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The stratigraphy of and well-completion reports for the Swanworth Quarry No. 1 and No. 2 and Metherhills No 1 boreholes (RGGE Project), Dorset

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1. INTRODUCTION

1.1 Rapid Global Geological Events (RGGE) Project

There has been increasing international awareness and concern in recent years about possible global climatic changes and their effects on local environments. In many of those parts of the world where detailed records have been kept for the last 50 to 100 years there is clear evidence of higher average summer temperatures, rising sea levels and a greater incidence of storms. The mechanisms behind these changes are not yet fully understood, and are likely to be complex. Increased emissions of carbon, nitrogen and sulphur oxides and hydrocarbon gases from transport and industrial processes are thought to have induced global climatic changes, but these changes are superimposed on natural changes that occur over time-scales that are too long for direct observation. For example, climatic changes related to variations in the radiant heat received from the sun are thought to occur as 21,000-year to 250,000-year cycles. The presence of such long-term climatic cycles can only be inferred from a detailed examination of the geological record.

It was for this reason that the Natural Environment Research Council (NERC) decided in 1995 to allocate £900,000 over 3 years to a special research topic, the Rapid Global Geological Events (RGGE) special topic, designed to examine in as great a detail as practicable a selected interval of the geological column. The aim is to apply to ancient sediments, analytical techniques used successfully to identify the effects of climatic changes in modern sediments. The Kimmeridge Clay was chosen by the RGGE Steering Committee (Chaired by Professor D J Vaughan, Manchester University) because it consists of an apparently unbroken sequence of highly fossiliferous marine mudstones, about 150 million years old, that represent about 3 million years of Earth history. The mudstones contain rhythmic variations in clay mineralogy, fauna and organic content that reflect climatic and sea-level changes. The aim of the project is to apply as many state-of-the art analytical methods as possible to a continuous core taken through the full thickness of the Kimmeridge Clay to enable these changes to be documented and the processes that cause them to be understood.

When the project was announced the NERC invited universities and research institutes to suggest and bid for specific research that would be carried out on borehole cores that would be obtained for the project. These bids resulted in the formation of a multidisciplinary research team, and a Science Committee (chaired by Dr H C Jenkyns of

Oxford University) to co-ordinate the research. In addition, eight oil-company sponsors provided funds and facilities to enable particular lines of research to be undertaken (see Appendix 1 for details). The British Geological Survey (BGS) was contracted to manage the acquisition of the borehole cores and the geophysical data, and to provide the on-site stratigraphical analysis of the cores to enable the most effective drilling and sampling programmes to be implemented.

1.2 Choice of drilling sites

The Science Committee decided, on the basis of the limited funds available, that the most appropriate drilling programme would be to try to obtain two continuous cores of about 100mm diameter through the full thickness of the Kimmeridge Clay at a single site as close as practicable to the cliffs of the type section at Kimmeridge, Dorset. It was thought that two boreholes, about 20m apart, would enable cores to be taken in such a way that any core losses due to faulting or heavily fractured ground in one hole would be at different levels in the second hole. Taken together, the two borehole cores should provide a virtually complete sample of the full thickness of the Kimmeridge Clay.

Six possible sites were suggested by the RGGE Science Committee, all on Portland Beds within the flat-lying limb of the Purbeck Monocline in the area of Dorset between Encombe [SY 945 785], Kingston [SY 955 795], Worth Matravers [SY 975 774] and St Alban's Head [SY 965 755] (Figure 1). All six sites were within an Area of Outstanding Natural Beauty and environmental considerations were therefore especially important. These included not only the possible impacts on local residents, wildlife and tourists, but also archaeological constraints if a greenfield site was to be used.

The site chosen, Swanworth Quarry [SY 9675 7823] near Worth Matravers (Figure 1) had marked logistical and environmental advantages over the other five possible sites. It was already a large industrial site with good road access (for up to 100 tons of equipment), a solid stone floor on which to work, mains water and electricity, and was screened by high quarry faces from the nearest habitation. It had two additional geological advantages: first, it enabled drilling to begin at a known stratigraphical horizon (the top of the Portland Sand) which avoided the difficult drilling conditions of the Portland Beds Cherty Series. Second, it could be seen from the adjacent quarry faces to be in an unfaulted area.

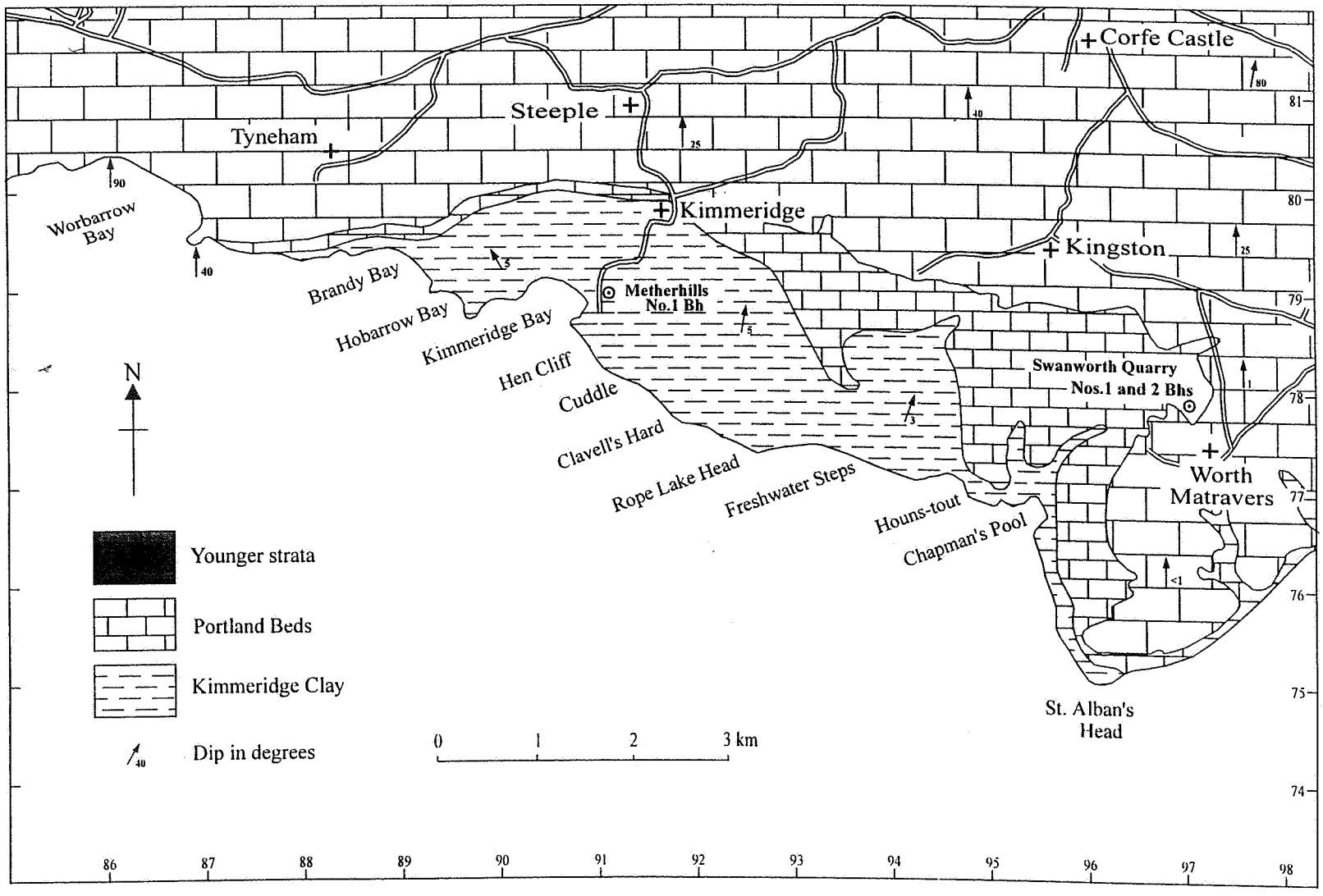


Figure 1. Sketch map of the solid geology of the Kimmeridge-Worth Matravers area showing the positions of the Swanworth Quarry and Metherhills boreholes.

The site also had, in Tarmac (Southern) Ltd, a landowner who was not only amenable to the use of the site, but was interested in the RGGE research and supportive of it. Planning consent was therefore obtained to drill two adjacent, continuously cored boreholes at Swanworth Quarry. Examination of all the available geophysical logs from boreholes through all or part of the Kimmeridge Clay in the Isle of Purbeck, together with seismic-reflection profiles kindly provided by British Petroleum Ltd., suggested that the full thickness of the formation was between 535 and 585m. To this was added 40m of Portland Sand and 15m to allow for the over-run of the geophysical tools at the bottom of the borehole. This gave an estimated total required depth for the boreholes of 590 to 640m. There was some uncertainty as to the full thickness of the Kimmeridge Clay in the area because the thicknesses proved in the two nearest hydrocarbon-exploration boreholes, British Petroleum's Encombe [SY 9412 7832] and Southard Quarry [SZ 0234 7775] boreholes, appeared from the available geophysical logs to be about 5% and 10% thinner respectively than that exposed in Kimmeridge Cliffs.

1.3 Borehole specifications

Because the possible total value of the drilling contract could exceed 300k ECU (£158k), it was necessary to place a notice in the European Union (EU) Journal inviting potential contractors to express an interest in tendering for the work. Of the four contractors who responded, two could not guarantee to meet the full specification. The remaining two were invited to submit tenders, but only one valid tender was returned. The estimated costs in this were approximately double those originally estimated, with the result that the funds set aside by the Steering Committee would only have been sufficient for a single borehole to the base of the Kimmeridge Clay at Swanworth Quarry. Even this might not have been possible if drilling difficulties were encountered.

The Steering Committee, therefore, considered various alternative proposals including drilling shallower holes at two sites on what was anticipated to be the same Kimmeridge Clay thickness isopachyte, at Swanworth Quarry and Kimmeridge Bay (Figure 1). The advantage of drilling shallower boreholes was that it would enable smaller equipment to be used. This would not only allow more contractors to be included in the tendering procedure and thereby make it more competitive, but would also reduce the drilling costs.

The Committee listed its preferred options, in order of decreasing priority/desirability as follows:

(i) two continuously cored boreholes through the full Kimmeridge Clay sequence at Swanworth Quarry: 100mm or greater size cores preferred, but 80mm cores acceptable if this reduced the cost significantly.

(ii) two continuously cored boreholes through the full Kimmeridge Clay sequence, split (two boreholes per site) between Swanworth Quarry (down to about the Hobarrow Bay Stone Band) and a new site at Kimmeridge Bay (starting at about the Hobarrow Bay Stone Band) and terminating in the top Corallian).

(iii) two continuously cored boreholes at Swanworth Quarry penetrating the upper half of the Kimmeridge Clay (as ii) and one borehole at Kimmeridge Bay penetrating the remainder of the formation.

(iv) one continuously cored borehole at Swanworth Quarry through the full Kimmeridge Clay sequence, with a second borehole at Swanworth coring the most scientifically interesting (to be defined) part of the sequence.

(v) one continuously cored borehole through the full Kimmeridge Clay sequence at Swanworth Quarry.

The Committee placed a high priority on the need for overlapping cores to try to ensure that, as far as practicable, the full sequence would be sampled. Tenders were therefore invited to drill a pair of continuously cored boreholes at Swanworth Quarry to a minimum depth of 350m with the possibility of continuing to 500m or beyond if this could be done safely and without loss of core quality. It was estimated that a 350m-deep borehole would terminate below the level of the Hobarrow Bay Stone Band and would therefore include the whole of the sequence exposed in Kimmeridge cliffs (Figure 2).

A contract was let to Soil Mechanics Ltd of Doncaster to drill a single borehole at Swanworth Quarry, with the possibility of drilling a second borehole at the same site if progress and quality on the first were satisfactory. This proved to be the case and the contract was subsequently extended to include a second Swanworth Quarry borehole (Figure 3) and a borehole at Metherhills [SY 9112 7911], Kimmeridge (Figure 4). Drilling commenced at the Swanworth Quarry No. 1 site on 15th December 1996. The borehole was terminated at a depth of 505.21m on 14th March 1997 when its stability was threatened by heavily fractured horizons which were caving badly. The anticipated depth to the base of the Kimmeridge Clay was within the capability of the drilling equipment, but only if the borehole remained stable.

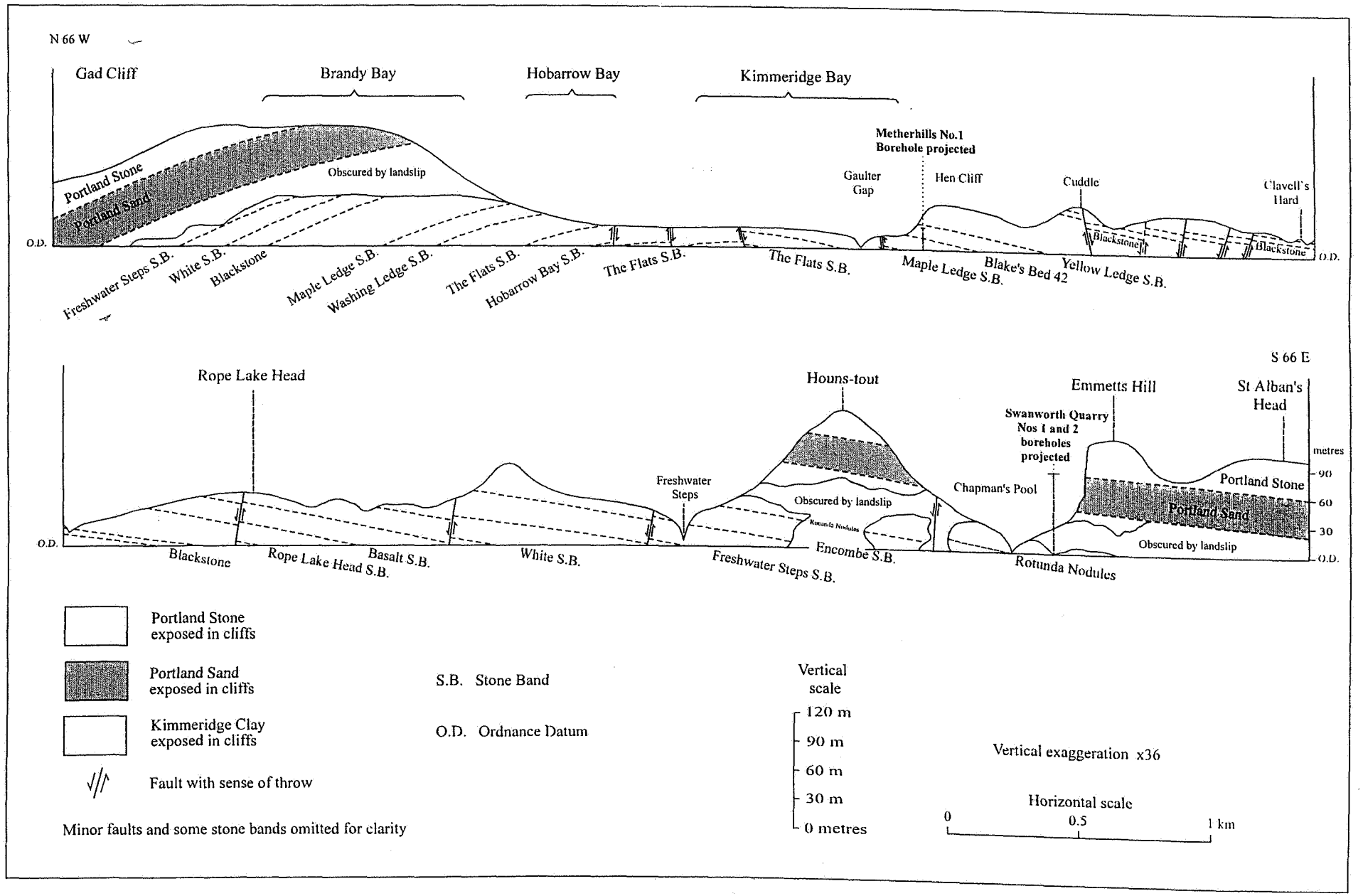


Figure 2. Geological sketch section of Kimmeridge cliffs showing the positions of selected marker bands and the projected positions of the Swanworth Quarry and the Metherhills boreholes.

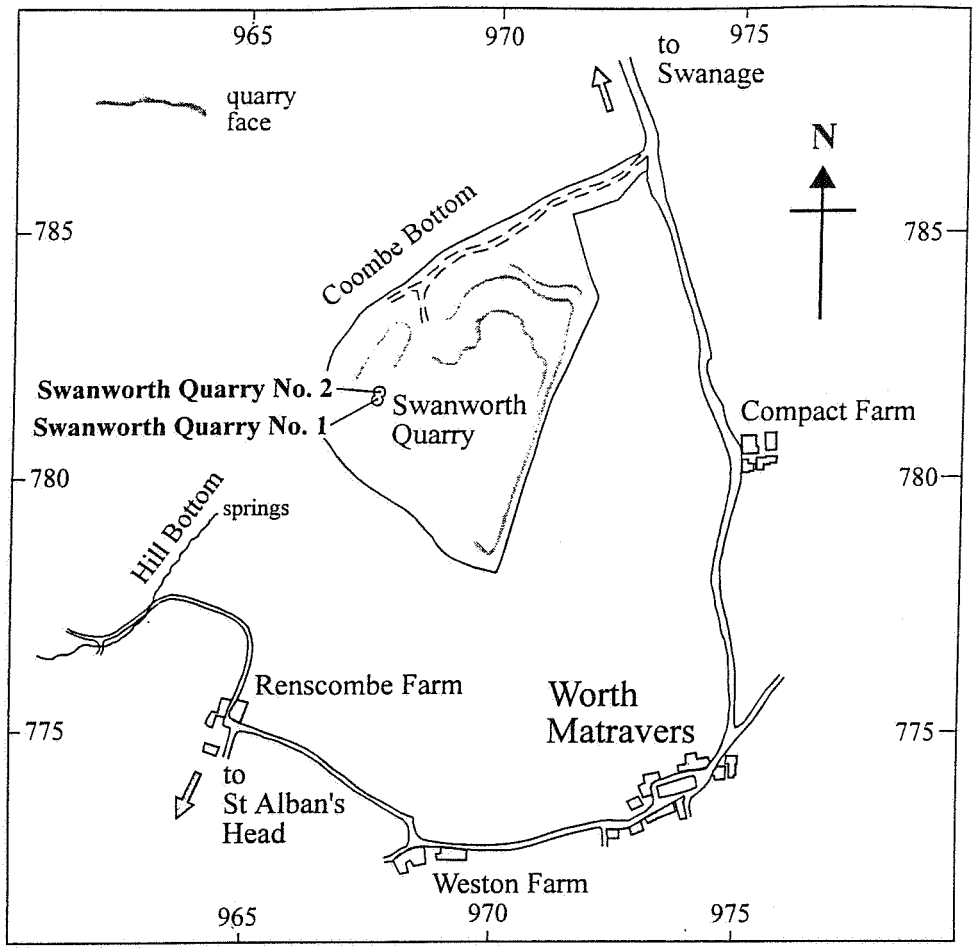


Figure 3. Site map for the Swanworth Quarry No. 1 and No. 2 boreholes.

Grid references:
No.1 Borehole
SY 9678 7823

No.2 Borehole
SY 9678 7824

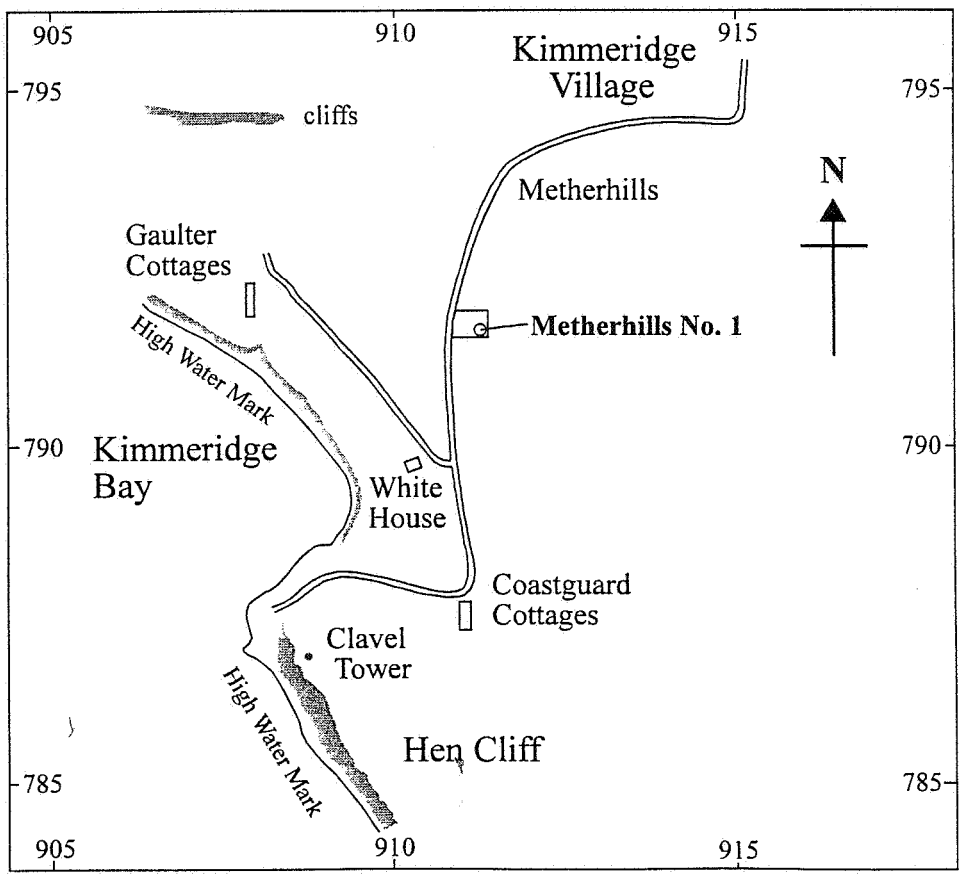


Figure 4. Site map for the Metherhills No. 1 Borehole.

Grid Reference
SY 9112 7911

Even a minor cave-in might have been sufficient to trap the core barrel, with a possible high consequent cost to the RGGE Project and the loss of the opportunity to carry out geophysical logging.

A second borehole, Swanworth Quarry No. 2, 18m from No. 1, commenced drilling on the 20th March 1997. It was terminated at a depth of 388.30m, a few metres below the Hobarrow Bay Stone Band, as planned, on 30th April 1997. The Metherhills No. 1 Borehole at Kimmeridge Bay commenced on 8th May 1997 and terminated in the Corallian Beds at a depth of 319.00m on 4th June 1997 (Figure 5). The funds remaining in the drilling allocation at that time were insufficient to drill a second borehole at Metherhills. The possibility of supplying additional funds was discussed by the Steering and Science committees: it was decided that these funds could be better used for research given the excellent core recovery and absence of faulting in the Metherhills No. 1 Borehole.

2. DRILLING AND CORING DETAILS

The Swanworth Quarry and Metherhills boreholes were drilled using a Boyles BB16 rig under the direction of Mr Les Szalki. The on-site curation, photography and, in part, the geological description of the cores were carried out by Mr Tom Berry, who also acted as the Soil Mechanics Site Agent. The on-site management of the drilling and geophysical logging was carried out by the author with the assistance of Miss Sarah Pearson of Southampton University.

The proximity of the Swanworth Quarry No. 1 and No. 2 borehole sites to natural springs at Hill Bottom that are used for public water supply (Figure 3) meant that great care needed to be taken when drilling the highest (permeable) parts of both boreholes. The springs emerge in a valley floor through a thick layer of periglacial head composed of Portland Sand and Portland Stone debris. Their source appears to be fractures in the top part of the Portland Sand that are fed by the highly fractured and in part karstically modified Chert Beds of the Portland Stone.

The boreholes were sited on a hard sandstone pavement close below the base of the Chert Beds. They were, therefore, drilled to 25m using air-flush to avoid all possible sources of contamination to the aquifer, at which depth they had penetrated about 15m into muddy siltstones and silty mudstones which form an aquitard in the lower part of the Portland Sand.

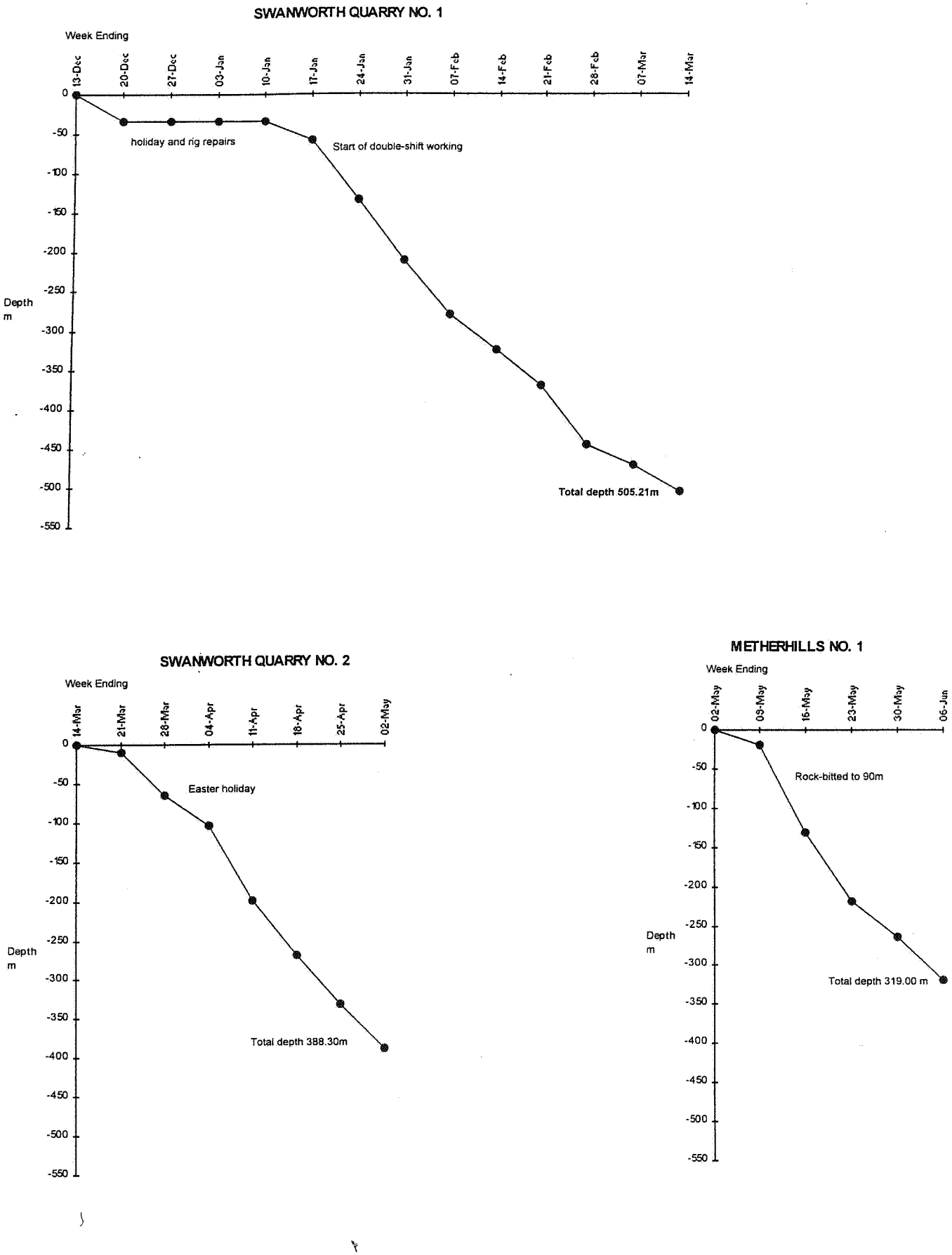


Figure 5. Drilling timetables for the Swanworth Quarry and Metherhills boreholes.

These highest parts of the boreholes were sealed with a cemented casing prior to drilling the remainder of the boreholes with mud flush. A similar procedure was followed for the Metherhills No. 1 Borehole to ensure that no drilling fluid leaked away from the borehole through open fractures in the highest, weathered, part of the Kimmeridge Clay.

2.1 Core recovery

Continuous 108mm-diameter cores were taken from ground level to total depth in all three boreholes using a double core barrel with a heavy-duty plastic liner. Because of its fine-grained nature, the Kimmeridge Clay produces very smooth-sided cores which are difficult to grip. This feature, coupled with the presence of steeply dipping joints and very weak bedding horizons such as horizontal shears and shell plasters, led to problems with core slippage.

A variety of core barrels, catchers and springs was tried, but these problems continued throughout the drilling of all three boreholes. Despite this, attempts to retrieve cores were invariably successful and excellent core recovery and quality was achieved for all three boreholes. The use of a heavy-duty plastic liner was a major factor in this success: in many cases heavily fractured core collapsed into rubble once the liner had been cut.

The nominal core losses were small: 2.24m in the Swanworth Quarry No. 1 Borehole and 3.85m in the Swanworth Quarry No. 2 Borehole. There was a nominal gain in the Metherhills No. 1 Borehole. The percentage core recovery for each borehole is summarised in Table 1. The full list of drilling-run depths and recoveries is given in Appendix 4.

When the RGGE drilling programme was planned, one of the principal aims was to try to ensure that as complete a core sample as practicable was obtained for the full Kimmeridge Clay sequence. Some of the proposed analytical research programmes required the whole of the formation to be sampled at 50mm intervals. The known state of fracturing of the formation within the Isle of Purbeck monoclinal structure combined with its fissility, suggested that it might not be possible to maintain an overall core-recovery rate of better than suggested that the boreholes might pass through one or more small faults, with up to 2m throws, which were too small to be traced inland. One of the principal reasons for drilling two adjacent boreholes was to try to obtain a composite section that would be the equivalent of 100% recovery.

Table 1. Summary of core recoveries as percentages in the Swanworth Quarry and Metherhills boreholes.

Swanworth Quarry No. 1

Run Nos	Length drilled	Length recovered	Recovery as percentage
1 to 50	110.63	109.41	99
1 to 100	197.46	196.41	99
1 to 150	343.50	341.55	99
1 to 208	505.21	503.97	100

Swanworth Quarry No. 2

1 to 50	163.50	159.97	98
1 to 100	341.18	339.51	99
1 to 113	388.30	384.55*	99
* loss includes 1.15m gravel hardcore at surface			

Metherhills No. 1

1 to 50	171.66	170.99	99
1 to 68	229.00	230.25	101

The core runs for the Swanworth No. 1 and No. 2 boreholes were, therefore, offset in such a way that end-of-run losses in one hole would be recovered in the middle part on a core run in the adjacent borehole. The faults observed in the cliff sections all had dips greater than about 70°, and mostly greater than 80°. Such a fault, if encountered in the two Swanworth Quarry boreholes, could only have intersected both boreholes at the same stratigraphical level if both boreholes had been precisely along the line of strike of the fault. Any small deviation from this line would have made a marked difference in the horizon intersected in the two boreholes.

In the event, no fault was encountered and the core recoveries were so good that the need for overlapping cores largely disappeared. This was fortunate because, although the core runs were designed to overlap, the continuing core slippages meant that the positions of the core breaks were impossible to control. In some cases the cores broke off at the same bedding-plane weakness in both boreholes (Table 2).

2.2 Core handling and labelling

The cores were retrieved from the core barrel in a hard, protective plastic liner. This was cut longitudinally on each side to produce two C-shaped pieces. The core was then washed, measured and put into one or more core boxes as two 1.0 to 1.5m lengths, the individual

lengths depending on the amount of core recovered. There were almost always enough natural breaks in the core for it to be fitted into the boxes without being artificially broken. Each box was labelled, inside and out, with the Soil Mechanics job number, the borehole number and the driller's depths. The depths of the start and finish of each run were marked on wooden blocks that separate each section of core. It should be noted that these depths are not the true depths of the cores because of the slippages referred to above. The driller's depths and true depths (obtained from the geophysical logs, see section 2.3) differ by up to 4m at some levels.

Every box of core was then photographed (see Appendix 5 for lists), re-checked against the driller`s worksheets for content, geologically described (Appendix 3), and the plastic liners re-sealed with tape and end caps. The top and bottom of each piece of plastic liner was marked "Top" and "Bottom" and with letters (A at top, B, C, E, F etc below) to show the components of each core run and their way-up. Every piece of plastic liner was also marked with the Soil Mechanics job number, borehole number, run number and an arrow which points *down* the borehole. Each core box was numbered: the correlation between the box numbers and the run numbers is given in Appendix 4.

2.3 Driller`s depths, laboratory depths and `true` depths

Determining the precise depths from which rock cores have been retrieved from the ground is always difficult, for a number of reasons. First, core recovery is never perfect: even when it is virtually complete, as in the case of the RGGE borehole cores, core slippage and subsequent retrieval can lead to confusing depth measurements. Only rarely in the RGGE drilling was a root core obtained, one in which the core breaks off just below the coring bit to leave a distinctive groove that marks the precise depth drilled. These occurrences are noted in Appendix 4. In the great majority of cases, fissility and jointing in the Kimmeridge Clay caused the core to break at some distance above the depth drilled. Second, natural fractures in the core tend to open in the core barrel due to vibration and the removal of the lithostatic load as the core is removed from the ground. This can add several percent to the apparent length of the core. In the case of the RGGE cores, this effect was minimised by the use of a heavy-duty plastic liner. Third, even solid sticks of core expand when brought to the surface due to the removal of the lithostatic load.

Table 2. Comparison of positions of core breaks in the Swanworth Quarry No. 1 and No. 2 boreholes.

Borehole 1	Borehole 2
1.00	2.05
2.51	3.43
4.99	4.88
6.70	6.37
9.20	9.55
11.70	11.17
14.20	14.05
16.70	
19.70	18.55
21.70	22.60
24.20	25.00
26.70	
29.20	28.74
31.70	32.72
34.20	
35.89	35.77
36.96	
39.41	39.81
41.91	
44.41	43.81
46.91	47.91
49.41	50.84
51.91	
54.41	54.94
55.91	
58.41	59.04
60.71	
63.21	63.11
65.71	64.67
68.00	67.11
70.50	71.16
73.00	
75.50	75.13
78.00	
80.41	79.63
83.05	83.45
85.55	
88.05	87.58
90.05	91.47
92.55	
95.13	95.73
97.67	
100.09	99.73
102.64	
102.88	103.69

Borehole 1	Borehole 2
105.38	
107.88	107.45
108.46	
110.63	111.45
113.46	114.95
116.06	
116.26	
116.46	
116.49	
119.02	119.04
121.52	
124.02	123.25
126.52	
126.80	
127.24	127.27
129.74	
132.34	131.20
134.84	
135.00	136.20
136.00	138.85
141.00	
141.30	
141.53	
143.73	142.92
146.39	146.92
148.89	147.27
151.39	151.36
153.89	
156.39	155.49
158.89	
159.25	159.49
159.41	
161.91	
163.41	163.50
165.91	
168.41	167.19
170.91	171.29
172.51	
175.01	175.29
175.87	
178.37	179.49
180.87	
181.22	
183.83	183.59

Borehole 1	Borehole 2
185.69	
187.11	187.69
189.61	
190.11	191.79
192.61	
195.46	195.69
197.96	
200.53	200.85
202.97	203.89
204.97	
207.50	207.89
209.92	
213.92	212.03
217.92	216.16
220.42	220.29
222.92	
224.42	224.29
228.13	228.00
231.98	232.03
235.98	236.06
240.13	240.06
244.24	244.06
247.78	248.06
249.46	
251.92	252.07
255.43	256.15
258.22	260.04
261.45	
264.93	263.86
268.93	268.14
272.67	271.94
272.87	276.09
276.80	278.36
280.80	
284.07	282.44
286.00	286.41
288.00	290.00
292.00	294.00
296.00	294.79
299.50	297.34
300.80	
301.28	301.28
305.35	305.18
309.35	308.98
310.35	312.68

Borehole 1	Borehole 2
313.35	313.18
316.39	317.88
318.02	
319.75	321.08
323.50	324.98
327.50	328.42
331.50	332.32
335.15	333.08
339.15	337.18
339.50	341.18
343.50	
344.70	345.31
351.50	349.31
353.50	353.31
357.50	357.42
361.52	360.00
363.00	
363.50	364.00
369.00	367.88
373.00	371.93
377.00	375.43
379.07	378.11
383.07	382.08
387.07	385.78
388.37	388.30

The net effect of these three sources of depth error is impossible to quantify on site. The cores and the core boxes were therefore labelled objectively (the *driller's depths* as listed in Appendix 4) using the depths drilled (as recorded from the datum on the drilling rig) and the measured length of the core recovered. For example, a coring run (Run A) that started at 100.00m and drilled for 4.00m but recovered only 3.50m of core, is shown as ending at 103.50m in the drilling-site descriptions of the cores (Appendix 3). The core barrel reached 104.00m and the missing 0.5m of core was, in every case in the RGGE drilling, left at the bottom of the borehole and available for retrieval. However, this could only be determined retrospectively and the missing 0.5m of core might have been ground away at one or more levels within the cored interval. The next coring run (Run B) would then start at 104.00m and would drill 3.50m (to ensure that the 4.5m core barrel would not be overfilled). If the remains of the old core and the whole of the new core were recovered (total 4.00m), the core description for Run B would then extend from 104.00m (the start of the coring run) to 108.00m (the end of the core) even though the borehole had only been drilled to 107.50m. The next coring run (Run C) would then start at 107.50m. This apparent anomaly, whereby the depth assigned to the bottom of a core (Run B) is greater than the depth of the top of the next core run (Run C), can cause confusion, but it does enable the observed lengths of core to be described objectively without making a subjective on-site assessment of where any core losses might be. In the case of the RGGE boreholes, the core losses were so low that the cores could be fitted together to provide a complete sequence. However, at some levels the number of the slippages and retrievals was such that there is a discrepancy of up to 4m between the *driller's depths* and the *true depths* obtained from the geophysical logs (see below).

Prior to being transported to the Southampton Oceanographic Centre, the cores were re-sealed in their plastic liners and tightly packed into boxes to minimise any further expansion due to handling. Whilst on site the cores were kept sealed in their plastic liners and boxes in a cool store, except for the short periods when they were required for photography and geological logging. Moisture loss can also cause natural joint and bedding-plane fractures to open and produce an apparent increase in the core length.

