GA. North Lincolnshire weekend field trip

Leaders: Dr. Michael Oates and Paul Hildreth

Saturday 3rd August and Sunday 4th August 2019

Field Notes: Ray Pratt

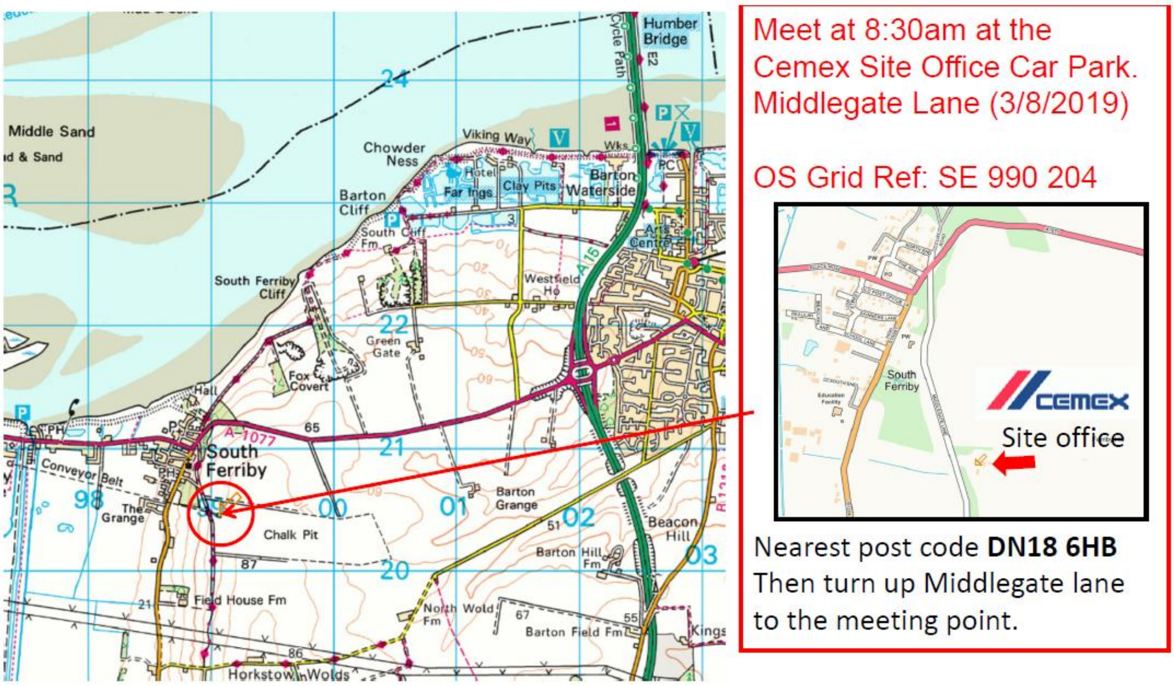
Trip Summary

This GA weekend Field Trip will focus on the Jurassic and Cretaceous rocks of North Lincolnshire. Access to a large working quarry has been obtained guaranteeing unobscured geology. PPE is essential and full requirements will be shared in the joining instructions..

Saturday 3rd August 2019: will start at South Ferriby, where we will spend the morning examining the Ampthill Clay, Red Chalk and Chalk in the CEMEX Quarry. After lunch we will drive to Scunthorpe and visit the Conesby Quarry where the Charmouth Mudstone and Frodingham Ironstone Formation yield numerous fossils.

