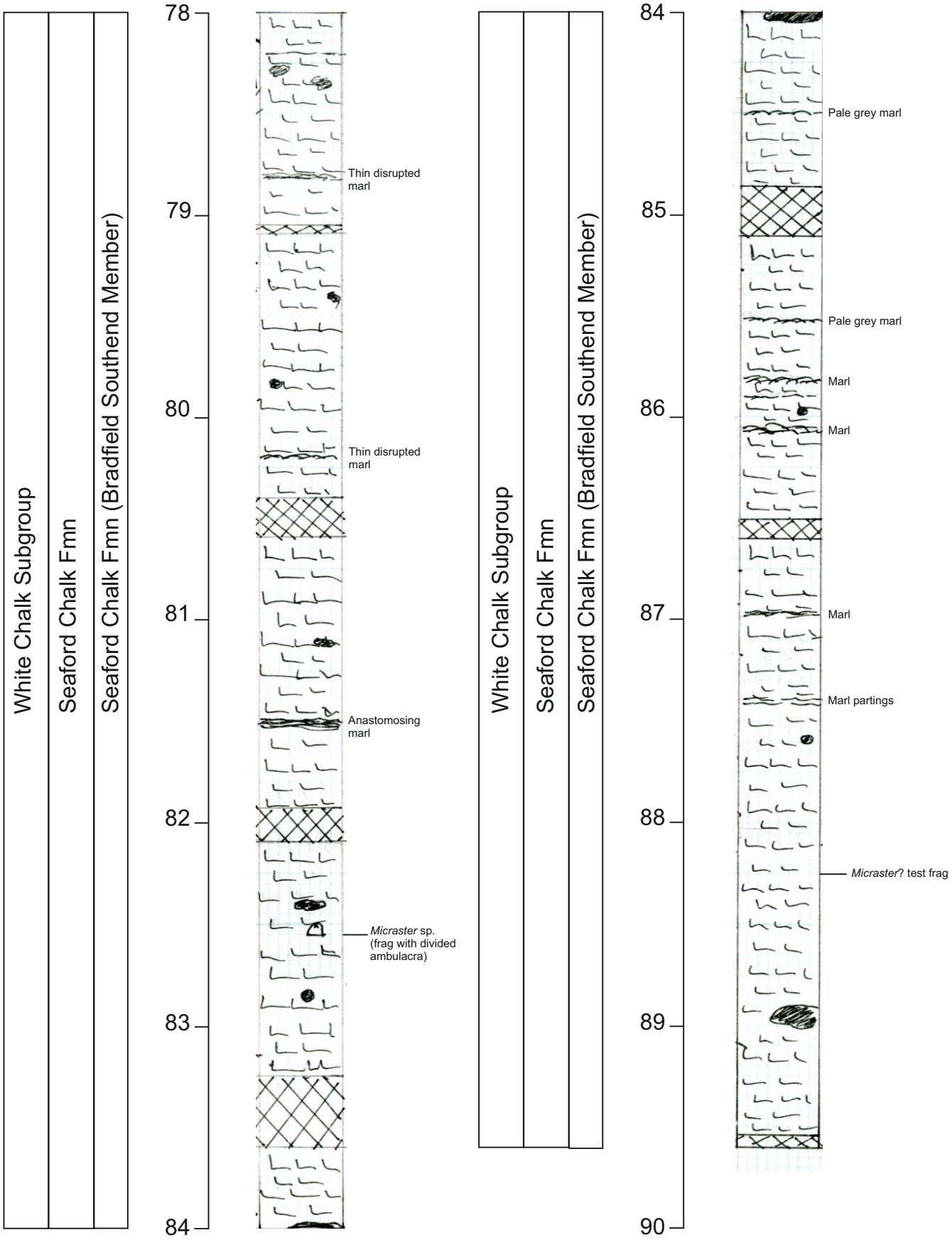



Figure 1. Annotated lithological log for part of the Bradfield Southend Borehole [SU 58204 70713], showing horizons and identifications of Chalk Group macrofossils and interpreted Chalk Group stratigraphy. Original lithological log and interpretation of Paleogene succession by P M Hopson (see this log for key to log symbology).


White Chalk Subgroup
Seaford Chalk Fmn (Bradfield Southend Member)
Newhaven Chalk Fmn
U. socialis Zone
M. coranguinum Zone
66
67
68
69
70
71
72
Wavy very fine black marl partings
oyster
Thin marl
Pycnodonte
Thin marl
Bourgueticrinus
Thin marl
Bourgueticrinus (columnals)
inoceramid shell fragment; small flint fragment
asteroid plate; inoceramid shell frag
inoceramid shell frag; oyster frag
oyster
Spondylus?
Platyceramus (thin)
Marl wisps
Marly anastomosing partings
Marly
Conulus sp. (frag); Mimachlamys cretosa (frag); echinoid test frag (?Echinocorys); cidarid spine frag
Platyceramus (shell frags); oyster (frag.)
Bourgueticrinus (columnal)
?Acutostrea incurva
Conulus (crushed)
Kingena; external mould of echinoid frag
irregular, ?nodular chalk surface
oyster (frag)
Platyceramus? (thin)
White Chalk Subgroup
Seaford Chalk Fmn (Bradfield Southend Member)
M. coranguinum Zone
72
73
74
75
76
77
78
Platyceramus? (frag)
Black marl filaments
Orbirhynchia sp. (O. pisiformis?)
Grey marl filaments
Thin marl
Marl
Phosphatic nodule
Complex marl
Complex marl
Platyceramus? (thin shelled)
echinoid test frags
Marl parting