On arrival at the Southampton laboratory the cores were transferred, in 1.5m sections, to the laboratory bench for magnetic susceptibility and other measurements. This piecemeal transfer caused some of the fractures to open up with the result that the *laboratory depths*, made on the reassembled cores on the bench, are up to 2.5% greater than the *true depths*. The

relationship between the *laboratory* and *true depths* is not linear, due to the variable intensity of the fracturing in the cores (Table 3). The *laboratory depths* can only be corrected piecemeal by comparing them, section by section, with the *true depths* of the lithological marker bands. On completion of the bench measurements, the cores were transferred back to the boxes, and probably increased slightly in length again. In the meantime, drying out of the cores from the time that their protective plastic liner had been removed probably reduced their gross volume. This will have caused more discontinuities (mostly along bedding planes) to open up, and will have increased the difficulty of reassembling them in their drilling-site condition.

Table 3. Comparison of the *true depths* and *laboratory depths* for selected stone bands in the Swanworth Quarry No. 1 Borehole.

Stone Band	True depth (m)	Laboratory depth (m)	Difference (m)
Encombe	147.5	148.3	+0.8
Basalt	215.1	219.1	+4.0
Rope Lake Head	238.4	243.6	+5.2
Grey Ledge	260.3	265.8	+5.8
Cattle Ledge	272.1	278.1	+6.0
Yellow Ledge	287.0	293.2	+6.2
Maple Ledge	329.8	337.2	+7.4
The Flats	365.2	374.1	+8.9
Hobarrow Bay	380.4	389.9	+9.5
Swanworth **D**	400.4	410.4	+10.0
Swanworth **C**	410.4	420.8	+10.4
Swanworth **B**	421.5	432.4	+10.9
Swanworth **A**	442.8	454.7	+11.9
Metherhills	488.1	501.0	+12.9
FINAL DEPTH	505.2	518.0	+12.8

True depth taken at approximate centre of stone band: laboratory depth taken at magnetic susceptibility peak (Dr David Gunn, MS).

A close approximation to the depths at which the lithological boundaries occur in the ground (the *true depths*) can be obtained from the geophysical logs, and only from these logs. The stone bands proved to be especially useful for this purpose because they have lithologically sharp bases and tops, and they give rise to gamma-ray, resistivity and density responses that are markedly different from those of the adjacent mudstones. The Formation Microscanner (FMS) and Formation Microimager (FMI) logs made by Schlumberger Ltd.,

which provide pictorial images of the core based on resistivity differences, proved to be particularly useful. They enabled the positions of the tops and bottoms of the stone bands to be measured to within ±50mm of their true depths. The positions of the other principal lithological changes were slightly more difficult to determine. The bituminous mudstones, oil shales, minor cemented bands and some other lithologies also give distinctive traces in the FMS/FMI logs. Using the stone bands as datums, and by comparing the thicknesses recorded between them and the other lithologies in the drilling-site geological logs with the FMS/FMI logs, it was possible to accurately identify the depths of the subsidiary lithologies.

In summary, the depths shown on the 1:500 scale graphical Wellog plots for the three RGGE boreholes (Appendix 6) are the *true depths*. These depths are also used in the chronostratigraphical summary (Appendix 2). The depths given in the drilling-site geological logs (Appendix 3), those recorded on the core boxes (Appendix 4) and in the core photographs (Appendix 5) are the *driller's depths*. The depths given in the Southampton MSL reports are the *laboratory depths*.

It is clear from the above that care will needed to resolve the problem of how best to assign depths to the RGGE samples to be analysed to avoid possible future confusion. This is especially true for the datasets that will be derived from the detailed systematic sampling, and which will be used in cross analysis with other datasets including the geophysical logs.

3. GEOPHYSICAL LOGGING

Both the RGGE Steering and Science committees saw the provision of a complete a suite of geophysical logs as an important part of the research project. In addition to the more routine logs such as resistivity, gamma-ray, bulk density and sonic, particular interest was expressed in magnetic susceptibility, palaeomagnetism, geochemical, nuclear magnetic resonance and borehole imaging logs. Several of these, namely the palaeomagnetism tool (GHMT), geochemical tool (GLT), borehole imaging tools (FMS and FMI) and the nuclear magnetic resonance tool (CMR), are unique to Schlumberger Ltd. A contract was therefore let to Schlumberger to log the Swanworth Quarry No. 1 Borehole, the suite of logs to include the 'standard' logs, FMI and any other tools available. In the event, the unexpectedly sudden termination of the borehole meant that it had to be logged at short notice and the GLT, GHMT (which includes magnetic susceptibility) and CMR tools were unavailable. The

waiting-time charges for the drilling crew and rig were such that it would not have been cost effective to wait until these tools became available.

The geophysical logs run in the three RGGE Project boreholes are listed in Table 4. In addition to the full suite of geophysical logs required in the Swanworth Quarry No. 1 Borehole on its completion, it was also necessary to carry out 'insurance' logging in the borehole as it progressed in order to monitor its stability and to provide a minimal suite of logs if the borehole collapsed before it could be fully logged. This logging was carried out by Dr D E Buckley using the British Geological Survey (BGS) logging facility. The Science Committee also required a minimal suite of geophysical logs (gamma-ray and resistivity) to be run in the Swanworth Quarry No. 2 Borehole, sufficient to effect correlations between the No. 1 and No. 2 boreholes if accurate lithological correlations were not possible. These logs, also made by BGS, included a magnetic susceptibility log to enable comparison to be made with the multisensor measurements made on the core at the Southampton Oceanographic Centre.

The same geophysical logging procedures were followed for the Metherhills No. 1 Borehole. Intermediate logging was carried out by BGS and a full suite of logs, including GHMT and CMR, was run by Schlumberger Ltd. on completion of the borehole. The geochemical tool (GLT) was again unavailable. There is now little commercial demand for it and there are, in consequence, few GLT tools available at any one time in the U.K. sector.

4. GEOLOGICAL SEQUENCES

The drilling-site geological logging of Swanworth Quarry No. 1 Borehole was carried out by the author with the assistance of Miss Sarah Pearson of Southampton University; that of the Swanworth Quarry No. 2 Borehole largely by Mr Berry; and that of the Metherhills No. 1 Borehole by the author with the assistance of Mr Berry. The drilling-site logs were prepared using the *driller's depths* (Appendix 3). Graphical (Wellog) plots at 1:500 scale showing the *true depths* of the lithostratigraphy, biostratigraphy and chronostratigraphy of the sequences proved in all three boreholes, together with selected geophysical logs, are given in Appendix 6. The cored intervals and the correlation of selected marker bands between the three boreholes are shown in Figure 6.

Table 4. Geophysical logs run in the Swanworth Quarry and Metherhills boreholes.

Swanworth Quarry No. 1 Borehole

Datum: ground level (G.L.), 79.89m above Ordnance Datum. Casing: 8-inch diam. plastic cemented to 23.3m
Standing water levels: 8.94m below G.L.on 24/1/97; 17.62m below G.L. on 31/1/97; 18.04m below G.L. on 21/2/97; 22.74m below G.L. on 6/3/97

Date	Contractor	Run	Logs	Depths (m)		Units	BGS Wellog Abbreviation
							swan 1
24/1//97	**BGS**	1	Focused Resistivity Total Gamma Ray (GR)	G.L.	124	 counts/sec	fe 1 gr 1
		2	Magnetic Susceptibility Induction Resistivity	G.L.	124	.	mgs 1 ind 1 res 1
		3	Caliper Total Gamma Ray (NGAM) Point Resistance Self Potential	G.L.	124	inches API units	cal 1 gam 1 spr 1 sp 1
31/1/97	**BGS**	1	Focused Resistivity Total Gamma Ray (GR)	G.L.	210	 counts/sec	fe 2 gr 2
		2	Caliper Total Gamma Ray (NGAM) Point Resistance Self Potential	G.L.	210	 API units	cal 2 gam 2 spr 2 sp 2
		3	Magnetic Susceptibility Induction Resistivity	G.L.	210		mgs 2 ind 2 res 2
7/2/97	**BGS**	1	Caliper Total Gamma Ray (NGAM) Point Resistance Self Potential	G.L.	281	inches API units	cal 3 gr 3 spr 3 sp 3
		2	Focused Resistivity Total Gamma Ray (GR)	190	280	 counts/sec	fe 3 gam 3
		3	Magnetic Susceptibility Induction Resistivity	190	280		mgs 3 ind 3 res 3
21/2/97	**BGS**	1	Focused Resistivity Total Gamma Ray (GR).	229	375	 counts/sec	fe 4 gr 4
		2	Caliper Total Gamma Ray (NGAM) Point Resistance Self Potential	G.L.	375	inches API units	cal 4 gam 4 spr 4 sp 4
		3	Sonic MLS)	G.L.	375		sv 4
6/3/97	**BGS**	1	Caliper Total Gamma Ray (NGAM) Point Resistance Self Potential	G.L.	467	inches API units	cal 5 gam 5 spr 5 sp 5
	hole blocked at 408m	2	Focused resistivity Total Gamma Ray (GR)	350	408	 counts/sec	fe 5 gr 5
	hole blocked at 408m	3	Magnetic Susceptibility Sonic (MLS)	G.L.	408	 defective tool	mgs 5 sv 5
14/3/97	**Schlumberger**	1	Caliper, Microresistivity (MSFL) Laterolog Shallow (LLS) Laterolog Deep (LLD) Array Sonic (AS) Total gamma ray (GR)	G.L. G.L. G.L. 	502 485 482 	inches API units	
		2	Spectral Gamma (NGS) Lithodensity (LDL) Neutron Porosity (CNL)	G.L. G.L. G.L.	495 502 500	API units	
		3	Formation Microscanner (FMS)	G.L.	496		

Table 4. Geophysical logs run in the RGGE Project boreholes (continued)

Swanworth Quarry No. 2 Borehole

Datum: ground level (G.L.), 80.26m AOD. Casing: 8-inch diameter steel cemented to 23.3m

Standing water levels: 9.25m below G.L. on 10/4/97; 14.85m below G.L.on18/4/97; 18.79m below G.L. on 30/4/97

Date	Contractor	Run	Logs	Depths		Units	BGS Wellog Abbreviation
							swan2
10/4/97	BGS	1	Caliper Total gamma (NGAM) Point resistance Self potential	G.L.	171	inches API units	cal 1 gam 1 spr 1 sp 1
		2	Focused resistivity Total gamma (GR)	G.L.	171	counts/sec	fe 1 gr 1
		3	Magnetic susceptibility Induction Resistivity	G.L.	171		mgs 1 ind 1 res 1
18/4/97	BGS	1	Caliper Total gamma (NGAM) Point resistance Self potential	G.L.	267	inches API units	cal 2 gam 2 spr 2 sp 2
		2	Focused resistivity Total gamma (GR)	G.L.	268	counts/sec	fe 2 gr 2
		3	Magnetic susceptibility Induction Resistivity	G.L.	268		mgs 2 ind 2 res 2
30/4/97	BGS	1	Caliper Total gamma (NGAM) Point resistance Self potential	G.L.	386	inches API units	cal 3 gam 3 spr 3 sp 3
		2	Focused resistivity Total gamma (GR)	G.L.	386	counts/sec	fe 3 gr 3
		3	Magnetic susceptibility Induction Resistivity	G.L.	386		mgs 3 ind 3 res 3

Metherhills No. 1 Borehole

Datum: ground level (G.L.), 40.0m AOD. Casing: 8-inch diameter steel cemented to 14.5m

Standing water levels: 22.62m below G.L. on 22/5/97; 22.59m below G.L. on 4/6/97

Date	Contractor	Run	Logs			Units	BGS Wellog Abbreviation
							m
22/5/97	BGS	1	Caliper Total Gamma Ray (NGAM) Point Resistance Self Potential.	G.L.	214	inches API units	cal gam 1 spr 1 sp 1
		2	Focused Resistivity Total Gamma Ray (GR)	G.L.	214	counts/sec	fe 1 gr 1
		3	Magnetic Susceptibility Induction Resistivity.	G.L.	214		mgs 1 ind 1 res 1
4/6/97	BGS	1	Magnetic Susceptibility Induction Resistivity.	G.L.	315	logging interrupted	mgs 2 & 3 ind 2 & 3 res 2 & 3
4/6/97	Schlumberger	1	Caliper Geomagnetism (GHMT) Total Gamma Ray (GR).	G.L.	315	API units	
		2	Array Sonic (AS) Laterologs (LLS and LLD)	G.L.	315		lls&lld
		3	Formation Microimager (FMI) Total Gamma Ray (GR).	G.L.	315	API units	
		4	Microresistivity (MSFL) Lithodensity (LDL) Neutron Porosity (CNL)	G.L.	315		
		5	Magnetic Resonance (CMR) Spectral Gamma Ray (NGS)	G.L.	316	API units	magr sgr; pota; thor; uran

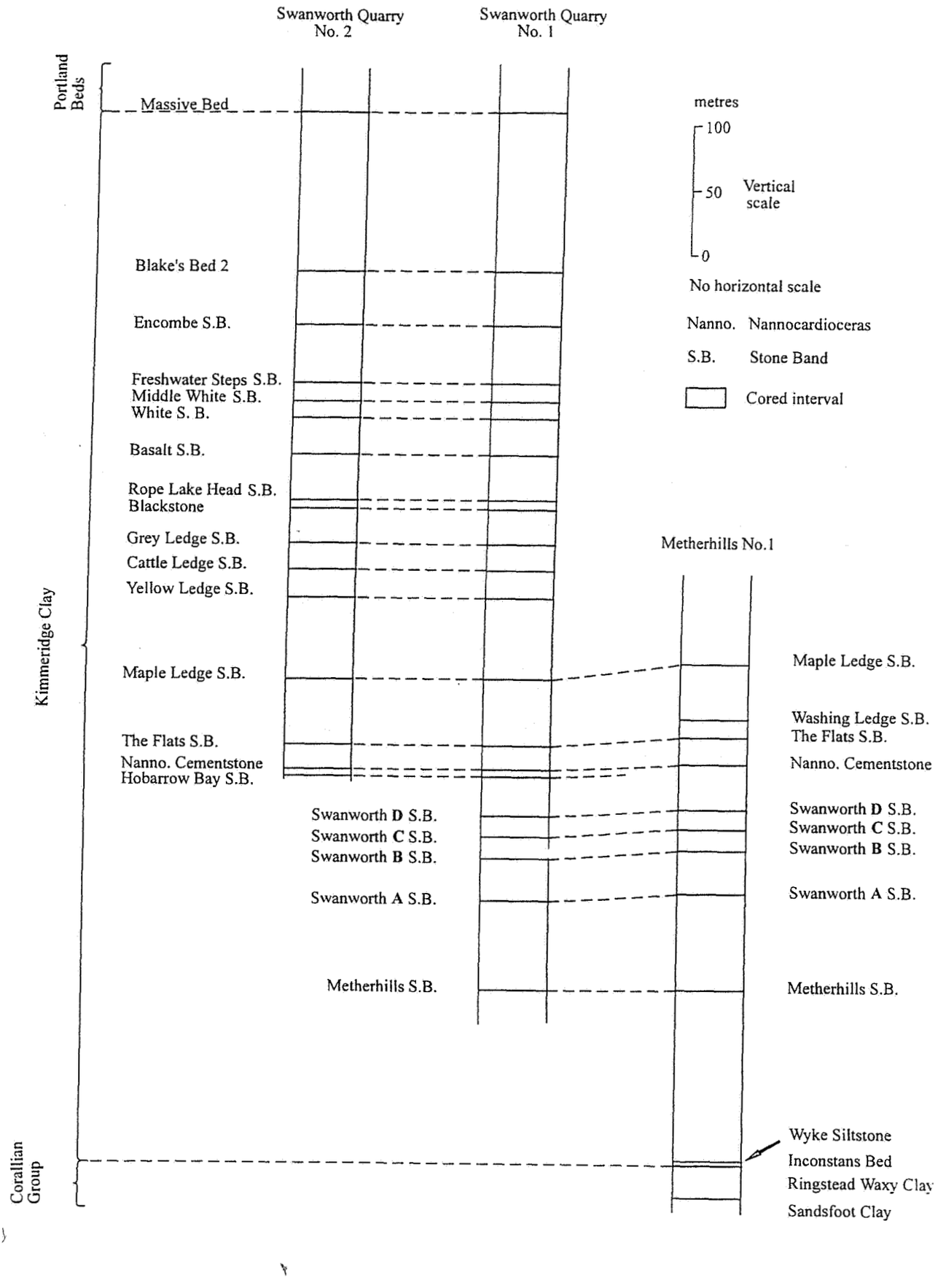


Figure 6. Cored intervals and the correlation of selected marker bands in the Swanworth Quarry and Mertherhills boreholes.

4.1 Lithostratigraphy, biostratigraphy and chronostratigraphy of the Kimmeridge Clay

The Kimmeridge Clay of most of the English onshore outcrop is made up of a series of mudstone-dominated, small-scale (0.5 to 1.5m thick) to large-scale (tens of metres thick) rhythms. In the lower part of the formation (Baylei to Mutabilis zones), these rhythms consist of thin beds of transgressive silt or silty mudstone overlain by dark grey mudstones and pale grey, more calcareous mudstones. In the middle part of the sequence (Eudoxus to Pallasioides zones), the rhythms consist of organic-rich mudstones (oil shales and bituminous mudstones) overlain by dark grey mudstones and pale grey highly calcareous mudstones. In the highest part of the Kimmeridge Clay (Rotunda and Fittoni zones) the rhythms become progressively more silty, and organic-rich horizons are rare.

Many of the individual small-scale rhythms can be correlated over distances of tens of kilometres in borehole cores and wireline geophysical logs. The larger-scale rhythms can be correlated throughout much of the onshore outcrop. The broader lithological changes described above, from more to less calcareous, more to less organic-rich, and more to less silt-rich, are superimposed on the rhythms and can themselves be regarded as very large-scale rhythms. The rhythms are presumed to reflect short- and long-term fluctuations in organic productivity and clastic supply influenced by variations in factors such as climatic, sea-level and seasonal changes. Coarser sediments, mostly fine-grained sands and silts, occur locally around the edges of the concealed London Platform where they replace parts of the rhythmic mudstone sequence.

The Kimmeridge Clay is wholly marine throughout Britain, and at most levels is rich in ammonites, bivalves and foraminifera. Gastropods, serpulids, crinoids, belemnites and coccoliths are abundant at some levels; vertebrate remains, mostly fish scales and marine reptile bones, also occur. Palynomorphs, including dinoflagellates and pollen spores which are now mostly diagenetically altered to amorphous kerogen, form up to 45 wt% of the more organic-rich horizons (oil shales). Plant debris is common at many levels.

The ammonites in the Kimmeridge Clay are mostly crushed, but otherwise well preserved. They are present in large numbers in exposures at most stratigraphical levels, and are sufficiently common in borehole cores for them to be stratigraphically useful. They occur in assemblages of rapidly evolving forms and therefore provide the basis for the zonal scheme. This is based on species of the perisphinctaceans *Pictonia*, *Rasenia*, *Aulacostephanus*, *Pectinatites*, *Pavlovia* and *Vigatopavlovia* (Arkell, 1933; Ziegler, 1962;

Cope, 1967; 1978). Other ammonites are common at some horizons in the *Rasenia* and *Aulacostephanus* zones: these include *Amoeboceras* (*Amoebites*), *Amoeboceras* (*Nannocardioceras*), *Aspidoceras* and its aptychal plate *Laevaptychus*, *Crucelliceras* and *Sutneria.* The last named and rare *Gravesia* (in the Autissiodorensis to Scitulus zones) form important links with Kimmeridgian sequences elsewhere in north-west Europe, and with Volgian and Tithonian sequences in more distant areas. Thin beds containing flood occurrences of coccoliths, the crinoid *Saccocoma*, brachiopods and certain species of ammonite and bivalve provide additional marker horizons that are probably isochronous.

There is still a difference of opinion as to whether or not the ammonite zones are biostratigraphical or chronostratigraphical. Dr B M Cox (in Cox, Gallois and Sumbler, 1994) has noted that the "apparent conflict of opinion is largely dogmatic" because the boundaries of most Jurassic ammonite zones are based on "an ammonite-based `event` stratigraphy" in which the "boundaries are positioned at convenient lithological markers or erosion surfaces, which may not exactly coincide with the boundary of the ammonite biozone". The zonal scheme for the lower part of the Upper Kimmeridgian is a good example of this: Cope (1967) placed the zonal boundaries at convenient lithological marker bands (mostly named stone bands) which lay below the recorded ranges of the zonal ammonite assemblages. The names of the ammonite zones in the present account follow the current majority practice for the Jurassic in which the zones are regarded as chronostratigraphical and referred to by their species name in Roman script; e.g. Pectinatus Zone has replaced Pectinatites (*Pectinatites*) *pectinatus* Zone.

The Kimmeridge Clay has been extensively explored in continuously cored boreholes in eastern England and has been divided into 49 stratigraphical units (referred to as KC 1 to KC 49) on the basis of a combination of lithological and macrofaunal characters (Gallois and Cox, 1976; Cox and Gallois, 1979). This scheme of stratigraphical subdivision was subsequently shown to be applicable, with minor additions and local variations, to the whole of the Kimmeridge Clay onshore outcrop from Dorset to Yorkshire, the onshore subcrop, and beneath the southern North Sea. It has also been correlated with wireline geophysical logs that have enabled the classification to be recognised in uncored boreholes (Penn, Cox and Gallois, 1986). Taken together, the lithological, palaeontological and geophysical evidence suggests that these distinctive units are bounded by events which are isochronous surfaces

throughout much of the Kimmeridge Clay outcrop and subcrop. They are, therefore, considered to be chronostratigraphical units.

The original classification ended at chronostratigraphical unit KC 49, a little above the base of the Pectinatus Zone, because the higher parts of the Kimmeridge Clay are cut out by erosion at the base of the latest Jurassic or early Cretaceous over much of eastern England. Stratigraphically higher beds occur locally, as at Hartwell, Bucks (Neaverson, 1924) and Swindon, Wilts (Chatwin and Pringle, 1922), but these higher sequences are fragmentary and much of them in sandy facies. The highest part of the Kimmeridge Clay up to the junction with the Portland Beds is exposed in mudstone facies in Kimmeridge Cliffs westwards from Freshwater Steps (Figure 1). Later measurements made on the Dorset coast by the author suggested that the subdivision of the highest part of the Kimmeridge Clay (KC 47 to KC 49) in eastern England was too detailed to be laterally persistent, and a new scheme was proposed for the beds between KC 46 and the Rotunda Nodule Bed (Gallois MS, 1988; quoted by Wignall, 1990). This scheme was also subsequently revised in the light of more recent palaeontological collecting and observations. New measurements by Mr S. Etches and the author on the highest part of the Kimmeridge Clay in the type section at Chapman`s Pool and in the lower cliffs of the Houns-tout, have enabled the chronostratigraphical scheme to be extended to the top of the Kimmeridgian Stage (Figure 7).

The revised and extended chronostratigraphical scheme is described in Appendix 2. Its application to the Swanworth Quarry and Metherhills boreholes is summarised in Appendix 3 (drilling-site descriptions) and Appendix 6 (1:500-scale graphical plots). The descriptions of chronostratigraphical units KC 1 to KC 45 are taken from Cox and Gallois (1979) and Gallois and Cox (1976) as updated in Gallois (1994). This part of the scheme has been applied to the Kimmeridge Clay exposed in Kimmeridge cliffs (Cox and Gallois, 1981) and is applied here to the RGGE boreholes, with one exception. The base of KC 36 has been taken consistently throughout the Kimmeridge Clay onshore outcrop and subcrop at the base of an oil shale immediately above the highest recorded *Aulacostephanus,* except at Kimmeridge Bay. There, the KC 35/KC 36 boundary, which coincides with the base of the Elegans Zone (Cope, 1967) and the base of the Upper Kimmeridge Clay (Arkell, 1933), has until now been taken at the base of Blake`s (1875) Bed 42. This last named is a thin, impersistently cemented bituminous mudstone about 8m above the highest recorded *Aulacostephanus.*

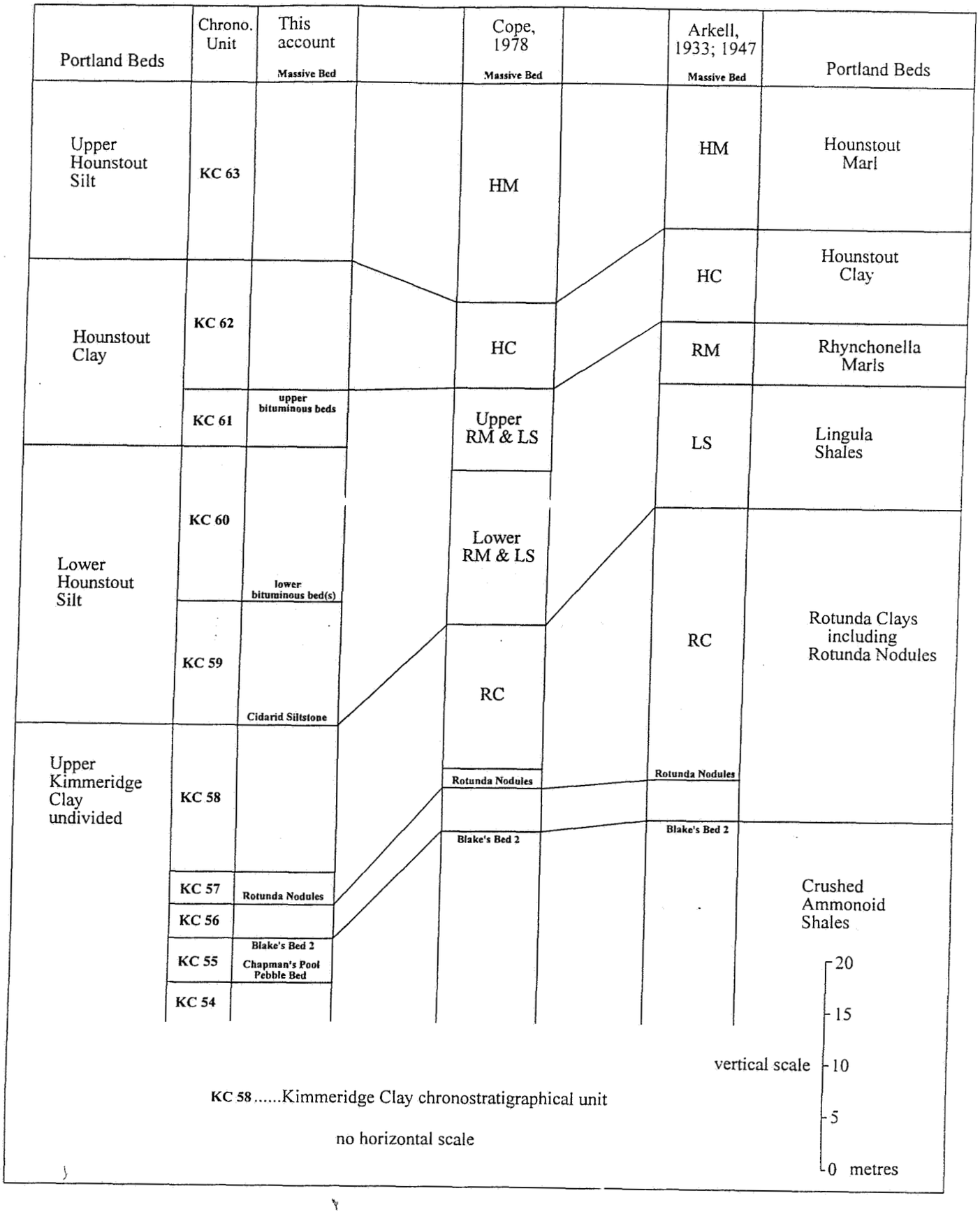


Figure 7. Subdivisions of the Kimmeridge Clay above Blake's (1875) Bed 2 at Chapman`s Pool and in Houns-tout Cliff (after Gallois and Etches, MS).

Blake's Bed 42 has only been recorded in Hen Cliff, on the east side of Kimmeridge Bay (Figure 4): it is absent in the cliffs at Brandy Bay on the west side of Kimmeridge Bay, in the Swanworth Quarry boreholes, and in all the inland boreholes recorded to date. The original definition of the KC 35/ KC 36 boundary, which is dependent on the presence or absence of *Aulacostephanus*, has therefore been used in the classification of the Swanworth Quarry boreholes.

It is conventional practice to define the bases of biozones by the incoming of new species or assemblages. However, the sudden, apparently synchronous disappearance of species of *Aulacostephanus* at the KC 35/36 boundary Clay throughout Britain provides an unusual, but reliable, biostratigraphical marker event that is important for international correlation. This boundary marks the base of the Upper Kimmeridgian Substage (Arkell, 1933), the base of the Portlandien Stage (sensu gallico), and is the presumed correlative of the base of the Volgian Stage.

The named marker bands (mostly stone bands) referred to in the drilling-site descriptions (Appendix 3) and the graphical plots (Appendix 6) are those of Blake (1875), Arkell (1933) and Cox and Gallois (1981). New names have been introduced for previously unrecorded marker bands which have been shown to be laterally persistent: some of these have been proved in boreholes beyond the Isle of Purbeck, but others are as yet only known locally. The beds to which new names have been given are described below in ascending stratigraphical order.

The base of the Eudoxus Zone throughout the onshore outcrop and subcrop of the Kimmeridge Clay is marked by a minor erosion surface that is overlain by a shelly and gritty siltstone (KC 24) which marks the last, and probably the most extensive, of a series of early Kimmeridgian transgressions. At some localities, particularly those close to the edge of the concealed London Platform, a second transgressive pulse gives rise to a second shelly siltstone (KC 25) just above the first. The misidentification of these two lithologically similar siltstones has given rise to some confusion, and it is therefore proposed here to use the name **North Wootton Siltstone** for the lower bed (KC 24). The type section is the continuously cored interval between 87.30 and 88.55m in the North Wootton Borehole, Norfolk [TF 6439 2457] (Gallois, 1979).

A thin (up to 30mm thick), lithologically distinctive bed of fluidised shelly mudstone which cuts a laminated coccolith-rich bed, was recorded in the Eudoxus Zone in all three

RGGE boreholes. This bed had only previously been recorded in situ at Hobarrow Bay and as loose blocks of uncertain stratigraphical provenance at Ringstead Bay. The Hobarrow Bay and the borehole occurrences are all at the same stratigraphical level, close below the Nannocardioceras Cementstone, and the bed seems to mark an isochronous event, probably a seismic shock. It is referred to here as the **Hobarrow Bay Fluidised Bed.**

New names have been given to five stone bands which have not been recorded at outcrop but which were proved to be laterally persistent in the Mutabilis and Eudoxus zones in the RGGE boreholes and in hydrocarbon-exploration boreholes in the region (see section 4.2). A sixth stone band, in the Hudlestoni Zone, was proved in the Swanworth Quarry boreholes, but does not crop out in Kimmeridge cliffs.

A stone band which was proved in the cores of BGS Encombe Borehole [SY 9446 7785], the Swanworth Quarry boreholes and in the geophysical-log signatures in hydrocarbon-exploration boreholes in the area, but which is present only as a weakly cemented, very pale mudstone in the cliffs at Egmont Bight, has been named the **Encombe Stone Band.**

At Chapman`s Pool, a thin (up to a few centimetres thick) gritty, shelly, silt-rich mudstone with abundant belemnites and oysters, and phosphatised bivalves and body chambers of pavlovid ammonites rests on a bioturbated surface. It marks an important sedimentary break and faunal change at the base of the Rotunda Zone. Its correlatives at Gad Cliff and Ringstead Bay also contain abundant phosphatised ammonite and bivalve fragments, and phosphatic and other pebbles. It has been named the **Chapman`s Pool Pebble Bed.**

The highest part of the Kimmeridge Clay, between the Rotunda Nodule Bed and the Massive Bed at the base of the Portland Beds, is deeply weathered and partially landslipped in its only exposures above Chapman`s Pool and beneath the Houns-tout. There is no satisfactory published account: the lithological descriptions are oversimplified and the total thickness has been underestimated by over 20%. New measurements by Mr S. Etches and the author have shown that 10 to 15m of strata are probably missing from the published accounts. The subsequent drilling of the Swanworth Quarry boreholes confirmed this, the outcrop measurements being within a few per cent of the borehole thicknesses. Few marker bands can be correlated between the outcrop and the borehole cores because of the deeply weathered nature of the outcrop. However, the broader lithological changes can be closely matched. The

existing terminology (the Lingula Shales, Rhynchonella Marls and Hounstout Marl of Arkell, 1933) has been replaced (Gallois and Etches, MS) by terms (**Lower** and **Upper Hounstout Silt**) that better describe the broad lithological characters of the sequence (Figure 7).

4.2 Swanworth Quarry No. 1 and No. 2 boreholes

The principal marker bands exposed in the Kimmeridge cliffs, notably the named stone bands and the more prominent oil-shale horizons, were readily identified in both Swanworth Quarry boreholes (Figure 8).

All but two of the named beds at outcrop, which range from the Hobarrow Bay Stone Band to the Massive Bed, were identified in both boreholes. The exceptions were the Washing Ledge Stone Band and Blake's Bed 42 (a patchily cemented stone band). The close similarity of the Swanworth Quarry No. 1 and No. 2 cored sequences indicates that the two missing horizons are absent through lateral variation in the Kimmeridge Clay, not because of faulting. Such lateral variation is present within the cliff sections themselves. For example, the Yellow Ledge Stone Band is the most prominent bed in Hen Cliff on the east side of Kimmeridge Bay, but is absent in Brandy Bay, 1km to the west. No significant fault (throw >1m) is present in either of the Swanworth Quarry boreholes.

In addition to the named stone bands, the Swanworth Quarry No. 1 Borehole proved five stone bands below the Hobarrow Bay Stone Band (Figure 6), the lowest bed exposed in Kimmeridge cliffs. All five stone bands were recorded in the Metherhills No.1 Borehole and the geophysical logs of several deep hydrocarbon-exploration boreholes in the Isle of Purbeck suggest that they are also present there. None of these bands has been identified at outcrop in south Dorset: they have therefore been named here, in stratigraphically ascending order, the **Metherhills** and the **Swanworth Quarry A** to **D** stone bands.

An additional stone band recorded close below the Grey Ledge Stone Band in the Swanworth Quarry No. 1 and No. 2 boreholes, but absent at outcrop in Kimmeridge cliffs, has been named the **Southard Stone Band** after the Southard Quarry Borehole [SZ 0234 7775] (drilled by British Petroleum in 1989) where it has a strong geophysical signature. The limited borehole data suggest that it is restricted to the eastern part of the Isle of Purbeck.

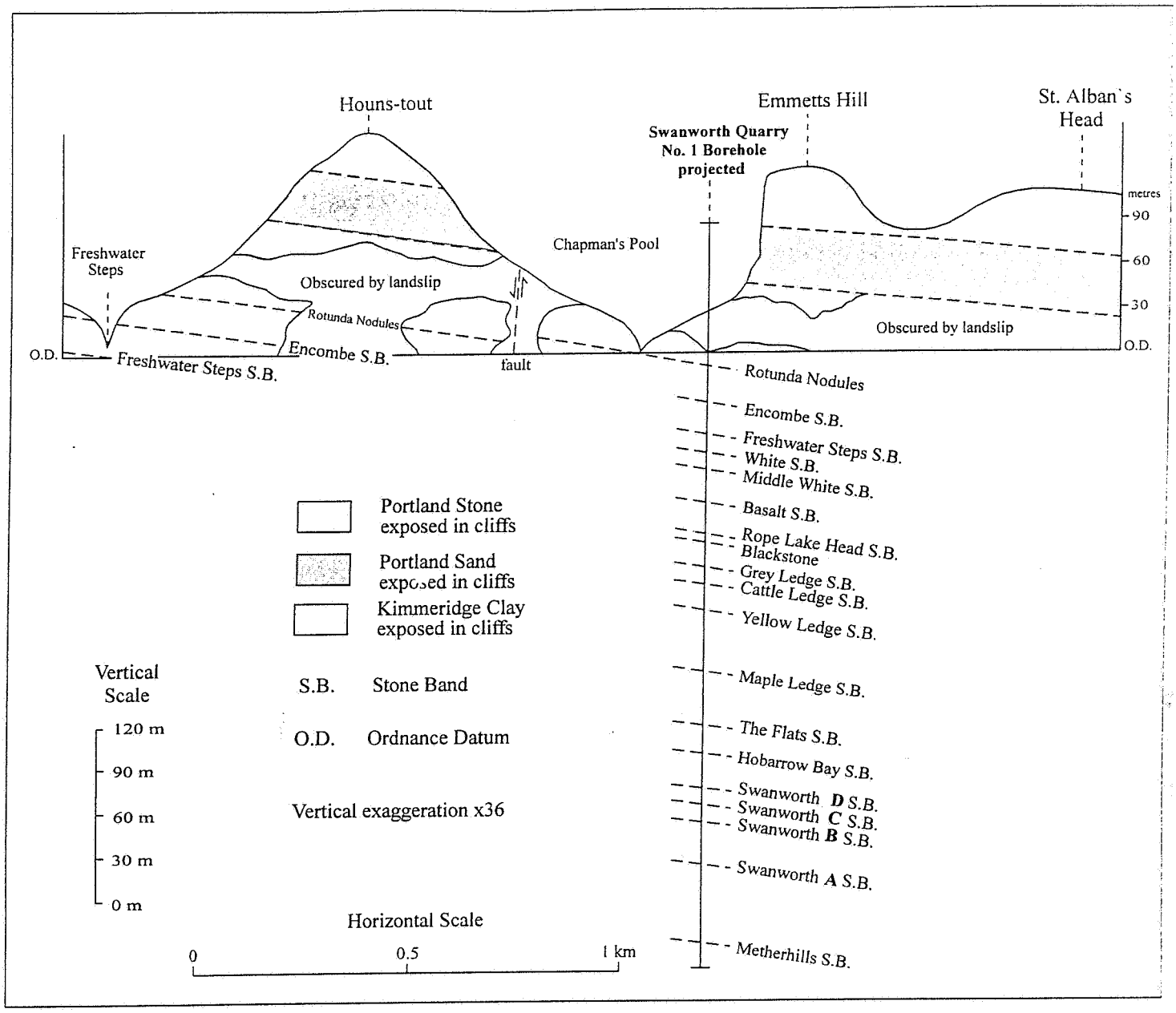


Figure 8. The positions of stone bands proved in the Swanworth Quarry No. 1 Borehole projected into Kimmeridge cliffs.

Comparison of the thicknesses between the marker bands proved in the Swanworth Quarry boreholes with those published for the nearby cliff sections (Cox and Gallois, 1981) shows an almost linear relationship, in which the Swanworth Quarry sequence is 7% thinner than the sequence exposed in the cliffs between Chapman's Pool and Kimmeridge Bay (Table 5 and Figure 9).

