

Volcanoes, tropical seas, glaciers and elephants: geology of the Essex coast.

Bill George

Essex is generally an unprepossessing county with not a great deal of geology. However, at about 400 miles, it has the longest coastline of any county and it is constantly changing, presenting unrivalled exposures and a fantastic heritage of geology and archaeology in rocks ranging from chalk to alluvium. There are one or two hills in mid-Essex, with the highest point at 400 feet OD around Saffron Walden but along the Thames and the coast it is very flat. The River Thames has river and estuarine alluvium, with a small patch of chalk at Purfleet. The Essex cliffs at Clacton, Cudnose Grove and Shoeburyness have Pleistocene at 300,000 years, Harwich has Red Crag at 2Ma, Burnham, Southend and Frinton have London Clay at 50Ma and Walton on the Naze has Harwich Formation at 55Ma and Purfleet has the Upper Chalk at 85Ma.

The speaker took us on a tour of the Essex coast in 5 main areas:

- The Stour – Manningtree to Harwich;
- Walton Backwater to Brightlingsea;
- The Blackwater – Mersea to Bradwell;
- The Crouch – Burnham to Foulness; and
- The Thames – Shoeburyness to the Lea.

The Stour – Manningtree

A very low-lying area, Wrabness has Pleistocene sands and gravels and brickearth (210,000 years), Pliocene Red Crag (2Ma) and Eocene Harwich Formation (54Ma). A borehole sunk in 1894-5 at nearby Stutton in a search for coal went down to 1,525 feet and passed through alluvium, London Clay and Reading Beds, the Upper, Middle and Lower Chalk and the Gault, terminating in Silurian rocks (425Ma).

The cliffs on the right bank of the Stour at Wrabness have several white bands of volcanic ash, evidence of the North Atlantic Igneous Province (62-53Ma) during the break-up between Europe and Greenland. This explosive volcanic activity deposited more than 200 ash layers over Denmark, north-west Germany, the Netherlands, and south-east England. 30 or so ash bands may be seen at Wrabness, representing a massive volcanic eruption every few thousand years. The bands are not affected by sea-bed organisms. Whitaker of the Geological Survey sketched these bands in the 1880s to show the Wrabness Fault but described them as calcareous layers.



Wrabness Cliffs



Volcanic ash layers



Brickearth



The Wrabness mammoth

Wrabness Church is built of local cementstone, as is the font. In the Harwich Formation/Red Crag at Wrabness, shark teeth are common and there are selenite crystals in the cliff, locally called “Wrabness diamonds”. Pleistocene deposits in the cliff have fossil shells and elephant bones. The Wrabness mammoth was found in 1701 at a depth of 15-16 feet when digging for gravel and was considered by Morant in the 1760s to have been buried by the Romans. In 1803/1805, teeth found

at Walton and Harwich were considered to be remnants of Noah's flood and it was only in the 1820s that they were recognised as fossils.

The brickearth is very soft and easily eroded. In 1906 it yielded elephant and mammoth bones and in 2009, a mammoth mandible was found on the beach, as was an Acheulian hand-axe. Other archaeological finds have included hand axes at Harkstead, a Wrabness scraper and an Edward III half-noble of the 1360s, known as the cursing half-noble.

Harwich

An 1860s painting shows Harwich built on flat ground with London Clay cliffs to the south. Fossils have been collected from at least the 1690s, and Samuel Dale did a detailed description of the cliff in 1703 and described the fossils in an appendix to Silas Taylor's *The history and antiquities of Harwich and Dovercourt, in the County of Essex* in 1732. A borehole sunk in 1854-57 went through London Clay, Woolwich and Reading Beds, Chalk, Upper Greensand and Gault, terminating at 1,098 feet in Devonian rocks. The formerly exposed Red Crag cliff at Harwich had shelly sands deposited 50-80 feet deep in cool seas but it is now gone from here, though well exposed at Walton-on-the-Naze and Bawdsey.

