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Geology of the Mursley area

1:10 000 Sheet **SP 82 SW**
Part of 1:50 000 sheets 219 (Buckingham)
and 220 (Leighton Buzzard)

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=C O N T E N T S=

1 INTRODUCTION

This report describes the geology of 1:10 000 Geological Sheet SP 82 NW (the Mursley area), and is best read in conjunction with that map.

The Mursley area straddles two sheets of the 1:50 000 geological map series; 219 (Buckingham) in the west and 220 (Leighton Buzzard in the east), the boundary between the two approximating to grid-line 821. Sheet 220 was surveyed during the 1980s and was published in 1992. It is described by Wyatt et al. (1988) and Shephard-Thorn et al. (1994). The western part of the Mursley area was not surveyed until 1990-91, partly in connection with a survey of potential resources of sand and gravel carried out for Buckinghamshire County Council (see Sumbler, 1990), and partly in connection with the resurvey of 1:50 000 Sheet 219, which was completed in 2000. The 1:50 0000 map and an explanatory Sheet description are now (March, 2001) in preparation. This report deals principally with this western part of the Mursley area, which was surveyed mainly by the author in 1990-91 and other than the account of the drift deposits by Sumbler (1990), not hitherto described. The general descriptions of the geological formations is pertinent to the whole sheet.

The survey of the area involved the collection of new data on the ground, but use was also made of earlier geological maps, records of boreholes and wells, and commercially available aerial photography. The resulting map includes some important revisions to the earlier versions, notably in the accurate depiction of boundaries, revision of the stratigraphical classification of the rocks, and the delineation of drift deposits.

Notes:
Both this report and the corresponding map (Geological Sheet SP 82 NW) should be regarded as provisional documents pending publication of the new version of Sheet 219; in particular, certain geological concepts and lithostratigraphical names may be subject to future revision. Sheet SP 82 NW indicates the outcrop limits of deposits which are mostly concealed beneath soil and vegetation; the geological boundary lines are inferred from indirect evidence such as the form of the ground surface and soil type, or are extrapolated from adjoining ground. It is thus the subjective interpretation of the surveyor, and all geological boundaries carry an element of uncertainty. Boundaries of solid geological formations which, in the opinion of the surveyor, can be located to an accuracy of about 10 m or less on the ground, are shown as unbroken lines; all others are shown broken.

Copies of the 1:10 000 map can be purchased from BGS, Keyworth, where records of boreholes and other data may also be consulted by prior arrangement. Copyright restrictions apply to the use of both the map and this report, and to the copying of the material thereof. The map and report are internal publications of the BGS and any information extracted from them should be acknowledged by the appropriate bibliographical reference.

The BGS memoirs for the adjoining 1:50 000 Sheets 220 (Leighton Buzzard) and 237 (Thame) also give much pertinent background information regarding the stratigraphy (Shephard-Thorn et al., 1994; Horton et al., 1995) as will the Sheet explanation for 1:50 000 Sheet 219 (Buckingham; in prep.).

Throughout this report National Grid References are given in square brackets; all lie within

100 km grid square SP (or 42) unless otherwise stated.

QUATERNARY:	
Alluvium	up to 2
Head	up to 3
Glaciofluvial deposits	up to 21
Till	up to 30
UPPER JURASSIC:	
PORTLAND GROUP	
Portland Formation	2 seen
ANCHOLME GROUP:	
Kimmeridge Clay Formation	30
Ampthill Clay Formation	20
West Walton Formation	15
Oxford Clay Formation	5

Table 1. Geological sequence proved within SP 82 NW (Mursley), giving estimated thicknesses in metres.

2 UPPER JURASSIC: ANCHOLME GROUP

2.1 Oxford Clay Formation

The oldest strata to reach outcrop in the Mursley area belong to the Oxford Clay Formation. The formation is about 70 m in total thickness, but only a few metres, belonging to the Weymouth Member (i.e. 'Upper Oxford Clay) are seen; they reach outcrop in the valley east of Drayton Parslow on the eastern margin of the map. These strata comprise pale grey, smooth-textured mudstones and slightly silty mudstones, which weather to produce a pale grey and fawn clay soil. The very topmost beds part of the formation are concealed by glacial drift, and the boundary shown of the map is consequently somewhat conjectural.

