

World's oldest DNA sequenced from million-year-old mammoths

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The DNA showed that million-year-old steppe mammoths were already adapted to the cold long before wolly mammoths emerged

Teeth from mammoths buried in the Siberian permafrost for more than a million years have yielded the world's oldest DNA ever sequenced, according to a study published on Wednesday, shining the genetic searchlight into the deep past.

Researchers said the three specimens, one roughly 800,000 years old and two over a million years old, provide important insights into the giant Ice Age mammals, including the ancient heritage of the woolly [mammoth](#).

The genomes far exceed the oldest previously sequenced DNA—a horse dating between 780,000 to 560,000 years ago.

"This DNA is incredibly old. The samples are a thousand times older than Viking remains, and even pre-date the existence of humans and Neanderthals," said Love Dalen, a professor of evolutionary genetics at the Centre for Palaeogenetics in Stockholm, senior author of the study published in *Nature*.

The mammoths were originally discovered in the 1970s in Siberia and held at the Russian Academy of Sciences in Moscow.

Researchers first dated the specimens geologically, with comparisons to other species, like small rodents, known to be unique to particular time periods and found in the same sedimentary layers.

This suggested that two of the mammals were ancient steppe mammoths more than a million years old.

The youngest of the trio is one of the earliest woolly mammoths yet found.



Researchers said the DNA provides important insights into the giant Ice Age mammals

DNA jigsaw

They also extracted [genetic data](#) from tiny samples of powder from each mammoth tooth, "essentially like a pinch of salt you would put on your dinner plate," Dalen told a press briefing.

While it had degraded into very small fragments, scientists were able to sequence tens of millions of chemical base pairs, which make up the strands of DNA, and conduct age estimates from genetic information.

This suggested that the oldest mammoth, named Krestovka, is even older

at approximately 1.65 million years old, while the second, Adycha, is around 1.34 million years old, and the youngest Chukochya is 870,000 years old.

Dalen said the discrepancy for the oldest mammoth could be an underestimation in the DNA dating process, meaning the creature was likely around 1.2 million years old, as suggested by the geological evidence.

But he said it was possible the specimen was indeed older and had thawed out of the permafrost at one point and then become wedged in a younger layer of sediment.

The DNA fragments were like a puzzle with millions of tiny pieces, "way, way, way smaller than you would get from modern high quality DNA", said lead author Tom van der Valk, of the Science for Life Laboratory, Uppsala University.

Using a genome from an African elephant, a modern relative of the mammoth, as a blueprint for their algorithm, researchers were able to reconstruct parts of the mammoth genomes.

The study found that the older Krestovka mammoth represents a previously unrecognised genetic lineage, which researchers estimated diverged from other mammoths around two million years ago and was ancestral to those that colonised North America.



It may be possible to sequence even older DNA from remains found in the permafrost, which dates back 2.6 million years

The study also traced the lineage from the million-year-old Adycha steppe mammoth to Chukochya and other more recent woolly mammoths.

It found gene variants associated with life in the Arctic, like hairiness, thermoregulation, fat deposits and cold tolerance in the older specimen, suggesting mammoths were already hairy long before the woolly mammoth emerged.

Ice Age giants

Siberia has alternated between dry and cold Ice Age conditions and warm, wet periods.

Now climate change is melting the permafrost and revealing more specimens, Dalen said, although higher rainfall could mean remains are washed away.

He said new technologies mean it may be possible to sequence even older DNA from remains found in the permafrost, which dates back 2.6 million years.

Researchers are keen to look at creatures such as the ancestors of moose, muskox, wolves, and lemmings, to shine a light on the evolution of modern species.

"Genomics has been pushed into deep time by the giants of the Ice Age," said Alfred Roca, a professor in the Department of Animal Sciences at the University of Illinois, in a comment piece published in *Nature*.

"The wee mammals that surrounded them might soon also have their day."

More information: Million-year-old DNA sheds light on the genomic history of mammoths, *Nature* (2021). [DOI: 10.1038/s41586-021-03224-9](https://doi.org/10.1038/s41586-021-03224-9) , dx.doi.org/10.1038/s41586-021-03224-9

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