White Chalk Subgroup
Seaford Chalk Fmn
Seaford Chalk Fmn (Bradfield Southend Member)
78
79
80
81
82
83
84
Thin disrupted marl
Thin disrupted marl
Anastomosing marl
Micraster sp. (frag with divided ambulacra)
White Chalk Subgroup
Seaford Chalk Fmn
Seaford Chalk Fmn (Bradfield Southend Member)
84
85
86
87
88
89
90
Pale grey marl
Pale grey marl
Marl
Marl
Marl
Marl partings
Micraster? test frag

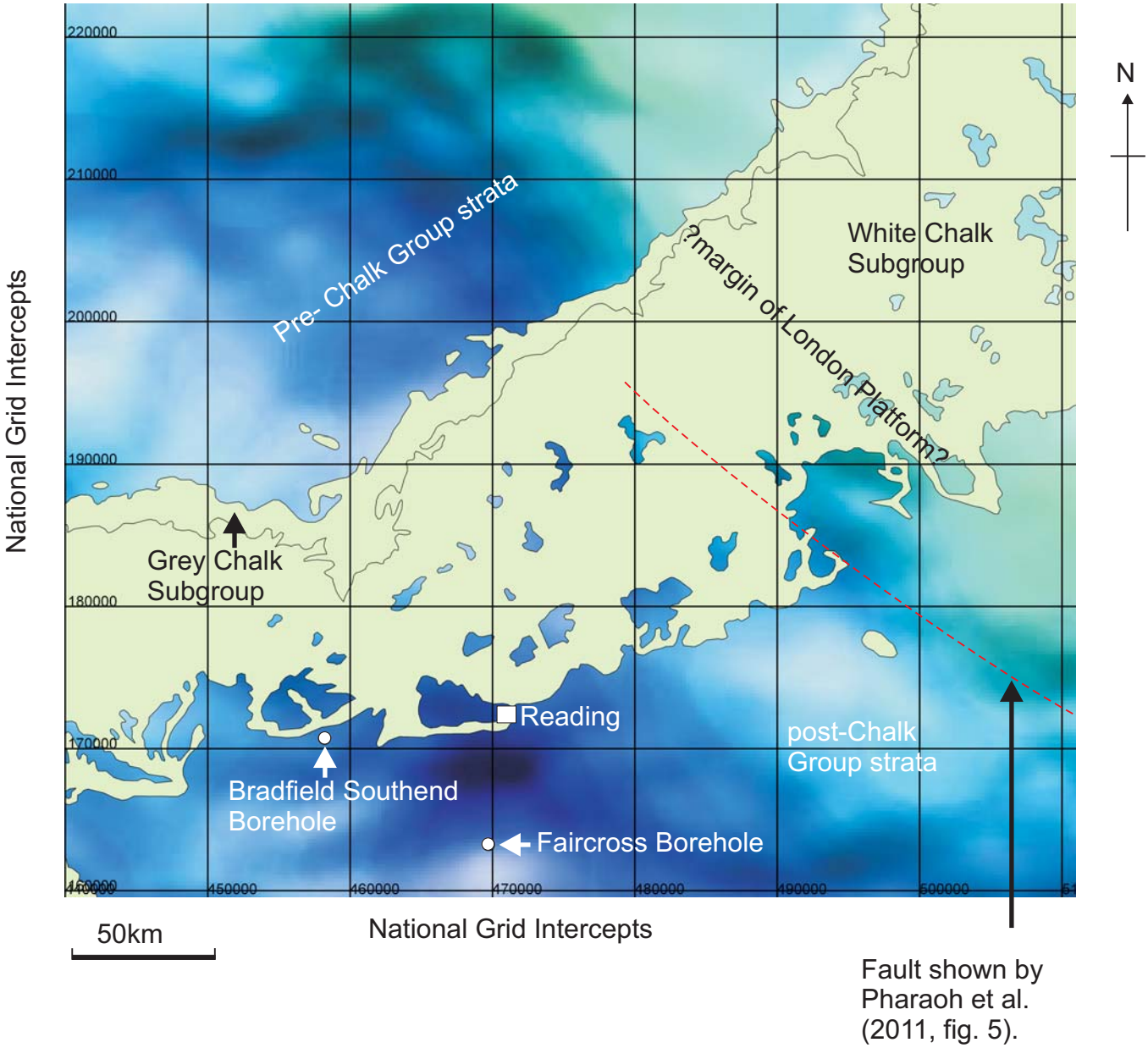



**Figure 2**. Relationship of the Bradfield Southend and Faircross boreholes to regional gravity anomaly data. Darker colours denote negative anomalies