2.2 West Walton Formation

The West Walton Formation is a succession of somewhat silty mudstones about 15m thick, which occurs between the Oxford Clay and Ampthill Clay formations throughout eastern England. On the 1992 edition of 1:50 000 Sheet 220 (in which the eastern part of the Mursley area lies), the West Walton and Ampthill Clay formations are not separated, being combined as 'Corallian', although this latter term strictly refers to the Corallian Group of limestones and sands/sandstone which replaces much of the mudstone succession in the Oxford area and to the south-west (see Horton et al., 1995). The West Walton Formation and Ampthill Clay have now been separated throughout the Mursley area; in the drift-free, western part the boundary is readily mappable (see below), and the position of the sub-drift boundary shown in the east has been constructed on the basis of inferred structure and, as with all sub-drift boundaries, is necessarily approximate.

The West Walton Formation occupies much of the northern and western part of the map, although much (in the north-east) is concealed by drift deposits. The base of the formation does not reach outcrop in the Mursley area but the boundary with the underlying Oxford Clay is deduced to be present beneath drift near Drayton Parslow (see above) in the north-eastern part of the map. It is likely that beds very close to the base of the formation are represented at outcrop in the west, notably in the valley north of Swanbourne [272 276], and also in the north-west corner of the map [803 296].

The West Walton Formation is made up of dark grey, silty mudstone and pale grey, more calcareous mudstone, in rhythmic alternations. At outcrop, the formation gives rise to a stiff grey, clay soil which typically has darker brown and more ochreous weathering colours than that produced by the uppermost Oxford Clay (Weymouth Member) or succeeding Ampthill Clay formations. Characteristic dark bluish grey slightly silty clay with ochreous mottles, race (i.e. tufa granules), selenite and shell dust was augered in a number of places [e.g. 802 282; 808 276]. A distinctive fauna of large and (commonly) serpulid-encrusted and bored *Gryphaea dilatata*, and other 'oysters' such as *Lopha* and *Nanogyra* are also characteristic, and have been found in brash or amongst material dug from ditches at many localities (including localities A and C of Appendix 1).

Exposures in a stream-way east of Swanbourne (localities E [8136 2706] and F [8150 2709] of Appendix 1) showed silty clays and cementstone with abundant *Nanogyra* (often cemented into aggregates) and rarer *Lopha* and large serpulids. These beds are underlain by bluish grey and ochreous clays with bands of soft, pale grey, silty cementstone. Just to the north [814 272], the beds form a broad dip-slope. At approximately the same stratigraphic level, some 300m to the south-south-west [8137 2682], debris from an excavation comprised grey silty clay with race and abundant nodules of pale grey cementstone, including both smooth-textured septarian, and silty non-septarian types, in some cases exhibiting *Chondrites* burrows on their outer surfaces. Some of the cementstones contained small (juvenile) *Gryphaea*, and sporadic specimens of the gastropod *Dicroloma*. Sporadic large *N. nana* and *G. dilatata* were found in the associated clays. South-westwards, this unit becomes hard to trace, but at two other localities [813 266; 8073 2600] forms minor topographic features. At the latter locality (Mill Mound), debris from a ditch comprised common smooth-textured, often septarian cementstone associated with serpulid-encrusted *G. dilatata*. No specimens of *N. nana* were found here.

The apparently discontinuous outcrop of this unit of *N. nana*-rich mudstones with cementstones suggests that it is restricted to lenticular 'reefs'. It lies above a thick sequence of West Walton Formation and is taken as a marker for the top of the formation in the Mursley area. As such, the unit is analogous to the Oakley Member, i.e. the feather edge of the Corallian Group in the Thame district to the south-west (Horton et al., 1995). By contrast, the lithologically rather similar Elsworth Rock Member of areas to the north-east (see Ampthill and Millbrook; Wyatt, 1988; Shephard-Thorn et al., 1994) lies near the base of West Walton Formation.

2.3 Ampthill Clay Formation

The West Walton Formation is overlain by c. 20 m of mudstones below the mapped base of the Kimmeridge Clay Formation. In accord with practise in the Thame district (Sheet 237;

Horton et al., 1995), this is assigned to the Ampthill Clay although there (and possibly therefore, within the Mursley area) the lowest part of this unit includes beds equivalent to the uppermost part of the type West Walton Formation of Fenland (Gallois and Cox 1977; Cox and Gallois 1979).