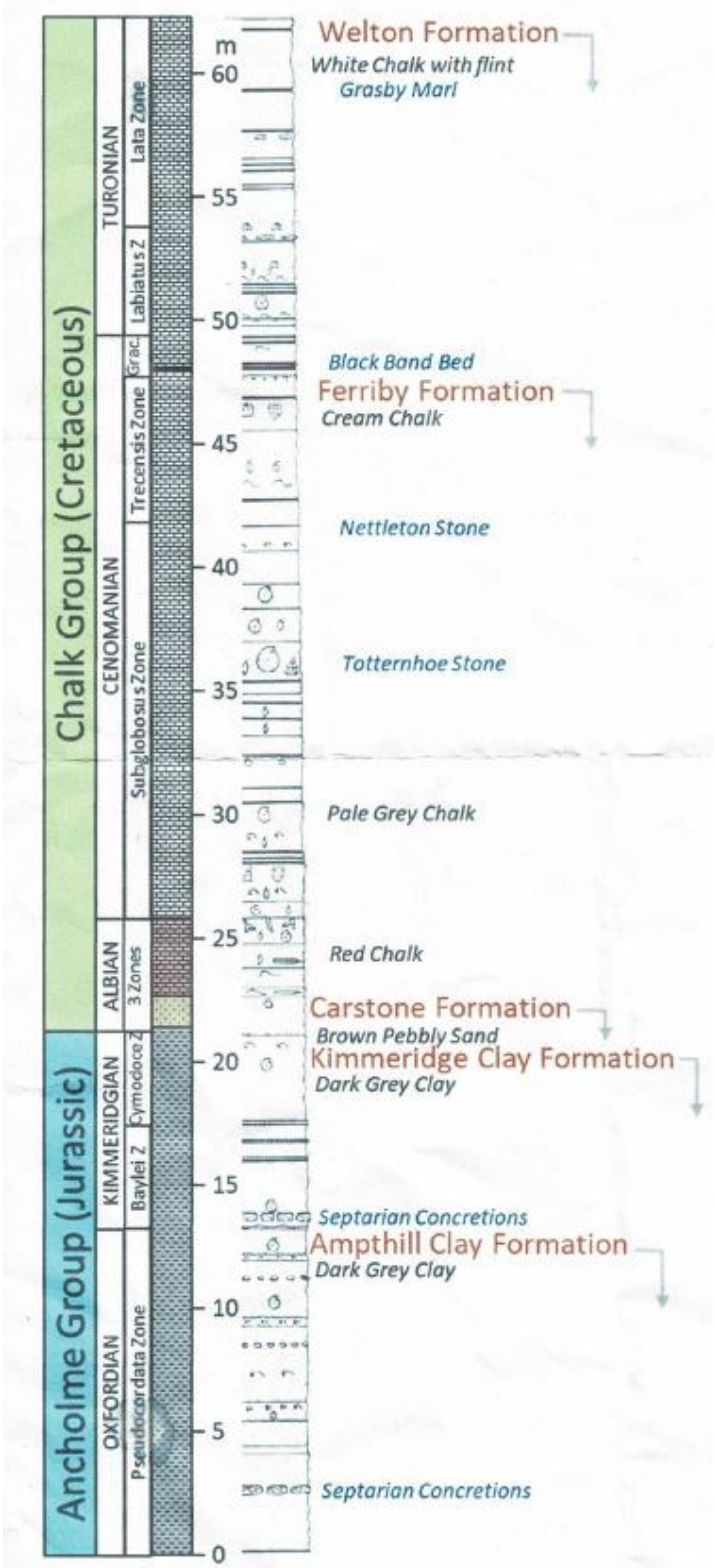
Sunday 4th August 2019: will start at Ulceby Vale, where we will examine a Chalk section and discuss a tantalising structural problem. After lunch we shall go to Elsham, to look at the Kimmeridgian Elsham Sandstone and consider its significance. The excursion will conclude around 3.00pm.

Location1. Middlegate Quarry, South Ferriby



This is a working quarry and permission to enter this quarry must be sought well in advance.

This excursion will start at South Ferriby at 8:30am, where we will spend the morning examining the Ampthill Clay, Red Chalk and Chalk in the Cemex Quarry.



This quarry allows the entire sequence from Oxfordian to Turonian to be examined. The entire early Cretaceous is missing. In the area at that time was a local feature known as the Market Weighton High, a 10 km wide positive feature running east west, co-incident with the edge of one of the Pennine blocks. Further south in Caister we see a thick early Cretaceous section which we assume has been eroded off at this location prior to red chalk deposition. The uppermost part of the Jurassic was also removed. Moving towards Market Weighton the red chalk sits directly on top of the Lias. (Jurassic eroded off prior to Cretaceous deposition).

The Red Chalk is the northern equivalent of the southern Gault Clay. Underneath the red chalk is the Carstone (Greensand Equivalent) which contains reptilian fragments. It is greenish in colour and is very sandy. This sits unconformably on top of the Kimmeridge Clay.

The Scunthorpe pliosaur was discovered in this quarry, 1m below the base of the Carstone.

The bottom of the quarry is in the Ampthill Clay Formation. This merges upwards and imperceptivity into the Kimmeridge Clay Formation. Other places in England there is a contrast between the two formations. The Boundary is just below a layer of doggers.

Lots of fossils, particularly the oyster called Loifer , as well as other oysters and brachiopods. Belemnites and ammonites are also here.

Lowermost 25m of chalk is flintless and marly called the Ferriby chalk

Above this is the Blank Band (Plenus Marl) 30cm thick - extinction event. Part of the variegated beds which start with a chalky conglomerate, then silts, then the black band, more silts, then sticky geenish clay then back into chalk (1.5m in total)

Above this is the Welton Chalk, the lowermost 1.5-2m is flintless with lots of inoceradides (bivalve) - the marker fossil. Above this the flints are present. These are nodular flits. Need to go higher in the sequence (at other locations) to get the massive tabular flints (seen at Ulceby Vale Quarry)

Tertiary

Top of quarry. Recent soils sit atop Quaternary? clay with flints

Welton Formation

Grasby Marl: White chalk with flint

The uppermost chalk is grey, overlying a very white chalk. (This could be a recent development post onset of quarrying). In areas we see that the outer surface is grey but when broken is white.

Notice the wavy horizontal clay band in the white chalk. These Turonian chalks are silica rich which gives them a ceramic ring sound when hit

Pitted surface solution marks ?

Chert / flint nodules

Wavy horizontal clay deposit. These are sometimes due to volcanic ash fallout rather than a change in depositional environment


Thin but extensive clay band


Flint nodules

The wavy surface in the uppermost part of this picture is a quarrying surface and not a bedding plane. Note that there are lots of small scale faults that can be identified in the chalk faces throughout the quarry. There is a small exposure of red "soil" within the quarry face. Given its location is puzzling as to how it got there as it is not just surficial, but goes into the quarry face. Possible washed in like a neptunian dyke. Seen at the same level in a number of places in the quarry.