Below the Hobarrow Bay Stone Band, the oldest horizon exposed in Kimmeridge cliffs, the shell-rich Supracorallina Bed (KC 22), the North Wootton Siltstone (KC 24) and

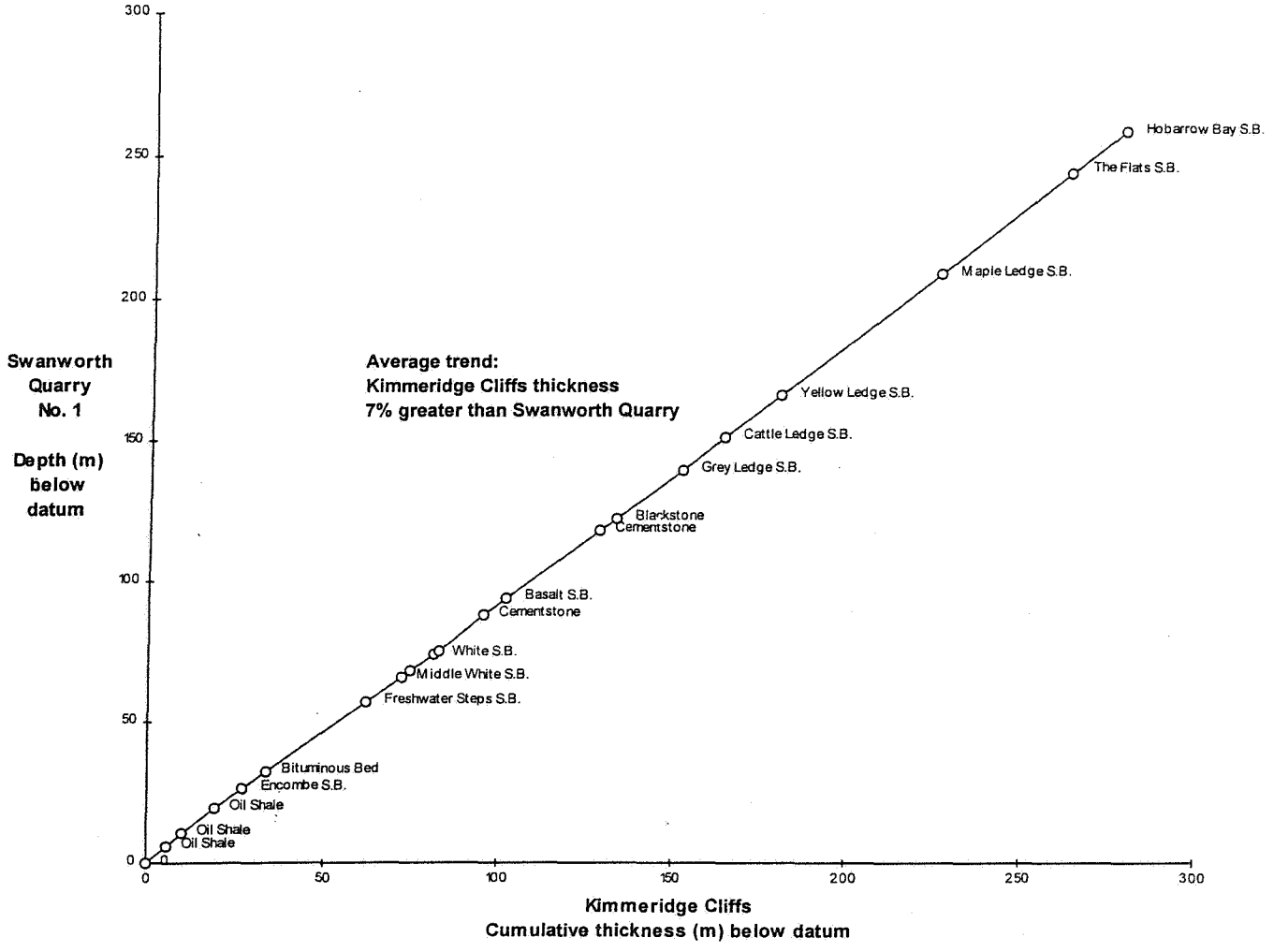
the five newly named stone bands described above, were present in the Swanworth Quarry No.1 Borehole cores. Above the Hobarrow Bay Stone Band, in addition to the named horizons listed in Table 5, the Nannocardioceras Cementstone, the Hobarrow Bay Fluidised Bed, the *Nannocardioceras*-rich bands, and the Rebholzi and Volgae ammonite-marker bands, were present in their expected positions in the upper part of the Eudoxus Zone and the lower part of the Autissiodorensis Zone.

Table 5. Comparison of thicknesses between selected marker bands in Kimmeridge cliffs with those proved in the Swanworth Quarry No. 1 Borehole.

Base of Blake's Bed 2 taken as datum. Cliff thicknesses taken from Cox and Gallois (1981).

Kimmeridge Cliffs	Swanworth Quarry No. 1	Marker Horizon
0	0	Base Blake's Bed 2 (oil shale)
5.8	5.8	oil shale
10.3	10.4	oil shale
19.5	19.6	oil shale
27.0	26.3	Encombe Stone Band
33.9	32.4	bituminous bed
61.8	56.9	Freshwater Steps Stone Band
72.2	65.8	Middle White Stone Band
74.5	68.2	cementstone
81.1	73.7	cementstone
82.4	75.0	White Stone Band
95.3	87.8	cementstone
101.5	93.9	Basalt Stone Band
128.0	118.1	Rope Lake Head Stone Band
132.7	122.0	Blackstone
151.8	139.1	Grey Ledge Stone Band
163.8	150.9	Cattle Ledge Stone Band
179.7	165.7	Yellow Ledge Stone Band
225.1	208.5	Maple Ledge Stone Band
262.0	243.8	The Flats Stone Band
277.5	259.3	Hobarrow Bay Stone Band

In the highest part of the sequence, the Chapman's Pool Pebble Bed and two thin organic-rich horizons in the Fittoni Zone (Figure 7) provide useful correlative links with the outcrop at Chapman's Pool/Houns-tout. All the strata above the Rotunda Nodule Bed crop out in sections above the zone of wave erosion and they are, in consequence, deeply weathered. In the Swanworth Quarry boreholes, the two bituminous beds were highly pyritic, which in part accounts for their deeply rotted condition at outcrop.



S.B. Stone Band
Base of Blake's Bed 2 taken as datum. Cliff thicknesses taken from Cox and Gallois (1981).

Figure 9. Comparison of thicknesses between selected marker bands in Kimmeridge cliffs with those proved in the Swanworth Quarry No. 1 Borehole.

The organic-rich bands (the stratigraphically highest yet recorded in the Kimmeridge Clay) give rise to sharp gamma-ray spikes and low densities on the geophysical logs, which suggests that they would be easy to identify in uncored boreholes.

No Rotunda Nodule Bed was recorded in the boreholes, but a pyrite-rich band about 3m above Blake's Bed 2 in the boreholes probably correlates with a similar bed which occurs in association with the lower of the two horizons of Rotunda Nodules at outcrop. The cidarid-rich siltstone which marks the base of the Lower Hounstout Silt at outcrop (Gallois and Etches, MS) was not recorded in the Swanworth Quarry boreholes, but the rapid upward

change to silty mudstones and muddy siltstones that it marks is clearly reflected in the gamma-ray, resistivity and sonic logs.

4.3 Metherhills No. 1 Borehole

A reconnaissance field survey combined with a comparison of the geophysical logs from the Swanworth Quarry No. 1 Borehole and an incomplete and indistinct resistivity log from the Kimmeridge No. 5 hydrocarbon-exploration borehole [SY 9042 7935] (British Petroleum, 1961), suggested that theYellow Ledge Stone Band was close to ground level at the Metherhills site.

The Metherhills No. 1 Borehole was therefore rock-bitted to 90m depth, to a level a little above the estimated position of the Hobarrow Bay Stone Band. The aim was to begin coring at a stratigraphical level that would provide a small overlap with the Swanworth Quarry No. 2 cores, and continue to the base of the Kimmeridge Clay with a short continuation into the underlying Corallian Beds to allow the geophysical tools to record the junction (Figure 10). Taken together, the Metherhills No. 1 and Swanworth Quarry No. 2 boreholes would then provide a section through the full thickness of the Kimmeridge Clay. Funds permitting, a second Metherhills borehole was planned to core the lowest part of the Kimmeridge Clay, the part not penetrated by the Swanworth Quarry No. 1 Borehole.

In the event, the Hobarrow Bay Stone Band was not present in the Metherhills No. 1 Borehole, despite the fact that it was present in the Swanworth Quarry boreholes and that its outcrop on the shore could be seen from the top of the drilling mast. However, its close companions, the Nannocardioceras Cementstone and the Hobarrow Bay Fluidised Bed, were present and confirmed that the absence of the stone band was due to lateral facies variation and not to faulting. The geophysical logs confirmed the presence of The Flats, Washing Ledge and Maple Ledge stone bands in the uncored part of the borehole.

The sequence proved below the Hobarrow Bay Stone Band in the Metherhills No. 1 Borehole is not exposed in Kimmeridge cliffs (Figure 10). Parts of it are exposed from time to time farther west at Ringstead Bay [762 815], Osmington Mills [734 818] and Black Head [725 820], but are much affected by landslip. The base of the Kimmeridge Clay in the Metherhills No. 1 Borehole was marked by a bioturbated junction in which dark grey, shelly, gritty mudstone (KC 1) rests on and is burrowed into a partially phosphatised hardground at the top of pale grey, smooth textured (smectite-rich) mudstones of the Ringstead Waxy Clay.

Marker bands which crop out at Ringstead Bay and Black Head, which have been recorded in boreholes throughout the onshore outcrop and which were present in the Metherhills No. 1 Borehole, include *Deltoideum delta*-rich mudstones (KC 2), the Wyke Siltstone (KC 5), the Black Head Siltstone (KC 8), the shell-rich Supracorallina Bed (KC 22), and the North Wootton Siltstone (KC 24). The five prominent stone bands (Metherhills and Swanworth **A** to **D**) were also present.

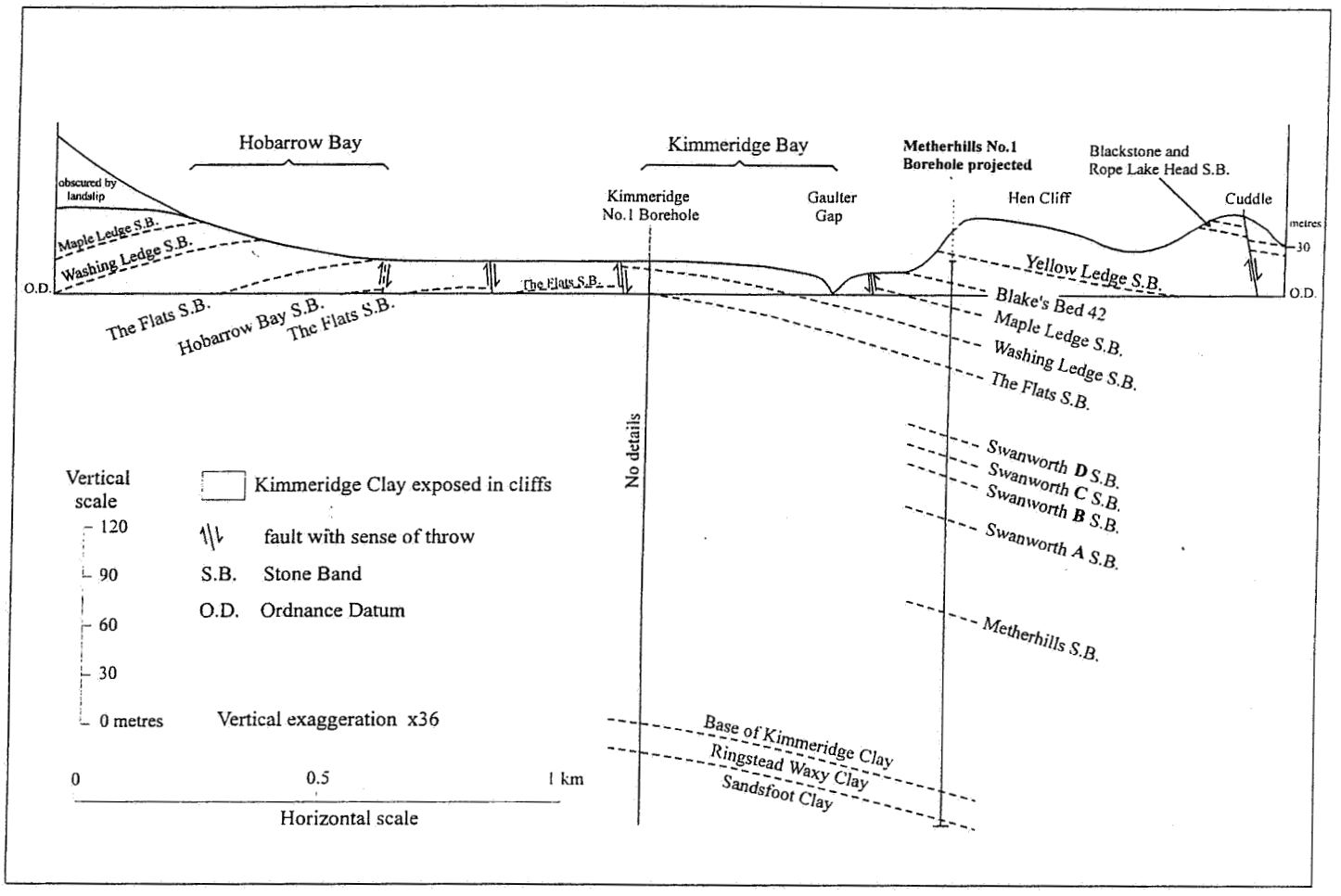


Figure 10. The positions of the principal marker bands proved in the Metherhills No.1 Borehole projected into Kimmeridge cliffs.

A simplified correlation of the Metherhills No. 1 and Swanworth Quarry No. 1 and No. 2 boreholes is shown in Figure 6. Taken together, the three boreholes provided two continuous cores from the top of the Kimmeridge Clay to a level high in the Mutabilis Zone, and a single core from there to the base of the formation.

5. WELL-COMPLETION DETAILS

On completion of the drilling, the primary concern at both the Swanworth Quarry and Metherhills sites was to ensure that the boreholes were satisfactorily sealed. The proximity of the very large and deep Swanworth Quarry excavation to the public-water-supply springs in Hill Bottom (Figure 3) required the upper parts of the two Swanworth Quarry boreholes to be sealed. This was done to a depth well below that which could provide a pollution pathway from the excavation (or its backfill) into the aquifer at some future date. The final caliper logs for both boreholes showed constrictions at the level of the highest thick, hard oil shale (Blake's Bed 2) at about 122m depth. A tapered wooden stake was jammed into the constriction and used to support a bentonite and cement plug. When this had hardened, the remainder of the borehole was cemented up, giving a permanent, impermeable plug from ground level to a depth of 122m (about 42m below Ordnance Datum). With time, the mudstones in the lower, uncemented part of the borehole will become impermeable through natural squeezing.

A similar procedure was followed for the Metherhills No. 1 Borehole. There, The Flats Stone Band provided a suitable constriction at a depth of 90m which enabled an impermeable cement plug to be set from that depth (about 50m below Ordnance Datum) to ground level. There was no aquifer to pollute at this site, but the borehole was drilled only a few tens of metres from the oil-and-gas bearing Kimmeridge No.5 Borehole (British Petroleum, 1961) which is cased, but reportedly unsealed in its upper part.

6. ACKNOWLEDGEMENTS

The successful acquisition of the borehole cores and geophysical data for the RGGE Project could not have been achieved without the skill and dedication of a large number of people. The Soil Mechanics drilling crew, under the direction of Mr Les Szalki, worked long hours in unpleasant conditions and often with little to show for it, but nevertheless persevered and overcame the problems caused by the many slippages. Mr Tom Berry, the Site Agent, was a key member of the Soil Mechanics team. Not only did he ensure that the drilling crew had the facilities that they required but also, by his excellent geological observations and communications, contributed greatly to the efficient and safe management of the drilling programme.

Miss Sarah Pearson provided invaluable on-site assistance and, in collaboration with Mr Ross Williams, ensured that the cores were transported to the Southampton Oceanographic Centre in a state that was as close as practicable to their in situ condition. Mr David Buckley of the BGS Wallingford office worked long and unsociable hours to obtain the 'insurance' geophysical logs for all three boreholes. The Schlumberger crews, under the direction of Mr Bjorn Sirum, worked with great skill and dedication to produce excellent suites of logs for the Swanworth Quarry No. 1 and Metherhills No. 1 boreholes. Finally, thanks are due to all those who provided indirect assistance, including the staff of Tarmac (Southern) Ltd at Swanworth Quarry; Mr J Hole the farm tenant at the Metherhills site, and Mr O J H. Chamberlain, the Agent for the Smedmore Estate; Mr J D Dubois the Agent for the Encombe Estate; British Petroleum staff based at Wytch Farm Oilfield who provided geological information and advice on deep drilling in the area; and the members of the RGGE Steering (Chairman, Professor D J Vaughan) and Science (Chairman, Dr H C Jenkyns) committees who provided advice and support at every stage of the project (see Appendix 1 for memberships).

7. REFERENCES

Arkell, W J. 1933. *The Jurassic System in Great Britain.* (Clarendon Press: Oxford).

Blake, J F. 1875. On the Kimmeridge Clay of England. *Quarterly Journal of the Geological Society of London*, Vol. 31, 196-233.

Chatwin, C P, and Pringle, J. 1922. The zones of the Kimmeridge and Portland rocks at Swindon. *Summary of Progress of the Geological Survey for 1921*, 162-168.

Cope, J C W. 1967. The palaeontology and stratigraphy of the lower part of the Upper Kimmeridge Clay of Dorset. *Bulletin of the British Museum (Natiral History), Geology,* Vol. 15, 3-79.

Cope, J C W. 1978. The ammonite faunas and stratigraphy of the upper part of the Upper Kimmeridge Clay of Dorset. *Palaeontology*, Vol. 21, 469-533.

Cox, B M, and Gallois, R W. 1979. Description of the standard stratigraphical sequences of the Upper Kimmeridge Clay, Ampthill Clay and West Walton Beds. *Institute of Geological Sciences* Report No. 78/19, 68-72.

Cox, B M, and Gallois, R W. 1981. The stratigraphy of the Kimmeridge Clay of the Dorset type area and its correlation with some other Kimmeridgian sequences. *Institute of Geological Sciences Report* No. 80/4, 1-44.

Cox, B M, Gallois, R W, and Sumbler, M G. 1994. The stratigraphy of the BGS Hartwell Borehole, near Aylesbury, Buckinghamshire. *Proceedings of the Geologists` Association,* Vol.105, 209-224.

Gallois, R W. 1979. Geological investigations for the Wash water storage scheme. *Institute of Geological Sciences Report* No.78/19, 1-74.

Gallois, R W. 1994. The geology of the country around King`s Lynn and The Wash. *Memoir of the British Geological Survey*, sheet 145 and part of 129 (England and Wales).

Gallois, R W and Cox, B M. 1976. The stratigraphy of the Lower Kimmeridge Clay of eastern England. *Proceedings of the Yorkshire Geological Society*, Vol. 41, 13-26.

Neaverson, E. 1924. The zonal nomenclature of the Upper Kimmeridge Clay. *Geological Magazine*, Vol. 61, 145-151.

Penn, I E, Cox, B M, and Gallois, R W.1986. Towards precision in stratigraphy: geophysical log correlation of Upper Jurassic (including Corallian Group) strata of the Eastern England shelf. *Journal of the Geological Society, London*, Vol. 143, 381-410.

Wignall, P B. 1990. Benthic palaeoecology of the Late Kimmeridge Clay of England. *Special Papers in Palaeontology*, No. 43.

Ziegler, B. 1962. Die Ammoniten-Gattung *Aulacostephanus* im Oberjura (Taxonomie, Stratigraphie, Biologie), *Palaeontographica,* Vol. 119A, 1-172.

APPENDIX 1. List of industrial sponsors, and membership of the RGGE Steering and Science committees.

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APPENDIX 2. A revised and extended chronostratigraphical classification for the Kimmeridge Clay.

See Section 4.1 for discussion of the chronostratigraphical scheme. The Swanworth Quarry No. 1 and Metherhills No. 1 depths referred to below are the *true depths* as defined in Section 2.3. The faunal identifications for **KC 1** to **KC 47** are those of Dr B. M. Cox (in Gallois, 1994). The ammonite identifications for **KC 49** to **KC 63** are based on Cope (1978).

Upper Hounstout Silt:

KC 63 Siltstone, muddy and silty and very silty mudstones, thickly interbedded; medium grey and brownish grey becoming paler with increasing silt content; highly bioturbated at many levels with *Teichichnus, Rhizocorallium, Arenicolites* and other burrows picked out by pale silt content; poorly preserved bivalves and ammonites including *Virgatopavlovia hounstoutensis* Cope, *V.* sp. nov. aff. *fittoni* Cope and *Pavlovia* spp. indet.; base taken at downward change to finer-grained lithologies.
Dorset Coast: wholly exposed on steep slopes below the central and western parts of the main cliff face at Houns-tout; junctions with overlying Portland Sand (taken at base of Massive Bed, 2m-thick bed of fine-grained sandstone) and underlying bed well exposed. Parts of lateral equivalent poorly exposed below Gad cliff.
Swanworth Quarry No.1: 40.05 to 56.87 m.

Hounstout Clay:

KC 62 Mudstone, silty and very silty with several thick interbeds of silty mudstone; medium grey, paler where more silty; highly bioturbated as bed above with burrows exceptionally well preserved in more silt-rich horizons; fauna as bed above including *Virgatopavlovia hounstoutensis, V.* sp. nov. aff. *fittoni* and *Pavlovia* spp.; base taken at top of bituminous mudstone.
Dorset Coast: upper part well exposed on steeper slopes below central and western parts of the main cliff face at Houns-tout; lower part more patchily exposed in same area.
Swanworth Quarry No.1: 56.87 to 69.58m.

KC 61 Mudstone, silty and very silty, highly calcareous in part and with thin interbeds of fissile slightly bituminous and bituminous mudstone in upper part; base taken at downward change to more silty lithologies; no fauna recorded.
Dorset Coast: partially exposed between dedris mounds on the bench below the main face at Houns-tout cliff; small exposures of the bituminous beds occur at Pier Bottom and below Gad Cliff.
Swanworth Quarry No.1: 69.58 to 74.87m.

Lower Hounstout Silt:

KC 60 Siltstone, muddy and silty and very silty mudstones, thinly and thickly interbed, commonly in units 0.10 to 0.40m thick; base taken at top of thin bituminous bed; no fauna recorded.
Dorset Coast:wholly exposed in the upper part of the lower cliff below Houns-tout, where the bituminous bed forms a prominent rib at the base of the unit, and couplets of more (pale) and less (dark) silt-rich beds form up to seven distinctive rhythms in the upper part. Poorly exposed in part below Gad Cliff.
Swanworth Quarry No.1: 74.87 to 87.50m.

KC 59 Siltstone, muddy and silty mudstone; rhymically interbedded as KC60; one (locally two) thin (5 to 15cm), laminated brownish grey bituminous mudstone beds with common pyritized oysters and other bivalves at top of unit; no ammonite fauna recorded; thin siltstone at base rest with marked lithological contrast on underlying mudstones; basal siltstone contains rich and diverse fauna including oysters, *Entolium, Hibolites* and cidarid spines; no ammonite recorded.
Dorset Coast: upper part well exposed in the lower cliff below Houns-tout, where the siltstone at the base of unit forms a prominent rib, change of slope and seepage line. Lower part, including the cidarid-rich siltstone, well exposed at St Albans Head lower cliff and below Gad Cliff
Swanworth Quarry No.1: 87.50 to c.98.0m.

Upper Kimmeridge Clay (undifferentiated):

KC 58 Mudstone, medium and pale grey, highly calcareous, becoming progressively more silty in highest part; interbeds of very pale grey mudstone with subconcoidal weathering at several levels; two or more thin (10 to 20m) beds of dark grey, fissile shelly mudstone with abundant crushed bivalves; small oysters, *'Astarte', Protocardia, Thracia* scattered throughout and common at some levels; *Pavlovia rotunda* (Sowerby), *P.* spp. indet; *P. concinna* (Neaverson), *P.* aff *concinna:* base taken at top of line of burrowfill nodules.
Dorset Coast: wholly exposed in the lower part of the cliff below Hounstout, in the cliffs above Chapman's Pool, and below Gad Cliff. Almost wholly exposed at St Albans Head lower cliff and in upper cliff above Egmont Bight.
Swanworth Quarry No.1: c.98.0 to 113.83m

KC 57 Mudstone, medium and pale grey, highly calcareous with subconcoidal weathering in part; line of large (up to 10 x 20cm) dense calcareous burrowfill nodules at top enclosing bivalves and rare *Pavlovia*; line of similar, but smaller nodules at base commonly containing well preserved *Pavlovia*, including *P. concinna*, *P. rotunda* and *P. rotunda gibbosa* (Buckman).
Dorset Coast: 'Rotunda Nodule Bed' (auctt.) wholly exposed at Chapman's Pool, the lower cliff below Houns-tout, the upper cliff at Egmont Bight and below Gad Cliff.
Swanworth Quarry No.1: 113.83 to 117.12m

KC 56 Mudstone, medium and pale grey, as bed above; *Pavlovia concinna, P. rotunda, P.* sp. B Cope and *P.* spp. indet; base taken at top of oil shale.
Dorset Coast: as **KC 57**
Swanworth Quarry No.1: 117.12 to 120.33m

KC 55 Mudstone, thinly interbedded, dark and medium grey with thick oil shales (Blake's Bed 2) at top and erosion surface overlain by gritty, shell-rich pebble bed with abundant *Hibolites*, crushed pavlovids, oysters and other bivalves, and partially phosphatized *Pavlovia* sitting on erosion surface at base; *Pavlovia concinna, P.* sp. nov. aff. *varicostata* Ilovaisky, *P. rotunda, P.* sp. B.
Dorset Coast: as **KC 57**; the basal pebble bed is especially well exposed at Chapman's Pool and below Gad Cliff. Its lateral equivalent is represented in a complex pebble bed in the upper cliff at Ringstead Bay.
Swanworth Quarry No.1: 120.33 to 123.95m including Blake's Bed 2 and Chapman's Pool Pebble Bed.

KC 54 Mudstone, mostly medium and pale grey with widely spaced thin (<0.3m) interbeds of brownish grey bituminous mudstone; *Pavlovia composita* Cope, *P. composita waddingtoni* Cope, *P. pallasiodes* (Neaverson), *P. superba* Cope, *P.* aff. *strajevsky* Ilovaisky, *P.* sp B?, *P.* spp. indet, *Pectinatites (Pectinatites) circumligatus* Cope; thin bituminous bed at base.
Dorset Coast: wholly exposed at Egmont Bight where bituminous beds form prominent ribs; upper part exposed at Chapman's Pool and in the lower cliff below Houns-tout.
Swanworth Quarry No.1: 123.95 to 142.95m

KC 53 Mudstone, medium and pale grey, highly calcareous with subconcoidal weathering at several levels; very pale band, weakly cemented in middle part of bed passes locally into cementstone (Encombe Stone Band) in south Dorset; *Pavlovia composita, P.* sp. A Cope, *P.* spp. indet, *Pectinatites (Pectinatites) devillei* (de Loriol), *P. (P.)* cf *devillei*; base taken at top of thin bituminous bed.
Dorset Coast: wholly exposed at Egmont Bight where bituminous beds form prominent ribs.
Swanworth Quarry No.1: 142.95 to 152.88m including Encombe Stone Band.

KC 52 Mudstone, medium and pale grey with some thin dark grey interbeds and several thin, brownish grey bituminous mudstone beds; *Pavlovia* spp. fragments in upper part; *Pectinatites (Pectinatites) dorsetensis* Cope, *P. (P.) strahani* Cope and *P. (P.) tricostulatus* (Buckman) in lower part; base taken at thin bituminous mudstone.
Dorset Coast: wholly exposed at Egmont Bight where bituminous beds form prominent ribs.
Swanworth Quarry No.1: 152.88 to 163.04m

KC 51 Mudstone, medium and pale grey, highly calcareous with up to three horizons with small (mostly 0.1 to 0.2m), dense calcareous concretions; *Pectinatites* sp. indet.
Dorset Coast: wholly exposed at Egmont Bight.
Swanworth Quarry No.1: 163.04 to 166.00m

KC 50 Mudstone, medium and pale grey with two or more thin, dark grey, fissile pyrite-rich beds; base taken at top of underlying laminated beds; *Pectinaties (P.) cornutifer* (Buckman), *P. (P.) paravigatus* (Buckman), *P. (P.) pectinatus* (Phillips), *P. (P.) naso* (Buckman), *P. (P.) rarescens* (Buckman).
Dorset Coast: wholly exposed at western end of Egmont Bight.
Swanworth Quarry No.1: 166.00 to 175.70m

KC 49 Mudstone, finely laminated pale and dark grey mudstones, brownish grey bituminous mudstones and off-white coocolith rich mudstones; finely laminated coccolith-rich limestone at base. *Pectinatites (Pectinatites) cornutifer, P. (P.) naso, P. (P.) paravirgatus.*
Dorset Coast: wholly exposed at Freshwater Steps.
Swanworth Quarry No.1: 175.70 to 178.50m

KC 48 Mudstone, predominantly medium and pale grey thinly interbedded with dark grey fissile mudstone, brownish grey bituminous mudstone and greyish brown oil shale; pale coccolith-rich laminae in several oil shales; finely interlaminated coccolith-rich mudstone and oil shale at base passing laterally into coccolith-rich limestone.
Dorset Coast: wholly exposed at and immediately west of Freshwater Steps; Freshwater Steps Stone Band at base. Incomplete exposures at western end of Brandy Bay.
Swanworth Quarry No.1: 178.50 to 187.55m including Freshwater Steps Stone Band.

KC 47 Mudstone, predominantly dark and medium grey with several thin interbeds of pale grey mudstone and, in upper part, oil shale; generally sparsely shelly with *Isocyprina miniscula* (Blake), *Protocardia morinica* (de Loriol), *Pseudorhytidopilus latissima* (J Sowerby) and *Lingula ovalis* J Sowerby common at some levels; *Camptonectes* cf. *morini* (de Loriol), *Grammatodon, Modiolus autissiodorensis* (Cotteau), *Pleuromya, Oxytoma* and small oysters also present; fragments of finely ribbed perisphinctid ammonites including *Pectinatites (P.) eastlecottensis* (Salfeld); base taken at base of coccolith-rich band
Dorset Coast: wholly exposed immediately west of Freshwater Steps and at western end of Brandy Bay; Middle White Stone Band at base.
Swanworth Quarry No.1: 187.55 to 194.18m including Middle White Stone Band.

KC 46 Mudstone, dark and medium grey, thinly interbedded with fissile, shelly oil shales which include several thin bands of pale brownish grey, coccolith-rich limestone; fauna as Bed KC 47 but with fish debris and faecal pellets common in the oil shales; *Pectinatites (P.) eastlecottensis* common throughout; rarer *P. (P.) cornutifer* (Buckman) and *P. (P.) pectinatus* (Phillips); base taken at base of White Stone Band where present, or at base of shelly oil shale which marks the lower limit of *P. (P.) eastlecottensis*
Dorset Coast: wholly exposed between Freshwater Steps and Rope Lake Head, and at Brandy Bay. Partly exposed in upper slopes at Ringstead Bay and Black Head. White Stone Band forms a prominent marker bed in all sections.
Swanworth Quarry No.1: 194.18 to 196.75m including White Stone Band.

KC 45 Mudstone, dark and medium grey with thin oil-shale interbeds common in upper part; prominent pale grey band in middle part; sparsely shelly except in lower part; scattered *Dicroloma, Lingula, Isoyprina, Protocardia, Thracia* and small oysters; *Pectinatites*, including *P. (Virgatosphinctoides) encombensis* Cope, scattered throughout; colour change at base
Dorset Coast: wholly exposed between Freshwater Steps and Rope Lake Head, and at Brandy Bay. Intermittently exposed in part at Ringstead Bay and Black Head.
Swanworth Quarry No.1: 196.75 to 207.70m

KC 44 Mudstone, pale and medium grey, highly calcareous; sparsely shelly with well- preserved ammonites including *Pectinatites (Virgatosphinctoides) reisiformis* Cope and rarer *P. (Arkellites) hudlestoni* Cope, *P. (V.) donovani* Cope and, in the lower part, *P.(V.) pseudoscruposus* (Spath); epizoic oysters common and other bivalves including *Pleuromya; Dentalium* and fish fragments; locally persistent tabular cementstone bands

occur within the bed; pyritised pins; base marked by sharp colour change with evidence of minor erosion in some sections
Dorset Coast: wholly exposed below Rope Lake Head and at Brandy Bay. Poorly exposed in part at Ringstead Bay and Black Head. Basalt Stone Band forms prominent marker bed.
Swanworth Quarry No.1: 207.70 to 233.75m including Basalt Stone Band.

KC 43 Mudstone, medium and dark grey; sparsely shelly with fragments of bivalves including oysters, fish debris, *Dicroloma* and ammonites including *Pectinatites (V.) pseudoscruposus, P. (V.) reisiformis* and *P. (V.) wheatleyensis* (Neaverson); base taken at top of oil-shale seam
Dorset Coast: wholly exposed below Rope Lake Head and at Brandy Bay. Poorly exposed at Ringstead Bay.
Swanworth Quarry No.1: 233.75 to 236.25m

KC 42 Oil shale, fissile, shelly, foraminifera-spotted with plasters of *Isocyprina* and fragmentary ammonites including *Pectinatites (V.) grandis* (Neaverson), *P. (V.) pseudoscruposus, P.(V.) reisiformis* (highest part only) and *P. (V.) wheatleyensis*; pyritised radial plates of *Saccocoma* common in one band in upper part of bed; interbeds of dark and medium grey, sparsely fossiliferous mudstone occur throughout; *Isocyprina* small oysters and *Dentalium* locally common; *Protocardia, Opis, 'Chemnitzia', Dicroloma; Pseudorhytidopilus, Lingula* and fish fragments also present; the junction of the Hudlestoni and Wheatleyensis zones falls within this bed; base of bed taken at base of oil-shale seam
Dorset Coast: wholly exposed between Rope Lake Head and Clavell's Hard, and at Brandy Bay. Poorly exposed in part at Ringstead Bay. The coccolith-rich Short Joint Coal forms a prominent marker band at the top of the unit, and the Rope Lake Head Stone Band and Blackstone form laterally persistent marker beds within it.
Swanworth Quarry No.1: 236.25 to 248.10m including Blackstone, Rope Lake Stone Band and Short Joint Coal.

KC 41 Mudstone, dark grey, smooth-textured with pyrite halos'; sparsely shelly with bivalves including *'Astarte'* and well-preserved ammonites including *Pectinatites (V.) grandis, P. (V.) pseudoscruposus, P. (V.) wheatleyensis* and *P. (V.) woodwardi* (Neaverson), some with epizoic oysters and some with partial infilling of cream- coloured phosphate; rare wood fragments and rhynchonellids; colour change at base
Dorset Coast: wholly exposed between Clavell's Hard and Cuddle, and at Brandy Bay. Partly exposed from time to time at Ringstead Bay.
Swanworth Quarry No.1: 248.10 to 260.16m

KC 40 Mudstone, pale grey in upper part becoming medium and dark grey, brownish grey and silty textured with depth, with some burrowfills of oil shale; sparsely shelly in part with *Lingula, Isocyprina miniscula, Modiolus autissiodorensis, Nanogyra virgula* (Defrance), *Protocardia* and ammonites including *Pectinatites (V.) grandis, P. (V.) pseudoscruposus* and *P. (V.) wheatleyensis;* base taken at top of thin oil-shale seam
Dorset Coast: wholly exposed below Cuddle, and at Brandy Bay. Partially exposed at Ringstead Bay. Grey Ledge forms prominent marker bed at top of unit. A second stone band, the Southard Stone Band, is laterally persistent in nearby boreholes; both stone bands may be present at Ringstead Bay.
Swanworth Quarry No.1: 260.16 to268.65m including Grey Ledge and Southard Stone bands.

KC 39 Oil shale, brownish grey, shelly with *Isocyprina* plasters, *Modiolus, Protocardia, Thracia* and oysters; passing down into pale grey and brownish grey, smooth-textured mudstone; colour change at base
Dorset Coast: wholly exposed below Cuddle and at Brandy Bay. Partially exposed at Ringstead Bay. Cattle Ledge Stone Band forms prominent marker bed close to base of unit in all sections.
Swanworth Quarry No.1: 268.65 to273.20m including Cattle Ledge Stone Band.

KC 38 Mudstone, medium and dark grey, sooty- textured in part with much comminuted plant debris; foraminifera-spotted in part; sparsely shelly with *Grammatodon, Protocardia* oysters, *Pseudorhytidopilus, Lingula* and fragments of *Pectinatites* including *P. (Virgatosphinctoides)* sp.; rare thin interbeds of oil shale; bed crowded with *Nanogyra virgula* locally present near base
Dorset Coast: wholly exposed below Cuddle and at Brandy Bay.
Swanworth Quarry No.1: 273.20 to 276.40m

KC 37 Oil shale with interbeds of dark and medium grey mudstone; shelly in part with *Isocyprina* plasters and burrowfill concentrations of other bivalves including *'Astarte'* and *Protocardia*; rarer *Dentalium, Dicroloma, Pseudorhytidopilus* and *Pectinatites*; base taken at base of densely calcite-cemented oil shale

Dorset Coast: wholly exposed between Cuddle and Hen Cliff, and at Brandy Bay. Yellow Ledge Stone Band forms prominent marker bed at Cuddle but is represented only by weakly cemented oil shale at Brandy Bay.
Swanworth Quarry No.1: 276.40 to 287.49m including Yellow Ledge Stone Band.

KC 36 Mudstone, dark, medium and pale grey interbedded and with thin interbeds of oil shale; shelly in part with *'Astarte'; Camptonectes, Inoceramus Isocyprina, Nanogyra virgula, Protocardia, Dicroloma* and *Pectinatites* including *P. (V.) elegans* Cope and *P. (Arkellites) primitivus* Cope; base taken at base of oil shale immediately above highest *Aulacostephanus*.
Dorset Coast: wholly exposed between Hen Cliff and Kimmeridge Bay, and at Brandy Bay. Partially exposed at Ringstead Bay.
Swanworth Quarry No.1: 287.49 to 313.40m

Lower Kimmeridge Clay

KC 35 Mudstone, dark and medium grey, sparsely shelly, with *Aulacostephanus (Aulacostephanoceras) autissiodorensis* (Cotteau), *A. (Aulacostephanoceras)* cf. *volgensis* (Vischniakoff) and *A. (Aulacostephanus)* cf. *fallax* Ziegler; several thin interbeds of brownish grey, fissile, shelly mudstone (some weakly cemented); iridescent *Aulacostephanus* spat debris common in upper part of bed; *'Astarte'* and oysters common throughout; this bed includes highest *Aulacostephanus* and lowest *Pectinatites?* fragments; base taken at change from sparsely to very shelly mudstones.
Dorset Coast: wholly exposed (except for minor faulted section) at Kimmeridge Bay, and at Brandy Bay. Partially exposed at Ringstead Bay. The Maple Ledge Stone Band forms a prominent marker bed about 5m above the base of the unit.
Swanworth Quarry No.1: 313.40 to 334.60m including Maple Ledge Stone Band.
Metherhills No. 1: Maple Ledge Stone Band at 48m (not cored).