The foreshore has cementstone and in 1528 Cardinal Wolsey had cement stone removed from the beach at Harwich for his college at Ipswich. In 1796, James Parker lodged a patent for a hydraulic cement used in damp proof stucco. There were many disputes about ownership of beach stones, which were owned by Lord of Manor, not the landowner. In 1828, at Steeple, on the Blackwater, a lease for sale of "clay noddles" payment in kind for chalk, rag stone and flint for sea walls and roads was made and between 1812-1845 several hundred thousand tons of stones were removed from the base of Beacon Cliff, Harwich. In 1845 the digging of stone within 50 feet of Harwich cliff was banned. In 1848 there were 200-300 boats dredging for stones and dredging took place as late as 1917.



Harwich cementstone



Shark teeth, London Clay

London Clay (55Ma) was deposited in a warm sea up to 600 feet deep under a subtropical climate. It is up to 500 feet thick, mainly stiff clay, silty, with sand at the base and top and contains cementstones and septaria. It took 3 million years to deposit. The fossil turtle *Chelonia harvicensis*, was dredged up in 1827 4 miles offshore. Other London clay fossils include the complete skeleton of a horse, lots of shark teeth, bird bones, crocodile skin, fish scales etc.

In the 1670s John Ray describes Copperas works at Brightlingsea and in 1730 Dale shows boys collecting copperas stones (iron pyrites washed out of London Clay) from Harwich beach. In 1772, a 21-year lease from the Earl of Rochford to Ephraim Seckl to collect stones from Walton was signed and the practice continued to about 1900, with further deeds being issued in 1870, 1884 and 1898.

Dovercourt Cliff had an interesting example of pulhamite on the cliff face. This material was developed by James Pulham (1793-1838), in a business started in 1806. It was a hydraulic lime or natural cement binder gauged with sand & other aggregates, which was applied to a masonry core. By the 1880s it looked more geologically authentic, so much so that one example at Lockinge, Berkshire, even fooled Sir Rodney Impey Murchison. This has now gone, having been covered up.

Walton Backwater to Brightlingsea

This part of the coast includes the “sunshine coast” resorts of Walton-on-the-Naze, Frinton, Clacton, Jaywick and Brightlingsea.

The Naze cliffs have London Clay and Harwich Formation with orange loess on top. Fossils finds here have included turtles, shark teeth, fish bones, echinoids and the Walton parrot and there are also tektites. Copperas stones on the beach, mainly bits of fossil wood, were picked by boys, who were given copperas tokens. The practice even made it into literature in Elisabeth Jeffrey’s novel *Mollie on the shore*. The Red Crag was the source of what was claimed at the time to be the oldest human portrait, dug from the cliffs in the 1870s; sadly the face was only fortuitous. John Brown (1780-1859) collected fossils from Walton and Clacton and was known as the elephant hunter.

The East Terrace at Walton-on-the-Naze had a low cliff from which lots of fossils – hyenas, rhinos, hippos – of Pleistocene and later age. The earliest reference found to Pleistocene mammals is to giant’s teeth by Ralph, abbot of Coggeshall (1207-18). There are lots of archaeological sites in the loess and alluvial deposits including the remains of Roman saltings. Flints were collected by John Hassell the artist and a human skeleton, the most complete prehistoric skeleton, was found in September 1910, 10 feet below the salting surface.



Naze cliffs, Walton



Naze cliffs



Red Crag

Frinton had more copperas digging and there were cliffs up to the 1930s to 1950s but all are protected now. Clacton has 2,020 feet of sea wall constructed in 1881. An important fossil site was discovered in the 1830s by John Brown an Essex amateur geologist and a river channel was exposed in the cliff and on the foreshore. Samuel Hazzledine Warren, an amateur geologist and archaeologist, of Loughton collected from the site in the early 1900s; finds included elephant remains, stone tools and a wooden spear. At Jaywick, the London Clay has crinoid stems and a fossil horse and a Pleistocene channel was formerly exposed in the cliffs.

The Blackwater

This area includes Mersea Island, Osea Island, Northey Island, Maylandsea, Steeple and Bradwell.