Fracture surface in the chalk running NE-SW. Blackish dippled surface, algal growth ? Not easy to remove. Uneven surface.

Thin clay beds are seen at several horizons (volcanic ash ?)

Thin fissile clay beds separate thicker massive chalk deposits

cm displacement fracture

The quarry entrance is in the west Looking west we see that the chalks are horizontally bedded. The chalks are more white inthe east and grey in the west. If this is simply erosional then it suggests the quarry workings are oldest to the west (which makes sense).

Black Band Bed (Plenus Marl)

The black band is very distinctive and stands out in strong contrast to the surrounding white chalk. It is organic rich and firm. When wet turns to a pliable clay. Immediately above the black clay is an olive green marl.

Ferriby Formation

Most noticeable thing in the quarry face the fractures and faults, often stained brown. Faults in this eastern end of the quarry run SSE-NNW

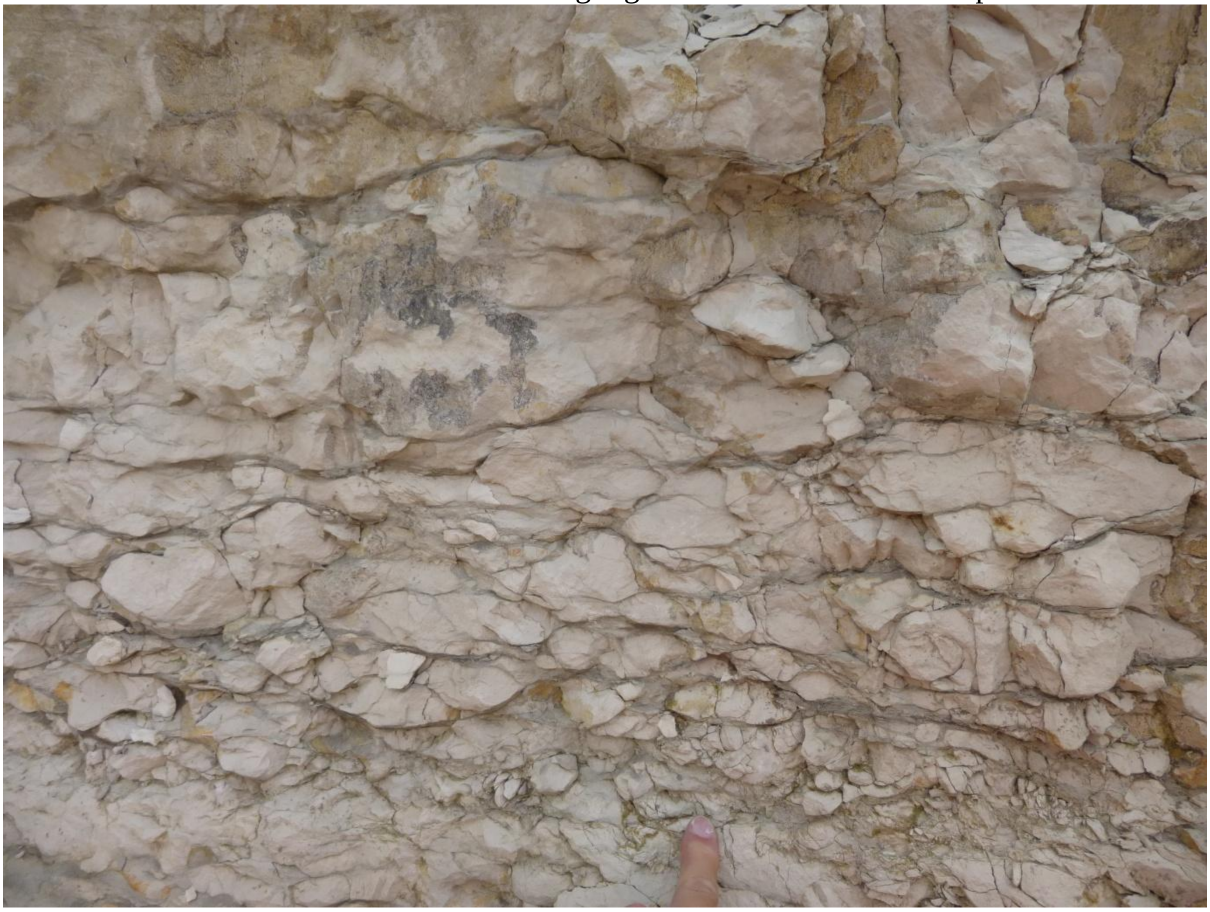
Drag can be seen on the beds at the fault plane. This is a normal fault with the downthrow to the right (south), with a trow of 1.50 - 2.0 m

Thick massive marly chalks with nodular flints

Two faults running through the entire quarried section

Towards the base the chalks become more grey, increasingly argillaceous / marly. Wispy clay laminations can be identified within the calks. Change in depositional environment.

Towards the lower section of the Ferriby Fm the massive chalks give way to a more rubbly / nodular chalk. This is related to the increasing argillaceous content of the deposits.