KC 34 Mudstone, medium and dark grey, blocky, with a few thin beds of oil shale and weakly bituminous shale (quasi oil shale); some thin beds of beef and calcite-coated surfaces; shelly and very shelly with large *Aulacostephanus (Aulacostephanoceras) autissiodorensis* common in pyrite preservation with calcite and gypsum overgrowths; *A. (Aulacostephanoceras)* aff. *rigidus* Ziegler and *A. (Aulacostepanoceras) volgensis* also present; plasters of *Amoeboceras (Nannocardioceras)* spp., including *A. (N.) krausei* (Salfeld) and *A.(N.) volgae* (Pavlow), in lower part of bed; *Nanogyra virgula* (Defrance), *Lopha* and rhynchonellid brachiopods including *Rhynchonella subvariabilis* (Davidson) locally common; base taken at change to dark grey mudstones coinciding with upper limit of range of *Aspidoceras*.
Dorset Coast: wholly exposed at Kimmeridge and Hobarrow bays. Partially exposed at Ringstead Bay. The Washing Ledge Stone Band forms a prominent marker bed in the coastal sections, but is absent in the Swanworth Quarry boreholes where it correlates with a weakly cemented bituminous mudstone. Probably represented by widely spaced calcareous nodules at Ringstead Bay.
Swanworth Quarry No.1: 334.60 to 351.82m
Metherhills No. 1: Washing Ledge Stone Band at 72m (not cored).

KC 33 Mudstone, dark grey, moderately shelly, with some thin beds of oil shale crowded with iridescent *Amoeboceras (Nannocardioceras) krausei* and rarer *A. (N.)* cf. *anglicum*; *Aspidoceras (Aspidoceras)* cf. *longispinum* (J de C Sowerby), *A. (A.) sesquinodosum* (Fontannes); *Aulacostephanus (Aulacostephanoceras)* cf. *autissiodorensis, A. (Aulacostephanoceras)* cf. *jasonoides* (Pavlow), *A. (Aulacostephanoceras)* aff. *kirghisensis* (d'Orbigny), *A. (Aulacostephanoceras)* cf. *volgensis, Laevaptychus, Sutneria* cf. *rebholzi* (Berckhemer), oysters and other small bivalves also present; base taken at top of prominent oil-shale seam
Dorset Coast: wholly exposed at Kimmeridge and Hobarrow bays with several fault repetitions. Partially exposed in slipped masses at Ringstead Bay.
Swanworth Quarry No.1: 351.82 to 365.10m

KC 32 Oil shale, fissile, shelly, with plasters of *Amoeboceras (Nannocardioceras)* cf. *anglicum* and *A. (N.)* cf. *krausei*, the latter dominant in the upper part of the bed, and larger *Amoeboceras (Amoebites)* including aff. *quadratolineatum* (Salfeld), commonly with foraminifera and ammonite dust debris; including a few thin beds of pale and medium grey, sparsely shelly mudstone with *Aulacostephanus (Aulacostephanoceras)* cf. *eudoxus* (d'Orbigny), *A. (Aulacostephanus)* cf. *rigidus, Laevaptychus*, small bivalves including oysters, and *Dicroloma*; base taken at base of prominent oil-shale seam

Dorset Coast: all except lowest few metres exposed at Hobarrow Bay. Partially exposed at Black Head and in slipped masses at Ringstead Bay. The Flats Stone Band forms a prominent marker bed at the top of the unit, and the Nannocardioceras Cementstone/Hobarrow Bay Stone Band pair form a marker close to the base.
Swanworth Quarry No.1: 365.10 to 385.20m including the Flats and Hobarrow Bay stone bands and the Nannocardioceras Cementstone.
Metherhills No.1: 85.70 to105.34m including Nannocardioceras Cementstone and the Flats Stone Band, but Hobarrow Bay Stone Band absent.

KC 31 Mudstone, pale grey, burrow-mottled, sparsely and moderately shelly with large *Nanogyra virgula*; interbedded with oil shale, brownish grey, fissile; shelly, including *Aspidoceras, Sutneria, Protocardia* and lowest *Nannocardioceras* plaster; serpulids locally common in lower part of bed; base taken at base of prominent oil- shale seam.
Dorset Coast: not recorded at outcrop.
Swanworth Quarry No.1: 385.20 to 387.08m
Metherhills No.1: 105.34 to 110.75m

KC 30 Mudstone, pale and medium grey, blocky, shelly, rubbly, slightly silty-textured; *Nanogyra virgula* common and very common, often large in size, in places forming *N. virgula*-rich soft 'limestone' in upper part of bed; persistent band of cementstone doggers in middle part of bed; fauna includes *Amoeboceras (Nannocardioceras)* cf. *anglicum*, *Aspidoceras (Aspidoceras)* cf. *iphericum* (Oppel), *A. (Aspidoceras) sesquinodosum*, *Aulacostephanus (Aulacostephanoceras)* cf. *eudoxus*, *A. (Aulacostephanus)* cf. *pseudomutabilis* (de Loriol), *A. (Aulacostephanoceras)* cf. *undorae* (Pavlow), *Laevaptychus, Sutneria* sp., small bivalves including *'Astarte', Entolium, Grammatodon, Isocyprina, Protocardia, Thracia*, with fish fragments and *Dicroloma; Crussoliceras* plasters in middle part of bed form marker band that is locally cemented ; base taken at top of prominent oil-shale seam.
Dorset Coast: partially exposed at Black Head. Virgula Limestone forms marker bed in middle part of unit.
Swanworth Quarry No.1: 387.08 to 412.10m including Swanworth C and D stone bands.
Metherhills No.1: 110.75 to 133.54m including Swanworth C and D stone bands.

KC 29 Mudstone, pale and medium grey, moderately shelly, hackly fracture, burrow- mottled, interbedded with oil shale, brownish grey, fissile, shelly, intensely foraminifera-spotted; *Amoeboceras (Amoebites)* spp. including aff. *elegans* Spath, *A. (Nannocardioceras)* cf. *anglicum*, *Aspidoceras* spp. including *A. (Aspidoceras) longispinum, Aulacostephanus (Aulacostephanoceras)* cf. *eudoxus, A. (Aulacostephanus)* cf. *pseudomutabilis, A. (Aulacostephanoceras) mammatus* Ziegler, *A. (Aulacostephanoceras)* cf. *volgensis, Laevaptychus, Sutneria* cf. *cyclodorsata* (Moesch); *Sutneria eumela* (d'Orbigny) common; small bivalves including *Grammatodon, Nanogyra virgula* and other oysters, *Oxytoma, Palaeoneilo?, Plicatula, Posidonia, Protocardia* and *Thracia;* fish fragments, *Dicroloma* and *Lingula*; serpulids common particularly in upper part of bed; two bands with *Saccocoma*, one near top of bed and one at base, form widespread marker bands; base taken at base of oil shale.
Dorset Coast: partially exposed at Black Head.
Swanworth Quarry No.1: 412.10m to 424.05m including Swanworth B Stone Band.
Metherhills No.1: 133.54 to144.45m including Swanworth B Stone Band.

KC 28 Mudstone, medium to dark grey, burrow-mottled, silty, in part cemented, shelly with rubbly and hackly fracture; *Amoeboceras (Amoebites)* spp., *Aspidoceras* sp., *Aulacostephanus (Aulacostephanoceras)* cf. *eudoxus, A. (Aulacostephanoceras)* aff. *mammatus, A. (Aulacostephanus) pseudomutabilis*, *Laevaptychus, Sutneria* spp.; small bivalves, often fragmentary, including tiny *'Astarte', Grammatodon, Protocardia* and small oysters*; Lingula, Dicroloma*, rare small belemnites; passing down into
Dorset Coast: not recorded at outcrop.
Swanworth Quarry No.1: 424.05 to 443.14m
Metherhills No.1: 144.45 to165.16m

KC 27 Mudstone, medium and dark grey, shelly, burrow-mottled, rubbly and hackly fracture; extremely rich in *Nanogyra virgula*, with *Aspidoceras* sp., *Aulacostephanus (Aulacostephanus) pseudomutabilis* and *Laevaptychus*; passing down into
Dorset Coast: not recorded at outcrop.
Swanworth Quarry No.1: 443.14 to c 450.00m
Metherhills No.1: 165.16 to c.172.5m

KC 26 Mudstone, dark and medium grey, slightly silty; moderately and sparsely shelly with thin, more shelly beds often rich in *'Astarte'*; oysters common; brownish grey quasi oil-shale bed in lower part; foraminifera-spotted in burrow concentrations; *Aspidoceras* spp. including cf. *iphericum* and cf. *sesquinodosum*, *Aulacostephanus (Aulacostephanoceras)* cf. *eudoxus, A. (Aulacostephanoides)* cf. *mutabilis* (J de C Sowerby), *A. (Aulacostephanus) pseudomutabilis, A. (Aulacostephanoceras) volgensis, Laevaptychus, Dicroloma*; highest *A. (Aulacostephanites) eulepidus* (Schneid) in lowest part of bed; passing down into
Dorset Coast: partially exposed at Black Head.
Swanworth Quarry No.1: c 450.00 to 446.00m including Swanworth A Stone Band at base.
Metherhills No.1: c.172.50 to 189.35 including Swanworth A Stone Band at base.

KC 25 Mudstone, dark grey, fissile, very shelly with plasters of *Aulacostephanus (Aulacostephanites) eulepidus* and *A. (Aulacostephanoides) linealis* (Quenstedt); also *A. (Aulacostephanoceras)* cf. *eudoxus, A. (Aulacostepanoceras)* cf. *pseudomutabilis,*
Aspidoceras sp. *Laevaptychus, Nanogyra virgula*, rhynchonellid brachiopods; in places silty and indistinguishable from
Dorset Coast: partially exposed at Black Head and Osmington Mills.
Swanworth Quarry No.1: 446.00 to 468.60m
Metherhills No.1: 189.35 to 193.85m

KC 24 North Wootton Siltstone: mudstone, dark grey, shelly, locally very shelly at base; slightly silty throughout becoming very silty at base, partially calcite- cemented with rare cementstone doggers; *Aspidoceras* sp. locally very common, *Aulacostephanus (Aulacostephanites) eulepidus, A. (Aulacostephanoides) linealis, A. (Aulacostephanoides) mutabilis, Laevaptychus*, rare *Aulacostephanus* of the *eudoxus* group and *Sutneria* sp.; rhynchonellid brachiopods *(Rhynchonella?)* common; bivalves including *Nanogyra* and other oysters, *Entolium, Grammatodon*; very rare *Saccocoma*; interburrowed junction and widespread erosion surface at base marking incoming of *Aspidoceras, Aulacostephanus* of the *eudoxus* group and *Sutneria.*
Dorset Coast: wholly exposed at Black Head and Osmington Mills.
Swanworth Quarry No.1: 468.60 to 479.30m
Metherhills No.1: 193.85 to 203.50m

KC 23 Mudstone, medium grey, moderately shelly with *Aulacostephanus (Aulacostephanites) eulepidus*; as KC 22 but less shelly; passing down into
Dorset Coast: wholly exposed at Black Head and Osmington Mills.
Swanworth Quarry No.1: 479.30 to 480.00m
Metherhills No.1: 203.50 to 204.26m

KC 22 Supracorallina Bed: mudstone, pale to medium grey, tough, shelly and intensely shelly in part, with myriads of tiny crushed *"Astarte' supracorallina'* d'Orbigny' [now *Nicaniella extensa* (Phillips)]; partially calcite-cemented; including also some almost barren pale beds; *Aulacostephanus (Aulacostephanites) eulepidus, A. (Aulacostephanites)* cf. *peregrinus* Ziegler; oyster fragments including *Nanogyra* and *Grammatodon*; passing down into
Dorset Coast: wholly exposed at Black Head and Osmington Mills.
Swanworth Quarry No.1: 480.00 to 484.65m
Metherhills No.1: 204.26 to 209.16m

KC 21 Mudstone, medium to dark grey, with some paler bands; mostly sparsely shelly with *Aulacostephanus (Aulacostephanites)* cf. *peregrinus*, common *Nicaniella* and *Entolium*; passing down into
Dorset Coast: wholly exposed at Black Head and Osmington Mills.
Swanworth Quarry No.1: 484.65 to 485.62m
Metherhills No. 1: 209.16 to 210.10m

KC 20 Mudstone, medium slightly brownish grey, faintly bituminous, fissile, shelly, with plasters and debris of *Aulacostephanus (Aulacostephanites) eulepidus*; *A. (Aulacostephanoides)* cf. *linealis*, small oysters, *Protocardia*, fish fragments; locally with thin oil-shale beds; passing down into
Dorset Coast: wholly exposed at Black Head and Osmington Mills.
Swanworth Quarry No.1: 485.62 to 485.83m
Metherhills No.1: 210.10 to 210.31m

KC 19 Mudstone, medium grey, sparsely to moderately shelly with a few slightly more shelly bands with *Aulacostephanus (Aulacostephanites) eulepidus, A. (Aulacostephanoides) cf. linealis, A. (Aulacostephano*ides) cf. *mutabilis*, bivalve fragments including *Entolium* and *Thracia*; silty in lower part with plant debris; shell chips with *Bullapora*, echinoid spines, oysters, a *Nicaniella* plaster and *Pleuromya*; passing down into
Dorset Coast: wholly exposed at Black Head and Osmington Mills.
Swanworth Quarry No.1: 485 to 505.21m total depth, including Metherhills Stone Band.
Metherhills No.1: 210.31 to 227.00m including Metherhills Stone Band.

KC 18 Mudstone, pale grey, blocky, mostly sparsely shelly, but locally shelly in lower part; some very pale bands and persistent cementstone at one level, locally at two; locally silty or with silty burrowfills, gritty in part with broken shell debris, pyrite pins and trails; *Aulacostephanus (Aulacostephanites) eulepidus, A. (Aulacostephanoides)* cf. *mutabilis*, very rare small aptychi cf. *Laevaptychus*, indeterminate perisphinctid; *Entolium, Isocyprina (Venericyprina)* cf. *compressa* Cox common, *Lopha, Nanogyra* (typically of small size with large attachment area), *Parallelodon, Pholadomya* cf. *acuticosta*, J de C. Sowerby, *Pinna, Pleuromya, Dicroloma*; pentacrinoid columnals form widespread marker band; echinoid spines and other fragments common, rare rhynchonellid brachiopods; crustacean claws and pyritised wood; passing down into
Dorset Coast: wholly exposed at Black Head and Osmington Mills. Widely spaced cementstone concretions form marked bed in middle part of unit.
Metherhills No.1: 227.00 to 248.51m

KC 17 Mudstone, medium and dark grey, interburrowed, moderately shelly;
becoming very shelly, silty and intensely burrow-mottled in lower part;
Aulacostephanus (Aulacostephanites) cf. *eulepidus, A. (Aulacostephanoides)* cf. *linealis, A. (Aulacostephanoides) mutabilis*; bivalves, mostly broken, including *'Astarte', Lopha, Nanogyra, Thracia*; rhynchonellid brachiopods common; interburrowed base with minor erosion surface.
Dorset Coast: wholly exposed at Black Head and Osmington Mills.
Metherhills No.1: 248.51 to 250.16m

KC 16 Alterations of mudstone, dark grey, very smooth, almost barren; quasi oil shale,dark brownish grey, fissile, shelly; and mudstone, dark grey fissile, moderately shelly, foraminifera-spotted; in part sooty- textured due to comminuted plant debris; *Amoeboceras (Amoebites)* sp., *Aulacostephanus (Aulacostephanoides)* aff. *desmonotus* (Oppel), *A. (Aulacostephanites) eulepidus* (well- preserved, iridescent specimens of a more coarsely ribbed variety particularly abundant), *A. (Aulacostephanites)* cf. *peregrinus*; bivalves including *Nanogyra* and other oysters *Entolium*; in places containing a shelly oyster bed with *Bullapora* and belemnites; rare *Xenostephanus* sp. in lower part of bed; passing down into
Dorset Coast: wholly exposed at Black Head and Osmington Mills.
Metherhills No.1: 250.16 to 265.90m

KC 15 Mudstone, medium to pale grey, becoming silty to very silty towards base; sparsely to moderately shelly with *Aulacostephanus (Aulacostephanoides)* cf. *mutabilis, Rasenia (Semirasenia)* cf.*moeschi* (Oppel), *Anisocardia, Pholadomya acuticosta, Pleuromya* and oysters; very shelly oyster-rich bed with rhynchonellid brachiopods at base, locally cemented into doggers; interburrowing and chondritic mottling marking minor, but widespread, erosion surface at base
Dorset Coast: wholly exposed at Black Head and Osmington Mills. Pumpkin-shaped calcareous concretions form marker bed.
Metherhills No.1: 265.90 to 269.85m

KC 14 Mudstone, medium grey, slightly silty, shelly, with body-chamber fragments of large *rasenia, rasenia (Semirasenia)* cf. *moeschi, Xenostephanus?, 'Astarte'*, oysters, *Isognomon?, Thracia* and rare rhynchonellid brachiopods; passing down into
Dorset Coast: wholly exposed at Black Head and Osmington Mills.
Metherhills No.1: 269.85 to c. 273m.

KC 13 Mudstone, medium and pale grey, slightly silty, sparsely shelly, with rare cementstones; *Rasenia (Rasenioides)* cf. *lepidula* (Oppel), *Aulacostephanus (Aulacostephanoides)* aff. *mutabilis, Xenostephanus* sp. and *Thracia*; passing down into
Dorset Coast: wholly exposed at Black Head and Osmington Mills.
Metherhills No.1: c.273.0 to 275.65m

KC 12 Mudstone, medium and dark grey, shelly; pale silty, shelly bed in middle part; well- preserved *Xenostephanus* common in upper part; *Rasenia* aff. *cymodoce* (d'Orbigny), *R.* aff. *erinus* (d'Orbigny), *R. (Rasenioides)* cf. *lepidula, R. (Eurasenia)* aff. *trifurcata* (Reinecke), R. *(Involuticeras)* sp. and *Lingula*; interburrowed junction.
Dorset Coast: wholly exposed at Black Head and Osmington Mills.
Metherhills No.1: 275.65 to 277.28m

KC 11 Mudstone, medium and dark grey, paler in upper part, interburrowed; sparsely to moderately shelly with oysters and *Rasenia* spp. including *R.* cf. *anglica* Geyer and *R.* aff. *lepidula*; very foraminifera-spotted in part; interburrowed base.
Dorset Coast: wholly exposed at Black Head and Osmington Mills.
Metherhills No.1: 277.28 to 280.96m

KC 10 Mudstone, pale grey, sparsely shelly, locally foraminifera-spotted; *Rasenia* spp. including *R.* aff. *anglica* and *R.* aff. *erinus*; in places a basal shelly oyster-ammonite bed with serpulids; striking chondritic mottling and interburrowing at base.
Dorset Coast: wholly exposed at Black Head and Osmington Mills.
Metherhills No.1: 280.96 to 283.05m

KC 9 Mudstone, medium to dark grey, smooth, sparsely to moderately shelly; well- preserved, fine-ribbed *Rasenia*, including *R. (Semirasenia)* aff. *askepta* Ziegler, with *R.* aff. *anglica* and *R. (Rasenioides)* cf. *paralepida* Schneid; passing down into
Dorset Coast: wholly exposed at Black Head and Osmington Mills.
Metherhills No.1: 283.05 to 284.60m

KC 8 Black Head Siltstone: mudstone, medium grey, silty and very silty; partially calcite-cemented and locally well-cemented to form doggers; shelly with leached calcite shells and pyrite ghosts; *Amoeboceras (Amoebites)* spp. including *A.* aff. *cricki* (Salfeld) locally common; large encrusted *Rasenia* and *Pictonia?* with numerous small *Rasenia*; strikingly interburrowed base marking widespread minor erosion surface with local phosphatisation, rare soft pale brown phosphatic nodules and hard black phosphatic chips.
Dorset Coast: wholly exposed at Ringstead Bay (west end), Black Head, Osmington Mills and Wyke Regis.
Metherhills No.1: 284.60 to 285.30m

KC 7 Mudstone, very pale grey, almost barren, locally intensely interburrowed with silt from above; rare cementstones; passing down into
Dorset Coast: wholly exposed at Ringstead Bay (west end), Black Head, Osmington Mills and Wyke Regis.
Metherhills No.1: 285.30 to 291.31m

KC 6 Mudstone, dark grey, almost barren, finely laminated, sooty textured, silty; rare Amoeboceras; passing down into
Dorset Coast: wholly exposed at Ringstead Bay (west end), Black Head, Osmington Mills and Wyke Regis.
Metherhills No.1: 291.31 to 299.79m

KC 5 Wyke Siltstone: mudstone, medium and dark grey, partially calcite-cemented; rare large *Pachypictonia?* and bivalves infilled with soft, pale brown phosphate; strikingly interburrowed and silty at base with hard, black phosphatic angular chips and similarly preserved ammonite fragments marking widespread erosion surface
Dorset Coast: wholly exposed at Ringstead Bay (west end), Black Head, Osmington Mills and Wyke Regis.
Metherhills No.1: 299.79 to 300.05m.

KC 4 Mudstone, very pale grey, almost barren,with cementstone doggers; passing down into
Dorset Coast: wholly exposed at Ringstead Bay (west end), Black Head, Osmington Mills and Wyke Regis.
Thin lenses of dense, sideritic mudstone occur at several levels at all localities.
Metherhills No.1: 300.05 to c.301.0m

KC 3 Mudstone, medium grey, shelly to moderately shelly with *Dicroloma*, *Deltoideum delta* (Wm Smith) small *Gryphaea* and other oysters, *Oxytoma* and *Thracia*; passing down into

Dorset Coast: wholly exposed at Ringstead Bay (west end), Black Head, Osmington Mills and Wyke Regis. Large numbers of *D. delta* weather out of the mudstones at Ringstead Bay.
Metherhills No.1: 301.00 to 301.50m

KC 2 Mudstone, medium and pale grey with rare cementstones; very sparsely shelly with pyrite trails and pins and rare pyritised perisphinctid nuclei; *Dicroloma*, *Deltoideum delta*, *Pinna*, *Placunopsis* and *Thracia*; passing down into
Dorset Coast: wholly exposed at Ringstead Bay (west end), Black Head, Osmington Mills and Wyke Regis. At Ringstead Bay the Nana Bed of Arkell (1933) on account of the abundance of *Nanogyra nana* (deFrance).
Metherhills No.1: 301.50 to 302.69m

KC 1 Mudstone, strikingly interburrowed, pale and dark grey; sparsely shelly with *Entolium* and *Modiolus*; minor but widespread erosion surface at base marked by burrowing and rare phosphatic nodules, with some bivalves and ammonites (including *Pictonia*) preserved in soft, pale brown phosphate.
Dorset Coast: wholly exposed at Ringstead Bay (west end), Black Head, Osmington Mills and Wyke Regis. The distinctive brachiopod *Torquirhychia inconstans* is locally abundant at Ringstead Bay and other localities, and has given rise to the name Inconstans Bed.
Metherhills No.1: 302.69 to 303.00m

Ampthill Clay

Mudstone, pale and very pale grey, calcareous and highly calcareous; sparse, low diversity fauna dominated by *Thracia* and other bivalves, and *Microbiplices*.

Dorset coast: partially exposed at Ringstead Bay and Black Head as deeply weathered, very pale clays (Ringstead Waxy Clay). Lenses of shelly limestone (Ringstead Coral Bed) with corals form marker bed at top of unit at Ringstead Bay.
Metherhills No. 1: 303.00 to 316.8m.

APPENDIX 3. Borehole-site descriptions of the Swanworth Quarry No. 1 and Metherhills No. 1 cores.

SWANWORTH QUARRY NO. 1 [SY 9676 7823]

Borehole Site Log

Note: depths referred to in the following descriptions are ***driller's depths****: they are not the* ***'true' depths*** *(see Section 2.3 for discussion). In each description, the driller's depth for the beginning of the run is taken as datum, and subsequent depths were obtained by measuring down the core. In runs where the amount of core recovered is greater than that drilled (due to slippage on previous runs) This commonly results in an apparent anomaly whereby the depth assigned to the bottom of a core can be greater than the depth of the top of the next core run. The fossil identifications given below are based on individual specimens and parts of specimens that were visible on broken surfaces in the core. No attempt was made to break the core to make a more comprehensive faunal list. Details of the chronostratigraphical classification (***KC 1*** *to* ***KC 63****) are given in Appendix 2.*

PORTLAND SAND

Run 1 **0.00 to 1.00m** **Recovered 0.93m (93%)**	*Thickness* m	*Depth* m
Sandstone, very fine-grained, muddy and silty; densely calcareously cemented; very dark grey with greyish brown oxidation along some surfaces; calcite veining	0.93	0.93 (end recovery)

Run 2 **1.00 to 2.51m** **Recovered 1.20m (79%)**	*Thickness* m	*Depth* m
Siltstone, calcareously cemented, hard; dark grey with greyish brown oxidation patches; bioturbation picked out by mudstone and very fine-grained sand	0.05	1.05
Pebble bed; siltstone matrix with angular and rounded clasts of calcareous siltstone up to 5cm across; irregular hardground surface at base	0.15	1.20
Siltstone, calcareously cemented, as above	0.27	1.47
Interlaminated and bioturbated mudstone and siltstone	0.03	1.50
Siltstone, calcareously cemented, as above	0.70	2.20 (end recovery)

Run 3 **2.51 to 4.99m** **Recovered 2.45m (99%)**	*Thickness* m	*Depth* m
Siltstone, calcareously cemented; hard; as bed above; dark grey with some greyish brown weathered horizons.	2.45	4.96 (end recovery)

Run 4 **4.99 to 6.70m** **Recovered 1.85m (108%)**	*Thickness* m	*Depth* m
Sandstone, dark grey, fine - and very fine-grained, muddy and silty; calcareously cemented; slightly coarser, shelly, brown-weathering band at 6.00 to 6.20m	1.85	6.84 (end recovery)

Run 5 **6.70 to 9.20m** **Recovered 2.51m (100%)**	*Thickness* m	*Depth* m
Sandstone, as above; becoming darker grey and more muddy with depth; dense cemented pale grey dogger (curved boundary) at 8.00 to 8.25m; pale grey more dense calcareously cemented band at 8.15 to 8.50m with burrowfills of dark grey mudstone	2.51	9.21 (end recovery)

Run 6 9.20 to 11.70m Recovered 2.68m (107%)	*Thickness* m	*Depth* m
Highly bioturbated mixture of mudstone, siltstone and very fine-grained sandstone; dark grey; variable calcite cement	2.68	11.88 (end recovery)

Run 7 11.70 to 14.20m Recovered 2.47m (98%)	*Thickness* m	*Depth* m
Bioturbated mixture as bed above	2.47	14.17 (end recovery)

Run 8 14.20 to 16.70m Recovered 2.44m (97%)	*Thickness* m	*Depth* m
Bioturbated mixture as bed above; hard siltstone band at 14.20 to 14.30m	2.44	16.64 (end recovery)

Run 9 16.70 to 19.20m Recovered 2.67m (106%)	*Thickness* m	*Depth* m
Bioturbated mixture as above; becoming more muddy with depth; pale grey calcareously cemented patch at 17.80 to 17.90m	2.67	19.37 (end recovery)

Run 10 19.20 to 21.70m Recovered 2.58m (103%)	*Thickness* m	*Depth* m
Bioturbated mudstone and siltstone mixture; dark grey; variable carbonate cement; paler grey, more densley cemented patches at 19.40 to 19.47m and 19.75 to 20.00m	2.58	21.78 (end recovery)

Run 11 21.70 to 24.20m Recovered 1.89m (76%)	*Thickness* m	*Depth* m
Bioturbated mudstone and siltstone mixture as bed above	1.89	23.59 (end recovery)

Run 12 24.20 to 26.70m Recovered 2.76m (110%)	*Thickness* m	*Depth* m
Bioturbated mudstone/siltstone mixture as above; paler grey, more densely cemented doggers at 25.55 to 25.70m and 25.82 to 25.93m	2.76	26.96 (end recovery)

Run 13 26.70 to 29.20m Recovered 2.76m (110%)	*Thickness* m	*Depth* m
Very prominently bioturbated mudstone/siltstone mixture as above	2.76	29.46 (end recovery)

Run 14 29.20 to 31.70m Recovered 2.48m (99%)	*Thickness* m	*Depth* m
Mudstone/siltstone mixture as bed above	2.48	31.68 (end recovery)

Run 15 31.70 to 34.20m Recovered 2.51m (100%)	*Thickness* m	*Depth* m
Mudstone/silstone mixture as bed above	2.51	34.21 (end recovery)

Run 16 34.20 to 35.89m Recovered 0.70m (41%)	*Thickness* m	*Depth* m
Mudstone, very silty; highly bioturbated	0.70	34.90 (end recovery)

Run 17 35.89 to 36.96m Recovered 1.98m (185%)	*Thickness* m	*Depth* m
Mudstone, very silty, dark grey; highly bioturbated	0.71	36.60
Siltstone, very muddy, pale and medium grey; highly bioturbated	0.20	36.80
Mudstone, very silty, dark grey; highly bioturbated	1.07	37.87
		(end recovery)

Run 18 36.96 to 39.41m Recovered 2.17m (89%)	*Thickness* m	*Depth* m
Mudstone, very silty, dark grey; highly bioturbated; passing down into	0.44	37.40
Massive Bed: siltstone, very muddy, medium and pale grey; highly bioturbated; passing down into	1.30	38.70
Siltstone, muddy, pale grey; highly bioturbated	0.43	39.13
		(end recovery)

KIMMERIDGE CLAY
Upper Hounstout Silt

Run 19 39.41 to 41.91m Recovered 2.45m (98%)	*Thickness* m	*Depth* m
KC 63		
Mudstone, alternating silty and very silty, paler and darker greys; highly bioturbated throughout	2.45	41.86
		(end recovery)

Run 20 41.91 to 44.41m Recovered 2.49m (99%)	*Thickness* m	*Depth* m
Mudstone, silty laminated	0.16	42.07
Mudstone, very silty, bioturbated	0.35	42.42
Mudstone, very silty, bioturbated and laminated	0.68	43.10
Mudstone, silty, laminated	0.18	43.28
Mudstone, very silty, bioturbated	0.18	43.46
Mudstone, silty, with thin silt laminae	0.54	44.00
Mudstone, silty	0.18	44.18
Mudstone, very silty, bioturbated and laminated	0.12	44.30
Mudstone, silty	0.10	44.40
NB variable carbonate cement: crushed bivalves and ammonites throughout		(end recovery)

Run 21 44.41 to 46.91m Recovered 2.78m (111%)	*Thickness* m	*Depth* m
Mudstone, silty, laminated with wispy, low-angle bioturbation	0.66	45.07
Thinly interlaminated (cf well preserved varves) siltstone and silty mudstone; bioturbated	2.12	47.19
		(end recovery)

Run 22 46.91 to 49.41m Recovered 2.43m (97%)	*Thickness* m	*Depth* m
Thinly interbedded silty and very silty mudstones with some thin interbeds of muddy siltstone; bioturbated at most levels	2.43	49.43

Run 23 49.41 to 51.91m Recovered 2.55m (102%)	*Thickness* m	*Depth* m
As Run 22, thinly interbedded silty and very silty mudstones with some thin interbeds of muddy siltstone	2.55	51.96

Run 24 51.91 to 54.41m Recovered 1.20m (48%)	*Thickness* m	*Depth* m
Thinly interbedded silty and very silty mudstones with some thin interbeds of		

muddy siltstone; bioturbated at most levels	1.20	53.11

Run 25 **54.41 to 55.91m** **No recovery**

Run 26 **55.91m to 55.91m** **Recovered 2.71m (infinity)**	*Thickness* m	*Depth* m
As Run 26, thinly interbedded silty and very silty mudstones with some thin interbeds of muddy siltstone; bioturbated	2.71	58.62

Hounstout Clay

Run 27 **55.91m to 58.41** **Recovered 2.02m (81%)**	*Thickness* m	*Depth* m
KC 62		
Thinly interbedded silty and very silty mudstones with some thin interbeds of muddy siltstone; bioturbated at most levels	2.02	57.93

Run 28 **58.41 to 60.71m** **Recovered 1.74m (76%)**	*Thickness* m	*Depth* m
Thinly interbedded more (paler) and less (darker) silt-rich mudstones with prominent bioturbation picked out by silt in silt-rich beds; predominently muddy and less visibly bioturbated at 58.41 to 58.90m and 59.30 to 60.15m	1.74	60.15 (end recovery)

Run 29 **60.71 to 63.21m** **Recovered 2.48m (99%)**	*Thickness* m	*Depth* m
Thinly interbedded dark grey silty and sparsely silty mudstone and very silty, predominantly bioturbated mudstone; muddy with very few silt wisps from 60.71 to 61.70m; predominantly muddy but with common silt wisps from 61.70 to 61.90m, 62.15 to 62.40m and 62.58 to 62.80m	2.48	63.19 (end recovery)

Run 30 **63.21 to 65.71m** **Recovered 1.88m (75%)**	*Thickness* m	*Depth* m
Thinly interbedded silty mudstone and highly bioturbated very silty mudstone; predominently muddy at 63.21 to 63.50m, 64.20 to 64.35m, 64.42 to 64.64 and 65.75 to 67.71m	1.88	65.09 (end recovery)

Run 31 **65.71 to 68.00m** **Recovered 2.70m (118%)**	*Thickness* m	*Depth* m
Mudstone, dark grey, silty	0.05	65.76
Mudstone, very silty, highly bioturbated	0.09	65.85
Mudstone, dark grey, silty	0.19	66.04
Mudstone, very silty, highly bioturbated	0.90	66.94
Mudstone, dark grey, silty	1.09	67.13
Mudstone, silty, sparsely bioturbated	0.47	67.60
Mudstone, dark grey, silty	0.81	68.41

Run 32 **68.00 to 70.50m** **Recovered 2.25m (90%)**	*Thickness* m	*Depth* m
Mudstone, dark grey, silty with lamination and bioturbation picked out by variations in paler silt content; sparse fauna of bivalves in clay-cast preservation; relatively common small brown *Lingula* in lower part; concentrations of silt burrowfills at 68.35 and 69.70m	2.25	70.25 (end recovery)

Run 33 70.50 to 73.00m Recovered 2.97m (119%)	*Thickness* m	*Depth* m
KC 61		
Hounstout Upper Bituminous Beds:very fissile, bituminous and slightly bituminous bands at 70.50 to 71.50m and 72.25 to 73.02m, with thin bituminous horizons at several other levels; thinly interbedded with dark grey silty mudstones and very dark grey slightly silty mudstones; weak lamination; cut by subhorizontal and subvertical very thin calcite and pyrite films; sparse fauna of mostly bivalves in clay-cast and pyrite-film preservation; prominent thin highly bioturbated bands with well preserved individual burrows with spreiten at 71.50 to 71.52m;71.80 to 71.98m; 72.22 to 72.25m; 73.02 to 73.22m and 73.40 to 73.50m	2.97	73.47 (end recovery)

Run 34 73.00 to 75.50m Recovered 2.29m (92%)	*Thickness* m	*Depth* m
Thinly interbedded dark grey silty mudstone and paler, highly bioturbated very silty mudstone	0.56	73.56
Mudstone very silty with a few darker, more muddy bands	0.38	73.94
Mudstone, silty, dark grey	0.46	74.40
Mudstone, very silty, bioturbated	0.60	75.00
Mudstone, silty, dark grey	0.29	75.29
N.B. Cement cavings in photo (now removed)		(end recovery)

Run 35 75.50 to 78.00m Recovered 2.02m (81%)	*Thickness* m	*Depth* m
Mudstone, silty, dark grey with weak lamination; fissile, weakly bituminous	0.86	76.36
Lower Hounstout Silt		
KC 60		
Mudstone, very silty, paler than bed above, prominently bioturbated	0.32	76.68
Mudstone, silty, laminated	0.27	76.95
Mudstone, very silty, bioturbated	0.28	77.23
Mudstone, silty, laminated, dark grey; sharp contact with	0.14	77.37
Mudstone, very silty, and very muddy siltstone (top 0.1m), bioturbated, pale grey	0.15	77.52 (end recovery)

Run 36 78.00 to 80.41m. Recovered 3.07m (127%)	*Thickness* m	*Depth* m
Mudstone, silty and very silty alternating in beds 0.10 to 0.40m thick; more silty bands prominently bioturbated with chondrites, rhizocorallium and escape structures; darker bands weakly laminated; predominently silty mudstone with more silt-rich bands at 78.68 to 79.10m; 79.25 to 79.35m; 79.80 to 80.00m and 80.70 to 80.85m; laminated band broken by bioturbation at 80.25m	3.07	81.07 (end recovery)

Run 37 80.41 to 83.05m Recovered 2.61m (99%)	*Thickness* m	*Depth* m
Mudstone, very silty, prominently bioturbated; darker, slightly more muddy and slightly less burrowed bands at 81.03 to 81.09m; 81.40 to 81.50m; 81.75 to 81.77m; 81.96 to 82.05m and 82.27 to 82.43m; shelly band at 81.53 to 81.56m with bivalves and pyritised ammonite	2.61	83.02 (end recovery)

Run 38 83.05 to 85.55m Recovered 2.28m (91%)	*Thickness* m	*Depth* m
Siltstone, very muddy and very silty mudstone; spectacularly mixed by bioturbation with many low-angle burrows with well-preserved spreiten; wood fragment at 83.25m	2.28	85.33 (end recovery)

Run 39 **85.55 to 88.05m** **Recovered 1.70m (68%)**	*Thickness* m	*Depth* m
Mudstone, very silty, prominently bioturbated with well defined individual burrows with spreiten; slightly smoother textured, more laminated bands at 85.77 to 85.85m; 86.09 to 86.13m and 86.85 to 87.05m	1.70	87.25 (end recovery)