At the surface, the mudstones weather to a brown clay indistinguishable from the other clay formations of the area, but where seen fresh (as from ditches and drains) the formation is dominated by pale grey and mid bluish-grey clays. Pale bluish grey and ochreous silt was seen in a ditch [9154 2671]. Small (generally less than 15 cm), pale grey, smooth-textured, often septarian cementstone nodules occur at some levels, and have been found amongst ditch debris at two localities [8067 2535; 8163 2617]; both probably represent the same horizon, estimated to be c. 8 m above the base of the formation. Large *G. dilatata*, often bored and encrusted with serpulids are common in the lower c. two-thirds of the formation, and occur amongst ditch debris at many localities. They are replaced by the flatter, thinner-shelled, more bluish-grey *Deltoideum delta* in the upper part of the formation.

Common *D. delta*, with sporadic large *N. nana*, associated with pale grey clay with race and fragments of fawn, earthy cementstone occur in the soil of a field [8185 2575] north-east of Hoggeston, just below the top of the formation. This assemblage is characteristic of the uppermost beds of the Ampthill Clay in the region (see Horton et al., 1995) and may equate with beds AC 40-42 of the standard sequence of Cox and Gallois (1979). A considerable number of fossils were collected from this level just south of the map margin from a silage pit at Hoggeston [8075 2493].

2.4 Kimmeridge Clay Formation

Kimmeridge Clay occurs in the south-eastern part of the area, though much of the outcrop is obscured by glacial deposits. Inliers, where streams have cut through the till cover to expose the Kimmeridge Clay occur at Stewkley Dean [834 265] and around Kiln Farm [850 250] (see Locality K).

The Kimmeridge Clay Formation is dominated by grey mudstones, which weather to a brown and ochreous clay at the surface, generally of a darker shade than the underlying Ampthill Clay. In contrast to the underlying Ampthill Clay, fossil oysters are very rare. Using these criteria it has been found that the base of the formation corresponds approximately with the change of gradient at the foot of the till-capped escarpment between Hoggeston and Lower Dean Farm [83 27]; phosphatic nodules from this level [8121 2524] provide some additional confirmation that this level marks the base of the formation (see Horton et al., 1995). On the scarp, the vertical interval between the base of the formation and the base of a Portland outlier east of Hoggeston [8177 2500] suggests a total thickness of c. 15 to 20 m for the Kimmeridge Clay Formation. However, the Portland strata at this locality are severely cambered (see below) and the true stratigraphic thickness of the Kimmeridge Clay is probably at least 30 m, and possibly up to 40 m or more (see Horton et al., 1995).

Fragments of brown-weathered cementstone have been found in the fields north-east of Hoggeston [8111 2519; 8137 2519; 8141 2503; 8183 2519; 8187 2514; 8173 2557]. They are characteristically silty in texture (in contrast to those of the Ampthill Clay), and generally contain white aragonitic shell fragments. Probably at least three cementstone nodule bands

are represented, estimated to be c 5, 10 and 15 m above the base of the Formation respectively. An old pit [8473 2501] west of Kiln Farm was probably used as a source of brick-clay.

3 UPPER JURASSIC: PORTLAND GROUP

3.1 Portland Formation

A small area of Portland strata cap a spur [818 250] 1 km east of Hoggeston at just over 135 m OD. The mapped limits of the outcrop shows that overall, the beds dip steeply downhill. This is almost certainly a superficial effect, due to cambering. Traced southwards onto adjoining Sheet SP 82 SW they occur at up to c. 145m OD. The strata comprise limestone with abundant glauconite grains, which weather down to an olive-green loam. Small oysters (c.f. *Nanogyra*) occur in patches. Probably no more than about 2 m of strata are represented. The lithology is comparable with the Portland Sand Member of the Aylesbury area (Horton et al., 1995). This Portland Sand is the basal member of the Portland; the formation where complete in this region is up to about 12 m in thickness.