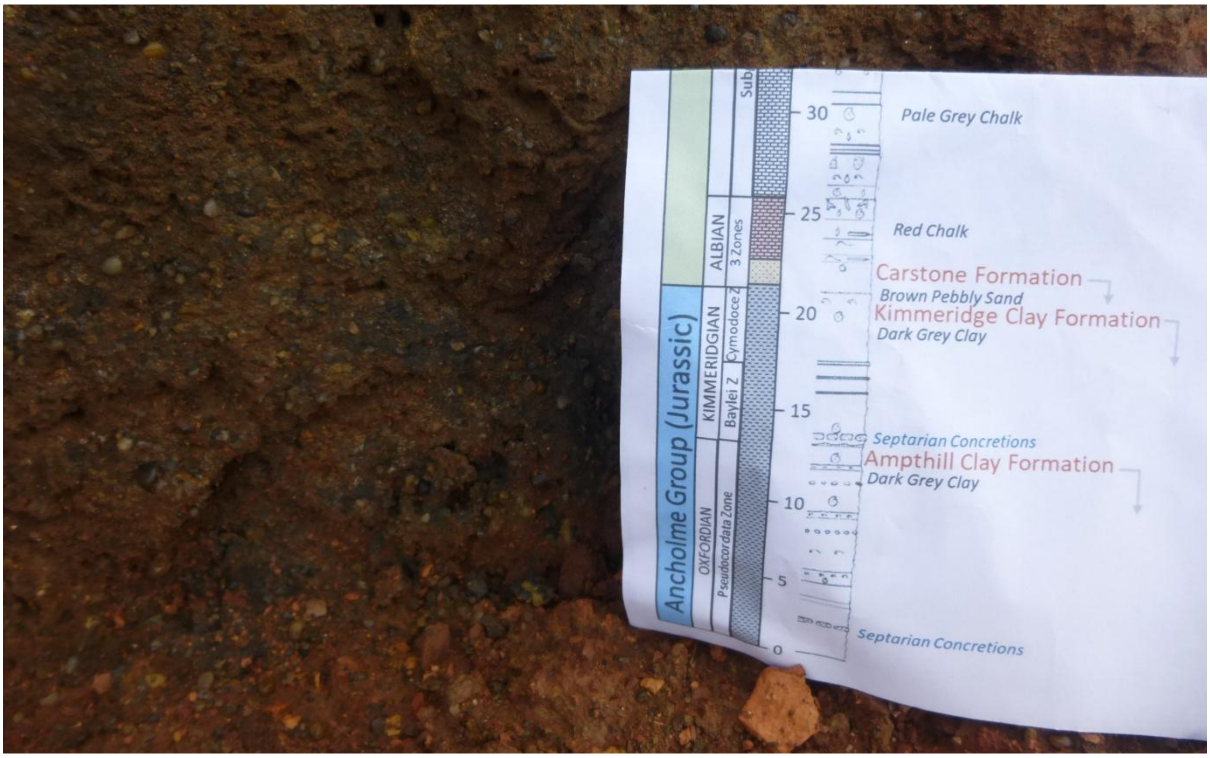
The nodular effect will originate during diagenesis, with the clays compacting and dewatering in and around the more ridgid chalks

Standing o top of the red chalk we can see that the faulting in the chalks above is listric with very little displacement with depth.

Bedding plane between the overlying Pale Grey Chalk and the underlying Red Chalk

Red Chalk

Carstone Formation



The Carstone results from a marine transgression over an erosional surface whereby the uppermost Jurassic and all Lower Cretaceous is missing. This mixed sand and pebble deposit exhibits a fining upwards sequence from coarse at the base to a very fine, grained argillaceous sand at the top. Above this is the red chalks, the red colour coming from the large amounts of red clay within the formation.