Run 40 **88.05 to 90.05m** **Recovered 2.56m (128%)**	*Thickness* m	*Depth* m
Mudstone, very silty passing into muddy siltstone at some levels; prominent bioturbation picked out by paler silt burrowfills on dark grey, more muddy matrix; passing down into	0.29	88.34
Hounstout Lower Bituminous Beds: mudstone, brownish grey, bituminous, smooth textured, laminated; moderately common oysters and and other bivalves preserved in pyrite	0.07	88.41
Mudstone, very silty and muddy siltstone, highly bioturbated	0.13	88.54
Mudstone, brownish grey, bituminous, laminated and with pyritised fauna; thin vertical pyrite vein	0.18	88.72
KC 59		
Mudstone, very silty and muddy siltstone; highly bioturbated	1.89	90.61 (end recovery)

Run 41 **90.05 to 92.55m** **Recovered 2.92m (117%)**	*Thickness* m	*Depth* m
Mudstone, very silty; highly bioturbated with burrowfills picked out by pale silt on dark grey mudstone matrix; laminated in part with laminations disturbed by burrows; passing down gradually into	1.15	91.20
Mudstone, dark grey, silty and very silty; more prominently laminated and with less prominant bioturbation; very friable below c. 92.0m	1.77	92.97 (end recovery)

Run 42 **92.55 to 95.13** **Recovered 2.58m (100%)**	*Thickness* m	*Depth* m
Mudstone, dark grey, silty with lamination and bioturbation faintly picked out by paler silt concentrations; sparsely fossilferous with bivalves (dominant) preserved as clay films	2.58	95.13 (end recovery)

Run 43 **95.13 to 97.67m** **Recovered 2.31m (91%)**	*Thickness* m	*Depth* m
Mudstone, dark grey, slightly silty; well defined lamination and bioturbation picked out by pale silt content at many levels; common *Thracia*, rare ammonites	2.31	97.44 (end recovery)

Run 44 **97.67 to 100.09m** **Recovered 2.79m (115%)**	*Thickness* m	*Depth* m
KC 58		
Mudstone, dark grey, very slightly silty matrix but with many, prominent silt laminae; becoming fissile on de-stressing (as Run 47); common *Thracia* and other bivalves preserved as thin, white calcite films	2.79	100.46 (end recovery)

Run 45 **100.09 to 102.64m** **No recovery.**

Run 46 **102.64 to 102.88m** **Recovered 2.72m (1133%)**	*Thickness* m	*Depth* m
Mudstone, dark grey, uniform, as Run 47 with common silt laminae; moderately		

shelly with small *'Astarte'*, *Protocardia* and small, very finely ribbed (nuclei) perisphinctitids all preserved as thin, white, calcitic films	2.72	105.36 (end recovery)
Run 47 102.88 to 105.38m Recovered 2.14m (86%)	*Thickness* m	*Depth* m
Mudstone, dark grey with thin interbeds of faintly brownish grey; very slightly silty in upper part with lamination picked out by silt-rich horizons; smooth textured becoming fissile on de-stressing, common small whole and fragmentary bivalves preserved in white calcite, including paired myids, common *Thracia* and relatively common finely ribbed perisphinctids; pyrite films and burrow linings.	2.14	105.02 (end recovery)
Run 48 105.38 to 107.88m Recovered 0.78m (31%)	*Thickness* m	*Depth* m
Mudstone, dark grey, smooth textured; bivalves and finely-ribbed perisphinctid (?nuclei) ammonities preserved in white calcite occur throughout	0.78	106.16 (end recovery)
Run 49 107.88 to 108.46m Recovered 2.16m (372%)	*Thickness* m	*Depth* m
Mudstone, dark grey, smooth textured with white calcite bivalves and ammonities scattered throughout.	2.16	110.04 (end recovery)
Run 50 108.46 to 110.63m Recovered 2.80m (129%)	*Thickness* m	*Depth* m
Mudstone, dark grey drying to medium grey; very slightly silty; finely laminated in part; small bivalves preserved in white calcite scattered throughout; small belemnites (*Hibolites*?) at 108.60, 110.50 and 11.06m (two); *Pavlovia* at 111.15 and 111.2m; some pyritic trails and films	2.80	111.26 (end recovery)
Run 51 110.63 to 113.46m. Recovered 2.79m (96%)	*Thickness* m	*Depth* m
Mudstone, dark grey, very slightly silty; scattered bivalves and finely ribbed pavlovid fragments in white calcite and clay-cast preservation; belemnites at 110.71, 110.92, 111.70, 112.42 and 112.66m; pyrite trails and films	2.79	113.42 (end recovery)
Runs 52, 53 and 54 113.46 to 116.49m No recovery		
Run 55 116.49 to 116.49m Recovered 2.81m (infinity)	*Thickness* m	*Depth* m
Mudstone, dark grey, very slightly silty; sparsely shelly as beds above; redrilled (broken) core at 115.68 to 115.27	2.81	116.27 (end recovery)
Run 56 116.49 to 119.02m Recovered 2.32m (92%)	*Thickness* m	*Depth* m
KC 57 Mudstone, dark grey, very slightly silty; fossiliferous with common crushed medium sized pavlovids and small bivalves in white calcite and clay-cast preservation; belemnite at 116.98m; small pyrite concretions at 117.10 to 117.20m and 117.65 to 117.70m; many large pyrite knots at 118.05 to 118.30m; common pyritised trails and pyrite-film bivalves including *Protocardia* at several levels; nuculids, including concentrations as burrow linings, common at several levels	2.32	118.84

(end recovery)

Run 57 119.02 to 121.52m Recovered 2.52m (101%)	*Thickness* m	*Depth* m
KC 56		
Mudstone, dark grey, fissile with lamination picked out by shell debris; common small bivalves and crushed pavlovids preserved in white calcite; common pyritised bivalves and trails; very shell-rich at 121.15 to 121.30m with bivalve and ammonite debris	2.52	121.54 (end recovery)

Run 58 121.52 to 124.02m Recovered 2.80m (112%)	*Thickness* m	*Depth* m
Mudstone, medium and dark grey, shelly	1.08	122.10
KC 55		
Blake's Bed 2: oil shale, greyish brown, finely laminated with laminae of dark grey mudstone	0.40	122.50
Mudstone, dark grey with common laminae of brownish grey bituminous mudstone	0.35	122.85
Oil shale, greyish brown, as above	0.25	123.10
Mudstone, medium and dark grey with lamination picked out by abundant crushed bivalves and pavlovid ammonites preserved in white calcite; rare small belemnites; *'Astarte'* common in burrow linings	0.33	123.33
Oil shale with thin calcite veins	0.04	123.27
Mudstone, shelly, laminated, as above to c. 123.6m; passing down into paler, more calcareous, bioturbated mudstone	1.05	124.32 (end recovery)

Run 59 124.02 to 126.52m Recovered 0.14m (6%)	*Thickness* m	*Depth* m
Mudstone, dark grey weathering to medium grey; calcareous	0.14	124.16 (end recovery)

Run 60 126.52 to 126.80m No recovery.

Run 61 126.80 to 127.24m Recovered 3.03m (689%)	*Thickness* m	*Depth* m
Mudstone, dark grey drying to medium grey, with common bivalves and ammonites;	0.06	126.86
Chapman's Pool Pebble Bed: Mudstone, silty, gritty with much shell debris; abundant belemnites, phosphatic pebbles including pavlovid body chambers; very shelly with bivalves and pavlovids preserved as white films; irregular, bioturbated junction with	0.02	126.88
KC 54		
Mudstone, dark grey with common crushed bivalves, ammonites and *Dicroloma*	2.07	128.95
Bituminous mudstone	0.16	129.11
Mudstone, dark grey	0.72	129.83 (end recovery)

Run 62 127.24 to 129.74m Recovered 2.51m (100%)	*Thickness* m	*Depth* m
Mudstone, dark grey with abundant bivalves and ammonites; highly fractured at 127.30 to 127.58m	0.34	127.58
Bituminous mudstone and oil shale, interlaminated	0.12	127.70
Mudstone, shelly, highly fractured	0.16	127.86
Mudstone, dark grey	1.88	129.75 (end recovery)

Run 63 129.74 to 132.34 Recovered 2.58m (99%)	*Thickness* m	*Depth* m
Mudstone, dark grey; shelly with common crushed bivalves and ammonites from 129.74 to 130.12m; sparsely shelly below 130.12m; vertical calcite vein at 132.04 to 132.19m	2.58	132.32 (end recovery)

Run 64 132.34 to 134.84m No recovery.

Run 65 134.84 to 135.00m Recovered 1.11m (694%)	*Thickness* m	*Depth* m
Mudstone, dark grey; calcite vein at 134.74 to 134.90m dips at c 45 degrees	0.29	135.13
Bituminous mudstone	0.03	135.16
Oil shale	0.08	135.24
Bituminous mudstone	0.17	135.41
Mudstone, dark grey	0.54	135.95
Vertical calcite vein at 135.14 to 135.32m		(end recovery)

Run 66 135.00 to 136.00m Recovered 2.62m (262%)	*Thickness* m	*Depth* m
Mudstone, dark grey, uniform; very broken areas at 135.50 to 135.68m, 135.80 to 135.85m, 136.18 to 136.19m and 136.28 to 136.45m	1.45	136.45
Bituminous mudstone	1.17	137.62
Vertical calcite vein at 137.17 to 137.33m.		(end recovery)

Run 67 136.00 to 138.50m Recovered 2.51m (100%)	*Thickness* m	*Depth* m
Mudstone, paler grey than above; faintly laminated throughout; shelly with common fragmented bivalves and ammonites from 136.75 to 136.80m; sparsely shelly below 136.80m	2.51	138.51 (end recovery)

Run 68 138.50 to 141.00m No recovery.

Run 69 141.00 to 141.30m No recovery.

Run 70 141.30 to 141.53m Recovered 2.41m (1048%)	*Thickness* m	*Depth* m
Mudstone, dark grey, uniform; several vertical calcite veins at 139.90 to 140.91m	2.41	143.71 (end recovery)

Run 71 141.53 to 143.73 Recovered 2.82 (128%)	*Thickness* m	*Depth* m
Mudstone, dark grey	0.25	141.78
Bituminous mudstone	0.02	141.80
Oil shale with laminae picked out by fragmented shells	0.06	141.86
Bituminous mudstone	0.13	141.99
Oil shale	0.03	142.02
KC 53		
Mudstone, dark grey, shears with calcite veins at 142.42 to 142.43m and 142.51 to 142.53m	0.51	142.53
Mudstone, dark grey, faintly laminated	0.47	143.00
Mudstone, dark grey	1.35	144.35 (end recovery)

Run 72 143.73 to 146.39m Recovered 2.73m (103%)	*Thickness* m	*Depth* m
Mudstone, dark grey, faintly laminated throughout	2.73	146.46 (end recovery)

Run 73 146.39 to 148.89m Recovered 2.56m (102%)	*Thickness* m	*Depth* m
Mudstone, pale grey with curved fractures; faintly laminated throughout; passing down into	1.31	147.70
Encombe Stone Band: cementstone, pale grey, densely cemented; passing down into	0.50	148.20
Mudstone, pale grey, faintly laminated, silty in part	0.76	148.95 (end recovery)

Run 74 148.89 to 151.39m Recovered 2.49m (100%)	*Thickness* m	*Depth* m
Mudstone, grey, uniform with very faint lamination	2.49	151.38 (end recovery)

Run 75 151.39 to 153.89m Recovered 2.53m (101%)	*Thickness* m	*Depth* m
Mudstone, dark grey with very faint lamination	0.84	152.23
Mudstone, paler grey than above, more silty	0.18	152.41
Mudstone, dark grey; very faint lamination	1.51	153.92 (end recovery)

Run 76 153.89 to 156.39m **No recovery.**

Run 77 156.39 to 156.39m Recovered 2.37m (infinity)	*Thickness* m	*Depth* m
Mudstone, dark grey, uniform	1.36	155.25
Mudstone, with higher silt content than above; pale grey	0.06	155.31
KC 52		
Bituminous and slightly bituminous mudstone	0.92	156.23
Mudstone, dark grey, uniform	0.03	156.26 (end recovery)

Run 78 156.39 to 158.89m Recovery 0.14m (6%)	*Thickness* m	*Depth* m
Mudstone, pale grey, uniform	0.14	156.53 (end recovery)

Run 79 158.89 to 159.25m **No recovery.**

Run 80 159.25 to 159.41m Recovered 3.06m (1913%)	*Thickness* m	*Depth* m
Mudstone, dark grey with fragmented shells scattered sparsely throughout	0.05	159.30
Mudstone, dark grey with vertical calcite vein	0.16	159.46
Mudstone, dark grey, uniform	2.85	162.31 (end recovery

Vertical joint from 159.25 to 160.04m

Run 81 159.41 to 161.91m Recovered 1.37m (55%)	*Thickness* m	*Depth* m
Mudstone, dark grey	0.10	159.51
Calcite-filled belt of shears crossing core at c 45 degrees, individual seams 0.01 to 0.03m in thickness	0.15	159.66
Mudstone, dark grey	0.17	159.83

Mudstone, fissile	0.05	159.88
Mudstone, dark grey with scattered fragmented shells	0.52	160.40
Mudstone, pale grey with some paler laminae	0.38	160.78
		(end recovery)

Run 82 161.91 to 163.41m Recovered 2.55m (170%)

	Thickness m	*Depth* m
Mudstone, dark grey with bivalves and ammonites scattered sparsely throughout; slightly higher silt content than above; uniform	2.55	164.46
		(end recovery)

Run 83 163.41 to 165.91m Recovered 2.17m (87%)

	Thickness m	*Depth* m
Mudstone, dark grey, slightly silty, uniform	1.06	164.47
Mudstone, dark grey with a shell-rich band	0.30	164.77
Mudstone, dark grey, more uniform than above	0.81	165.58
		(end recovery)

Run 84 165.91 to 168.41m Recovered 2.52m (101%)

	Thickness m	*Depth* m
KC 51		
Mudstone, dark grey, uniform; abundant fragmented shells scattered throughout, mostly bivalves including *Thracia*; *Dicroloma* and ammonites also present	2.52	168.43
		(end recovery)

Run 85 168.41 to 170.91m Recovered 1.37m (55%)

	Thickness m	*Depth* m
Mudstone, dark grey; sparsely to moderately shelly with fragmented shells; uniform; numerous sub-horizontal listric surfaces in highest 0.1m and lowest 0.4m	1.37	169.78
		(end recovery)

Run 86 170.91 to 172.51m Recovered 2.96 (185%)

	Thickness m	*Depth* m
KC 50		
Mudstone, fissile, dark grey; common listric surfaces in upper part	1.29	172.20
Mudstone, paler grey and more silty than bed above	0.10	172.30
Mudstone, dark grey, slightly silty; shelly in part with bivalves and pectinatitids, mostly fragmentary	1.57	173.87
Thin calcite vein from 170.91 to 171.06m.		(end recovery)

Run 87 172.51 to 175.01m Recovered 0.75m (30%)

	Thickness m	*Depth* m
Mudstone, dark grey; small fragmented shells sparsely scattered throughout; uniform	0.75	173.26
		(end recovery)

Run 88 175.01 to 175.87m Recovered 2.59m (301%)

	Thickness m	*Depth* m
Mudstone, dark grey, faintly laminated	2.51	177.52
KC 49		
Bituminous mudstone, slightly fissile, with visible paler laminae	0.08	177.60
		(end recovery)

Run 89 175.87 to 178.37m Recovered 2.55m (102%)

	Thickness m	*Depth* m
Mudstone, dark grey, laminated	0.54	176.41
Bituminous mudstone with coccolith-rich laminae	0.03	176.44
Mudstone, dark grey, laminated	0.21	176.65
Bituminous mudstone with coccolith-rich laminae	0.05	176.70

Mudstone, dark grey, laminated	0.08	176.78
Bituminous mudstone with abundance of coccolith-rich laminae increasing with depth	0.16	176.94
Mudstone, dark grey, laminated	0.63	177.57
Bituminous mudstone, well laminated	0.51	178.08
Bituminous mudstone with common coccolith-rich laminae; passing down into	0.24	178.32
Freshwater Steps Stone Band: finely laminated coccolith-rich limestone	0.10	178.42
		(end recovery)

Run 90 **178.37 to 180.87m** **Recovered 0.21m (8%)**

	Thickness m	*Depth* m
Freshwater Steps Stone Band: finely laminated coccolith-rich limestone	0.21	178.59
		(end recovery)

Run 91 **180.87 to 181.22m** **Recovered 2.66m (760%)**

	Thickness m	*Depth* m
Freshwater Steps Stone Band: finely laminated coccolith-rich limestone	0.05	180.92
KC 48		
Oil shale; dark brownish grey with coccolith-rich laminae at 180.92 to 180.96m	0.39	181.31
Mudstone, dark grey with some lamination	0.69	182.00
Bituminous mudstone	0.02	182.02
Bituminous mudstone thinly interbedded with oil shale with coccolith-rich laminae	0.34	182.36
Mudstone, dark grey; laminae diminish with depth	0.46	182.82
Bituminous mudstone	0.02	182.84
Mudstone, dark grey	0.32	183.16
Bituminous mudstone	0.01	183.17
Mudstone, dark grey	0.36	183.53
		(end recovery)

Run 92 **181.22 to 183.83m** **Recovered 2.61m (100%)**

	Thickness m	*Depth* m
Mudstone, dark grey	0.95	182.17
Oil shale	0.30	182.47
Mudstone, medium grey, calcareous	0.55	183.02
Mudstone, dark grey	0.60	183.62
Bituminous mudstone with some interlaminae of mudstone and oil shale	0.21	183.83
		(end recovery)

Run 93 **183.83 to 185.69m** **Recovered 0.86m (46%)**

	Thickness m	*Depth* m
Mudstone, dark grey, faintly bituminous; variably strong lamination; more bituminous where more clearly laminated; common pyritised oysters and trails; some bivalve and ammonite fragments in brown-film preservation	0.47	184.30
Mudstone, strongly laminated with common coccolith-rich pellets and partial laminae	0.13	184.43
Oil shale/bituminous mudstone; strongly laminated with coccolith-rich laminae and pellets picking out lamination	0.22	184.65
Mudstone, dark grey, faintly bituminous	0.04	184.69
		(end recovery)

Run 94 **185.69 to 187.11m** **Recovered 2.05m (144%)**

	Thickness m	*Depth* m
Mudstone, dark grey, faintly bituminous; pyrite-rich band at 186.35m; passing down into	0.95	186.64
Mudstone, brownish grey, fissile	0.08	186.72
Oil shale with coccolith-rich laminae concentrated in lower part	0.04	186.76
Mudstone, medium grey, fissile with scattered bituminous and coccolith-rich		

laminae	0.15	186.91
Oil shale, strongly coccolith-rich laminated with middle 1cm a coccolith limestone	0.12	187.03
Mudstone, faintly bituminous, fissile	0.07	187.10
Oil shale with coccolith-rich laminae	0.02	187.12
Bedding-plane shear	0.02	187.14
Mudstone, bituminous with the coccolith-rich pellets and laminae increasing rapidly with depth; prominent band of small, closely spaced pyrite concretions at 187.24 to 187.26m; sharp base.	0.12	187.26
Mudstone, dark grey, faintly bituminous	0.48	187.74 (end recovery)

Run 95 **187.11 to 189.61m** **Recovered 1.40m (56%)**

	Thickness m	*Depth* m
Mudstone, dark faintly brownish grey, faintly bituminous, fissile; pyritic trails and sparse pyrite-film bivalves; passing down into	0.42	187.53
Mudstone, brownish grey with common coccolith-rich pellets; numerous pyritised trails and small pyrite concretions	0.20	187.73
Middle White Stone Band: thinly interlaminated oil shale and coccolith rich laminae; becoming progressively brown and oil-shale rich with depth	0.21	187.94
KC 47		
Mudstone, faintly brownish grey, fissile with some more bituminous/more coccolith-rich laminae	0.23	188.17
Oil shale	0.32	188.49
Mudstone, faintly brownish grey, fissile with some lamination	0.02	188.51 (end recovery)

Run 96 **189.61 to 190.11m** **Recovered 1.58m (316%)**

	Thickness m	*Depth* m
Mudstone, dark grey with a few coccolith-rich laminae and pellets	1.27	190.88
Limestone, medium grey, moderately hard cementstone	0.31	191.19 (end recovery)

Run 97 **190.11 to 192.61m** **Recovered 2.37m (95%)**

	Thickness m	*Depth* m
Mudstone, dark grey with a few spotted laminae	2.37	192.48 (end recovery)

Run 98 **192.61 to 195.46m** **No recovery.**

Run 99 **195.46 to 195.46m** **Recovered 3.05m (infinity)**

	Thickness m	*Depth* m
Mudstone, uniform texture, dark grey becoming paler on drying; passing down into	2.55	198.01
KC 46		
Cementstone, pale grey, muddy	0.50	198.51 (end recovery)

Run 100 **195.46 to 197.96m** **Recovered 2.53m (100%)**

	Thickness m	*Depth* m
Mudstone	0.84	196.30
Bituminous mudstone, laminated	0.16	196.46
White Stone Band: finely laminated coccolith-rich limestone as coastal sections; hard dark brown oil-shale band (also as coast) at 197.04 to 197.06m	0.67	197.13
KC 45		
Mudstone, cream coloured, coccolith-rich, highly bioturbated; passing down into mudstone, coccolith-rich, as above but with higher mudstone content	0.07	197.36

Bituminous mudstone, dark brownish grey, fissile; pyrite concretious at 197.52m	0.34	197.70
Oil shale, dark brown with pale, coccolith-rich laminae	0.02	197.72
Bituminous mudstone, brownish grey, fissile, coccolith-rich pellets and laminae at 197.77 to 197.79m, 197.95m and 197.98 to 197.991m	0.27	197.99 (end recovery)

Run 101 197.90 to 200.53m Recovered 1.96m (76%)

	Thickness m	*Depth* m
Mudstone, blocky	0.72	198.68
Oil shale, brown, dense; coccolith-rich laminae at 198.68m; 198.80m and 198.89 to 198.93m	0.32	199.00
Mudstone, blocky	0.09	199.09
Oil shale, brown, uniform	0.07	199.16
Interlaminated and highly bioturbated oil shale/ coccolith-rich mixtture	0.05	199.21
Mudstone, brownish grey, faintly bituminous; pyrite-rich band at 199.41 to 199.43m	0.65	199.86
Interlaminated oil shale with coccolith-rich limestone	0.06	199.92 (end recovery)

Run 102 200.53 to 202.97m Recovered 2.03m (83%)

	Thickness m	*Depth* m
Interlaminated oil shale and coccolith-rich limestone	0.04	200.57
Mudstone, blocky, dark grey; passing down into	0.66	201.23
Mudstone, with lamination and bioturbation picked out by coccolith-rich horizons	0.07	201.30
Mudstone, faintly laminated	0.32	201.62
Mudstone with prominent coccolith-rich laminae	0.19	201.81
Mudstone with weak lamination at several levels; slightly fissile down to 202.57m, then more blocky; weak lamination at 202.23 to 202.26m	0.75	202.56 (end recovery)

Run 103 202.97 to 204.97m Recovered 2.69m (135%)

	Thickness m	*Depth* m
Mudstone, faintly brownish grey; mostly uniform but with lamination and bioturbation picked out by coccolith-rich horizons at 204.11 to 204.17m and 205.44 to 205.47m	2.69	205.66 (end recovery)

Run 104 204.97 to 207.50m Recovered 0.88m (35%)

	Thickness m	*Depth* m
Mudstone, dark grey, fissile in part; weak coccolith-rich lamination and spotting at 205.05 to 205.15m; bivalves common in clay-cast and brown-film preservation; passing rapidly down into	0.72	205.69
Oil shale/coccolith-rich limestone mixture; highly bioturbated; sharp base	0.06	205.75
Oil shale, dark brown	0.06	205.81
Oil shale interlaminated with coccolith-rich limestone	0.04	205.85 (end recovery)

Run 105 207.50 to 209.29m Recovered 4.42m (183%)

	Thickness m	*Depth* m
Bituminous mudstone, laminated	0.01	207.51
Oil shale, muddy; weak, variable lamination; common pale pellets	0.59	208.10
Mudstone, calcareous	0.70	208.80
Bituminous mudstone, laminated and with pellets	0.60	209.40
Oil shale, dark brown	0.20	209.60
KC 44		
Mudstone, calcareous	0.90	211.50
Cementstone	0.30	211.90

Mudstone, calcareous	0.02	211.92 (end recovery)

Run 106 209.92 to 213.92m Recovered 4.07m (102%)

	Thickness m	*Depth* m
Mudstone, dark and medium grey; sparsely fossiliferous with brown-film and pyritic preservation	4.07	213.99 (end recovery)

Run 107 213.92 to 217.92m Recovered 4.06m (102%)

	Thickness m	*Depth* m
Mudstone, calcareous, uniform; 0.25m-thick cemented band 0.60m above base	11.11	215.03
Basalt Stone Band:cementstone	1.05	216.18
Mudstone, calcareous; sparsely fossiliferous with brown film and pyritic preservation	1.80	217.98 (end recovery)

Run 108 217.92 to 220.43m Recovered 2.51m (100%)

	Thickness m	*Depth* m
Mudstone, medium grey, calcareous, sparse fauna	2.51	220.43 (end recovery)

Run 109 220.42 to 222.92m No recovery

Run 110 222.92 to 224.42m Recovered 3.52m (235%)

	Thickness m	*Depth* m
Mudstone, medium grey, calcareous; a few crushed pectinatitids and bivalves in white calcite but not common; pyritised bivalves and trails also present	3.52	226.44 (end recovery)

Run 111 224.42 to 228.13m Recovered 4.04m (109%)

	Thickness m	*Depth* m
Mudstone, calcareous as bed above	4.04	228.46 (end recovery)

Run 112 228.13 to 231.98m Recovered 3.93m (100%)

	Thickness m	*Depth* m
Mudstone, calcareous; as bed above, very thin (1 to 4mm) calcite sheets on 70°-dipping shear at 229.90 to 230.25m and on 45°- dipping shear at 231.15 to 231.26m	3.93	231.96 (end recovery)

Run 113 231.98 to 235.98m Recovered 4.00m (100%)

	Thickness m	*Depth* m
Mudstone, dark and medium grey, blocky; sparsely fossiliferous overall but with relatively common *Isocyprina* and *Pectinatites* preserved as brown and white calcite films.	0.42	232.40
KC 43		
Mudstone, dark grey, slightly more bituminous than bed above and with same fauna	2.48	234.88
Mudstone, dark grey, weakly bituminous; shelly with common *Isocyprina*, oysters and other bivalves in calcite and clay-cast preservation; pyritised oysters and crushed, calcite-film *Pectinatites* also common; passing down into	0.12	235.00
Oil shale and bituminous mudstone interlaminated and thinly interbedded; closely jointed and breaking into angular blocks; lamination picked out by pyrite lenses and pale spotting at 235.26 to 235.30m; pyrite-rich lens at 235.93 to 235.95m; pyritised and clay-cast bivalves and pectinatitids common at several levels	0.98	235.98 (end recovery)

Run 114 235.98 to 240.13m Recovered 3.93m (95%)	*Thickness* m	*Depth* m
Bituminous mudstone and mudstone, thinly interbedded; pyrite-rich at several levels; passing down into	0.30	236.28
KC 42 **Short Joint Coal**; hard brown oil shale with weak lamination from 236.28 to 236.34m; laminated and spotted, highly bioturbated coccolith- rich limestone from 236.34 to 236.40m; interlaminated oil shale and coccolith-rich limestone from 236.40 to 236.43m, passing down into hard brown oil shale; passing down into	0.27	236.55
Bituminous mudstone and mudstone, thinly interbedded; possible small fault at 236.77 to 236.82m with low angle (25 to 30°) calcite-coated shears crossing core and containing angular mudstone clasts in calcite cement	0.30	236.85
Mudstone with numerous shears and bounded by shear surfaces	0.35	237.27
Bituminous mudstone bounded by low-angle shear surfaces	0.07	237.34
Bituminous mudstone and fissile mudstone, thinly interbedded	0.71	238.05
Bituminous mudstone with thin interbeds of fissile mudstone and muddy oil shale; lamination picked out by pyrite-rich lenses at 238.13 to 238.38m; passing down into	0.60	238.65
Rope Lake Head Stone Band; hard grey cementstone, passing down into	0.41	239.06
Oil shale, pale brown, laminated	0.12	239.18
Oil shale and bituminous mudstone interlaminated and thinly interbedded; brown, hard producing smooth core; pyritised bivalve concentrations at several levels; faecal pellets common; calcite-coated low-angle (10 to 15°) shear at base crosses into Run 115	0.73	239.91 (end recovery)

Run 115 240.13 to 244.24m Recovered 3.74m (91%)	*Thickness* m	*Depth* m
Oil shale and bituminous mudstone, interbedded; weakly laminated at some levels; faecal pellets and pyritised bivalves and ammonites common in some horizons; closely spaced pyrite concretions at 241.04 to 241.06m; passing down into	0.67	240.80
Oil shale, massive, dark brown	0.50	241.30
Oil shale with thin bituminous mudstone interbeds; passing down into	0.40	241.70
Bituminous mudstone with thin oil shale interbeds; becoming more oil-shale-rich with depth; passing down into	1.60	243.30
Blackstone; very dark brown, hard; pyritic shell-rich band at 243.38m; pyritized *Saccocoma* abundant at many levels; large pyrite concretion at 243.37 to 243.44m	0.57	243.87 (end recovery)

Run 116 244.24 to 247.78m Recovered 1.58m (45%)	*Thickness* m	*Depth* m
Bituminous mudstone and mudstone thinly interbedded; laminated in part; *Saccocoma* at several levels	0.56	244.80
Mudstone with some thin bituminous mudstone interbeds; *Saccocoma* common at several levels	0.50	245.30
Bituminous mudstone with thin mudstone interbeds	0.31	245.61
Coccolith-rich limestone; pale, laminated and bioturbated	0.06	245.67
Bituminous mudstone and mudstone, thinly interbedded; laminated in part	0.16	245.83 (end recovery)

Run 117 247.78 to 249.46m Recovered 2.59m (154%)	*Thickness* m	*Depth* m
Thinly interbedded mudstone and bituminous mudstone; common pyritized *Saccocoma* at 248.60 and 248.90m; passing down into	1.52	249.30

Bituminous mudstone, passing down into	0.20	249.50
Oil shale, greyish brown; coccolith-rich pellets at 249.55 to 249.56m; conspicuous coccolith-rich laminae at 249.63 to 249.65m with pyrite lens and sharp base; weak coccolith-rich lamination and pellets at 249.65 to 249.69m; passing down into	0.19	249.69
Bituminous mudstone, brownish grey	0.52	250.21
Oil shale, laminated with many coccolith-rich laminae and pellets	0.07	250.28
Bituminous mudstone, brownish grey	0.09	250.37
		(end recovery)

Run 118 **249.46 to 251.92m** **Recovered 2.86m (116%)**

	Thickness m	*Depth* m
KC 41		
Mudstone, dark grey with a few thin interbeds of more fissile, bituminous mudstone	2.86	252.32
		(end recovery)

Run 119 **251.92 to 255.43m** **Recovered 2.86m (81%)**

	Thickness m	*Depth* m
Mudstone, dark grey with some thin interbeds and laminae of fissile, slightly brownish grey, bituminous mudstone	2.86	254.78
		(end recovery)

Run 120 **255.43 to 258.22m** **Recovered 3.13m (112%)**

	Thickness m	*Depth* m
Mudstone, dark grey, passing down into	1.92	257.35
Bituminous mudstone, brownish grey, laminated	0.05	257.40
Oil shale, greyish brown	0.05	257.45
Mudstone, dark slightly brownish grey, faintly bituminous	1.11	258.56
		(end recovery)

Run 121 **258.22 to 261.45m** **Recovered 4.17m (129%)**

	Thickness m	*Depth* m
Mudstone, dark grey with some faintly bituminous interbeds; passing down into	1.98	260.20
Bituminous mudstone	0.15	260.35
Mudstone, dark grey	0.21	260.56
Oil shale	0.04	260.60
Mudstone, dark grey	0.50	261.10
Oil shale	0.10	261.20
Mudstone, medium grey, highly calcareous	0.25	261.45
KC 40		
Grey Ledge Stone Band: dense, calcareously cemented mudstone	0.85	262.30
Mudstone, dark grey	0.09	262.39
		(end recovery)

Run 122 **261.45 to 264.93m** **Recovered 3.48m (100%)**

	Thickness m	*Depth* m
Mudstone, dark grey	0.35	261.80
Sheared mudstone with closely spaced, subhorizontal, polished shears	0.02	261.82
Mudstone, dark and medium grey; locally more calcareous	0.61	262.43
Southard Stone Band: dense, calcareously cemented mudstone	0.74	263.17
Mudstone, dark and medium grey; highly calcareous	1.76	264.93
		(end recovery)

Run 123 **264.93 to 268.93m** **Recovered 3.36m (84%)**

	Thickness m	*Depth* m
Mudstone, dark and medium grey; calcareous	2.13	267.06
Oil shale, pale brown	0.04	267.10

Mudstone, dark grey; calcareous	1.19	268.29 (end recovery)

Run 124 **268.93 to 272.67m** **Recovered 0.86m (23%)**

	Thickness m	*Depth* m
Thinly interbedded dark grey mudstone and brownish grey bituminous mudstone; common bivalves and trails preserved in pyrite	0.86	269.79 (end recovery)

Run 125 **272.67 to 272.87m** **Recovered 3.76m (1880%)**

	Thickness m	*Depth* m
KC 39		
Oil shale with thin interbeds of bituminous mudstone	0.20	272.87
Bituminous mudstone with dark grey mudstone interbeds	1.04	273.91
Interlaminated oil shale and highly bituminous mudstone with pale laminations and pellets (?coccolith-rich)	0.02	273.93
Bituminous mudstone with dark grey mudstone interbeds passing down into	1.28	275.21
Oil shale	0.32	275.53
Mudstone, dark grey	0.26	275.79
Cattle Ledge Stone Band: densely cemented muddy limestone	0.64	276.43 (end recovery)

Run 126 **272.87 to 276.80m** **No recovery.**

Run 127 **276.80 to 276.80m** **Recovered 3.89m (infinity)**

	Thickness m	*Depth* m
Mudstone, dark grey	0.21	273.08
Bituminous mudstone	0.12	273.20
Thinly interbedded and interlaminated bituminous mudstone and oil shale; **KC 38**		
pyrite-rich band at 273.00 to 273.20m; passing down into	0.23	273.43
Thinly interbedded mudstone and bituminous mudstone; common bivalves and **KC 37**		
ammonites in pyritic preservation; passing down into	3.07	276.50
Bituminous mudstone with common thin interbeds and laminae of dark grey mudstone	0.26	276.76 (end recovery)

Run 128 **276.80 to 280.80m** **Recovered 3.90m (98%)**

	Thickness m	*Depth* m
Mudstone, dark grey, uniform; parting closely along bedding	1.20	278.00
Bituminous mudstone (possible oil shale at some levels) interlaminated with dark grey mudstone	0.30	278.30
Mudstone, dark grey with some bituminous laminae	0.80	279.10
Oil shale, medium brown with bituminous laminae	0.07	279.17
Bituminous mudstone and dark grey mudstone, thinly interbedded and interlaminated; bedding picked out by crushed, thin-shelled bivalves, pectinatitids and very thin (hair-line) calcite films	0.33	279.50
Mudstone, dark grey with some bituminous laminae	1.20	280.70 (end recovery)

Run 129 **280.80 to 284.07m** **Recovered 1.87m (57%)**

	Thickness m	*Depth* m
Mudstone, dark grey	0.22	281.02
Bituminous mudstone, well laminated	0.14	281.16
Mudstone, dark grey	0.06	281.22
Sheared mudstone with horizontal calcite veins	0.01	281.23
Bituminous mudstone, well laminated	0.07	281.30

Mudstone, dark grey, sparse fauna	1.37	282.67 (end recovery)

Run 130 **284.07 to 286.00m** **Recovered 1.61m (83%)**	*Thickness* m	*Depth* m
Mudstone, dark grey with bituminous mudstone laminae; bivalve/ammonite debris picking out bedding at many levels; slightly more cemented at 285.15 to 285.25m	1.61	285.68 (end recovery)

Run 131 **286.00 to 288.00m** **Recovered 3.58m (179%)**	*Thickness* m	*Depth* m
Thinly interbedded and interlaminated bituminous mudstone and dark grey mudstone; more bituminous overall than Run 130; passing down into	1.03	287.03
Bituminous mudstone with thin interbeds of less bituminous mudstone; conspicuously laminated; passing down into	0.53	287.56
Mudstone, dark grey with bituminous mudstone laminae	0.48	288.04
Yellow Ledge Stone Band: densely cemented oil shale (pale brown) and bituminous mudstone (darker browns); pale and medium greyish brown to 288.46m with prominent darker brown wisps at 288.45 and 288.46m; darker brown below this	0.53	288.57
KC 36 Bituminous mudstone	0.01	288.58 (end recovery)

Run 132 **288.00 to 292.00m** **Recovered 3.88m (97%)**	*Thickness* m	*Depth* m
Mudstone, dark and medium grey with a few bituminous mudstone laminae; passing down into	1.62	289.62
Thinly interbedded and interlaminated mudstone and bituminous mudstone; predominantly bituminous at 289.88 to 290.06m and 290.45 to 290.64m with more conspicuous lamination; shelly at many levels with bedding picked out by white calcitic bivalve and ammonite debris; faecal pellets common in more bituminous horizons; becoming predominantly muddy below about 290.70m	2.26	291.88 (end recovery)

Run 133 **292.00 to 296.00m** **Recovered 3.63 (91%)**	*Thickness* m	*Depth* m
Mudstone, dark grey with some bituminous mudstone laminae; bedding picked out by common, crushed, thin-shelled bivlves and pectinatitids; passing down into	1.76	293.76
Bituminous mudstone, brownish grey with some mudstone laminae and thin interbeds; shelly throughout	0.19	293.95
Mudstone, calcareous, medium brown, faintly spotted; bioturbated lower surface	0.04	293.99
Mudstone, dark grey with common bituminous mudstone laminae	0.40	294.39
Mudstone, dark and medium grey with some bituminous mudstone laminae; very shelly with layers of thin-shelled bivalves and pectinatitids at 294.97 to 295.39m	1.13	295.52
Sheared mudstone, dark grey with closely spaced, polished shear surfaces	0.03	295.55
Mudstone, dark grey with more- widely- spaced polished shear surfaces	0.08	295.63 (end recovery)

Run 134 296.00 to 299.50m Recovered 0.89m (25%)	*Thickness* m	*Depth* m
Mudstone, dark grey with thin interbeds and laminae of shelly bituminous mudstone	0.89	296.89 (end recovery)