4 STRUCTURE

The mapped distribution of the solid geological boundaries shows that in the western part of the area, the strata dip gently towards the south-east, at approximately 0.7°, on average. A probable dip-slope produced by harder strata at the top of the West Walton Formation [814 271] accords with this inferred dip direction. There is little structural data available for the drift-covered eastern part of the area, but consideration of the situation in adjoining areas suggests that the dip swings round to a south or south-south-westward direction, on the flanks of a subdued south-eastward-trending syncline, the axis of which lies a few kilometres to the east of the margin of the map. The sub-drift boundaries of the West Walton, Ampthill Clay and Kimmeridge Clay formations have been constructed on this basis.

Cambering, an example of superficial (i.e. non-diastrophic) structure, affects the outcrop of the Portland Formation on the southern margin of the sheet. Developed mainly during the cold stages of the Quaternary epoch, fracturing, squeezing and wastage of the Kimmeridge Clay mudstones on the scarp slope has resulted in collapse of the overlying Portland beds, which consequently extend down-slope well below their original level. There may be associated occurrences of valley bulging at the base of mudstone slope and perhaps also in valley bottoms elsewhere, where mudstones are squeezed upwards by the weight of the superincumbent strata.

5 QUATERNARY

Over much of the Mursley area, the solid strata is concealed beneath a cover of Quaternary 'drift' deposits. The most extensive are glacial deposits believed to date from the Anglian Glaciation. According Sumbler (1995), this was a composite event, and the deposits in this area relate to the younger glacial phase, corresponding with deep-sea Oxygen Isotope Stage 10, very approximately 350 000 years ago. As such, the deposits perhaps should be considered as part of the Wolston Formation, with which they have many similarities (see Sumbler, 2001). The area lay near the southern limit of maximum ice advance, which was

probably somewhere just to the north of Aylesbury (see Horton et al., 1995; Sumbler, 1995). Post Anglian deposits, probably mainly of Devensian age, are restricted to minor accumulations of head, and alluvium in stream valleys.

The following notes relate chiefly to the western part of the area, surveyed by the author on 1990-91.

5.1 Till

Till accounts for the greater part of the surface area of the geological map of the Mursley area, and forms most of the highest ground. There is little data on the form of the underlying rockhead surface, but from the distribution of bedrock outcrop, the till must be up to c. 30 m thick in places. It is predominantly of the chalky type (Oadby Member; see Sumbler, 2001), comprising blue and grey mottled clay with abundant small chalk pebbles and rarer 'Bunter' quartzite, flint (including cobbles up to 15 cm diameter), *Gryphaea* fragments and rare ironstone and coaly shale. It weathers to form a brown clay soil with abundant scattered flints, occasional quartzite and variable quantities of chalk. Chalk is almost always present in auger holes but the till is locally decalcified near the surface. In other places, chalk pebbles are abundant in the soil; they may be up to 10 cm diameter and show glacial striations. Minor exposures of till are seen in ditches and ponds (e.g. Locality H, Appendix 1).

In the western part of the area, deposits of glaciofluvial sand and gravel underlie the chalky till deposits, described above. Beneath these, more till, probably up to 3 m thick, occurs in valleys north of Swanbourne [802 282; 803 276]. This material comprises blue, grey and brown mottled clays and silty and often gritty clays with relatively few pebbles and apparently, with no chalk at all. This may represent a locally derived ground moraine, or may conceivably relate to an older glacial event (see e.g. Horton et al., 1974), which in the context of the chronology advocated by Sumbler (1995; 2001) may correspond with Oxygen Isotope Stage 12.

5.2 Glaciofluvial deposits

Sand and gravel forms prominent spurs in valleys north of Swanbourne [802 279 area], close to the local base of the glacial drift sequence. It is up to c. 5 m thick but it dies out rapidly eastwards against the rising bedrock surface. It forms a brown sandy loam soil, being generally more sandy and less gravelly than the deposits higher in the sequence. A small (disused) pit (Locality B [8023 2780]) shows 1 m of very poorly sorted flint/chalk/quartzite gravel. Similar material at the base of the drift in the north-west corner of the map around Lower Grove Farm [804 299] infills a depression or channel in the bedrock surface, possibly a pre-glacial valley. It too has been worked from a small pit [8038 2977]. Two flooded pits on the till outcrop to the east [808 299] may have reached this sand and gravel but may alternatively have worked bedrock clays (West Walton Formation) for brickmaking.