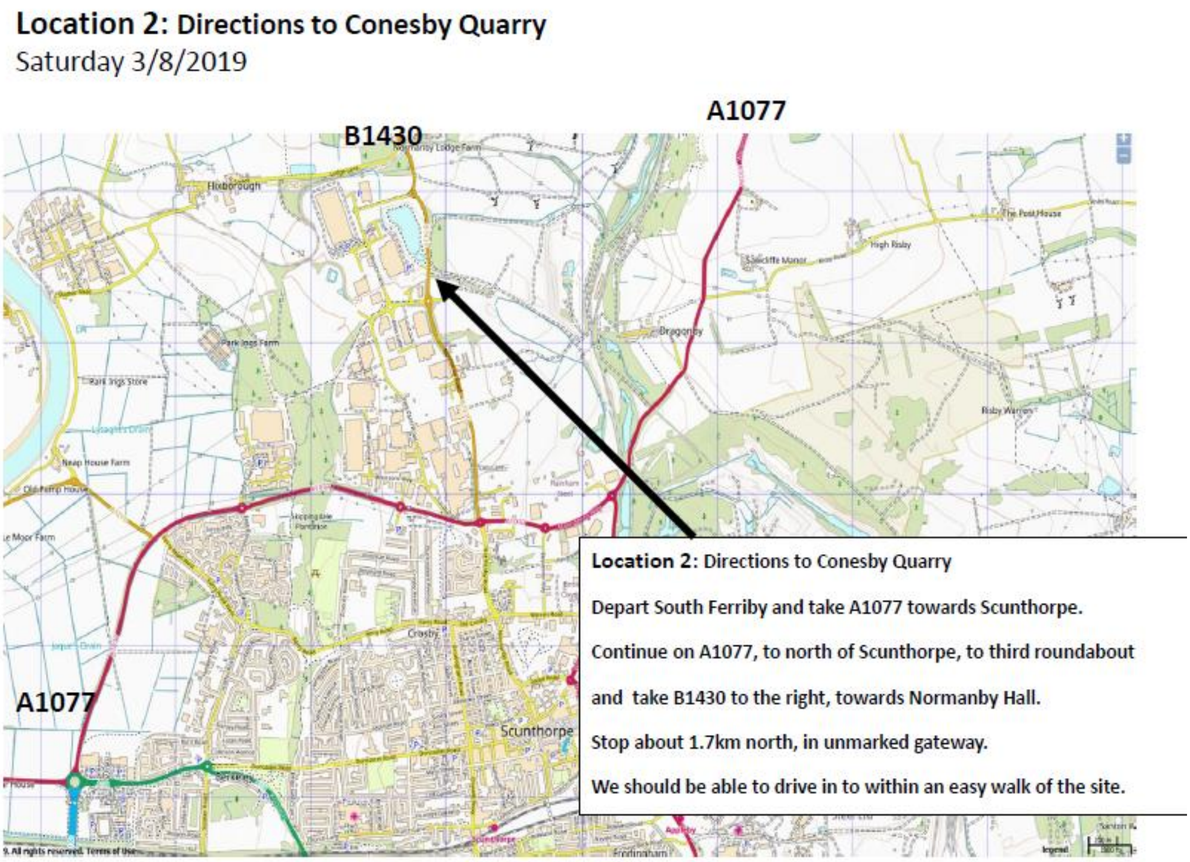
Jurassic. Kimmeridge Clay Formation

Lots of very large oyster shells were to be seen lying on the surface of the quarry floor

The Concretion lamination horizon is the lower. The uppermost concretions are the result of displacement during quarrying. This marks the boundary between the overlying Kimmeridge Clay Fm and the underlying Ampthill Clay Fm

	
Fossil shells in Septarian Concretion	Part of an ammonite
	
Complete ammonite	

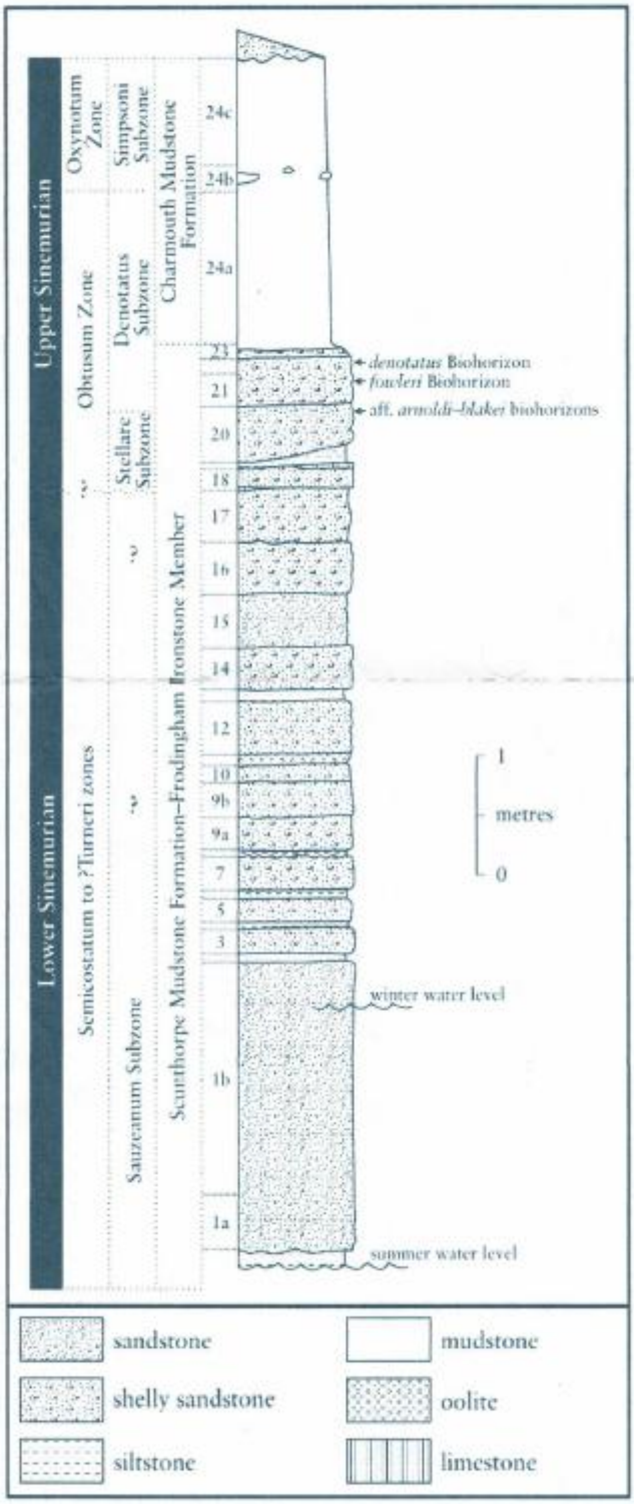
Location 2: Conesby Quarry, Scunthorpe



The section in this quarry is of the early Jurassic, Lias. Surrounded by Middle Jurassic Lincolnshire Limestone on which the Roman road, Erming Street, sits on top. The ironstone in this quarry is the reason Scunthorpe developed. Mined originally by the Romans and then redeveloped in the mid 19th century. At its peak there were 11 miles of working face. All the rocks are dipping gently resulting in a greater overburden (Charmouth mudstone Fm) to be moved as the mining progressed, eventually forcing the workings underground. The mine was shut in 1988

