The geology of the area

The quarry site sits in the River Thames valley upstream from Fairford and contains extensive spreads of Pleistocene fluvial sediments that has preserved an older palaeochannel* which has lead to the discovery of an exceptionally abundant and well preserved accumulation of large animals (known as a megafaunal assemblage) in the northwest corner of the quarry.

*palaeochannel is a remnant of an inactive river or stream channel that has been either filled or buried by younger sediment.

Geological setting

The quarry is underlain by Middle Jurassic rocks belonging to the Kellaways sand formation which is approximately 168 million years old. The Kellaways beds at the location consist of silty, micaceous, grey and bluish grey sand capped by buff coloured calcareous sandstone.

The Kellaways beds in North Wiltshire and South Gloucestershire are exceptionally fossiliferous and there is an abundant ammonite fauna at the quarry which indicate that the beds belong to the zone of Sigaloceras calloviense (a type of ammonite from 165 million years ago).

Archaeologist excavates mammoth tusk. Credit: DigVentures

The geology of the area

Palaeochannel stratigraphy and sedimentology

The deposits at the quarry consist mainly of medium to coarse limestone gravels with minor fine grained sand. Analysis indicates that, in addition to limestone derived ultimately from the Jurassic escarpment to the north of the site, there are also significant quantities of locally derived sandstone blocks and shelly fossils as well as large 50cm-1metre diameter septarian nodules (clay that has been turned into stone and filled with calcite crystals).

Mammoth bones from Hollingworth and DigVentures collections. Credit: DigVentures

Archaeologist excavates a mammoth tibia. Credit: DigVentures

Within silty gravels are pockets of lighter coloured sand and shell rich silt that pass laterally into silty organic rich sand. The organic rich sand has
formed pockets and depressions around and beneath large mammal bones and tusks. These organic rich silts yield abundant plant macro fossils, molluscs and gastropods.

Many of the mammoth bones and other mammal remains are found at all angles in the palaeochannel and some bones show evidence of trampling which is commonly observed where elephants live today in Africa.

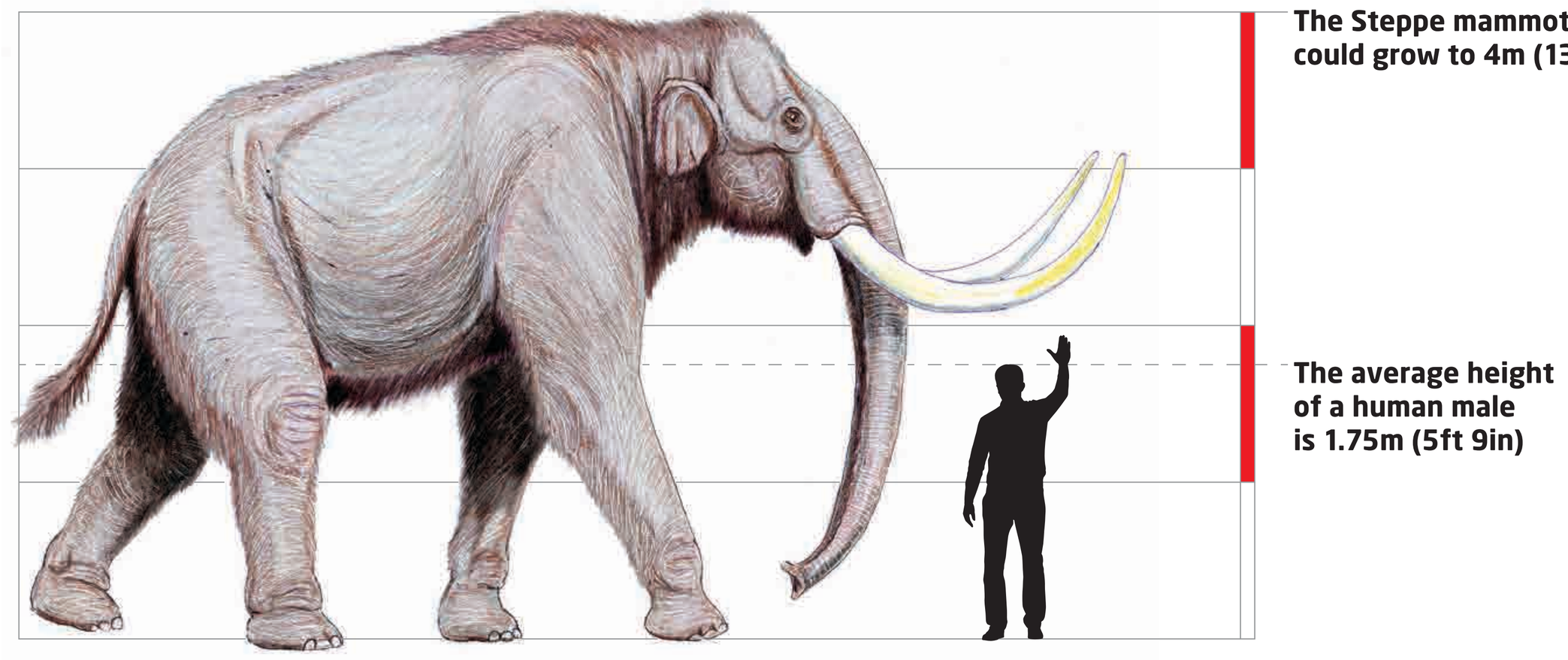
The geology of the area

Overlying younger Ice Age river gravels which are about 15,000 – 50,000 years old deposited during a very cold stage later in the Ice Age.