Run 135 299.50 to 300.50m Recovered 0.84m (84%)	*Thickness* m	*Depth* m
Mudstone, dark and medium grey with a few bituminous mudstone laminae; paler band at 299.69 to 299.75m; passing down into	0.40	299.90
Mudstone, dark and medium grey with common bituminous mudstone laminae	0.29	300.19
Oil shale with thin interbeds and laminae of mudstone	0.15	300.34 (end recovery)

Run 136 300.50 to 301.28m Recovered 4.49 (575%)	*Thickness* m	*Depth* m
Mudstone, dark grey, uniform; sparsely shelly; interlaminated with shelly bituminous mudstone at 300.10 to 300.18m and 303.70 to 303.97m including thin oil shale; passing down into	3.47	303.97
Mudstone with bituminous laminae	0.19	304.16
Thinly interbedded mudstone and bituminous mudstone; shelly with crushed, thin-shelled bivalves and pectinatitids; muddy oil shale at 304.79 to 304.80m	0.83	304.99 (end recovery)

Run 137 301.28 to 305.35m Recovered 4.10 (101%)	*Thickness* m	*Depth* m
Interlaminated and thinly interbedded mudstone and bituminous mudstone; passing down into	2.40	303.68
Bituminous mudstone, well laminated; passing down into	0.30	303.98
Interbedded mudstone and bituminous mudstone; passing down into	1.24	305.22
Bituminous mudstone, laminated	0.04	305.26
Interbedded mudstone and bituminous mudstone	0.12	305.38 (end recovery)

Run 138 305.35 to 309.35m Recovered 4.00 (100%)	*Thickness* m	*Depth* m
Mudstone and bituminous mudstone, thinly interbedded; no obvious marker bands; becoming predominantly bituminous in lower part, especially in lowest 1.00m	4.00	309.35 (end recovery)

Run 139 309.35 to 310.35 Recovered 1.21m (121%)	*Thickness* m	*Depth* m
Mudstone, dark grey; passing down into	0.56	309.91
Bituminous mudstone; passing down into	0.17	310.08
Oil shale; weakly to moderately strong carbonate cement; impersistent thin calcite vein dips 45° at 310.25m	0.30	310.38
Bituminous mudstone	0.16	310.54
Mudstone, dark grey	0.02	310.56 (end recovery)

Run 140 310.35 to 313.35m Recovered 1.43m (48%)	*Thickness* m	*Depth* m
Mudstone and bituminous mudstone, thinly interbedded; passing down into	1.07	311.42
Bituminous mudstone, well laminated with some oil shale laminae	0.36	311.78 (end recovery)

Run 141 313.35 to 316.39m Recovered 1.70m (56%)	*Thickness* m	*Depth* m
Bituminous mudstone (predominant) and mudstone, thinly interbedded; passing down into	1.02	314.37
Bituminous mudstone and oil shale, interlaminated and thinly interbedded	0.12	314.49
Oil shale, well laminated; 2 to 3° dip	0.07	314.56
Bituminous mudstone and oil shale, interlaminated with thin interbeds of mudstone; marked lithological change at base	0.49	315.05 (end recovery)

Run 142 316.39 to 318.02m Recovered 4.40m (270%)	*Thickness* m	*Depth* m
KC 35		
Mudstone and calcareous mudstone; sparsely fossiliferous with common bivalves including *'Astarte'* and *Protocardia*; crushed, mostly small pectinatitids and broken fragments including lappets; *Aulacostephanus* fragments common below 319.20m	4.40	320.79 (end recovery)

Run 143 318.02 to 319.75m Recovered 1.54m (89%)	*Thickness* m	*Depth* m
Mudstone, dark grey, very sparsely fossiliferous passing down into	1.10	319.12
Bituminous mudstone, laminated with bands of pale pellets, (?coccolith-rich); prominent pellet-rich band at 319.35 to 319.37m with lower contact subhorizontal; large *Aulacostephanus* with pyritic preservation	0.44	319.56 (end recovery)

Run 144 319.75 to 323.50m Recovered 3.45m (92%)	*Thickness* m	*Depth* m
Mudstone, dark grey, calcareous; vertical calcite vein from 319.75 to 320.17m	0.95	320.70
Mudstone with large clotted masses of pyrite; possible bedding feature with complex bioturbation at 320.76m	0.17	320.87
Mudstone, dark grey	0.18	321.05
Mudstone, dark faintly grey, brownish grey, slightly bituminous	0.63	321.68
Bituminous mudstone, laminated	0.25	321.93
Horizontal shears	0.02	321.95
Mudstone, dark grey; faintly laminated with thin interbeds of bituminous mudstone; sparsely fossiliferous with *Aulacostephanus,* pectinatitids and *Protocardia*	1.25	323.20 (end recovery)

Run 145 323.50 to 327.50m Recovered 4.34m (109%)	*Thickness* m	*Depth* m
Mudstone, dark grey, laminated; bivalve and ammonite spat	0.29	323.79
Bituminous mudstone, laminated; a few possible coccolith-rich pellets	0.17	323.96
Mudstone, dark grey, laminated	0.20	324.16
Horizontally sheared mudstone	0.04	324.20
Mudstone, dark grey, faintly laminated	0.35	324.55
Bituminous mudstone	0.03	324.58
Mudstone, dark grey with branching network of calcite veins	0.42	325.00
Mudstone, dark grey	0.21	325.21
Bituminous mudstone	0.12	325.33
Mudstone, dark grey, faintly laminated	0.40	325.73
Bituminous mudstone	0.14	325.87
Horizontally sheared mudstone	0.03	325.90
Mudstone, dark grey, faintly laminated	0.19	326.09
Bituminous mudstone	0.15	326.24
Mudstone, dark grey	0.25	326.49

Bituminous mudstone, laminated; *Aulacostephanus* common	0.14	327.63
Horizontally sheared mudstone	0.01	327.64
Mudstone, dark grey	0.20	327.84
Calcite veins, mostly vertical, occur at 323.50 to 323.87m, 324.20 to 324.38m and 326.63 to 326.96m.		(end recovery)

Run 146 **327.50 to 331.50m** **Recovered 3.67m (92%)**	*Thickness* m	*Depth* m
Mudstone, dark grey with some thin bituminous interbeds	0.73	328.23
Bituminous mudstone, moderately densely cemented stone band, passing down into	0.31	328.54
Mudstone, calcareous with some thin bituminous beds; pyritic, calcite- film and brown film preservation of abundant *Aulacostephanus*; passing down into	1.54	330.08
Maple Ledge Stone Band: well cemented bituminous mudstone, passing down into	0.34	330.42
Mudstone and calcareous mudstone	0.75	331.17
		(end recovery)

Run 147 **331.50 to 335.15m** **Recovered 4.04m (111%)**	*Thickness* m	*Depth* m
Mudstone and calcareous mudstone with thin shelly bituminous beds; abundant *Isocyprina* and broken thin shell debris; *Aulacostephanus* at 335.11m with part of shell replaced by fibrous pyrite.	4.04	335.54
		(end recovery)

Run 148 **335.15 to 339.15m** **Recovered 0.33m (8%)**	*Thickness* m	*Depth* m
KC 34		
Mudstone and calcareous mudstone with some bituminous interbeds; common pyritized *Aulacostephanus*	0.33	335.48
		(end recovery)

Run 149 **339.15 to 339.50m** **Recovered 4.17m (1191%)**	*Thickness* m	*Depth* m
Mudstone, dark grey; sparsely shelly but with a few bivalve and ammonite-rich horizons including *Aulacostephanus*	0.14	339.29
Bituminous mudstone	0.12	339.41
Mudstone, dark grey, as above	0.27	339.68
Bituminous mudstone	0.12	339.80
Mudstone, dark grey, as above	0.79	340.59
Bituminous mudstone	0.04	340.63
Mudstone, dark grey, as above	0.38	341.01
Bituminous mudstone	0.03	341.04
Mudstone, dark grey, as above; paired *Thracia* locally common	0.93	341.97
Mudstone, dark grey, very faintly laminated, slightly bituminous in part;	1.35	343.32
		(end recovery)

Run 150 **339.50 to 343.50m** **Recovered 3.85m (96%)**	*Thickness* m	*Depth* m
Mudstone, dark grey, faintly bituminous; pyritized layer with ammonite at base	0.09	339.59
Bituminous mudstone	0.48	340.07
Mudstone, dark grey, calcareous; sparsely fossilferous with bivalves and *Aulacostephanus*	0.23	340.30
Bituminous mudstone with a few paler laminae	0.36	340.66
Mudstone, dark grey, as above	0.20	340.86
Mudstone, dark grey, very faint lamination	0.65	341.51
Bituminous mudstone	0.45	341.96
Mudstone, dark grey, as above	0.83	342.79

Bituminous mudstone with a few paler laminae	0.31	343.10
Mudstone, dark grey, calcareous	0.25	343.35
		(end recovery)

Run 151 343.50 to 347.50m Recovered 3.74m (94%)	*Thickness* m	*Depth* m
Mudstone, dark grey; a few scattered ammonites including pectinatitids	0.60	344.10
Bituminous mudstone and oil shale, thinly interbedded	0.24	344.34
Mudstone, dark grey with slightly bituminous	0.34	344.68
Mudstone, dark grey, very faint lamination	0.48	345.16
Mudstone, dark grey	1.32	346.48
Oil shale	0.18	346.66
Bituminous mudstone	0.13	346.79
Mudstone, dark grey	0.45	347.24
Calcite vein, vertical from 343.77 to 344.50m.		(end recovery)

Run 152 347.50 to 351.50m Recovered 2.01m (50%)	*Thickness* m	*Depth* m
Mudstone, dark grey; fauna sparse with fragments of *Aulacostephanus,* and with rare *Amoeboceras (Nannocardioceras) volgae* (Pavlow) at 347.95 to 348.00m	0.50	348.00
Bituminous mudstone, well laminated, weakly cemented	0.14	348.14
Mudstone, dark grey, slightly calcareous, weakly cemented, sooty textured; passing down into	0.53	348.67
Mudstone, dark grey; sparse fauna with a few small and *Aulacostephanus*	0.46	349.23
Mudstone , slightly bituminous, fissile; abundant fauna with many plasters of *Amoe. (Nannocardioceras) anglicum* (Salfeld) and *A. N. krausei* (Salfeld)	0.23	349.46
Bituminous mudstone, fissile; abundant fauna and fissile, including *Nannocardioceras,* bivalves and oysters	0.05	249.51
		(end recovery)

Run 153 351.50 to 353.50m Recovered 4.53m (227%)	*Thickness* m	*Depth* m
Bituminous mudstone; abundant fauna with common *Amoe. (Nannocardioceras* plasters	0.26	351.76
Mudstone, dark grey, slightly bituminous; less fossiliferous than above	0.30	352.06
Mudstone, calcareous; sparse fauna	0.68	352.74
Bituminous mudstone with abundant *Amoe. (Nannocardioceras)*; vertical calcite vein from 352.94 to 353.13m	0.39	353.13
Bituminous mudstone; decreasing faunal content with depth; calcite vein at 353.23m	0.14	353.27
KC 33		
Working Ledge equivalent?: bituminous mudstone; weakly cemented; fragmented shells and abundant *Amoe. (Nannocardioceras)*	0.30	354.20
Oil shale	0.12	354.32
Mudstone, calcareous; sparse fauna	0.88	355.20
Bituminous mudstone	0.05	355.25
Mudstone calcareous; moderately fossilferous with *Aulacostephanus*	0.41	335.66
Bituminous mudstone; highly fossiliferous with abundant *Amoe. (Nannocardioceras)* as whole and fragmented shells	0.10	355.76
Mudstone, calcareous with horizontal calcite vein from 355.86 to 355.88m	0.14	355.90
Mudstone, dark grey, calcareous	0.10	356.03
		(end recovery)

Run 154 353.50 to 357.50m Recovered 4.01m (100%)	*Thickness* m	*Depth* m
Mudstone, dark grey, slightly calcareous passing down into	0.55	354.05
Bituminous mudstone, with beds of fragmented shells including		

Aulacostephanus; vertical calcite vein at 354.16 to 354.41m	0.43	354.48
Mudstone, dark grey, slightly bituminous	0.13	354.61
Bituminous mudstone, some shelly fragments	0.13	354.74
Mudstone, dark grey, calcareous, passing into	0.17	354.91
Bituminous mudstone, well laminated and highly fossiliferous; possibly passing into oil shale; abundant abundant *Amoe. (Nannocardioceras)*	0.33	355.24
Mudstone, slightly bituminous	0.59	355.83
Bituminous mudstone, with abundant *Amoe.* (*Nannocardioceras)* and bivalves	0.20	356.03
Mudstone, dark grey, slightly bituminous	0.16	356.19
Mudstone, dark grey	0.96	357.15
Mudstone, slightly bituminous, more cemented; with fragmented shells including *Aulacostephanus*; plaster of *Isocyprina* and *Sutneria rebholzi* Berckhemer at 357.35m	0.23	357.38
Mudstone, dark grey; shelly in part; *Aspidoceras* at 357.40m	0.13	357.51
		(end recovery)

Run 155 357.50 to 361.62m Recovered 4.12m (100%)

	Thickness m	*Depth* m
Mudstone, dark grey, slightly calcareous; belt of shears dips 10° at 358.00 to 358.10m	0.62	358.12
Mudstone, with thin interbedded bituminous bands with more fragmented shells and ammonites	0.11	358.23
Mudstone, dark grey; horizontal shears at 358.25 to 358.35m	0.15	358.38
Bituminous mudstone; fossiliferous with bivalves and oysters	0.40	358.78
Mudstone, dark grey	0.90	359.68
Mudstone, dark grey with fragmented shells	0.06	359.74
Mudstone, dark grey, calcareous	0.24	359.98
Mudstone, more bituminous than above	0.03	360.01
Mudstone, dark grey	0.10	360.11
Mudstone and bituminous mudstone, thinly interbedded; fragmented shells	0.09	360.20
Mudstone, dark grey; vertical calcite vein from 357.26 to 357.83m	0.78	360.98
Bituminous mudstone with calcareous mudstone laminae; *Aulacostephanus* spp.	0.18	361.16
Mudstone, dark grey, calcareous	0.46	361.62
		(end recovery)

Run 156 361.62 to 365.50m Recovered 3.15m (81%)

	Thickness m	*Depth* m
Mudstone, dark grey, calcareous; vertical calcite vein and fracture at 362.14m with shearing	0.52	362.14
Mudstone, dark grey, slightly calcareous	0.33	362.47
Slightly bituminous mudstone	0.29	362.76
Mudstone, slightly calcareous; pyrite nodule at 362.90m	0.30	363.06
Bituminous mudstone/oil shale, very well laminated and more cemented than above	0.41	363.47
Mudstone, dark grey; weakly cemented and slightly bituminous	0.20	363.67
Mudstone, dark grey; horizontal shear at 363.69 to 363.70m	0.16	363.83
Mudstone, more bituminous than bed above	0.04	363.87
Mudstone, calcareous; horizontal shears at 364.05 to 364.06m	0.35	364.22
Mudstone, slightly bituminous; shear 364.54 (horizonal) at 364.54m	0.34	364.56
Mudstone, calcareous	0.21	364.77
		(end recovery)

Run 157 365.50 to 369.00m Recovered 3.92m (112%)

	Thickness m	*Depth* m
Mudstone, faintly brownish grey; blocky texture; passing rapidly down into **KC 32**	0.33	365.83

The Flats Stone Band: finely intelaminated medium and dark brown oil shale and muddy oil shale with some pale (?coccolith-rich) laminae; rapid passage

down into	0.30	366.13
Bituminous mudstone, greyish brown; well laminated at most levels; thinly interbedded with dark grey mudstone; shelly at many levels with calcite-film and pyritic preservation; a few *Aulacostephanus* of *eudoxus* group, common *Amoe. Nannocardioceras, Protocardia* and *Isocyprina;* subhorizontal shears with calcite films at 367.06 to 367.12m; pyritic lenses at 366.36m; pyrite-rich burrows and fossils form almost continous sheet at 367.85 to 367.85m; bituminous laminae and interbed concentrations (some possibly oil shales) at 366.13 to 366.25m, 367.50 to 367.70m, 368.30 to 368.50m and 369.30 to 369.40m	3.29	369.42 (end recovery)

Run 158 **369.00 to 373.00m** **Recovered 4.33 (108%)**

	Thickness m	*Depth* m
Mudstone, dark grey with common shelly partings; large pyrite lens at 369.75m; passing rapidly down into	0.80	369.80
Oil shale, mid-brown; hard with subconchoidal fracture; a few thin mudstone partings; several shell plasters with *Aspidoceras* and bivalves.	0.21	370.01
Mudstone, dark grey; pyrite-rich at 371.05 to 371.20m; shell-rich partings at 371.60 to 371.64m	1.91	371.92
Oil shale with mudstone laminae	0.06	371.98
Mudstone, shelly as above; bituminous laminae common down to 372.45m; more uniform with shell-rich partings below this; massive pyrite lens at 372.05m.	1.35	373.33 (end recovery)

Run 159 **373.00 to 377.00** **Recovered 1.83m (46%)**

	Thickness m	*Depth* m
Mudstone, dark grey parting along shelly layers; common ammonites and bivalves in calcitic and pyritic preservation; passing down into	1.16	374.16
Mudstone and oil shale interlaminated; oil shale content increasing with depth	0.11	374.27
Oil shale, medium brown, solid; passing down into	0.13	374.40
Mudstone and oil shale interlaminated; bivalve and *Amoe. (Nannocardioceras)* plasters at several levels; layer of large pyritic lenses at 374.52m	0.34	374.74
Oil shale, medium and dark brown, hard; partly cemented with large (5cm) pyrite concretion; grizzled texture of pyritized *Amoe. (Nannocardioceras)* debris and spat on some bedding surfaces	0.09	374.83 (end recovery)

Run 160 **377.00 to 379.07** **Recovered 3.85m (193%)**

	Thickness m	*Depth* m
Oil shale thinly interbedded with mudstone; oil shale dominant	0.16	377.16
Mudstone thinly interbedded with oil shale: mudstone dominant	0.28	377.44
Oil shale, medium brown	0.06	377.50
Mudstone, dark grey, uniform; fissile; rare fossils; passing down into	0.77	378.27
Mudstone with some bituminous interbeds; pyrite-rich band at 318.60m	0.38	378.65
Oil shale, medium brown	0.13	378.78
Mudstone	0.13	378.91
Oil shale	0.07	378.98
Mudstone	0.06	379.04
Oil shale	0.04	379.08
Mudstone	0.10	379.18
Nannocardioceras Cementstone: hard, calcareously and pyritically cemented bituminous mudstone or oil shale	0.12	379.30
Interlaminated oil shale and bituminous mudstone; hard; several pyrite-rich layers; pyritized *Amoe. (Nannocardioceras)* (mostly spat) and bivalves throughout	0.46	379.76
Hobarrow Bay Fluidised Bed: oil shale, prominent medium brown with many white coccolith-rich laminae in top 5cm, cut by fluidised mud	0.13	379.89
Mudstone with bituminous mudstone interbeds	0.26	380.15

Oil shale, prominent medium brown	0.16	380.31
Mudstone, dark grey; fissile partings; a few bituminous interbeds up to 3cm thick	0.54	380.85
		(end recovery)

Run 161 379.07 to 383.07m Recovered 4.40m (110%)	*Thickness* m	*Depth* m
Mudstone, dark grey, fissile; continuation of Run 161; several brownish grey bituminous mudstone interbeds up to 5cm thick; more prominent beds at 380.10 to 380.50m; passing down into	1.51	380.58
Interlaminated and interbedded dark grey mudstone and dark brown bituminous mudstone; sharp base	0.10	380.68
Hobarrow Bay Stone Band: densely cemented, well laminated medium grey and medium and dark brown	0.44	381.12
Mudstone, dark grey, fissile; very sparsely fossiliferous with mostly pyritic fauna	1.58	382.70
Oil shale, medium brown, hard; a few muddy laminae	0.08	382.78
Mudstone, fissile; almost barren; prominent horizontal shears at 282.88 to 282.90m	0.69	383.47
		(end recovery)

Run 162 383.07 to 387.07m Recovered 1.28m (32%)	*Thickness* m	*Depth* m
Mudstone, dark grey, distinctly uniform with fine-grained sooty texture; very sparsely shelly; fissile with de-stressing partings at regular 3 to 5 cm intervals; many horizontal shears include prominent bands at 383.17 to 383.22m, 383.26m and 383.49 to 383.50m; passing down rapidly into	1.17	384.24
Oil shale, muddy, dark grey becoming medium brown purer oil shale with depth; hard, possibly cemented; rare pyritic and pyritic film fauna; core break (spin) at base	0.11	384.35
		(end recovery)

Run 163 387.07 to 388.37 Recovered 4.23 (325%)	*Thickness* m	*Depth* m
Oil shale, medium brown: dense with much pyritic cement; core spin at top matches Run 162; horizontal shear at sharp lithological change at base	0.05	387.12
Mudstone, dark grey, sooty textured, fissile (as higher beds) when de-stressed; very uniform; very sparse fauna of bivalves and ammonite fragments; horizontal shear at 387.20m; passing rapidly down into	0.75	387.87
Oil shale, mid brown, hard; passing down into	0.07	387.94
KC 31		
Mudstone, as beds above; uniform, fissile; sparsely fossiliferous but with common serpulids at some levels	0.78	388.72
Bituminous mudstone thinly interbedded with mudstone; pyrite-rich in more bituminous layers	0.08	388.80
Mudstone, as beds above	0.98	389.78
Bituminous mudstone and mudstone, thinly interbedded	0.07	389.85
KC 30		
Mudstone, as beds above; horizontal shears at 390.20m	1.45	391.30
		(end recovery)

Run 164 388.37 to 392.65m Recovered 4.26m (100%)	*Thickness* m	*Depth* m
Mudstone, dark grey, sooty textured, uniform; sparsely fossiliferous; as beds above	4.25	392.63
		(end recovery)

Run 165 392.65 to 396.77m No recovery

Run 166 **396.77 to 397.15m** **No recovery**

Run 167 **397.15 to 397.15m** **Recovered 4.37m (infinity)**

	Thickness m	*Depth* m
Mudstone, uniform, as beds above but medium and dark grey, more calcareous and less sooty textured; sparsely fossiliferous with crushed but well preserved irridescent *Aulacostephanus, Amoe. (Amoebites)*, a few *Amoe. (Nannocardioceras)*, and *Nanogyra virgula* (DeFrance), *Protocardia* and other bivalves; brown bituminous mudstone band at 397.48 to 397.50m; passing down into	2.15	399.30
Mudstone as above but with common thin, pyrite-rich bituminous mudstone interbeds	0.20	399.50
Mudstone, uniform, dark and medium grey, sparsely fossiliferous; as beds above; horizontal shear belt at 401.07 to 401.17m	2.02	401.52 (end recovery)

Run 168 **397.15 to 399.15m** **No recovery**

Run 169 **399.15 to 401.15m** **Recovered 3.73m (187%)**

	Thickness m	*Depth* m
Mudstone, as beds above; fissile on de-stressing; sparsely fossilferous with a few ammonites and bivalves; passing down into	3.08	402.23
Swanworth D Stone Band: densely cemented, grey tabular bed; presumed cementstone	0.59	402.82
Mudstone, as beds above	0.06	402.88 (end recovery)

Run 170 **401.15 to 405.15m** **Recovered 3.83m (96%)**

	Thickness m	*Depth* m
Mudstone, as beds above; faintly bituminous in part; sparsely shelly but with a few more shelly, bivalve-rich bands; common *Nanogyra virgula* at some levels; cemented *N. virgula*-rich band at 404.08 to 404.32m	3.83	404.98 (end recovery)

Run 171 **405.15 to 407.05m** **Recovered 2.42m (131%)**

	Thickness m	*Depth* m
Mudstone, dark and medium grey, calcareous; uniform, as beds above; sparse fauna as above	2.42	407.57 (end recovery)

Run 172 **407.05 to 411.17m** **Recovered 4.19m (102%)**

	Thickness m	*Depth* m
Mudstone, dark and very dark grey, calcareous; sparse and very sparse fauna of fragmented bivalves and ammonities; fibrous pyrite at 408.16 to 408.18m and 408.97 to 408.99m with pyritised burrowfills; horizontal shears at 410.13 to 410.14m and 410.22 to 410.24m; passing down into	3.37	410.42
Mudstone, well laminated; passing down into	0.08	410.50
Swanworth C Stone Band; grey bioturbated cementstone with *Chondrites*	0.32	410.82
Mudstone, dark grey, as above	0.42	411.24 (end recovery)

Run 173 **411.17 to 415.15m** **Recovered 0.84m (21%)**

	Thickness m	*Depth* m
Mudstone, dark grey, calcareous; fibrous pyrite at 411.27 to 411.30m; horizontal shears at 411.32m and 4211.53m, and from 411.65 to 411.66m	0.84	412.01 (end recovery)

Run 174 415.15 to 416.15m Recovered 3.32m (332%)	*Thickness* m	*Depth* m
Mudstone, dark grey passing down into	0.17	415.32
KC 29		
Oil shale and bituminous mudstone, interbedded	0.25	415.57
Bituminous mudstone; pyritised *Nanogyra* and other oysters and common *Amoe. (Amoebites)*	0.18	415.75
Mudstone, dark grey, calcareous	0.60	416.35
Bituminous mudstone	0.45	416.80
Mudstone, dark grey, calcareous; slightly bituminous with more abundant pyritised shell fragments; common whole and fragmentary *Placunopsis* in grey film and pyritic preservations at 417.20m	0.56	417.36
Oil shale and bituminous mudstone, interbedded	0.33	417.69
Bituminous mudstone; pyrite nodule at 417.70m	0.48	418.17
Oil shale and bituminous mudstone with a few paler laminae	0.10	418.27
Mudstone, dark grey	0.20	418.47 (end recovery)

Run 175 416.15 to 419.65m Recovered 4.21m (120%)	*Thickness* m	*Depth* m
Mudstone, dark grey, slightly calcareous and bituminous; passing down into	0.91	417.06
Oil shale and bituminous mudstone, interbedded	0.13	417.19
Mudstone, dark grey, calcareous and slightly bituminous	0.11	417.30
Bituminous mudstone; a few iridescent ammonite fragments (green and red) here and in beds below; whole and fragmentary, faintly iridescent *Placunopsis* present, together with *Aspidoceras, Amoe. (Amoebites)* and *Sutneria*	0.07	417.37
Mudstone, dark grey, calcareous and slightly bituminous	0.33	417.70
Bituminous mudstone	0.22	417.92
Mudstone, dark grey slightly calcareous and bituminous	0.45	418.37
Bituminous mudstone	0.10	418.47
Mudstone, dark grey, calcareous	0.64	419.11
Bituminous mudstone; passing down into	0.35	419.46
Oil shale; passing down into	0.34	419.80
Bituminous mudstone	0.43	420.23
Mudstone, dark grey, calcareous	0.13	420.36 (end recovery)

Run 176 419.65 to 423.65m Recovered 3.18m (80%)	*Thickness* m	*Depth* m
Mudstone, dark grey, calcareous	0.31	419.96
Bituminous mudstone	0.36	420.32
Oil shale with bituminous mudstone laminae; pyrititsed ammonite and bivalve fragments including *Placunopsis*	0.57	420.89
Bituminous mudstone ; passing down into	0.04	420.93
Mudstone, dark grey, calcareous	0.73	421.66
Mudstone, dark grey	0.03	421.69
Swanworth B Stone Band: cementstone; calcite-veined shear at 421.97 to 422.02m dips 30°	0.36	421.97
Mudstone, dark grey; passing down into	0.19	422.24
Oil shale, laminated; fibrous pyrite at 422.47 to 422.50m; abundant *Placunopsis*	0.26	422.50
Bituminous mudstone	0.02	422.52
Mudstone, dark grey, calcareous	0.31	422.83 (end recovery)

Run 177 423.65 to 426.85m Recovered 1.77m (55%)	*Thickness* m	*Depth* m
Mudstone, dark grey; passing down into	0.09	423.74

Bituminous mudstone	0.28	424.02
Oil shale	0.10	424.12
Mudstone, dark grey, calcareous; shelly fragments; horizontal shears at 424.15m 424.17 to 424.19m and 424.22m	0.49	424.61
Mudstone, dark grey, slightly bituminous; passing down into	0.17	424.78
Oil shale and bituminous mudstone, interbedded; abundant bivalves and much finely comminuted *Placunopsis* debris	0.25	425.03
KC 28		
Mudstone, dark grey, calcareous; ammonites and bivalves dispersed evenly throughout	0.38	425.41
Horizontal shear	0.01	425.42
		(end recovery)

Run 178 **426.85 to 428.62m** **No recovery**

Run 179 **428.62 to 428.62m** **Recovered 4.20m (Infinity)**

	Thickness m	*Depth* m
Mudstone, dark grey, calcareous; passing down into	0.30	428.92
Mudstone, dark grey, less calcareous and with greater abundance of shelly debris	0.78	429.70
Mudstone, dark grey, calcareous; sparse fauna; large vertical calcite vein from 428.90 to 429.80m	0.16	429.86
Mudstone, dark grey, calcareous	0.89	430.75
Mudstone, dark grey with abundant bivalves; passing down into	0.20	430.95
Mudstone, more bituminous than above; shelly	0.51	431.46
Bituminous mudstone; abundant ammonites and bivalves	0.10	431.56
Mudstone, dark grey with horizontal calcite-veined shears	0.03	431.59
Mudstone, dark grey; passing down into	0.60	432.19
Mudstone, more bituminous than above; more calcareous band with many bivalves at 432.47m	0.28	432.47
Mudstone, with large horizontal shear	0.08	432.55
Mudstone. calcareous; core very broken	0.27	432.82
		(end recovery)

Run 180 **428.62 to 432.62m** **Recovered 0.11m (3%)**

	Thickness m	*Depth* m
Mudstone, dark grey, calcareous	0.11	428.73
		(end recovery)

Run 181 **432.62 to 432.62m** **Recovered 3.95m (Infinity)**

	Thickness m	*Depth* m
Mudstone, medium grey, calcareous; bivalves and ammonites throughout	0.94	433.56
Bituminous mudstone; abundant fauna including *Aulacostephanus* and *Aspidoceras*	0.11	433.67
Mudstone, medium grey, calcareous; horizontal shears at 433.85 to 433.86m and at base	0.79	434.46
Mudstone, dark grey, very slightly bituminous and faintly laminated; abundant fauna	0.63	435.09
Mudstone, dark grey, calcareous; common bivalves and ammonites	1.04	436.13
Mudstone and bituminous mudstone, interbedded	0.43	436.56
Horizontal shear at base	0.01	436.57
		(end recovery)

Run 182 **432.62 to 436.67m** **Recovered 4.11m (102%)**

	Thickness m	*Depth* m
Mudstone, dark grey, calcareous; horizontal shears at 432.94 to 432.96m; passing down into slightly bituminous mudstone	1.11	433.73
Mudstone, dark grey calcareous horizontal shears at 434.93 to 434.95m;	0.06	433.79
Mudstone, dark grey, calcareous; sparse fauna of bivalves and iridescent		

ammonities including *Aulacostephanus* spp.; passing down into	1.92	435.71
Bituminous mudstone and oil shale	0.16	435.87
Mudstone, dark grey calcareous; horizontal shears at 436.23m	0.86	436.73
		(end recovery)

Run 183 436.67 to 440.52m Recovered 3.95m (103%)

	Thickness m	*Depth* m
Mudstone, dark grey, calcareous; sparse fauna	0.79	437.46
Bituminous mudstone with common pyritised fauna; pyrite concretions at 438.438.02m; passing down into	0.58	438.04
Mudstone, dark grey, calcareous; horizontal shears at 438.26m, 439.01 to 439.02m, 439.73m, 440.15m and 440.62m	2.58	440.62
		(end recovery)

Run 184 440.52 to 444.59m Recovered 4.12m (101%)

	Thickness m	*Depth* m
Mudstone, dark and very dark grey, calcareous; uniform; vertical fracture	0.96	441.48
Mudstone, slightly bituminous; pyrite nodules at 441.82m	0.42	441.90
Mudstone, dark grey, calcareous	0.83	442.73
Swanworth A Stone Band: cementstone	0.43	443.16
KC 26 & 27		
Mudstone, dark grey, calcareous; fossiliferous with common *Dicroloma* and bivalve and ammonite fragments	1.48	444.64
		(end recovery)

Run 185 444.59 to 448.60m Recovered 3.65m (91%)

	Thickness m	*Depth* m
Mudstone, dark grey, calcareous; very uniform; sparse fauna with a few *Aulacostephanus*; calcitic and pyritic preservation	3.65	448.24
		(end recovery)

Run 186 448.60 to 452.52m Recovered 0.65m (17%)

	Thickness m	*Depth* m
Mudstone, dark and very dark grey, slightly calcareous; uniform; sooty textured in part; sparse fauna	0.65	449.25
		(end recovery)

Run 187 452.32 to 452.72m Recovered 0.50m (250%)

	Thickness m	*Depth* m
Mudstone, dark grey, calcareous; uniform; sparse fauna includes pyritised *Aul.* cf *eulepidus* (Schneid)	0.50	453.02
		(end recovery)

Run 188 452.72 to 453.21m Recovered 0.59m (120%)

	Thickness m	*Depth* m
Mudstone, dark grey, calcareous; uniform; sparse fauna includes *Aul.* ex gr. *eudoxus* (d'Orbigny)	0.59	453.31
		(end recovery)

Run 189 453.21 to 453.71m Recovered 4.06m (812%)

	Thickness m	*Depth* m
Mudstone, dark grey, calcareous; sparse fauna; fibrous pyrite at 453.48m; horizontal shear at base	1.47	454.68
Mudstone, dark grey, calcareous;uniform; sparse fauna	0.89	455.57
Mudstone, slightly bituminous; sparse fauna includes *Aulacostephanus* spp.	0.37	455.80
Mudstone, dark grey, calcareous; uniform; sparse fauna; pyritic and calcitic preservation	1.47	457.27
		(end recovery)

Run 190 **453.71 to 457.76m** **No recovery**

Run 191 **457.76 to 457.96m** **Recovered 4.05m (2025%)**

	Thickness m	*Depth* m
Mudstone, dark grey, calcareous; uniform; sparse fauna; filmy grey *Placunopsis* fragments at 457.80m; *Aul.*ex gr. *eudoxus* at 459.53m and 460.36 to 460.46m; horizontal shears at 457.94m, 458.06 to 458.09 (20° to 30° dip), 458.52 to 458.54m, 459.17m, 459.75 to 459.76m, 460.46 to 460.47m, 460.56m (20° to 30° dip) and 461.63 to 461.64m	4.05	461.81 (end recovery)

Run 192 **457.96 to 461.96m** **Recovered 1.62m (41%)**

	Thickness m	*Depth* m
Mudstone, dark and very dark grey, sooty textured in part; fissile with curved fractures; smooth textured in part; very sparsely fossiliferous overall with shell-debris concentrations in mostly barren matrix; fauna includes whole *Aulacostephanus* and fragments, mostly with epizoic oysters; nuculids, oysters and other bivalves; fauna mostly preserved in white or brown calcite, with some pyrite	1.62	458.58 (end recovery)

Run 193 **461.96 to 463.46m** **Recovered 3.16m (211%)**

	Thickness m	*Depth* m
Mudstone, dark grey, very slightly silty in part; sparsely fossiliferous overall but with local concentrations of shell debris, mostly oysters and *Aulacostephanus* fragments; *Aul. eudoxus* at 462.62, 462.68 and 462.85m; *Aspidoceras* very common at 462.80 to 463.75m with good examples at 462.95, 463.10 and 463.75m; shell-debris plaster at 462.71m with *Nanogyra virgula*, many oysters and *Aulacostephanus* in pyritic and iridescent calcitic preservation passing down into	1.84	463.80
Mudstone, very dark grey, very sparsely shelly with nuculids and iridescent red and green *Aulacostephanus* the only common fossils; common listric surfaces and a few shears	1.32	465.12 (end recovery)

Run 194 **463.46 to 466.71m** **No recovery**

Run 195 **466.71 to 466.71m** **Recovered 3.74m (infinity)**

	Thickness m	*Depth* m
KC 25 Mudstone, dark grey, calcareous with closely spaced partings and curved fractures; uniform; more fossiliferous than Run 193; common , *Aul. eulepidus,* whole and fragmentary with red and green iridescence, and crushed iridescent *Aul.* cf. *mutabilis* (J. de C. Sowerby), many with large body chambers that fill whole bedding plane; small oysters and nuculids scattered throughout; horizontal sheared band at 463.55 to 463.60m; horizontal shears at 463.55 to 463.60m	3.74	467.20 (end recovery)

Run 196 **466.71 to 470.51m** **Recovered 1.60 (42%)**

	Thickness m	*Depth* m
KC 24 Mudstone, dark grey, slightly sooty textured interbedded with medium grey, more calcareous; sparsely shelly with a few large and small oysters, other bivalves and fragments of iridescent ammonites including *Aul. eulepidus* and *Aul.* sp.; nuculids, filmy preservation *Placunopsis, Dicroloma,* small *Nanogyra virgula*; iridescent *Aspidoceras longispinum* (J. de C. Sowerby) at 468.31m; pyritic preservation common in darker beds, includes small oysters and serpulids	1.60	468.31m

(end recovery)

Run 197 470.51 to 472.51 Recovered 2.43m (120%)	*Thickness* m	*Depth* m
Mudstone, dark grey, slightly sooty textured; sparsely fossiliferous; as bed above; passing down into	0.32	470.83m
Mudstone, dark grey, slightly silty with irregular fracture; sparsely to moderately shelly with small oysters, *Nanogyra virgula*, other bivalves, ammonite fragments; serpulids and cidarid spine; horizontal shear at base	0.51	471.34m
Horizontally, highly sheared mudstone	0.01	471.35m
Mudstone, dark grey, smooth textured; sparsely fossiliferous with bivalve and ammonite fragments throughout including *Aulacostephanus eulepidus*, mostly as crushed fragments	1.59	472.94m (end recovery)

Run 198 472.51 to 475.01m Recovered 1.44m (58%)	*Thickness* m	*Depth* m
Mudstone, dark grey, slightly sooty textured; very sparsely fossiliferous; core break at base	0.60	473.11
Mudstone, medium grey, moderately to very shelly with local abundance of nucilids; *Aul. eulepidus* fragments and whole shells scattered throughout; passing down into	0.29	473.40m
Mudstone, dark grey, slightly sooty textured, sparsely fossiliferous	0.55	473.95m (end recovery)