The Charmouth mudstone, at the top, is full of Belemnites with occasional ammonites.
The Scunthopre Mudstone Fm is documented to yield Plesiosaurs. Ironstone litters the top surface. Ammonites can be found in the lower ironstone zone and at the top of the ironstone. Ammonites have been used to zone the ironstones.

Scunthorpe Mudstone Fm - Fodingham Ironstone Mb - Charmouth Mudstone Fm



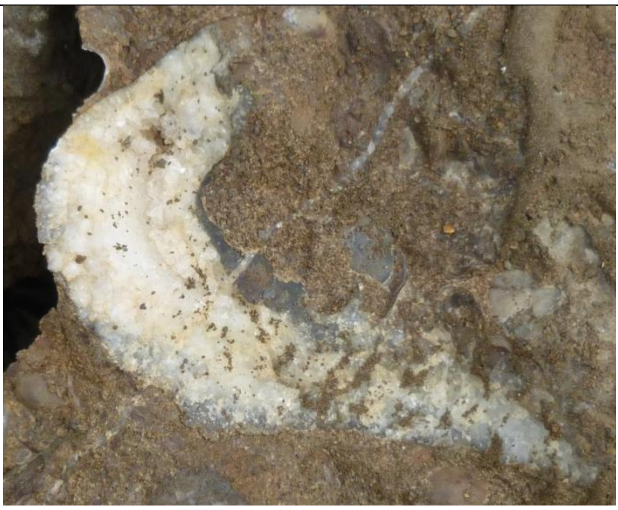

Iron rich shelly sandstone


Bivalve rich layer


Iron rich section - left on mine closure


Small channel features can be seen in the sands

Gryphaea can be found in abundance. Gryphaea, common name devil's toenails, is a genus of extinct oysters, marine bivalve molluscs in the family Gryphaeidae. These fossils range from the Triassic period to the late Palaeogene period, but are mostly restricted to the Triassic and Jurassic

	Cross section through a remineralised Gryphaea fossil. Note the calcite vein cutting diagonally across the photograph


Iron enrichment and oxidation


Iron Nodule

Iron rich shelly sandstone sandwiched between thin claystone layers

Cross section through a chambered fossil	Iron rich boulder
	

Scunthorpe Mudstone Formation

Computer Code:	SMD	Preferred Map Code:	SMd

Status Code:	Full
Age range:	Rhaetian Age (TR) — Sinemurian Age (JS)
Lithological Description:	Grey, variably calcareous and silty, blocky or fissile mudstone with thin beds of argillaceous limestone (bioclastic or micritic) and calcareous siltstone, particularly near base and in upper part, which is ferruginous in the type area.
Definition of Lower Boundary:	Where lowest grey mudstone (may be laminated) of the Lias Group rests with sharp contact on bluish and greenish grey to (less commonly) reddish brown mudstone of the Cotham Member (Lilstock Formation, Penarth Group) or on grey porcellanous limestone of the Langport Member (Lilstock Formation, Penarth Group) where locally present.
Definition of Upper Boundary:	In type area, at top of Frodingham Ironstone (Gaunt, G D, Fletcher, T P and Wood, C J, 1992); elsewhere, at erosive base of thin pebbly ferruginous oolite (Glebe Farm Bed), which marks the base of the Charmouth Mudstone Formation.
Thickness:	To c.128m
Geographical Limits:	East Midlands Shelf (north) (Leicester to Market Weighton).
Parent Unit:	Lias Group (LI)
Previous Name(s):	Angulata Clays (-2626) Ferruginous Limestone Series (-4887) Scunthorpe Mudstones Formation (-3685) Hydraulic Limestones [Obsolete Name And Code: See SMD, BNT, ELL] (HYDL) Bucklandi Clays (-2431) Scunthorpe Mudstones (-1189) Granby Limestones (-3440)
Alternative Name(s):	*none recorded or not applicable*

Stratotypes:	
Type Area	North Lincolnshire and Humberside. Gaunt, G D, et al, 1992.
Type Section	British Geological Survey Blyborough Borehole, Blyborough, Lincolnshire (SK99SW/79) c.51.57-139.5m depth. Gaunt, G D, Fletcher, T P and Wood, C J, 1992.
Reference Section	Fulbeck Airfield Borehole F/B1 (SK85SE/25), depths 0 to 100.9m.
Reference Section	Borehole F/B5, Fulbeck, Lincolnshire (SK95SW/17) 4.58-117.65m depth. Brandon, A, Sumbler, M G and Ivimey-Cook, H C, 1990. See also Cox, B M, et al, 1999 for additional reference sections.

Reference(s):

Brandon, A, Sumbler, M G and Ivimey-Cook, H C, 1990. A revised lithostratigraphy for the Lower and Middle Lias (Lower Jurassic) east of Nottingham, England. Proceedings of the Yorkshire Geological Society, Vol.48, 121-141.