The glaciofluvial deposits associated with the main deposit of chalky till are characteristically poorly sorted, often bouldery gravels, commonly containing a considerable proportion of chalk, rendering them of limited commercial value. A few bodies of such material have been mapped within the body of the chalky till sheet. East of Lower Grove Farm, an outcrop of reddish brown loamy sand, locally with small (1 to 3 cm) flint, quartzite and chalk pebbles

has been pitted in two places [8096 2980; 8107 2978]. The deposit is probably no more than 3 m thick. An extensive area of sand and gravel around Drayton Parslow appears to from a lenticular body, probably a channel-infill, in which the deposits may locally be up to 10 m thick. A section was exposed in a small pit (Locality J [8308 2967]).

The most extensive sand and gravel deposits of the area occur at the local top of the glacial succession, notably around Mursley village [818 286], where the gravels form prominent features and spurs on the hillsides The deposits there give rise to a reddish brown gravelly loam soil with abundant flint and quartzite pebbles (typically 2 to 4 cm diameter). In the north-western part of the outcrop (between Mursley Hall Farm and the Water Tower), the deposit is more clayey than elsewhere, and near Spring Grove Farm [811 292], the basal layers are particularly clayey and include large cobbles and boulders.

Several fairly large pits occur west and south-west of village where the deposit has been exploited in the past [e.g. 8136 2831; 8123 2816; 8130 2806]. These pits are up to 3 m deep; burrows and scrapes show poorly sorted flint/quartzite gravel, in some cases with chalk and limestone pebbles, typically from 1 to 5 cm grade. Rarely, lenses of gravel are cemented by calcium carbonate into a natural concrete (see Locality I [8143 2860]).

Both the surface and base of the deposit dip to the south-west, and north-east of Mursley village, it feathers out on the rising surface of the underlying till. Thus, the thickest deposits probably occur south and west of the village. Generally the thickness is unlikely to exceed c. 6m, though thicknesses greater than this may be encountered in local channels. For example, resource exploration boreholes north-east of Mursley village show the deposit to be up to 21 m thick, although this thickness may include clayey (?till) intercalations.

A small outlier of similar sand and gravel occur in the centre of Swanbourne village [802 273] and at Stewkely North End [846 268].

5.3 Alluvium

A fairly extensive alluvial floodplain has been mapped along the course of the Claydon Brook, south of Swanbourne, and narrower floodplains occur in several other minor valleys. The material comprises grey to brown more or less loamy clay, commonly underlain by a thin basal gravel of locally derived material (see Locality E). The deposits are rarely more than 1 to 2 m in total thickness.

5.4 Head

Minor amounts of head, i.e solifluxion material possibly in part reworked by streams, is probably more or less ubiquitous at the foot of hill slopes on hill mapped in valleys. However, only the thicker deposits are indicated on the map. These occur in valleys, notably that in the south-west between Swanbourne and Hoggeston (i.e. the headwaters of the Claydon Brook) and also that in the north-west of the map. The material comprises loamy clays, locally gravelly depending on the nature of the up-slope source (see localities C, D, F and K). and is generally unlikely to exceed 1 to 2 m in thickness, though thicker accumulations may be encountered locally.

6 UNPUBLISHED INFORMATION SOURCES

The following lists the principal items of unpublished data that were consulted and considered in connection with the survey of Sheet SP 82 NW. All this data is held in BGS archives, and in most cases may be consulted on application to BGS. Other published data pertinent to the area is referred to in the text and listed in References

6.1 Boreholes

As of the date of this report, BGS held records of water wells, boreholes and trial pits for 36 sites within Sheet SP 82 NW, all but one being sand and gravel trial boreholes in the area immediately north-east of Mursley village. These records are held in the National Geological Records Centre at BGS Keyworth. Each is given a unique registration number, in which the borehole logs for each 1:10 000 sheet are numbered consecutively in order of acquisition; thus the full designation is in the form SP 82 NW/1.

6.2 Maps

The following large-scale geological maps fall entirely or in part within Sheet SP 82 NW; these unpublished maps are held in the National Geological Records Centre at BGS Keyworth.