Run 199 475.01 to 476.51m Recovered 2.57m (171%)	*Thickness* m	*Depth* m
Mudstone, dark grey, smooth textured, sparsely to moderately fossiliferous with common nuculids and a few ammonite fragments including *Aul. mutabilis*; passing down into	0.39	475.40
Mudstone, dark grey and greyish brown, bituminous mudstone thinly interbedded; sparsely fossiliferous; pyrite preservation dominant in bituminous beds	0.33	475.73
Mudstone, dark grey, sparsely fossiliferous; as above but with relatively common iridescent, small, crushed *Aul. eulepidus*	1.85	477.58 (end recovery)

Run 200 476.51 to 479.01m No recovery

Run 201 479.01 to 479.01m Recovered 3.95m (infinity)	*Thickness* m	*Depth* m
Mudstone, dark grey, smooth textured with several polished shears; uniform; a few thin interbeds of browner more bituminous mudstone; sparsely fossilferous with mixed leached calcite and pyrite preservation; burrow concentrations of nuculids; crushed *Aul. eulepidus* and *Aul. linealis*? (Quenstedt)	3.95	482.96m (end recovery)

Run 202 479.01 to 483.01m Recovered 3.70 (93%)	*Thickness* m	*Depth* m
Mudstone, dark grey, slightly sooty textured; passing down into	0.39	479.40

KC24		
North Wootton Siltstone: mudstone, medium and dark grey; slightly silty becoming more silty and shelly with depth; moderately shelly becoming very shelly in lowest part; *Aspidoceras longispinum* at 479.79m; very shelly with much ammonite and bivalve debris at 479.82 to 479.87m with common *Aul. eulepidus, Nanogyra virgula*; large and small oysters, cidarid spines and seruplids; much thick-shelled debris encrusted with foraminifera; irregular, highly bioturbated base with marked lithological contrast.	0.47	479.87
KC 23		
Mudstone, dark grey, very slightly silty in part, sooty textured in part; sparsely fossiliferous	0.70	480.57
KC 22		
Mudstone, medium and dark grey; sparsely fossiliferous with bivalves only common fossil including *Nicaniella*, plasters of large oysters and *Aul.* ex gr. *mutabilis* at 482.62 and 482.71m	2.14	482.71 (end recovery)

Run 203 **483.01 to 487.01m** **Recovered 2.01 (50%)**	*Thickness* m	*Depth* m
Mudstone, dark grey, sparsely fossiliferous; as bed above; passing down into	0.52	483.53
Thinly interbedded dark grey mudstone and greyish brown bituminous mudstone; shelly throughout; more bituminous layers highly pyritic	0.13	483.66
Supracorallina Bed; mudstone, medium and dark grey; crowded with *Nicaniella extensa* (Phillips) *[='Astarte' supracorallina* d'Orbigny*]*, interbedded with less shelly mudstones with common *Aulacostephanus* fragments and more pyritic preservation; passing down into	1.22	484.88
KC 21		
Mudstone, dark grey and grey brown bituminous mudstone, thinly interlaminated much pyrite in more bituminous beds	0.14	485.02 (end recovery)

Run 204 **487.01 to 488.91m** **Recovered 4.21m (222%)**	*Thickness* m	*Depth* m
Mudstone, dark grey, moderately shelly with common oysters, small bivalves mostly nuculids and *Aul. eulepidus* fragments; sooty textured in part with clay-cast preservation; more calcareous at other levels with thin calcite shells including some weak iridescence; passing down into	0.73	487.74
Mudstone, paler grey than above, calcareous; fossiliferous and very fossiliferous with common *Nicaniella extensa* and *Aul. eulepidus* fragments; plasters of *Nicaniella* and *Aul. eulepidus* at 487.78m; common nuculids and small pyritised oysters also present; passing down into	0.11	487.85
KC 20		
Bituminous mudstone, greyish brown, fissile; moderately fossiliferous with pyritised oysters and very common iridescent *Aul. eulepidus*; passing down into	0.15	488.00
KC 19		
Mudstone, dark grey, more calcareous than above, many curved fractures, sparsely fossiliferous with relatively common oysters; other bivalves and *Aul. eulepidus* fragments also present; passing rapidly down into	2.23	490.23
Metherhills Stone Band: dense muddy cementstone, passing rapidly down into	0.49	490.72
Mudstone, dark slightly brownish grey; slightly sooty textured; many curved fractures; sparsely fossiliferous with small bivalves and *Aul. eulepidus* fragments in clay-cast preservation	0.50	491.22 (end recovery)

Run 205 **488.91 to 493.01m** **Recovered 4.26m (104 %)**	*Thickness* m	*Depth* m
Mudstone, dark, faintly brownish grey, slightly silty, uniform; curved de-stressing fractures suggest high carbonate content; moderately fossiliferous		

throughout with common bivalves, *Lingula* and very common *Aul. eulepidus* fragments in clay-cast preservation; bivalves preserved as brown shells and films; some pyritic preservation and small pyritised trails and burrowfills	4.26	493.17 (end recovery)
Run 206 **493.01 to 497.13m** **Recovered 4.18m (102%)**	*Thickness* m	*Depth* m
Mudstone, dark, faintly brownish grey; uniform; as Run 205; *Aul. eulepidus* fragments and small bivalves, mostly nuculids, scattered throughout; a few larger, curved oysters	4.18	497.19 (end recovery)
Run 207 **497.13 to 501.21m** **Recovered 4.19m (103%)**	*Thickness* m	*Depth* m
Mudstone, dark grey becoming paler on drying; many curved destressing fractures; sparsely fossiliferous as beds above but with more common thicker shelled, white calcite bivalve fragments including oysters; *Aul. eulepidus* fragments common throughout in thin white shell and clay-cast preservation; gulielmites structures common in lower part	4.19	501.32 (end recovery)
Run 208 **501.21 to 505.21m** **Recovered 3.93m (98%)**	*Thickness* m	*Depth* m
Mudstone, medium grey, calcareous; very sparsely shelly with a few bivalves and ammonite fragments preserved in white calcite; passing down into	0.89	502.10
Mudstone, dark grey, smooth textured; very sparsely shelly with crushed *Aul. eulepidus* and bivalves; common gulielmites structures; passing down into	0.58	502.68
Bituminous mudstone fairly brownish grey, common crushed, *Aul. eulepidus* bivalves and small *Lingula* also present	0.13	502.81
Mudstone, dark grey, smooth textured; very sparsely shelly, *Aul. eulepidus* and bivalves; passing down into	2.11	504.92
Mudstone, medium to pale grey, slightly silty with angular shell debris and irregular fracture	0.22	505.14 (end recovery)
Final depth		**505.21m**

APPENDIX 3 (continued). Borehole-site descriptions of the Swanworth Quarry No. 1 and Metherhills No. 1 cores.

METHERHILLS NO. 1 [SY 9112 7911]

Borehole Site Log

*Note: depths referred to in the following descriptions are **driller's depths**: they are not the **'true' depths** (see Section 2.3 for discussion). In each description, the driller's depth for the beginning of the run is taken as datum, and subsequent depths were obtained by measuring down the core. In runs where the amount of core recovered is greater than that drilled (due to slippage on previous runs) This commonly results in an apparent anomaly whereby the depth assigned to the bottom of a core can be greater than the depth of the top of the next core run. The fossil identifications given below are based on individual specimens and parts of specimens that were visible on broken surfaces in the core. No attempt was made to break the core to make a more comprehensive faunal list. Details of the chronostratigraphical classification (**KC 1** to **KC 63**) are given in Appendix 2.*

KIMMERIDGE CLAY

Run 1 **90.00 to 94.15m** **Recovered 3.41m (82%)**	*Thickness* m	*Depth* m
KC 32 (pars)		
Mudstone, calcareous mudstone, bituminous mudstone and oil shale, thinly interbedded in units mostly less than one 10cm thick; pyritised and calcite - film fauna abundant and includes abundant *Nannocardioceras* together with *Aspidoceras*, *Dicroloma*, '*Lucina*' and *Aulacostephanus* as fragments; sub-horizontal calcite-filled shear horizons notably at 90.23 to 90.35m; 90.52 to 90.54m;.91.55 to 91.57m and 92.20 to 92.22m; oil shales at 90.99 to 91.00m and 91.33 to 91.36m; passing down into	2.40	92.40
Bituminous mudstone with laminae of mudstone and oil shale	1.01	93.41 (end recovery)

Run 2 **94.15 to 97.65m** **Recovered 2.44m (70%)**	*Thickness* m	*Depth* m
Mudstone and bituminous mudstone, thinly interbedded and with some thin oil shale seams, as above; passing down into	0.30	94.45
Bituminous mudstone with oil shale laminae; passing down into	0.38	94.83
Oil shale, medium and dark brown with bituminous mudstone and mudstone laminae; prominent seam; passing down into	0.37	95.20
Thinly interbedded and interlaminated mudstone, bituminous mudstone, and oil shale; passing down into	0.42	95.62
Oil shale with mudstone and bituminous mudstone laminae; passing down into	0.11	95.73
Bituminous mudstone with mudstone and oil shale laminae; passing down into	0.21	95.94
Oil shale; passing down into	0.04	95.98
Mudstone with bituminous mudstone and oil shale laminae; pyrite concretions at 96.09 to 96.11m; passing down into	0.15	96.13
Oil shale with mudstone laminae; passing down into	0.07	96.20
Bituminous mudstone with mudstone and oil shale laminae; horizontal calcite shears from 96.60 to 96.62m	0.39	96.59 (end recovery)

Run 3 **97.65 to 100.10m** **Recovered 4.28m (175%)**	*Thickness* m	*Depth* m
Mudstone with a few bituminous laminae	0.75	98.40
Interlaminated bituminous mudstone, oil shale and mudstone	0.16	98.56

Oil shale, shelly, laminated	0.05	98.61
Interlaminated mudstone and bituminous mudstone with some oil shale laminae	0.15	98.76
Oil shale	0.06	98.82
Mudstone with numerous calcite shears	0.04	98.86
Oil shale with bituminous mudstone laminae	0.11	98.97
Mudstone with bituminous laminae and calcareous shears	0.13	99.10
Oil shale with bituminous mudstone and mudstone laminae	0.05	99.15
Mudstone with a few bituminous mudstone and oil shales laminae; shelly partings and calcareous shears; passing down into	0.25	99.40
Bituminous mudstone with oil shale and mudstone laminae; passing down into	0.12	99.52
Nannocardioceras Cementstone: oil shale with cementstone dogger at 99.61 to 99.70m (maximum); fluidised shelly mudstone **(Hobarrow Bay Fluidised Bed)** at 99.70m ascending to 99.64m and cutting thin coccolith - rich band at 99.68m	0.18	99.70
Mudstone and oil shale, interlaminated and thinly interbedded	0.12	99.82
Mudstone with calcite shears; *Nanogyra virgula* plaster at 100.00m	0.32	100.14
Oil shales with some mudstone laminae	0.08	100.22
Mudstone with many calcite shears; prominent horizontal band of shears at 101.45 to 101.51m	1.71	101.93 (end recovery)

Run 4 **100.10 to 104.53m** **Recovered 4.34 (98%)**

	Thickness m	*Depth* m
Mudstone, dark grey, fissile, sooty textured in part; rare bituminous mudstone and oil shale laminae; common relatively thick sub-horizontal calcite shears, notably at 100.33 to 100.38 m; 101 42 to 101.35m; 101.82 to 101.98m; 102.72 to 102.76m and 103.55 to 103.67m; concentrations of bituminous laminae at 100.43 to 100.53m; 100.74 to 100.84 m and 102.50 to 102.63 m	4.34	104.44 (end recovery)

Run 5 **104.53 to 108.69m** **Recovered 3.14m (75%)**

	Thickness m	*Depth* m
Mudstone, dark grey, fissile, as above	0.15	104.68
Oil shale, medium brown, uniform, shell plaster at base	0.09	104.77
Mudstone, dark grey with prominent calcite shear veins at 104.76 and 104.83 m	0.23	105.00
Finely interlaminated bituminous mudstone, oil shale and mudstone	0.20	105.20
Mudstone, dark grey with curved fractures	0.30	105.50
Oil shale with laminae of bituminous mudstone and mudstone, passing down into	0.09	105.59
Bituminous mudstone with laminae of oil shale and mudstone, passing down into	0.06	105.65
KC 31	0.30	105.95
Mudstone with bituminous laminae, passing down into		
Mudstone, dark grey sooty textured, fissile with bituminous laminae throughout and a few local bituminous concentrations	1.72	107.67 (end recovery)

Run 6 **108.69 to 111.90m** **Recovered 3.29 (103%)**

	Thickness m	*Depth* m
Mudstone, dark grey as above, but paler grey in part; bituminous laminae concentrations at 110.40 to 110.44m; bituminous laminae rare below this; horizontal shears at 110.27 to 110.30 m; prominent calcite-coated shears dipping at 10° at 111.24 to 111.28 m	3.29	111.98 (end recovery)

Run 7 **111.90 to 115.22m** **Recovered 4.44m (134%)**

	Thickness m	*Depth* m
KC 30		
Mudstone, uniform; very sparsely shelly; dark grey, sooty textured in part with		

some curved fractures; thin calcite shears horizontal at 112.64m , 113.60m and 115.08 to 115.10 m; more widely spaced sub-horizontal calcareous shears at 114.83 to 114.91 m; becoming more shelly with bivalves and common *Aulacostephanus* below 115.60 m	4.44	116.34 (end recovery)
Run 8 115.22 to 119.53m Recovered 4.38m (102%)	*Thickness* m	*Depth* m
Mudstone, uniform as above; sparsely fossiliferous with a few more shelly bands with *Aulacostephanus, Nannocardioceras* and bivalves in calcite-film preservation anastomosing seams of calcite films at many levels, some sub-vertical	4.38	119.60 (end recovery)
Run 9 119.53 to 123.67m Recovered 4.08m (99%)	*Thickness* m	*Depth* m
Mudstone, sparsely fossiliferous as bed above; passing down into	1.17	120.70
Swanworth D Stone Band: cementstone, medium and pale grey;dense, (ferruginous?); possible bone fragment at 120.71 m; shelly partings with *Aspidoceras* and large flat oysters at base; passing down into	0.65	121.35
Mudstone, as beds above; moderately shelly with common large *Protocardia*	2.26	123.61 (end recovery)
Run 10 123.67 to 128.03m Recovered 4.37m (100%)	*Thickness* m	*Depth* m
Mudstone, dark grey, blocky texture; uniform except for a few bituminous laminae at 124.25 to 124.45m	4.37	128.0 (end recovery)
Run 11 128.03 to 132.33m Recovered 4.40m (102%)	*Thickness* m	*Depth* m
Mudstone, medium and dark greys, alternating more and less calcareous	3.07	131.80
Swanworth C Stone Band: cementstone, dense	0.68	131.78
Mudstone, medium and dark greys, as above; moderate to sparse fauna includes very common *Protocardia*, pyritised *Nanogyra virgula* and serpulids	0.55	132.43 (end recovery)
Run 12 132.33 to 136.63m Recovered 4.37 (100%)	*Thickness* m	*Depth* m
Mudstone, dark grey; alternating shelly and sparsely shelly with *Aspidoceras, Dicroloma, Placunopsis* and other bivalves preserved in white calcite	0.27	132.60
Mudstone and bituminous mudstone, interlaminated; calcite ghost preservation	0.08	132.68
Mudstone, fauna and lithology as above	0.22	132.90
KC 29		
Oil shale, bituminous mudstone and mudstone, interlaminated; fauna as above	0.12	133.02
Mudstone and bituminous mudstone, interlaminated	0.10	133.12
Mudstone, as above	0.06	133.18
Oil shale and mudstone, interlaminated	0.04	133.22
Mudstone, as above	0.66	133.88
Oil shale and mudstone, interlaminated	0.14	134.02
Mudstone, as above	0.68	134.70
Oil shale and mudstone, interlaminated	0.10	134.80
Mudstone, as above	1.87	136.67 (end recovery)
Run 13 136.63 to 140.53m Recovered 3.94m (101%)	*Thickness* m	*Depth* m
Mudstone, dark grey, as above shelly in part; pyrite lenses at 139.10m and		

139.30 to 139.35m; bituminous laminae at 139.40 to 139.50m; weakly bituminous at 136.97 to 137.01m	3.94	140.57 (end recovery)

Run 14 **140.53 to 144.69m** **Recovered 3.22m (77%)**	*Thickness* m	*Depth* m
Mudstone, dark grey, as above; mostly sparsely shelly; bituminous laminae at 140.76 to 140.80m; weakly bituminous laminae at 141.30 to 141.45m	1.63	142.16
Swanworth B Stone Band: cementstone cut by numerous calcite-filled cracks (1 to 2mm width) and brecciated veins (up to 50mm width); calcite veined shear at base dips at 45°	0.46	142.62
Mudstone, dark grey, as above	0.23	142.85
Oil shale with very fine laminae of mudstone, bituminous mudstone and possible coccolith-rich laminae; abundant fauna preserved in leached calcite includes *Aspidoceras*, small *Aulacostephanus*, *Sutneria*, *Laevaptychus*, *Dicroloma*, and bivalves; passing down into	0.20	143.05
Mudstone, dark grey, fauna as above; bituminous laminae common in upper part; abundant *Placunopsis* as pyritic and calcitic films	0.65	143.70
Oil shale, brown, shelly	0.05	143.75 (end recovery)

Run 15 **144.69m to 148.31** **Recovered 4.46m (123%)**	*Thickness* m	*Depth* m
Oil shale, greyish brown; shelly in part with bivalves and ammonites preserved as thin pale brown calcite films and as ghosts	0.06	144.75
KC 28 Mudstone, dark grey; shelly and moderately shelly with very common bivalves and rarer *Aspidoceras* and *Dicroloma* preserved as thin calcite films; pyritic in part	3.40	149.15 (end recovery)

Run 16 **148.31 to 152.53m** **Recovered 4.38m (104%)**	*Thickness* m	*Depth* m
Mudstone, dark grey with variable calcareous content; sparsely to moderately shelly with *Aspidoceras, Aulacostephanus* and bivalves; very shelly at some horizons.	4.38	152.53 (end recovery)

Run 17 **152.53 to 156.83m** **Recovered 4.21m (98%)**	*Thickness* m	*Depth* m
Mudstone, predominantly dark grey; lithologies and fauna as Run 16.	4.21	156.83 (end recovery)

Run 18 **156.83 to 160.93m** **No recovery.**

Run 19 **160.93 to 160.93m** **Recovered 4.34m (infinity)**	*Thickness* m	*Depth* m
Mudstone, dark grey; as Run 16.	4.34	160.93 (end recovery)

Run 20 **160.93 to 165.23m** **Recovered 3.68m (86%)**	*Thickness* m	*Depth* m
Mudstone, mostly dark grey; as Run 16	3.19	164.12
Swanworth A Stone Band: dense cementstone.	0.49	164.61 (end recovery)

Run 21 165.23 to 169.03m Recovered 4.47m (118%)	*Thickness* m	*Depth* m
KC 26 and 27 Mudstone, dark grey, fossiliferous in part	4.47	169.03 (end recovery)

Run 22 169.03 to 173.33m Recovered 4.43m (101%)	*Thickness* m	*Depth* m
Mudstone, dark grey, calcareous; fossiliferous in part with *Aulacostephanus, Aspidoceras* and common bivalves.	4.43	173.33 (end recovery)

Run 23 173.33 to 177.46m Recovered 3.03m (73%)	*Thickness* m	*Depth* m
Mudstone, predominantly dark grey; more calcareous at some levels; fauna and lithology as Run 22.	3.03	177.46 (end recovery)

Run 24 177.46 to 180.42m Recovered 4.05m (137%)	*Thickness* m	*Depth* m
Mudstone, predominantly dark grey; more calcareous at some levels; fauna and lithology as Run 22.	4.05	180.42 (end recovery)

Run 25 180.42m to 184.73m Recovered 4.14m (96%)	*Thickness* m	*Depth* m
Mudstone,dark grey; shelly in part with *Aspidoceras*, *Aulacostephanus* and bivalves	4.14	184.56 (end recovery)

Run 26 184.73 to 189.03m Recovered 4.43m (103%)	*Thickness* m	*Depth* m
Mudstone, dark grey, smooth textured, mostly uniform with some thin interbeds of faintly bituminous and more calcareous mudstones; shelly throughout with common small bivalves and small, medium and large ammonites preserved in cream - coloured calcite; small, medium and large *Aul. eulepidus* common at some levels with large, smooth body chambers of *Aul.* cf. *mutabilis;* all well preserved; large *Aul.* cf. *mutabilis* at 185.40 m; *Aspidoceras* at 186.35 m; calcitised shear zone dipping at 20 degrees at 186.20 to 185.23 m	4.43	189.16 (end recovery)

Run 27 189.03 to 193.03m Recovered 3.88m (97%)	*Thickness* m	*Depth* m
Mudstone, as above; common large *Aul. cf. mutabilis* and *Aul. eulepidus*	3.88	192.91 (end recovery)

Run 28 193.03 to 197.23m Recovered 3.95m (94%)	*Thickness* m	*Depth* m
Mudstone, as above but probably more calcareous; shells common but not abundant and preserved as pale brown or yellow calcite films; bivalves dominant; *Aul. eulepidus* and *Aul. mutabilis* common; *Aspidoceras* at 195.00, 194.90 and 197.00m; faintly bituminous band at 195.95 to 196.20 m	3.95	196.98 (end recovery)

Run 29 197.23 to 197.58 m Recovered 0.91m (260%)	*Thickness* m	*Depth* m
Mudstone, as above but more shelly; fauna as above in calcite-film and some pyrite preservation; small oysters locally common	0.91	198.14 (end recovery)

Run 30 197.58 to 201.58m Recovered 3.77m (94%)	*Thickness* m	*Depth* m
KC 25		
Mudstone, dark grey, uniform; moderately shelly and shelly with fauna as above; *Aspidoceras* at 199.13 and 199.56 m; fauna dominated by bivalves in thin calcite, calcite-film and some pyritic preservation	3.77	201.35 (end recovery)

Run 31 201.58 to 205.67m Recovered 4.54m (111%)	*Thickness* m	*Depth* m
KC 24		
Mudstone, dark and medium grey, blocky; shelly; if passing down into North Wootton Siltstone: siltstone medium grey, very shelly with many large and small fragments of ammonites and bivalves including shell chips; *Nanogyra virgula* common; calcite and calcite film preservation common; pyritic cement in part; irregular, possible burrowed base	2.25 0.29	203.83 204.12
KC 23		
Mudstone, dark grey, blocky texture; abundant and superabundant *Astarte supracorallina* and other bivalves; a few *Aul. eulepidus*; paler with much more shell dust giving silty texture at 204.55 to 204.65 m; almost barren at 204.85 to 205 .20 m; shelly as above to end of recovery	2.00	206.12 (end recovery)

Run 32 205.67 to 210.00m No recovery

Run 33 210.00 to 210.00m Recovered 4.42m (infinity)	*Thickness* m	*Depth* m
KC 22		
Supracorallina Bed: mudstone, very shelly with abundant and superabundant *Astarte supracorallina*; *Aul. eulepidus* with green and pink calcite preservation; passing down into	3.02	213.02
KC 20 and 21		
Mudstone, blocky with scattered bivalves and *Aul. eulepidus*; single large *Aul. mutabilis* plaster at 214.42m; blocky texture to end recovery	1.40	214.42 (end recovery)

Run 34 210.00 to 214.27m No recovery

Run 35 214.27 to 214.27m Recovered 4.27m (infinity)	*Thickness* m	*Depth* m
KC 19		
Mudstone, blocky with sooty texture; passing down into	2.40	212.40
Metherhills Stone Band: cementstone, densely cemented with some more muddy bands in highest part; passing down into	0.60	213.00
Mudstone, blocky with sooty texture and curved fractures; sparsely to moderately shelly with small bivalves and *Aul. eulepidus*, mostly fragments, preserved as calcite films; common, isolated, *Aul. eulepidus* well preserved as brown films	1.27	214.27

Run 36 214.27 to 218.35m No recovery

Run 37 218.35 to 218.35m Recovered 4.10m (infinity)	*Thickness* m	*Depth* m
Mudstone, dark grey, alternating sparsely and moderately shelly; blocky with irregular fracture as Run 38 (see below) and with same fauna as Run 38	4.10	218.37 (end recovery)

Run 38 218.35 to 222.51m Recovered 4.04m (97%)	*Thickness* m	*Depth* m
Mudstone, dark grey, highly fractured and possibly re-drilled in part; moderately		

shelly and sparsely shelly alternating; bivalves and *Aulacostephanus* preserved in white calcite with *Lingula* relatively common, small bivalves cf *Lucina* and small *Astarte supracorallina*	4.04m	222.39 (end recovery)

Run 39 **222.51 to 226.53m** **Recovered 3.62m (90%)**

	Thickness m	*Depth* m
Mudstone, dark grey, so slightly silty, sooty texture in part, irregular fracture in part; sparse and low diversity fauna with well preserved *Aul. eulepidus* and larger varieties; fauna more sparse and less diverse and matrix darker than Run 40	3.62	226.13 (end recovery)

Run 40 **226.53 to 230.15m** **Recovered 3.81m (105%)**

	Thickness m	*Depth* m
KC 18 Mudstone, medium grey, slightly silty with irregular fracture; general downward change from darker to paler at c 227.50m; moderately shelly to shelly with bivalves and ammonites preserved in white calcite including *Protocardia, Thracia, Modiolus*, myids, small *Astarte, Pinna, Aul. eulepidus* including small smooth forms; *Dicroloma* plaster at one level and *Dicroloma* in brown calcite scattered throughout: rare fish vertebrae and small thin cidarid spines; pyritised pins and trails common at many levels; some included darker, more muddy bands; tougher and possibly weakly cemented in part; passing down into Mudstone, as above but darker and more silty textured throughout; some tougher bands; same diverse fauna as the above; markedly silty at some levels	3.81	230.34 (end recovery)

Run 41 **230.15 to 234.30m** **Recovered 4.46m (108%)**

	Thickness m	*Depth* m
Mudstone, medium grey, slightly silty with irregular fracture; moderately shelly to shelly with Protocardia, Thracia, Modiolus, small Astarte, Pinna, myids and other bivalves preserved in white calcite; Aul. eulepidus including smooth varieties also present; pyritised pins and trails common in several thin, darker bands; tougher, possibly weakly cemented in part; passing down into	0.55	230.70
Mudstone, as above but darker grey, mostly less silty and smoother textured but with some markedly silty bands and some tougher (?weakly cemented) bands; fauna as bed above	3.91	234.61 (end recovery)

Run 42 **234.30 to 238.53m** **No recovery**

Run 43 **238.53 to 238.53m** **Recovered 4.40m (infinity)**

	Thickness m	*Depth* m
Mudstone, dark grey, becoming smoother textured with depth; shelly and very shelly with *Thracia* abundant at some levels and *Lucina* common, all preserved in white calcite; remaining fauna as bed above with addition of common small *Chlamys;* some small nuculids and bivalves preserved in brown calcite with, banding ; fauna leached to pale brown films at other levels; *Aul. eulepidus* common at some levels	4.40	238.70 (end recovery)

Run 44 **238.53 to 242.53m** **Recovered 4.00m (100%)**

	Thickness m	*Depth* m
Mudstone, dark grey, smooth textured; moderately shelly and shelly throughout with abundant *Aul. eulepidus* and bivalves and some *Aul. mutabilis*, all preserved in pale brown leached calcite; harder shelly bands with many large *Aul. eulepidus* and bivalves together with angular fragments of pyritised filmy *Placunopsis* with common paired bivalves at 239.75 to 239.93 m; passing down into	3.02	241.55

Mudstone, medium grey, more blocky than above and with curved fractures; much less shelly than bed above with common pyritic and brown-film and leached calcite preservations	0.98	242.53 (end recovery)

Run 45 **242.53 to 246.66 m** **Recovered 4.30m (104%)**	*Thickness* m	*Depth* m
Mudstone, medium and dark grey, sooty textured in part, as above; moderately shelly with 50% pyritic preservation and 50% shell preservation; paired pyritised *Thracia* very common; smaller bivalves mostly as calcite films; *Aul. eulepidus, Aul. mutabilis* and *Aul. linealis* present, a few pyritised; several *Gryphaea*	4.30	246.83 (end recovery)

Run 46 **246.66 to 250.96m** **Recovered 2.76m (63%)**	*Thickness* m	*Depth* m
Mudstone, as above with moderate shelly, but less pyritic fauna; dark grey; paired bivalves common; passing down into	0.84	247.50
Mudstone, very dark grey, silty textured; sparse fauna preserved as bleached calcite films; passing down into	0.40	247.90
KC 17		
Mudstone, medium and dark grey, very silty; fauna as bed above, broken and whole; possibly partly weakly cemented; passing down into	0.40	248.30
Mudstone, dark grey, slightly silty; shelly with common bivalves and ammonites, mostly as fragments preserved as brown films or thin calcite; calcitised *Gryphaea* relatively common; irregular fracture due to shell debris	1.12	249.42 (end recovery)

Run 47 **250.96 to 253.72m** **Recovered 0.04m (1%)**	*Thickness* m	Depth m
Mudstone, shelly as above	0.04	251.02 (end recovery)

Run 48 **253.72 to 253.72m** **Recovered 3.95m (infinity)**	*Thickness* m	*Depth* m
KC 16		
Mudstone, dark grey, sooty textured; sparsely and very sparsely shelly with a few shelly and very shelly bands; former mostly bivalves and ammonite in leached calcite-film preservation; shelly bands at 253.72 to 254.00 m and 255.80 to 255.90 m, fauna includes bivalves, *Aul. eulepidus* and *Aul. mutabilis*	3.95	257.67 (end recovery)

Run 49 **253.72 to 257.53m** **Recovered 4.29m (113%)**	*Thickness* m	*Depth* m
Mudstone, dark grey, smooth textured, moderately shelly throughout with calcite-film and leached calcite and some pyritic preservation; small bivalves, *Thracia* and *Aul. eulepidus* occur throughout; *Gulielmites* common; several more shelly bands 0.2 to 0.3m thick; calcitised shears at several levels; *Astarte*, coproliths and several completely crushed *Aul. eulepidus* and *Pinna* in the more barren beds; paler, harder and possibly weakly cemented at 256.55 to 256.70 m; passing down into	3.78	257.50
Mudstone, medium grey, silty; shelly and very shelly with numerous bivalves as whole shells and shell chips; *Nanogyra virgula* (small) common; calcite-film, brown calcite and leached calcite preservation present; many small oysters and large, coarsely ribbed *Aulacostephanus* in dark brown calcite preservation at 257.75 m	0.51	258.01 (end recovery)

Run 50 257.53 to 261.66m Recovered 1.55m (38%)	*Thickness* m	*Depth* m
Mudstone, silty and slightly silty; shelly and very shelly with abundant small *Nanogyra virgula*, other oysters in brown calcite films, thin-shelled bivalves in leached calcite, shell chips; bioturbated throughout	1.55	259.08 (end recovery)

Run 51 261.66 to 261.66m Recovered 2.15m (infinity)	*Thickness* m	*Depth* m
Mudstone, dark grey, less silty and less shelly than above, but with common fauna including *Aul. eulepidus* and *Aul. mutabilis*; fauna as ghosts or leached calcite films; silty textured in part; passing down into	1.14	262.80
Mudstone, less shelly and more silty than above; irregular fracture; shelly in lowest 10 cm with *Lingula*, bivalves and *Aul. eulepidus*	1.01	263.82 (end recovery)

Run 52 261.66 to 265.38m No recovery

Run 53 265.38 to 265.38m Recovered 4.13m (infinity)	*Thickness* m	*Depth* m
KC 15		
Mudstone, dark grey, slightly silty with some more shelly bands; shelly with very shelly and less shelly bands; common bivalves and *Aul. eulepidus* in leached calcite preservation; thin white calcite preservation becomes dominant below 265.80 m; passing down into	1.52	266.90
Mudstone, dark grey, smooth textured, sparsely shelly with common listric surfaces, many with calcite films with 10° to 30° dips; paired bivalves of crushed *Thracia* in white calcite the only common fossil; passing down into	1.30	268.20
Mudstone, as above but markedly shelly with common bivalves and *Aul. eulepidus*; silty in part, markedly so at 268.50 to 268.73 m; *Xenostephanus* at 268.25, 268.70 and 268.83 m	1.31	269.51 (end recovery)

Run 54 265.38 to 269.53m Recovered 3.96m (95%)	*Thickness* m	*Depth* m
KC 12 to 14		
Mudstone, drying to medium and pale grey with curved fractures; dicey weathering in part; moderately shelly with some more shelly bands with fauna mostly of bivalves; common *Thracia*, abundant nuculids, *Chlamys*, several very large, thick-shelled gryphaeid oysters and *Lingula;* a few small ammonite fragments and whole specimens;common small *Dicroloma* at some levels; all fauna preserved in pale and medium brown calcite; *Gulielmites* structures at several levels; calcite-film shears at some levels, notably at 267.10 to 267.13 m with 10° to 20° dips; passing down into	2.32	267.70
Mudstone, dark grey with curved fractures, as above but markedly less shelly; *Gulielmites* abundant; whole and fragmentary ammonites relatively common with some coarse-ribbed possible *Rasenia*; passing down into	1.60	269.30
Mudstone, as above but more calcareous and with abundant nuculids, *Lingula* and other fossils, some as burrow linings; faecal pellets and fish scales common; mostly calcitic but some pyritic preservation; this bed probably forms rhythms of darker, less shelly, more ammonite-rich and paler, more bivalve-rich mudstone with beds above	0.04	269.34 (end recovery)

Run 55 269.53 to 273.53m Recovered 2.68m (67%)	*Thickness* m	*Depth* m
Mudstone, as above for about 0.20 m, then becoming rapidly darker grey, less shelly and in places almost barren; a few thick-shelled oysters; *Rasenia* at 271.00m	2.68	272.21 (end recovery)

Run 56 273.53 to 277.33m Recovered 4.64m (122%)	*Thickness* m	*Depth* m
Mudstone, as above; alternating almost barren and very sparsely shelly with *Lingula* the only common fossil; silty in part, especially in lowest 0.2 m	4.64	278.17 (end recovery)

Run 57 277.33 to 281.53m Recovered 4.25m (101%)	*Thickness* m	*Depth* m
KC 11 Mudstone, as above, mostly almost barren; very friable, dark grey; pale brown cementstone (possible siderite mudstone) at 280.65 to 280.75m with indistinct top and base	4.25	281.58 (end recovery)

Run 58 281.53 to 285.78m Recovered 4.15m (98%)	*Thickness* m	*Depth* m
KC 10 Mudstone, as above, almost barren; a few small curved oysters; passing rapidly down into	2.57	284.10
KC 9 Mudstone, dark grey, very silty; highly bioturbated with burrowfills of pale silt; shelly at 284.23 to 284.28 m; highly bioturbated below this; distinct burrows becoming less obvious below 284.38 m, but with high silt content maintained; several small pale brown phosphatic burrows with black, *Chondrites* infillings; rounded, dense,septarian dogger at 284.67 to 284.71m; shelly with common small *Exogyra* below this and common pale and coffee-coloured phosphatic burrowfills and small nodules; passing down into	0.80	284.90
KC 8 **Black Head Siltstone:** siltstone, medium grey, very muddy; passing down into	0.20	285.10
Mudstone, medium grey very silty	0.58	285.68 (end recovery)

Run 59 285.78 to 290.08m Recovered 4.25m (96%)	*Thickness* m	*Depth* m
KC 7 Mudstone, dark grey, very sparsely shelly; very friable with curved fractures; *Thracia* and local knots of *Exogyra*	4.25	290.03 (end recovery)

Run 60 290.08 to 294.21m Recovered 4.13m (100%)	*Thickness* m	*Depth* m
Mudstone, dark grey, very friable, sparsely fossiliferous, as above; fauna preserved as brown films, mostly bivalves including *Thracia;* nuculids and gastropods also present; *Gulielmites* common; small brown septarian dogger at 290.55 to 290.58 m; tabular bed of sideritic mudstone at 290.74 to 290.81 m; several very large, curved gryphaeid oysters below 292.20 m; a few local concentrations of thick-shelled bivalve chips and serpulids	4.13	294.21 (end recovery)

Run 61 294.21 to 298.33m Recovered 2.54m (62%)	*Thickness* m	*Depth* m
KC 6		
Mudstone, very sparsely shelly and locally almost barren, as above; large curved oysters, *Thracia,* and nuculids preserved in brown calcite in the rare more shelly horizons; *Gulielmites* present	2.54	296.75 (end recovery)

Run 62 298.33 to 300.78m Recovered 4.18m (165%)	*Thickness* m	*Depth* m
Mudstone, sparsely shelly as above with pectinids, *Thracia* and nuculids; medium brown phosphatic pebble (burrowfill?) at 299.23 m; *Exogyra nana* abundant at 299.29 to 299.31 m, 299.36, to 299.43 m, and 299.90 to 300.03 m, all with serpulid knots; passing down into	2.32	300.65
KC 5		
Wyke Siltstone: siltstone, tough probably weakly cemented; *Exogra nana* and serpulids common at some levels; core break at base, probably at bioturbated horizon	0.47	301.12
KC 4		
Mudstone, dark grey, shelly and friable with *Thracia* and pectinids common, as brown calcite films; small, finely ribbed *Pictonia?*; passing down into	0.50	301.62
Mudstone, medium grey, very silty, highly fractured; sparsely and very sparsely shelly	0.89	302.51 (end recovery)

Run 63 300.87 to 305.00 m Recovered 4.20m (102%)	*Thickness* m	*Depth* m
KC 1 to 3		
Mudstone, dark grey, very shelly with abundant oysters and other bivalves; dense and possibly cemented in part	0.18	301.05
Mudstone, dark grey, smooth textured with many *Gulielmites* and listric surfaces; very friable; bivalves common at some levels and pyritised pins common throughout; serpulid-rich layer at 301.57 m; *Deltoideum delta* at 302.45 and 302.56 m; small pale brown phosphatic pebble at 302.64 m; large phosphatised mudstones pebbles (2x3 cm) at 302.74 and 302.86 m; fragments of phosphatised broken hardground at base; highly irregular and highly bioturbated base	1.84	302.88 to.89
RINGSTEAD WAXY CLAY		
Mudstone, pale brown, partly phosphatised at top and making strong colour contrast with bed above; burrowfills of dark grey mudstone extend down from bed above to 303.03 m; becoming more greyish brown with depth, with pale lenticular bands of phosphatised brown clay at several levels down to 303.60 m	2.18	305.07 (end recovery)

Run 64 305.00 to 309.10 m Recovered 4.10m (100%)	*Thickness* m	*Depth* m
Mudstone, pale and medium grey, very smooth textured, very uniform, faintly silty; almost barren with rare small bivalves preserved in brown calcite; very weak traces of bioturbation and lamination at some levels	4.10	309.10 (end recovery)

Run 65 309.10 to 313.20 m Recovered 4.10m (100%)	*Thickness* m	*Depth* m
Mudstone, pale and medium grey, grey uniform, almost barren, as above; a few bands of pale brownish grey mudstone from 5 to 10 cm thick	4.10	313.20 (end recovery)

Run 66 313.20 to 317.33 m No recovery

Run 67 317.33 to 317.33 m Recovered 2.47m (infinity)	Thickness m	Depth m
Mudstone, pale slightly brownish and greenish grey, as above; becoming greyer with depth; pale brown, lenticular-tabular sideritic mudstone bands at 318.52 to 318.54 m, 318.80 to 318.82 m, 318.70 to 318.71 m (up to 1cm-thick lens) and from 318.07 to 318.09 m; barren throughout but with bioturbation and weak lamination at several levels	2.47	319.80 (end recovery)

Run 68 317.33 to 319.00m Recovered 3.66m (219%)	Thickness m	Depth m
Mudstone, faintly greenish grey, barren, smooth textured, as above; passing slowly downwards into more bioturbated mudstone with rare small bivalves; core break at base	1.62	318.95
Mudstone, medium grey, slightly silty becoming steadily more silty with depth; bioturbation increasing with depth; sparse shell content, mostly small nuculids, *Pinna, Chlamys* and *Microbiplices*, in brown-film and calcite-shell preservations, becoming more common with depth; *Microbiplices* at 320.20 m, 320.25 and 320.35 m; whole, very well preserved *Chlamys* at 320.20 and 320.30 m; passing down into	1.55	320.50
Siltstone, medium grey, muddy, highly bioturbated; fauna as above with *Pinna*, *Chlamys*, nuculids and small oysters; pyritised trials and pins common; irregular passage down into	0.18	320.67 to 68
Siltstone, pale grey, very shelly with small, pale brown phosphatised pebbles and burrows and angular shell chips; resting on irregular burrowed surface	0.03	320.71
SANDSFOOT CLAY		
Mudstone, slightly greenish grey; very shelly with *Thracia* crushed and in life position, common *Chlamys* and numerous large curved serpulids; five, regularly spaced bands up to 5mm thick crowded with serpulids and shell debris	0.28	320.99 (end recovery)
Final depth		320.99

APPENDIX 4. Core runs, core recoveries, box numbers and stratigraphical marker bands.