Cox, B M, Sumbler, M G and Ivimey-Cook, H C, 1999. A Formational framework for the Lower Jurassic of England and Wales (Onshore Area). British Geological Survey Research Report No. RR/99/01.

Gaunt, G D, Fletcher, T P and Wood, C J. 1992. Geology of the country around Kingston upon Hull and Brigg. Memoir of the British Geological Survey, sheets 80 and 89 (England and Wales). 172pp.

Locations 3 & 4

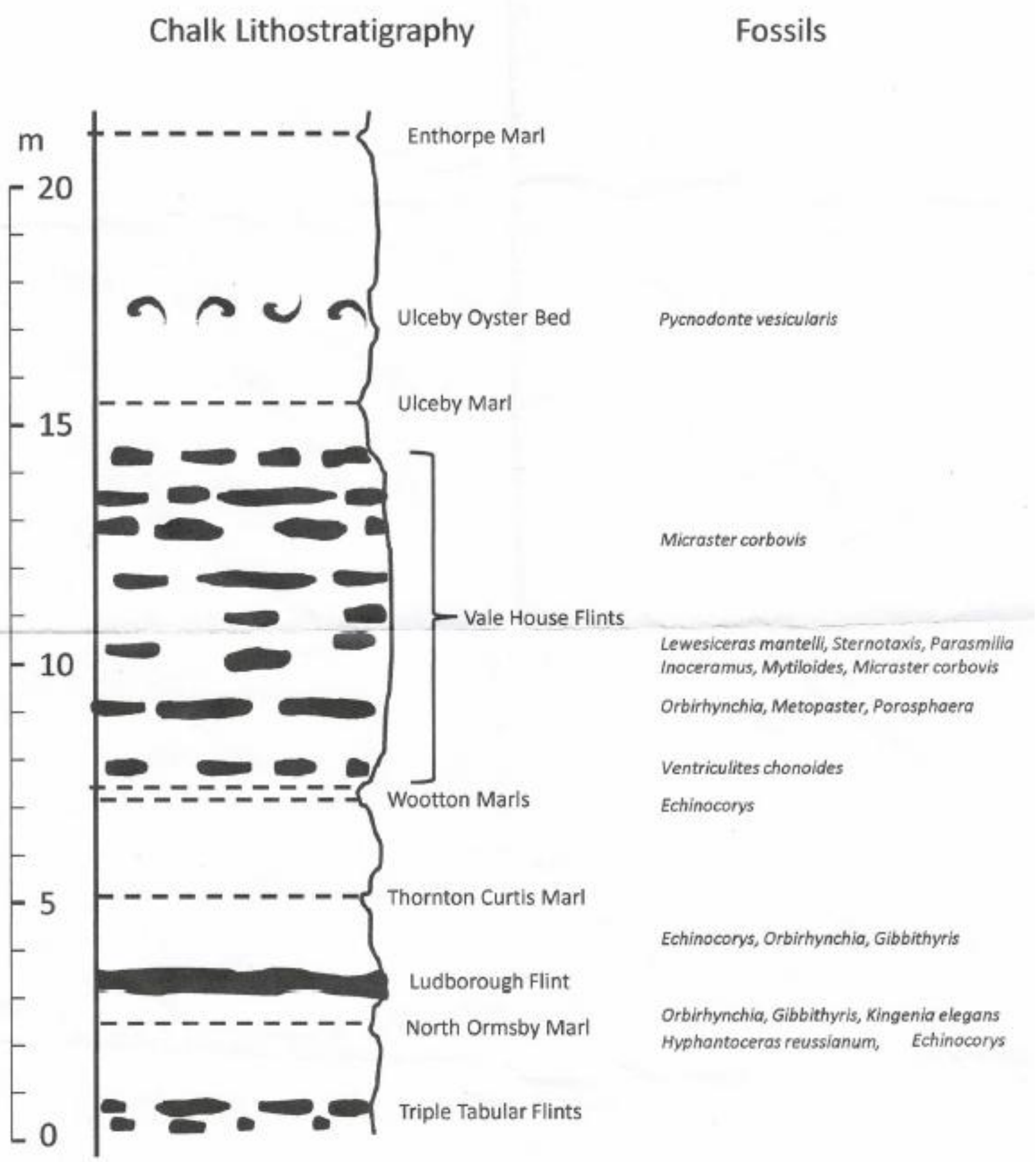
Location of : Elsham Sandstone Pit and Ulceby Vale Chalk Pit
Sunday 4/8/2019

Location 3: Ulceby Vale Quarry

The chalk in this quarry is full of flint and represents younger chalks than seen at Middlegate Quarry, South Ferriby. This is a disused quarry. It was used as fill material for a nearby oil terminal. Due to the high flint content the rock is useless for much else. The company lost the licence to quarry further here when they went too deep and penetrated the underlying water table. The flint horizons here are the equivalent of the Brandon Flint Mines. The flints horizons from this quarry can be traced all the way to Flamborough Head. These Vale House Flint Member can be traced into East Anglia where there is a BGS borehole (Trunch borehole) . These rocks are the same age although the lithology is chalk. The borehole is drilled into a transition and it is within the Transitional Province. Correlate with sponges from both localities.