Buckinghamshire 19 NE. 1:10 560-scale MS field slip
Buckinghamshire 19 SE. 1:10 560-scale MS field slip
Buckinghamshire 20 NW. 1:10 560-scale MS field slip
Buckinghamshire 20 SW. 1:10 560-scale MS field slip
Buckinghamshire 23 NE. 1:10 560-scale MS field slip
Buckinghamshire 24 NW. 1:10 560-scale MS field slip

All the above were partially surveyed by A C G Cameron between 1895 and 1897. They provide little information and in many places are substantially incorrect. Overall these maps, and other old small-scale maps (such as Old Series One-Inch (1:63 360-scale) Sheet 46 NW, published in 1865) provide minimal information and are entirely superseded by those of the most recent survey:

SP 82 NW R J Wyatt, M G Sumbler and J J Pattison. 1988-91. 1:10 000-scale MS field map (full survey)
SP 82 NW M G Sumbler 2000. 1:10 000-scale MS standard (full survey)

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APPENDIX 1 SECTIONS AND EXPOSURES

The localities described below are indicated on 1:10 000 Geological Sheet SP 82 NW. Thicknesses are given in metres.

A [8033 2999] Ditch section, recorded by M G Sumbler and J J Pattison in 1990

West Walton Formation
Clay, dark bluish grey, weathering to pale grey with ochreous mottles; much finely divided selenite and some race pellets; abundant *Gryphaea dilatata* and rare *Lopha*. 1.7

B [8023 2781] Section in old gravel pit, recorded by M G Sumbler in 1990.

Glaciofluvial deposits
Gravel, sandy, orange-brown, poorly sorted , with flint, chalk and quartzite pebbles typically 5 to 50mm diameter. 1.0

C [8074 2762] Ditch section, recorded by M G Sumbler and J J Pattison in 1990.

Head
Loam and gravel, brown. 2.0
West Walton Formation
Clay, mid bluish grey, with finely divided shell debris; abundant large *Gryphaea dilatata* and sporadic *Lopha* and serpulids. 3.0

D [8082 2674] Section in old gravel pit, recorded by M G Sumbler in 1991.

Head
Gravel, clayey, ochreous brown, poorly sorted, with flint and quartzite pebbles and rotted chalk; sporadic seams and pods of sandy clay. 2.0

E [8136 2706] Section in stream, recorded by M G Sumbler in 1990.

Alluvium
Gravel in stream bed composed principally of large *Nanogyra*, often cemented into large aggregates; rarer *Lopha* and large serpulids; sporadic lumps of *Nanogyra*-rich cementstone. 0.3

F [8150 2709] Section in stream bank and bed, recorded by M G Sumbler in 1990.

Head
Clay, loamy, with gravel at base. 1.2
West Walton Formation (ls)
Clay, slightly silty, mid to dark bluish grey, with race and abundant *Nanogyra*. 0.4
Silt, very pale grey and fawn mottled, massive, unfossiliferous. 0.3
Clay, very silty, mid bluish grey and ochreous mottled, with sparse *Nanogyra*. 0.4
Cementstone, very silty, hard, pale grey, with burrows. 0.2

G **[8138 2755]** Section in ditch recorded by M G Sumbler in 1990.

West Walton Formation
Clay, pale grey and fawn mottled, with race; large perisphinctid ammonite preserved in cementstone; rare *Nanogyra*. 1.1

H **[8132 2802]** Section in old gravel pit recorded by M G Sumbler in 1990.

Till
Clay, pale bluish grey mottled, with abundant small chalk pebbles, rarer quartzite and flint, *Gryphaea* fragments, ironstone and carbonaceous shale; occasional flint cobbles up to 150mm diameter. 1.5

I **[8143 2860]** Section in old gravel pit recorded by M G Sumbler in 1990.

Glaciofluvial deposits
Gravel, clayey, pale brown, poorly sorted, with flint, quartzite, chalk and Jurassic limestone pebbles; irregular masses cemented into hard conglomerate. 1.4

J **[8308 2967]** Section in old gravel pit recorded by M G Sumbler in 1990.

Glaciofluvial deposits
Gravel, sandy, pinkish brown, with flint, quartzite, limestone, sandstone and chalk pebbles typically 10 to 30mm diameter. 0.8

K **[8481 2579]** Section in ditch recorded by R J Wyatt in 1988.

Head
Clay, very silty and sandy, brown, with small flint and quartzite pebbles. 0.6
Kimmeridge Clay Formation
Clay, dark grey. 0.3