The Mammoth bearing channel deposit is underlain by Jurassic Bedrock of the Kellaways formation, approximately 165 million years old. This rock contains abundant ammonites and other fossils that lived in a tropical sea.

Old river channel beneath younger gravel that is incised into Jurassic Bedrock. It is filled with grey silt and sandy gravel with abundant Mammoth remains and is over 200, 000 years old. This channel was created during a warmer stage of the last Ice Age by the River Thames.

Steppe Mammoth
(Mammuthus trogontherii)



The Mammuthus trogontherii, is an extinct species of Elephantidae that ranged over most of northern Eurasia during the late Early and Middle Pleistocene, approximately 1.8 million-200,000 years ago.

It evolved in northern China during the Early Pleistocene from Mammuthus meridionalis which was a highly successful species that endured from 2.5 million to 0.75 million years ago. Starting about 2 million years ago northern China experienced an increasingly seasonal climate, with very cold winters and the spread of a largely open, grassy habitat.

These changes probably triggered evolution in a local population of Mammuthus meridionalis, resulting in the formation of the new species Mammuthus trogontherii, sometimes known as the 'Steppe mammoth'.

Mammuthus trogontherii retained the very large size of its immediate ancestor, being up to 4 metres tall (13 feet) with a body mass up to 10 tonnes.

After its origin in China, Mammuthus trogontherii spread to other regions of Eurasia as the climate cooled and new habitats were created. By a million years ago it had arrived in southern Russia, and by around 800,000 years ago in central Europe. Mammuthus trogontherii was the first mammoth to extend its range across the entire Artic Circle. It was the first stage in the evolution of the steppe and tundra elephants and the ancestor of the Woolly mammoth and Columbian mammoth of the later Pleistocene.

What was discovered?

Britain's biggest Ice Age discovery in recent years

The remains of at least five Ice Age mammoths, including tusks, leg bones, ribs and vertebrae from two adults, two juveniles, and one infant, were discovered, with a number of stone tools, including a hand axe, made by Neanderthals found nearby.

Archaeologists believe that both the artefacts and mammoth remains date to around 210,000 – 220,000 years ago, towards the end of a warmer interglacial period when Britain was still occupied by Neanderthals. Towards the end of this period, early humans abandoned Britain as temperatures dropped and the land was covered under ice.

Analysis has revealed that the bones belong to a species of Steppe mammoth, which predate the iconic Woolly mammoth, and may have been smaller and less hairy; although early Steppe mammoths were among the largest, with some standing up to 4m tall at the shoulder, the species shrank as the climate became colder. Some of the bones are now being examined for evidence of butchery.

Mammoth bone in situ before lifting. Credit: DigVentures

What was discovered?

Further evidence of Neanderthal activity was revealed on the site, including 'scrapers' – small flint tools that would have been used for cleaning fresh hides, as well as debris from making other unknown tools.

Excavations also recovered the remains of Steppe bison, brown bears, horse and hyena. Seeds, pollen and plant fossils, which showed that extinct types of trees and beetles lived around the site as well as more familiar species, like hornbeam were also recovered. The samples included dung beetles, who co-evolved with the Ice Age megafauna and whose droppings they used for food and shelter.

Together, this evidence has created a snapshot of a long-lost habitat, and provides new clues about biodiversity and Neanderthal behaviour in Ice Age Britain.

Archaeologists excavating mammoth bones. Credit: DigVentures

Who found it?

Hills Quarry Products provides significant resources toward identification, excavation, recording and reporting of the archaeology and geology in the areas where the company has established sand and gravel quarries.

This work relies heavily on close working partnerships with local planning authorities, academic entities and community interest groups. The co-operation provided by Hills to these partners has been acknowledged as 'crucial to the success of a project' – something which Hills is extremely proud of and keen to maintain.

This particular 'mammoth graveyard' site was first highlighted in 2017 when Hills gave special permission to Sally and Neville Hollingworth (left) to search part of the quarry.

Originally hoping to find Jurassic marine fossils, they instead chanced upon an extraordinary quantity of fossilised mammoth remains, and a stone hand axe.

Inset: A more typical ammonite find

Sally Hollingworth with mammoth bone

Further excavations

Tusk in situ. Credit: DigVentures

Preparing to move the tusk

Lifting the mammoth tusk. Credit: DigVentures

Conservation. Credit: DigVentures

Recognising the significance of the site, professional archaeologists from DigVentures were called in to lead detailed scientific investigation, involving archaeologists, geologists, palaeontologists, and climate scientists from five different universities and the Natural History Museum. Additional support and resources were provided by Historic England and Hills Quarry Products.

The excavations, which were carried out by DigVentures in 2019 and 2021, were filmed by Windfall Films for a BBC One documentary 'Attenborough and the Mammoth Graveyard' presented by Sir David Attenborough and Professor Ben Garrod.

Historic England

BBC

DigVentures

windfallfilms

Sir David Attenborough (second left) with Peter Andrew, Group Director, Andrew Liddle, Divisional Director and Olly Thompson, Quarry Manager, all from Hills Quarry Products. Mike Hill Chief Executive with mammoth tooth. Peter Andrew with mammoth humerus bone.

Hills