The Transitional Province is a zone separating the Northern (Boreal) province chalks which goes across the North Sea to Germany, from the Southern province (Tethyan) of the south of England. In between is the transitional Province (East Anglia, Northern Norfolk) where there exists a bit of both. This was a periodic temporary barrier to faunal movement. The biostratigraphy of the two regions is different so correlation was challenging. Biostratigraphy at Ulceby Vale is similar to Germany. Here we have 1 biozone.

The flints at Ulceby Vale are not nodular, but are massive tabular flints, typical of the Burnham Chalk. Here we see the first appearance of carious (imperfect) flints. These contain white inclusions suggesting the zone has not been completely silicified. Flints believed to have formed as replacement of the chalk circa 6 m below the sea floor. Paramoudra flints also exist here. 4 or 5 of the marls in this quarry are the consequence of volcanic ash Marls represent periods of dominant terrigeneous material build up (slow deposition) whereas chalk collected during periods of organic algal blooms



Simplified Section of Sequence at Ulceby Vale Quarry
(Upper Turonian – Lower Coniacian)

Chalk section at Ulceby Quarry. The lower part of the quarry is the Burnham Chalk Formation (Turonian - Sternotaxis plana zone).

Inoceramids, Calcite leached out leaving the aragonite. Looks fibrous. Huge shells

(Inoceramidae is an extinct family of clam-like bivalves. Fossils of inoceramids are found in marine sediments of Permian to latest Cretaceous in age. Inoceramids tended to live in upper bathyal and neritic environments

Inoceramids had a thick shell paved with "prisms" of calcite deposited perpendicular to the surface, which gave it a pearly luster in life.[2] Most species have prominent growth lines which appear as raised semicircles concentric to the growing edge of the shell. Paleontologists suggest that the giant size of some species was an adaptation for life in the murky bottom waters, with a correspondingly large gill area that would have allowed the animal to survive in oxygen-deficient waters). Wikipedia

In the middle of the quarry floor exists a small fold feature (axis N-S, compression E-W)), not seen in the quarry faces.

Carious (rotten) or imperfect flint. Do not occur lower than the Vale ouse Flint member

Stylolites

North Ormsby Marl as seen at base of quarry face.

Tabular Ludborough Flint close to quarry floor (very prominent at Flamborough Head) This sequence forms the cliffs (and the cave) at North Landing. Very pale flint. Has been called a white flint by Roe. The precipitation of flints is linked to the Milankovitch cycles. Cyclic. Get a bloom of radiolaria then a slowing down and silica dissolution and precipitation. Stop Start due to many factors. (Redox boundary 1.5m below the sea floor). Vertical flints and Paramoudra don't fit this model. Chalk is significantly burrowed, populated by bacteria which releases the sulphides which migrate upwards through the burrows. Hit the Redox boudary where there is a chemical reaction taking place which triggers silica to come out of solution. Doesn't explain why some chalks have lots of flints and why some are nodular v tabular. Variability in iron (and other elements) may have an impact. Where iron and sulphur co-exist get pyrite. Palaeogeography, relative permeability and porosity also may have an impact

Paramoudra Flint (exists between the Ludborough and Vale House Flints). True Paramoudra have a central tube of chalk. Suggested that were originally a burrow that has acted as a zone for silica growth. Others advocate that all Paramoudras originate from sponges on the sea bed. https://www.flint-paramoudra.com/ Possibly not only 1 mechanism. Exhibits growth rings over thousands of years.

Ulceby Marl - partially volcanic ash


Ulceby Marl


Ulceby Oyster Bed

Marls are not good for correlation as they can split and disappear. On own not so good, but useful when comparing a sequence. Also need the fossils. The Ulceby Marl is one of several marl bands within the chalk of the Northern Province which has proved to contain volcanic ash and can be traced successfully into Saxony, Germany.


View from the west end of the quarry towards the east (entrance). Looking at the Ulceby marl & oyster bed on the north face

Location 4: Elsham Sandstone Pit

This location is in a privately owned field overlooking the Lincoln Edge to the west. It ceased to be a quarry many years ago and have become overgrown and used for grazing. There are a couple of exposures. Some of the exposed rocks are not in situ, the photo below is.

This exposure is in the WNW side of the field. 5 degrees dip. This is a medium to coarse grained sandstone

These sandstones are of Kimmeridge age. First mapped by BGS in 1946 and given as L Cret. Revised in 1963 after Kimmeridgian ammonites found here. Limited distribution. Extends north only to Bonby, only to Barnaby in the south (exposure at Gallows Hill). Lense of sand within the Kimmeridge clay. Believed to get coarser to the NW so believed to come from the NW. Maximum thickness is 9m.

At the Middlegate Lane Quarry, South Ferriby, we saw the lowermost 2 zones of the Kimmeridge, the zones above having been eroded. AS go south the section thickens as dips to the south. The uplift was the Market Weaton High (to the N&NW), which could be the origin for this sand. (The ironstone developed n the high also?). This sandstone could have extended to the north but may have been erode i.e. likely to have been more extensive. Always pinched out to the south.

Deposited as a quick flow of sand influx, possibly as a turbidite.