West Mersea has a well that was affected by the great Essex earthquake, of magnitude 4.7, which occurred at 9.18am on 22nd April 1884, with its epicentre near Colchester. It was quite a shallow earthquake and caused major damage to over 1,000 buildings, including churches and homes, with the cost of destruction being about £1,000 million at modern values. Cudmore Grove at East Mersea shows important Pleistocene channel deposits cut into the London Clay beneath alluvial gravels. Fossils found include hippopotamus, monkey, bear, beaver and straight-tusked elephant of Hoxnian age (300,000 years).



Cudmore Grove, London Clay



Pleistocene



Channel

Osea Island has Pleistocene gravels overlying London Clay, the latter having cementstone and fossils including lobster and crinoids. Palaeolithic flakes and Bronze Age flints have been found here. Maldon Church has cementstone from the beach containing fossil crinoids and with modern barnacles. Maylandsea has London Clay with shark teeth, brachiopods and foraminifera. Archaeology includes Mesolithic blades and arrowheads. Steeple Church, which was rebuilt in the 1880s, incorporates cementstone and other material from the previous church.

The River Crouch

Butts Cliff at Althorne is an important site for London Clay fossils, particularly fish teeth. All around the coast there are significant thicknesses of alluvium with archaeology from the Mesolithic, Bronze Age and Romans up the slope. A well at Foulness went through 41 feet of alluvium over 26 feet of London Clay, bottoming in the Chalk at over 500 feet depth.

Thames Estuary

The cliff at Shoeburyness is now gone. After a severe storm, Quarter Master Sergeant J.J. Gurnet found what was thought to be the remains of a “buried Viking ship complete with a litter of iron spear-heads” on the foreshore at Shoeburyness. In fact they were *Nipa burtini* (Brogniart) fruits from the London Clay and were associated with a double row of septarian nodules. Specimens were donated to the Natural History Museum, in 1913 by Colonel Alfred Peile (1868-1948). Specimens were also donated to the Geological Survey Museum and 80+ specimens were found in 2011/2012.

The cliffs at Southend are more or less covered now, while Hadleigh Castle has slumped London clay. A borehole at Canvey Island in the 1950s penetrated alluvium on London Clay underlain by Oldhaven Beds, Woolwich and Reading Beds, Thanet Beds, Chalk, Upper Greensand and Gault to reach Devonian sandstones and mudstones at 400m depth. A survey of archaeology at Hullbridge revealed differential occurrences of artefacts on 3 levels at 1.5m, 3.0m and 14.0m below sea level, with only Mesolithic artefacts on the lower level, Mesolithic and early Neolithic on the middle level and Mesolithic, early and late Neolithic on the upper level. At Tilbury, Richard Owen recorded the discovery of a human skeleton of Mesolithic age during the excavations for the East and West India Dock extensions

Grays long had a cement works using chalk and chalk has been extracted here since medieval times, when dene holes were dug. Quarries were excavated from the 1500s at Purfleet and Grays Thurrock for lime burning. Chalk has been used for fertilising the heavy Essex soils, as ballast, to repair sea walls, to make quick lime for building, for cement and to whiten toothpaste. In addition, flint was used for Stone Age tools, building, pottery manufacture and making gunflints and hard chalk, or clunch, has been used for interior walls and carved decoration in north Essex since the medieval period. Purfleet has chalk on the beach, at 85Ma, the oldest rock on the Essex coast. Purfleet had massive chalk cliffs in the 1700s to 1800s with Thanet Sand overlying the Chalk



Chalk on beach, Purfleet



Fossil hazelnuts



Rainham submerged forest

The Thames alluvium at Purfleet has a submerged forest exposed at extremely low tides (about 6 times per year), which has fossil hazelnuts from 8,000 years ago when sea level was 25m lower than today. The submerged forest at Rainham has massive tree trunks and the Dagenham breach in

the 1700s exposed a submerged forest, as did sewer excavation at Barking Creek and the excavation of the Royal Albert Dock in Newham.

Summary

In summary, Essex has the longest coast of any county, a coast which is constantly changing but it had or has unrivalled exposures of geology and archaeology, representing a fantastic heritage reflecting the changing environment over the last 90 million years. However, there is a need to beware, since exposures are rapidly disappearing and there are health and safety issues related to the risk of drowning, the tide and bait diggers, together with deep mud in creeks and possible unexploded ordnance.