Swanworth Quarry No.1 Borehole: depths are *driller's depths* as defined in Section 2.3

Date	Run No.	Run depths		Length Drilled	Recovered	Recovery as % age	Box No.	Comments:selected marker bands
		From	To					
15/12/96	1	0.00	1.00	1.00	0.93	93	bag	
	2	1.00	2.51	1.51	1.20	79	1	
	3	2.51	4.99	2.48	2.45	99	2	
16/12/96	4	4.99	6.70	1.71	1.85	108	3	
	5	6.70	9.20	2.50	2.51	100	4	
	6	9.20	11.70	2.50	2.68	107	5	
	7	11.70	14.20	2.50	2.47	98	6	water strike @ 14.20
	8	14.20	16.70	2.50	2.44	97	7	
	9	16.70	19.20	2.50	2.67	106	8	
	10	19.20	21.70	2.50	2.58	103	9	
	11	21.70	24.20	2.50	1.89	76	10	
17/12/96	12	24.20	26.70	2.50	2.76	110	11	
	13	26.70	29.20	2.50	2.76	110	12	
	14	29.20	31.70	2.50	2.48	99	13	
	15	31.70	34.20	2.50	2.51	100	14	
Subtotal	**1 to 15**	**0.00**	**34.20**	**34.20**	**34.18**	**100**		
15/1/97	16	34.20	35.89	1.69	0.70	41	15	
	17	35.89	36.96	1.07	1.98	185	16	root core
16/1/97	18	36.96	39.41	2.45	2.17	89	17	
	19	39.41	41.91	2.50	2.45	98	18	**Massive Bed**
	20	41.91	44.41	2.50	2.49	99	19	
	21	44.41	46.91	2.50	2.78	111	20	root core?
	22	46.91	49.41	2.50	2.43	97	21	
	23	49.41	51.91	2.50	2.55	102	22	
17/1/97	24	51.91	54.41	2.50	1.20	48	23	slipped core
	25	54.41	55.91	1.50	0.00	0	-	slipped core
	26	55.91	55.91	0.00	2.71	inf.	24	retrieved core: root core
	27	55.91	58.41	2.50	2.02	81	25	
Subtotal	**16 to 27**	**34.20**	**58.41**	**24.21**	**23.48**	**97**		
20/1/97	28	58.41	60.71	2.30	1.74	76	26	
	29	60.71	63.21	2.50	2.48	99	27	
	30	63.21	65.71	2.50	1.88	75	28	
21/1/97	31	65.71	68.00	2.29	2.70	118	29	
	32	68.00	70.50	2.50	2.25	90	30	
	33	70.50	73.00	2.50	2.97	119	31	
	34	73.00	75.50	2.50	2.29	92	32	
	35	75.50	78.00	2.50	2.02	81	33	
22/1/97	36	78.00	80.41	2.41	3.07	127	34	
	37	80.41	83.05	2.64	2.61	99	35	
	38	83.05	85.55	2.50	2.28	91	36	
	39	85.55	88.05	2.50	1.70	68	37	
	40	88.05	90.05	2.00	2.56	128	38	
Subtotal	**28 to 40**	**58.41**	**90.05**	**31.64**	**30.55**	**97**		
	41	90.05	92.55	2.50	2.92	117	39	
	42	92.55	95.13	2.58	2.58	100	40	
	43	95.13	97.67	2.54	2.31	91	41	
23/1/97	44	97.67	100.09	2.42	2.79	115	42	
	45	100.09	102.64	2.55	0.00	0	-	slipped core
	46	102.64	102.88	0.24	2.72	1133	43	
	47	102.88	105.38	2.50	2.14	86	44	
	48	105.38	107.88	2.50	0.78	31	45	
	49	107.88	108.46	0.58	2.16	372	46	
	50	108.46	110.63	2.17	2.80	129	47	
Subtotal	**41 to 50**	**90.05**	**110.63**	**20.58**	**21.20**	**103**		
Subtotal	**1 to 50**	**0.00**	**110.63**	**110.63**	**109.41**	**99**		

Date	Run No.	Run depths		Length Drilled	Recovered	Recovery as % age	Box No.	Comments:selected *marker bands*
	51	110.63	113.46	2.83	2.79	96	48	
	52	113.46	116.49	3.03	0.00	0	-	slipped core
	53	113.46	116.49	0.00	0.00	0	-	*retrieval run*
	54	113.46	116.49	0.00	0.00	0	-	retrieval run
24/1/97	55	113.46	116.49	0.00	2.81	inf.	49	retrieved core
	56	116.49	119.02	2.53	2.32	92	50	
	57	119.02	121.52	2.50	2.52	101	51	
	58	121.52	124.02	2.50	2.80	112	52	**Blake's Bed 2**
	59	124.02	126.52	2.50	0.14	6	53	
	60	126.52	126.80	0.28	0.00	0	-	slipped core
Subtotal	**51 to 60**	**110.63**	**126.80**	**16.17**	**13.38**	**83**		
	61	126.80	127.24	0.44	3.03	689	54	
25/1/97	62	127.24	129.74	2.50	2.51	100	55	
	63	129.74	132.34	2.60	2.58	99	56	
	64	132.34	134.84	2.50	0.00	0	-	slipped core
	65	134.84	135.00	0.16	1.11	694	57	box incorrectly labelled 134.74m
	66	135.00	136.00	1.00	2.62	262	58	
	67	136.00	138.50	2.50	2.51	100	59	
	68	138.50	141.00	2.50	0.00	0	-	*slipped core*
26/1/97	69	141.00	141.30	0.30	0.00	0	-	slipped core
	70	141.30	141.53	0.23	2.41	1048	60	
Subtotal	**61 to 70**	**126.80**	**141.53**	**14.73**	**16.77**	**114**		
	71	141.53	143.73	2.20	2.82	128	61	
	72	143.73	146.39	2.66	2.73	103	62	
	73	146.39	148.89	2.50	2.56	102	63	**Encombe Stone Band**
	74	148.89	151.39	2.50	2.49	100	64	box incorrectly labelled 150.39m
	75	151.39	153.89	2.50	2.53	101	65	
	76	153.89	156.39	2.50	0.00	0	-	dropped barrel
27/1/97	77	156.39	156.39	0.00	2.37	inf.	66	retrieved barrel
	78	156.39	158.89	2.50	0.14	6	67	
	79	158.89	159.25	0.36	0.00	0	-	slipped core
	80	159.25	159.41	0.16	3.06	1913	67	
Subtotal	**71 to 80**	**141.53**	**159.41**	**17.88**	**18.70**	**105**		
	81	159.41	161.91	2.50	1.37	55	68	
	82	161.91	163.41	1.50	2.55	170	69	
	83	163.41	165.91	2.50	2.17	87	70	
	84	165.91	168.41	2.50	2.52	101	71	
	85	168.41	170.91	2.50	1.37	55	72	
28/1/97	86	170.91	172.51	1.60	2.96	185	73	
	87	172.51	175.01	2.50	0.75	30	74	
	88	175.01	175.87	0.86	2.59	301	75	
	89	175.87	178.37	2.50	2.55	102	76	**Freshwater Steps Stone Band**
	90	178.37	180.87	2.50	0.21	8	76	**Freshwater Steps Stone Band**
Subtotal	**81 to 90**	**159.41**	**180.87**	**21.46**	**19.04**	**89**		
	91	180.87	181.22	0.35	2.66	760	77	
	92	181.22	183.83	2.61	2.61	100	78	
29/1/97	93	183.83	185.69	1.86	0.86	46	79	dropped rods + barrel; successfully fished
30/1/97	94	185.69	187.11	1.42	2.05	144	80	
	95	187.11	189.61	2.50	1.40	56	81	**Middle White Stone Band**
	96	189.61	190.11	0.50	1.58	316	81	
	97	190.11	192.61	2.50	2.37	95	82	
31/1/97	98	192.61	195.46	2.85	0.00	0	-	slipped core
	99	195.46	195.46	0.00	3.05	inf.	83	retrieved core
	100	195.46	197.96	2.50	2.53	101	84	***White Stone Band***
Subtotal	**91 to 100**	**180.87**	**197.96**	**17.09**	**19.11**	**112**		
Subtotal	**1 to 100**	**0.00**	**197.96**	**197.96**	**196.41**	**99**		
	101	197.96	200.53	2.57	1.96	76	85	
	102	200.53	202.97	2.44	2.03	83	86	
	103	202.97	204.97	2.00	2.69	135	87	
	104	204.97	207.50	2.53	0.88	35	88	

Date	Run No.	Run depths		Length Drilled	Recovered	Recovery as % age	Box No.	Comments:selected marker bands
	105	207.50	209.92	2.42	4.42	183	88 & 89	cementstone
1/2/97	106	209.92	213.92	4.00	4.07	102	90 & 91	
	107	213.92	217.92	4.00	4.06	102	91 & 92	**Basalt Stone Band**
	108	217.92	220.42	2.50	2.51	100	93	
	109	220.42	222.92	2.50	0.00	0	-	slipped core
2/2/97	110	222.92	224.42	1.50	3.52	235	94 & 95	
Subtotal	**101 to 110**	**197.96**	**224.42**	**26.46**	**26.14**	**99**		
	111	224.42	228.13	3.71	4.04	109	95 & 96	
	112	228.13	231.98	3.85	3.83	100	97 & 98	root core
	113	231.98	235.98	4.00	4.00	100	99	
3/2/97	114	235.98	240.13	4.15	3.93	95	100 & 101	**Rope Lake Head Stone Band**
	115	240.13	244.24	4.11	3.74	91	101 & 102	**Blackstone**
	116	244.24	247.78	3.54	1.58	45	103	
	117	247.78	249.46	1.68	2.59	154	104	
4/2/97	118	249.46	251.92	2.46	2.86	116	105	
	119	251.92	255.43	3.51	2.86	81	106	
	120	255.43	258.22	2.79	3.13	112	107	
Subtotal	**111 to 120**	**224.42**	**258.22**	**33.80**	**32.56**	**96**		
	121	258.22	261.45	3.23	4.17	129	108 & 109	**Grey Ledge Stone Band**
5/2/97	122	261.45	264.93	3.48	3.48	100	110 & 111	**Southard Stone Band**
6/2/97	123	264.93	268.93	4.00	3.36	84	112	
	124	268.93	272.67	3.74	0.86	23	113	
7/2/97	125	272.67	272.87	0.20	3.76	1880	113 & 114	**Cattle Ledge Stone Band**
	126	272.87	276.80	3.93	0.00	0	-	slipped core
	127	276.80	276.80	0	3.89	inf.	115 & 116	retrieved core
	128	276.80	280.80	4.00	3.90	98	116 & 117	
11/2/97	129	280.80	284.07	3.27	1.87	57	118	
	130	284.07	286.00	1.93	1.61	83	119	
Subtotal	**121 to 130**	**258.22**	**286.00**	**27.78**	**26.90**	**97**		
	131	286.00	288.00	2.00	3.58	179	119 & 120	**Yellow Ledge Stone Band**
12/2/97	132	288.00	292.00	4.00	3.88	97	121 & 122	
	133	292.00	296.00	4.00	3.63	91	122	
	134	296.00	299.50	3.50	0.89	25	123 & 124	
	135	299.50	300.50	1.00	0.84	84	124	
13/2/97	136	300.50	301.28	0.78	4.49	575	125 & 126	
	137	301.28	305.35	4.07	4.10	101	126 & 127	
	138	305.35	309.35	4.00	4.00	100	128 & 129	
	139	309.35	310.35	1.00	1.21	121	129	
14/2/97	140	310.35	313.35	3.00	1.43	48	130	
Subtotal	**131 to 140**	**286.00**	**313.35**	**27.35**	**28.05**	**103**		
	141	313.35	316.39	3.04	1.70	56	130 & 131	
	142	316.39	318.02	1.63	4.40	270	131 & 132	root core
	143	318.02	319.75	1.73	1.54	89	133	
	144	319.75	323.50	3.75	3.45	92	133 & 134	
15/2/97	145	323.50	327.50	4.00	4.34	109	135 & 136	
	146	327.50	331.50	4.00	3.67	92	136 & 137	**Maple Ledge Stone Band**
	147	331.50	335.15	3.65	4.04	111	138	
16/2/97	148	335.15	339.15	4.00	0.33	08	138 & 139	
	149	339.15	339.50	0.35	4.17	1191	140 & 141	root core?
	150	339.50	343.50	4.00	3.85	96	141 & 142	
Subtotal	**141 to 150**	**313.35**	**343.50**	**30.15**	**31.49**	**104**		
Subtotal	**1 to 150**	**0.00**	**343.50**	**343.50**	**341.55**	**99**		
	151	343.50	347.50	4.00	3.74	94	143 & 144	
17/2/97	152	347.50	351.50	4.00	2.01	50	144 & 145	
	153	351.50	353.50	2.00	4.53	227	145 & 146	
	154	253.50	357.50	4.00	4.01	100	147 & 148	
18/2/97	155	357.50	361.62	4.12	4.12	100	148 & 149	
	156	361.62	365.50	3.88	3.15	81	150	
21/2/97	157	365.50	369.00	3.50	3.92	112	151 & 152	**The Flats Stone Band**
	158	369.00	373.00	4.00	4.33	108	152 & 153	

Date	Run No.	Run depths		Length Drilled	Recovered	Recovery as % age	Box No.	Comments:selected marker bands
	159	373.00	377.00	4.00	1.83	46	154	
	160	377.00	379.07	2.07	3.85	186	155 & 156	
Subtotal	**151 to 160**	**343.50**	**379.07**	**35.57**	**35.49**	**100**		
22/2/97	161	379.07	383.07	4.00	4.40	110	156 & 157	**Hobarrow Bay Stone Band**
	162	383.07	387.07	4.00	1.28	32	158	
	163	387.07	388.37	1.30	4.23	325	158 & 159	
	164	388.37	392.65	4.28	4.26	100	160 & 161	
23/2/97	165	392.65	396.77	4.12	0.00	0	-	slipped core
	166	396.77	397.15	0.38	0.00	0	-	slipped core
	167	397.15	397.15	0.00	4.37	inf.	161 & 162	retrieved core
	168	397.15	399.15	2.00	0.00	0		slipped core
	169	399.15	401.15	2.00	3.73	187	163 & 164	**Swanworth *D* Stone Band**
24/2/97	170	401.15	405.15	4.00	3.83	96	164 & 165	Box 164 incorrectly labelled 399.65m
Subtotal	**161 to 170**	**379.07**	**405.15**	**26.08**	**26.10**	**100**		
	171	405.15	407.05	1.90	2.42	131	166	
	172	407.05	411.17	4.12	4.19	102	167 & 168	**Swanworth *C* Stone Band**
	173	411.17	415.15	3.98	0.84	21	168	
	174	415.15	416.15	1.00	3.32	332	169 & 170	
	175	416.15	419.65	3.50	4.21	120	170 & 171	
26/2/97	176	419.65	423.65	4.00	3.18	80	172 & 173	**Swanworth *B* Stone Band**
	177	423.65	426.85	3.20	1.77	55	173 & 174	
	178	426.85	428.62	1.77	0.00	0	-	slipped core
	179	428.62	428.62	0.00	4.20	inf.	174 & 175	retrieved core
27/2/97	180	428.62	432.62	4.00	0.11	03	176	
Subtotal	**171 to 180**	**405.15**	**432.62**	**27.47**	**24.24**	**88**		
	181	432.62	432.62	0.00	3.95	inf.	176 & 177	retrieved core
	182	432.62	436.67	4.05	4.11	102	177 & 178	
	183	436.67	440.52	3.85	3.95	103	179 & 180	
28/2/97	184	440.52	444.59	4.07	4.12	101	180 & 181	**Swanworth *A* Stone Band**
	185	444.59	448.60	4.01	3.65	91	182 & 183	
3/3/97	186	448.60	452.52	3.92	0.65	17	183	
4/3/97	187	452.52	452.72	0.20	0.50	250	183	
	188	452.72	453.21	0.49	0.59	120	183	
	189	453.21	453.71	0.50	4.06	812	184 & 185	
	190	453.71	457.76	4.05	0.00	0	-	
Subtotal	**181 to 190**	**432.62**	**457.76**	**25.14**	**25.58**	**102**		
5/3/97	191	457.76	457.96	0.20	4.05	2025	185 & 186	
	192	457.96	461.96	4.00	1.62	41	187	
	193	461.96	463.46	1.50	3.16	211	187 & 188	
	194	463.46	466.71	3.25	0.00	0	-	slipped core
	195	466.71	466.71	0.00	3.74	inf.	189 & 190	retrieved core
7/3/97	196	466.71	470.51	3.80	1.60	42	190	
	197	470.51	472.51	2.00	2.40	120	191	
8/3/97	198	472.51	475.01	2.50	1.44	58	192	
	199	475.01	476.51	1.50	2.57	171	192 & 193	
	200	476.51	479.01	2.50	0.00	0	-	slipped core
Subtotal	**191 to 200**	**457.76**	**479.01**	**21.25**	**20.58**	**97**		
	201	479.01	479.01	0.00	3.95	inf.	193 & 194	retrieved core
9/3/97	202	479.07	483.01	4.00	3.70	93	195 & 196	**North Wootton Siltstone**
	203	483.01	487.01	4.00	2.01	50	196	
	204	487.01	488.91	1.90	4.21	222	197 & 198	**Metherhills Stone Band**
	205	488.91	493.01	4.10	4.26	104	198 & 199	
10/3/97	206	493.01	497.13	4.12	4.18	102	200 & 201	
	207	497.13	501.21	4.08	4.19	103	201 & 202	
	208	501.21	505.21	4.00	3.93	98	203 & 204	
Subtotal	**1 to 208**	**0.00**	**505.21**	**505.21**	**503.97**	**100**		
Total depth		**505.21**						

Swanworth Quarry No. 2 Borehole: depths are *driller's depths* as defined in Section 2.3

Date	Run No.	Run depths		Length Drilled	Recovered	Recovery as % age	Box No.	Comments: selected marker bands
		From	To					
21/3/97	1	0.00	2.05	2.05	0.90	44	1	lost recovery in gravel hardcore
	2	2.05	3.43	1.38	1.10	80	1	
	3	3.43	4.88	1.45	1.35	93	2	
	4	4.88	6.37	1.49	0.89	60	2	
	5	6.37	9.55	3.18	3.23	102	3 & 4	
	6	9.55	9.85	0.30	0.32	107	4	
	7	9.85	11.17	1.32	1.24	94	4	
22/3/97	8	11.17	14.05	2.88	3.09	107	5	
	9	14.05	18.55	4.50	4.23	94	6 & 7	
	10	18.55	22.60	4.05	4.07	101	7 & 8	
Subtotal	**1 to 10**	**0.00**	**22.60**	**22.60**	**20.42**	**90**		
	11	22.60	25.00	2.40	1.81	75	9	
25/3/97	12	25.00	28.74	3.74	3.72	100	10 & 11	
	13	28.74	32.72	3.98	3.95	99	11 & 12	
	14	32.72	35.77	3.05	2.95	97	13	
	15	35.77	39.81	4.04	4.20	104	14 & 15	
	16	39.81	43.81	4.00	3.99	100	15 & 16	**Massive Bed**
	17	43.81	47.91	4.10	3.58	89	17 & 18	
	18	47.91	50.84	2.93	3.21	110	18 & 19	
26/3/97	19	50.84	54.94	4.10	4.36	106	19 & 20	
	20	54.94	59.04	4.10	3.95	96	21 & 22	
Subtotal	**11 to 20**	**22.60**	**59.04**	**36.44**	**35.72**	**98**		
	21	59.04	63.11	4.07	3.62	89	22 & 23	
	22	63.11	64.67	1.56	1.60	103	24	
2/4/97	23	64.67	67.11	2.44	2.73	112	24 & 25	
	24	67.11	71.16	4.05	4.07	101	25 & 26	
3/4/97	25	71.16	75.13	3.97	4.02	101	27 & 28	
	26	75.13	79.63	4.50	4.38	97	28 & 29	
	27	79.63	83.45	3.82	3.91	102	30 & 31	
	28	83.45	87.58	4.13	4.11	100	31 & 32	
4/4/97	29	87.58	91.47	3.89	4.08	105	33 & 34	root core?
	30	91.47	95.73	4.26	3.96	93	34 & 35	root core
Subtotal	**21 to 30**	**59.04**	**95.73**	**36.69**	**36.48**	**99**		
	31	95.73	99.73	4.00	3.87	97	36 & 37	
5/4/97	32	99.73	103.69	3.96	3.98	101	37 & 38	
	33	103.69	107.45	3.76	3.79	101	39 & 40	
	34	107.45	111.45	4.00	0.00	0	40	slipped core
	35	111.45	111.45	0.00	4.05	inf.	40 & 41	retrieved core
	36	111.45	114.95	3.50	3.54	101	42 & 43	
	37	114.95	119.04	4.09	4.10	100	43 & 44	
	38	119.04	123.25	4.21	4.31	102	45 & 46	**Blake's Bed 2**
7/4/97	39	123.25	127.27	4.02	4.07	101	46 & 47	
	40	127.27	131.20	3.93	3.61	92	48 & 49	
Subtotal	**31 to 40**	**95.73**	**131.20**	**35.47**	**35.32**	**99**		
	41	131.20	135.20	4.00	3.87	97	49 & 50	cementstone
8/4/97	42	135.20	138.85	3.65	4.11	112	50 & 51	
	43	138.85	142.92	4.07	0.00	0	52	slipped core
	44	142.92	142.92	0.00	3.95	inf.	52 & 53	retrieved core
	45	142.92	146.92	4.00	0.30	08	54	
	46	146.92	147.27	0.35	4.20	1200	54 & 55	
9/4/97	47	147.27	151.36	4.09	4.20	103	55 & 56	**Encombe Stone Band**
	48	151.36	155.49	4.13	4.09	99	57 & 58	
	49	155.49	159.49	4.00	4.00	100	58 & 59	
	50	159.49	163.50	4.01	3.31	83	60 & 61	
Subtotal	**41 to 50**	**131.20**	**163.50**	**32.30**	**32.03**	**99**		
Subtotal	**1 to 50**	**0.00**	**163.50**	**163.50**	**159.97**	**98**		

Date	Run No.	Run depths		Length Drilled	Recovered	Recovery as % age	Box No.	Comments: selected marker bands
		From	To					
10/4/97	51	163.50	167.19	3.69	4.48	121	61&62	
	52	167.19	171.29	4.10	4.01	98	63 & 64	
	53	171.29	175.29	4.00	4.18	105	64 & 65	
11/4/97	54	175.29	179.49	4.20	4.28	102	66 & 67	
	55	179.49	183.59	4.10	3.81	93	67 & 68	**Freshwater Steps Stone Band**
	56	183.59	187.69	4.10	4.41	108	69 & 70	
	57	187.69	191.79	4.10	3.80	93	70 & 71	**Middle White Stone Band**
12/4/97	58	191.79	195.69	3.90	4.45	114	72 & 73	
	59	195.69	199.85	4.16	4.07	98	73 & 74	**White Stone Band**
	60	199.85	203.89	4.04	4.02	100	75 & 76	
Subtotal	**51 to 60**	**163.50**	**203.89**	**40.39**	**41.51**	**103**		
	61	203.89	207.89	4.00	4.14	104	76 & 77	
13/4/97	62	207.89	212.03	4.14	4.14	100	79 & 79	
	63	212.03	216.16	4.13	4.17	101	79 & 80	**Basalt Stone Band**
	64	216.16	220.29	4.13	4.11	100	81 & 82	
	65	220.29	224.29	4.00	3.42	86	82 & 83	
	66	224.29	228.00	3.71	4.33	117	84 & 85	
15/4/97	67	228.00	232.03	4.03	4.11	102	85 & 86	
16/4/97	68	232.03	236.06	4.03	3.59	89	87 & 88	
	69	236.06	240.06	4.00	4.19	105	88 & 89	**Rope Lake Head Stone Band**
	70	240.06	244.06	4.00	4.28	107	90 & 91	
Subtotal	**61 to 70**	**203.89**	**244.06**	**40.17**	**40.38**	**101**		
	71	244.06	248.06	4.00	3.61	90	91 & 92	
	72	248.06	252.07	4.01	4.47	112	93 & 94	
17/4/97	73	252.07	256.15	4.08	4.13	101	94 & 95	
	74	256.15	260.04	3.89	3.48	90	96 & 97	
	75	260.04	263.86	3.82	4.25	113	97 & 98	**Grey Ledge Stone Band: root core**
	76	263.86	268.14	4.28	0.00	0	99	slipped core
18/4/97	77	268.14	268.14	0.00	3.61	inf.	99 & 100	retrieved core
21/4/97	78	268.14	271.94	3.80	4.55	120	100 & 101	root core
	79	271.94	276.09	4.15	2.03	49	102	**Cattle Ledge Stone Band**
22/4/97	80	276.09	278.36	2.27	3.97	175	103 & 104	
Subtotal	**71 to 80**	**244.06**	**278.36**	**34.30**	**34.10**	**99**		
	81	278.36	282.44	4.08	3.98	98	104 & 105	
	82	282.44	286.41	3.97	3.64	92	106 & 107	
23/4/97	83	286.41	290.00	3.59	4.19	117	107 & 108	**Yellow Ledge Stone Band**
	84	290.00	294.00	4.00	0.78	20	109	
	85	294.00	294.79	0.79	2.55	323	109 & 110	
	86	294.79	297.34	2.55	4.49	176	110 & 111	
	87	297.34	301.28	3.94	3.76	95	112 & 113	
24/4/97	88	301.28	305.18	3.90	3.45	88	113 & 114	
	89	305.18	308.98	3.80	3.62	95	115 & 116	
	90	308.98	312.68	3.70	1.06	29	116	
Subtotal	**81 to 90**	**278.36**	**312.68**	**34.32**	**31.52**	**92**		
	91	312.68	313.98	1.30	4.32	332	116 & 117	
25/4/97	92	313.98	317.88	3.90	3.15	81	118	
	93	317.88	321.08	3.20	3.79	118	119 & 120	
	94	321.08	324.98	3.90	3.49	90	120 & 121	
	95	324.98	328.42	3.44	0.00	0	121	slipped core
26/4/97	96	328.42	328.42	0.00	3.93	inf.	121 & 122	retrieved core
	97	328.42	332.32	3.90	0.74	19	123	**Maple Ledge Stone Band**
	98	332.32	333.08	0.76	4.17	549	123 & 124	
	99	333.08	337.18	4.10	4.09	100	125 & 126	
	100	337.18	341.18	4.00	4.25	106	126 & 127	
Subtotal	**91 to 100**	**312.68**	**341.18**	**28.50**	**31.93**	**112**		
Subtotal	**1 to 100**	**0.00**	**341.18**	**341.18**	**339.41**	**99**		
27/4/97	101	341.18	345.31	4.13	4.01	97	128 & 129	
	102	345.31	349.31	4.00	4.12	103	129 & 130	
	103	349.31	353.31	4.00	4.08	102	131 & 132	

Date	Run No.	Run depths		Length Drilled	Recovered	Recovery as % age	Box No.	Comments: selected marker bands
		From	To					
	104	353.31	357.42	4.11	4.14	101	132 & 133	
28/4/97	105	357.42	360.00	2.58	2.74	106	134	
	106	360.00	364.00	4.00	3.63	91	135 & 136	
	107	364.00	367.88	3.88	3.97	102	136 & 137	**The Flats Stone Band**
	108	367.88	371.93	4.05	3.48	86	137 & 138	
29/4/97	109	371.93	375.43	3.50	2.70	77	138 & 139	
	110	375.43	278.11	2.68	4.13	154	139 & 140	
Subtotal	**101 to 110**	**341.18**	**378.11**	**36.93**	**37.00**	**100**		
	111	378.11	382.08	3.97	3.66	92	141 & 142	**Hobarrow Bay Stone Band**
30/4/97	112	382.08	385.78	2.70	2.48	67	142	
	113	385.78	388.30	2.52	2.00	79	143	
Subtotal	**1 to 113**	**0.00**	**388.30**	**388.30**	**384.55**	**99**		3.75m loss includes 1.15m hardcore
Total depth		**388.30**						

Metherhills No. 1 Borehole: depths are *driller's depths* as defined in Section 2.3

Date	Run No.	Run depths		Length Drilled	Recovered	Recovery as % age	Box No.	Comments: selected marker bands
		From	To					
13/5/97	1	90.00	94.15	4.15	3.41	82	1&2	
14/5/97	2	94.15	97.65	3.50	2.44	70	2&3	**Nanno. Cementstone**
	3	97.65	100.10	2.45	4.28	175	3&4	
	4	100.10	104.53	4.43	4.34	98	5&6	
15/5/97	5	104.53	108.69	4.16	3.14	75	6&7	
	6	108.69	111.90	3.21	3.29	103	8&9	
	7	111.90	115.22	3.32	4.44	134	9&10	
	8	115.22	119.53	4.31	4.38	102	11&12	
16/5/97	9	119.53	123.67	4.14	4.08	99	12&13	**Swanworth *D* Stone Band**
	10	123.67	128.03	4.36	4.37	100	14&15	
Subtotal	**1 to 10**	**90.00**	**128.03**	**38.03**	**38.17**	**100**		
17/5/97	11	128.03	132.33	4.30	4.40	102	15&16	**Swanworth *C* Stone Band**
	12	132.33	136.63	4.30	4.34	101	17&18	
	13	136.63	140.53	3.90	3.94	101	18&19	
	14	140.53	144.69	4.16	3.22	77	20&21	**Swanworth *B* Stone Band**
18/5/97	15	144.69	148.31	3.62	4.46	123	21&22	
	16	148.31	152.53	4.22	4.38	104	23&24	
	17	152.53	156.83	4.30	4.21	98	24&25	
	18	156.83	160.93	4.10	0.00	0		slipped core
19/5/97	19	160.93	160.93	0.00	4.34	inf.	26&27	retrieved core
	20	160.93	165.23	4.30	3.68	86	27&28	**Swanworth *A* Stone Band**
Subtotal	**11 to 20**	**128.03**	**165.23**	**37.20**	**36.97**	**99**		
	21	165.23	169.03	3.80	4.47	118	29&30	
	22	169.03	173.33	4.30	4.34	101	30&31	
	23	173.33	177.46	4.13	3.03	73	32&33	
20/5/97	24	177.46	180.42	2.96	4.05	137	33&34	
	25	180.42	184.73	4.31	4.14	96	34&35	
	26	184.73	189.03	4.30	4.43	103	36&37	
21/5/97	27	189.03	193.03	4.00	3.88	97	37&38	
	28	193.03	197.23	4.20	3.95	94	39&40	
	29	197.23	197.58	0.35	0.91	260	40	
21/5/97	30	197.58	201.58	4.00	3.77	94	41&42	
Subtotal	**21 to 30**	**165.23**	**201.58**	**36.35**	**36.97**	**102**		
22/5/97	31	201.58	205.67	4.09	4.54	111	42&43	North Wootton Siltstone
	32	205.67	210.00	4.33	0.00	0	-	slipped core
	33	210.00	210.00	0.00	4.42	inf.	44&45	retrieved core
	34	210.00	214.27	4.27	0.00	0	-	slipped core

Date	Run No.	Run depths		Length Drilled	Recovered	Recovery as % age	Box No.	Comments: selected marker bands
		From	To					
	35	214.27	214.27	0.00	4.27	inf.	45&46	**Metherhills Stone Band**
	36	214.27	218.35	4.08	0.00	0	-	slipped core
	37	218.35	218.35	0.00	4.10	inf.	47&48	retrieved core
27/5/97	38	218.35	222.51	4.16	4.04	97	48&49	
28/5/97	39	222.51	226.53	4.02	3.62	90	50&51	
	40	226.53	230.15	3.62	3.81	105	51&52	
Subtotal	**31 to 40**	**201.58**	**230.15**	**28.57**	**28.80**	**101**		
	41	230.15	234.30	4.15	4.46	108	53&54	
29/5/97	42	234.30	238.53	4.23	0.00	0	-	slipped core
	43	238.53	238.53	0.00	4.40	inf.	54&55	retrieved core
	44	238.53	242.53	4.00	4.00	100	56&57	
	45	242.53	246.66	4.13	4.30	104	57&58	
30/5/97	46	246.66	250.96	4.30	2.76	63	59	
	47	250.96	253.72	2.76	0.04	2	60	slipped core
	48	253.72	253.72	0.00	3.95	inf.	60&61	retrieved core
	49	253.72	257.53	3.81	4.29	113	61&62	
	50	257.53	261.66	4.13	1.55	38	63	
Subtotal	**41 to 50**	**230.15**	**261.66**	**31.51**	**29.75**	**94**		
Subtotal	**1 to 50**	**90.00**	**261.66**	**171.66**	**170.66**	**99**		
31/5/97	51	261.66	261.66	0.00	2.15	inf.	63&64	retrieved core
	52	261.66	265.38	3.72	0.00	0	-	slipped core
	53	265.38	265.38	0.00	4.13	inf.	64&65	retrieved core
	54	265.38	269.53	4.15	3.96	95	66&67	
	55	269.53	273.53	4.00	2.68	67	67&68	
1/6/97	56	273.53	277.33	3.80	4.64	122	69&70	
	57	277.33	281.53	4.20	4.25	101	70&71	cementstone
	58	281.53	285.78	4.25	4.15	98	72&73	cementstone
	59	285.78	290.08	4.45	4.25	96	73&74	
2/6/97	60	290.08	294.21	4.13	4.13	100	75&76	
Subtotal	**51 to 60**	**261.66**	**294.21**	**32.55**	**34.34**	**105**		
	61	294.21	298.33	4.12	2.54	62	76&77	
	62	298.33	300.87	2.54	4.18	165	77&78	**Wyke Siltstone**
	63	300.87	305.00	4.13	4.20	102	79&80	**base Kimmeridge Clay**
3/6/97	64	305.00	309.10	4.10	4.10	100	80&81	
	65	309.10	313.20	4.10	4.10	100	82&83	
	66	313.20	317.33	4.13	0.00	0	-	slipped core
4/6/97	67	317.33	317.33	0.00	2.47	inf.	83&84	retrieved core
	68	317.33	319.00	1.67	3.66	219	84&85	**base Ringstead Waxy Clay**
Subtotal	**1 to 68**	**90.00**	**319.00**	**229.00**	**230.25**	**101**		
Total depth		**319.00**						

APPENDIX 5. Lists of photographs of cores.

Note: depths are *driller's depths* as defined in Section 2.3

Swanworth Quarry No. 1

Film Number	Drilling Runs	Depths (m)	
		From	To
1	1 to 15	0.00	34.20
2	16 to 21	32.40	46.91
3	22 to 41	46.91	92.55
4	42 to 61	92.55	127.24
5	62 to 85	127.24	170.91
6	85 to 105	168.41	209.92
7	106 to 119	209.92	255.43
8	120 to 133	255.43	296.00
9	134 to 148	296.00	339.15
10	149 to 159	339.15	377.00
11	160 to 175	377.00	419.55
12	176 to 191	419.55	457.96
13	191 to 207	457.96	501.21
14	208	501.21	505.21

Swanworth Quarry No. 2

Film Number	Drilling Runs	Depths (m)	
		From	To
1	1 to 18	0.00	49.91
2	18 to 20	50.84	95.73
3	31 to 38	95.73	119.04
4	38 to 48	123.25	151.36
5	48 to 55	155.49	183.89
6	56 to 67	185.59	228.00
7	67 to 80	232.03	276.09
8	80 to 93	276.09	317.88
9	93 to 107	321.08	364.00
10	108 to 113	367.88	388.30

Metherhills No. 1

Film Number	Drilling Runs	Depths (m)	
		From	To
1	1 to 12	90.00	132.33
2	12 to 25	136.63	180.42
3	25 to 40	184.73	230.15
4	41 to 53	230.15	265.38
5	54 to 62	265.38	298.33
6	63 to 68	300.87	319.00

APPENDIX 6. Wellog plots at 1:500 scale.

The attached folder contains the following:

Swanworth Quarry No. 1 Borehole: 1:500-scale graphical plot showing lithologies, biostratigraphical zonation, chronostratigraphical classification and caliper, total gamma-ray, resistivity, magnetic susceptibility and sonic wireline logs.

Swanworth Quarry No. 2 Borehole: 1:500-scale graphical plot showing lithologies, biostratigraphical zonation, chronostratigraphical classification and caliper, total gamma-ray, resistivity, magnetic susceptibility and sonic wireline logs.

Metherhills No.1 Borehole: 1:500-scale graphical plot showing lithologies, biostratigraphical zonation, chronostratigraphical classification and caliper, total gamma-ray, resistivity, magnetic susceptibility and sonic wireline logs.