

The geology of the Naze cliffs

The Naze is one of the finest geological sites in Britain. The cliffs provide a glimpse into several periods of the distant past: from a time when Essex was a subtropical sea to one of the coldest periods of the Ice Age. Both the Red Crag and the London Clay here are of international importance and the cliffs are a Site of Special Scientific Interest (SSSI).

The London Clay – a time of crocodiles and palm trees

The London Clay was deposited on the floor of a subtropical sea during the Eocene period, some **50 million years ago**, which was home to crocodiles, sharks, giant turtles, and hundreds of other creatures. Their fossils, such as sharks' teeth and fish bones, have been washed out of the cliffs onto the beach where they can be found amongst the shingle.

The coastline consisted of rainforest dominated by mangroves and palms, similar to that found in present day Malaysia. Plant material (logs, twigs, fruits and seeds) was washed into the sea and can be found fossilised in the clay. These have been replaced by pyrite (fools' gold) and sometimes accumulate on the beach here in great numbers. Rivers flowing into the London Clay Sea also carried the bones of mammals that lived in the rainforest, such as an early horse, which was no larger than a small dog. These fossils give us a glimpse of the rapid evolution of mammals following the extinction of the dinosaurs. The London Clay here is also famous for some of the best preserved bird fossils of Eocene age in the world.



Sharks' teeth from the London Clay

Eocene volcanoes

During the Eocene period the North Atlantic Ocean was just starting to open, and this was accompanied by intense volcanic activity in western Scotland.

Evidence of this is present here as pale bands in the London Clay cliffs which contain volcanic ash from these eruptions.



Neptunia contraria



Fossil shells in the Red Crag

The Red Crag – a sea teeming with shellfish

The Naze is famous for the Red Crag, a layer of sand stained red by iron oxide and containing huge numbers of fossil shells. It was laid down as dunes on a sea bed during the Pliocene period, about **3 million years ago**, when the climate was cool, just before the start of the Ice Age. The shoreline was close by, and the fossils show that the sea had an extraordinarily rich diversity of shellfish - nearly 300 species have been recorded from the Naze. The shells are quite fragile, and look like modern shells, but they are real fossils. They include *Neptunia contraria* - the 'left handed whelk', which spirals in the opposite direction to almost all other species of gastropod.

Thames gravel – when the Thames flowed through north Essex

In the early part of the Ice Age, about 600,000 years ago, the Thames flowed through north Essex, across this area, and out across what is now the southern North Sea to become a tributary of the Rhine. Evidence of this is a layer of gravel at the top of the cliff, laid down by the Thames and containing characteristic pebbles from upstream in the Thames valley.

Giant sharks

The Red Crag lies directly on the London Clay, which means the junction between the two represents a time interval of about 47 million years.

However, there are some fossils at this junction and these can sometimes be found on the beach, such as the bones of whales that lived in the Miocene period, and the huge teeth of *Carcharodon megalodon*, a 12 metre long shark that was the largest shark that ever lived.

Teeth of *Carcharodon megalodon* can be up to 15 centimetres long.

Evidence of an extremely cold climate

At the top of the cliffs the gravel and sand is noticeably contorted and folded. This must have occurred during the most recent glacial period between 20,000 and 15,000 years ago - one of the coldest periods of the Ice Age. The ground was then frozen to a considerable depth (permafrost) with only the top metre or so thawing during each brief summer and refreezing during the autumn, deforming the ground surface. The same freeze-thaw process is happening in the Arctic today.

