



Press Release

Europe's Late Neanderthals descended from a single population

New study from the Senckenberg Nature Research Society and the University of Tübingen illustrates huge upheavals in Neanderthals' genetic history

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A recent study incorporating new DNA data and archaeological evidence has shown that the last Neanderthals in Europe experienced a major population turnover, resulting in little diversity in their gene pool prior to their disappearance some 40,000 years ago. In the study, an international research team led by Professor Cosimo Posth at the Senckenberg Center for Human Evolution and Palaeoenvironment at the University of Tübingen traced the dramatic genetic history of European Neanderthals. Researchers had already indications that Europe's widespread earlier Neanderthal populations had largely disappeared. The new study indicates that one localized group had survived the harsh conditions by retreating to a climate refuge some 75,000 years ago in what is now southwestern France – and that the descendants of these survivors spread across Europe after 65,000 years ago. Genetically, almost all Late Neanderthals descended from this one lineage.

Posth and his team also found that these Neanderthals later suffered a sharp decline in population around 45,000 years ago. This fall in numbers was rapid, reaching a minimum around 42,000 years ago – shortly before the Neanderthals became extinct altogether. The study has been published in the journal *PNAS*.

Genetically, Neanderthals can be clearly distinguished from modern humans, *Homo sapiens*, who replaced Neanderthals by around 40,000 years ago. "We have evidence that Neanderthals inhabited Europe continuously between 400,000 and 40,000 years ago. However, we have only fragmentary details of their population history," says Posth. "So far, we know very little about the evolutionary developments that preceded

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their extinction.” He and his research team were therefore particularly interested in the Late Neanderthals, who lived between about 60,000 and 40,000 years ago.

Ten rare new individuals

In their study, the researchers focused on the mitochondria in various samples of Neanderthal teeth and bones found in caves and rockshelters. These cell organelles – tiny organs within the cell – have their own DNA, which is inherited independently of the main DNA in the cell nucleus. “Mitochondrial DNA does not contain nearly as much genetic information as the entire genome of a human being, but it usually survives longer and is easier to obtain,” says Charoula Fotiadou from Posth's research group and first author of the study.

The team sequenced the mitochondrial DNA of ten new Neanderthal individuals from six archaeological sites in Belgium, France, Germany, and Serbia. These were analyzed alongside 49 other previously published samples of Neanderthal mitochondrial DNA. The results were combined with data on the presence of Neanderthals in Europe drawn from the large-scale archaeological database, ROAD, developed by the ROCEEH (The Role of Culture in Early Expansions of Humans) project of the Heidelberg Academy of Sciences, the Senckenberg Research Institute and Natural History Museum Frankfurt and the University of Tübingen. “This allowed us to combine the two lines of evidence and reconstruct the demographic history of Neanderthals in terms of space and time,” said study co-author Jesper Borre Pedersen from the ROCEEH project.

Late Neanderthals all of the same stock

The study indicates that the harsh climatic conditions of the Ice Age around 75,000 years ago severely affected European Neanderthals and depleted their genetically diverse populations. The researchers say around that time archaeological sites decline in number and become increasingly concentrated in southwestern Europe. “Our data enabled us to reconstruct geographically that Neanderthals retreated to what is now southwestern France. There, around 65,000 years ago, a new population emerged and later spread across the whole of Europe,” says Posth. “This explains why almost all Late Neanderthals sequenced so far – from the Iberian Peninsula to the Caucasus – belong to the same line of inherited mitochondrial DNA.” This demonstrates an enormous upheaval in the genetic history of European Neanderthals.

In addition, the researchers used a statistical program to calculate whether the genetic changes in mitochondrial DNA diversity over time were consistent with the assumption of a population of constant size. This was not the case: according to the calculation, the number of Neanderthals declined rapidly and sharply between 45,000 and 42,000 years ago. “Genetically speaking, the Late Neanderthals were

a very homogeneous group.” says Posth. “So it may be that the low genetic diversity – and possibly also the subsequent isolation of small groups – contributed to the disappearance of the Neanderthals.”



Entrance to Pešturina Cave in Serbia, where a Neanderthal tooth genetically analyzed in this study was discovered. Photo: Dusan Mihailovic



Excavations at the Tourtoirac rock shelter in France, where three Neanderthal remains analyzed in this study were found. Photo: Luc Doyon



Artist's impression of the glacial landscape encountered by Neanderthals during the Ice Age: Direction de l'archéologie du Pas-de-Calais / Benoît Clarys



Collection of Neanderthal skeletal elements retrieved from Goyet Cave in Belgium, three of which are investigated in this study. Photo: Royal Belgian Institute of Natural Sciences



Artist's reconstruction of the Neanderthal foetus from Sesselfelsgrötte in Germany. One of the highlighted bones recovered from this individual was analysed in this study.

Image: Alice Walczel Baldinazzo

Publication:

Charoula M. Fotiadou, Jesper Borre Pedersen, Hélène Rougier, Mirjana Roksandic, Maria A. Spyrou, Kathrin Nägele, Ella Reiter, Hervé Bocherens, Andrew W. Kandel, Miriam N. Haidle, Timo P. Streicher, Nicholas J. Conard, Flora Schilt, Ricardo Miguel Godinho, Thorsten Uthmeier, Luc Doyon, Patrick Semal, Johannes Krause, Alvis Barbieri, Dušan Mihailović, Isabelle Crevecoeur, Cosimo Posth: Archaeogenetic insights into the demographic history of Late Neanderthals. *PNAS*, <https://doi.org/10.1073/pnas.2520565123>

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