Siberian Fossils Were Neanderthals' Eastern Cousins, DNA Reveals

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Published: December 22, 2010

An international team of scientists has identified a previously shadowy human group known as the Denisovans as cousins to Neanderthals who lived in Asia from roughly 400,000 to 50,000 years ago and interbred with the ancestors of today's inhabitants of New Guinea.

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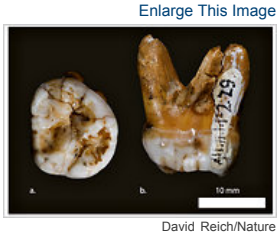


David Reich/Nature

The entire genome of the Denisovans was extracted from a tooth and finger bone.

All the Denisovans have left behind are a broken finger bone and a wisdom tooth in a Siberian cave. But the scientists have succeeded in extracting the entire genome of the Denisovans from these scant remains. An analysis of this ancient DNA, published on Wednesday in Nature, reveals that the genomes of people from New Guinea contain 4.8 percent Denisovan DNA.

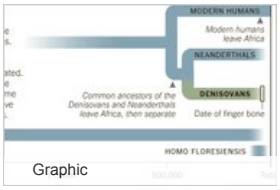
An earlier, incomplete analysis of Denisovan DNA had placed the group as more distant from both Neanderthals and humans. On the basis of the new findings, the scientists propose that the ancestors of Neanderthals and Denisovans emerged from Africa half a million years ago. The Neanderthals spread westward, settling in the Near East and Europe. The Denisovans headed east. Some 50,000 years ago, they interbred with humans expanding from Africa along the coast of South Asia, bequeathing some of their DNA to them.

"It's an incredibly exciting finding," said Carlos Bustamante, a Stanford University geneticist who was not involved in the research.

The research was led by Svante Paabo, a geneticist at the Max Planck Institute for Evolutionary Anthropology in Liepzig, Germany. Dr. Paabo and his colleagues have pioneered methods for rescuing fragments of ancient DNA from fossils and stitching them together. In May, for example, they published a complete Neanderthal genome.

The stocky, barrel-chested Neanderthals left a fossil record stretching from about 240,000 to 30,000 years ago in Europe, the Near East and Russia. Analyzing the Neanderthal genome, Dr. Paabo and his colleagues concluded that humans and Neanderthals descended from common ancestors that lived 600,000 years ago.

Multimedia



Graphic

Traces of Ancient DNA

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But the scientists also found that 2.5 percent of the Neanderthal genome is more similar to the DNA of living Europeans and Asians than to African DNA. From this evidence they concluded that Neanderthals interbred with humans soon after they emerged from Africa roughly 50,000 years ago.

Dr. Paabo's success with European Neanderthal fossils inspired him and his colleagues to look farther afield. They began to work with Anatoli Derevianko of the Russian Academy of Sciences, who explores Siberian caves in search of fossils of hominins (species more closely related to living humans than to chimpanzees, our closest living relatives).

Last year, Dr. Derevianko and his colleagues sent Dr. Paabo a nondescript fragment of a finger bone from a cave called Denisova. Dr. Derevianko thought that the fossil, which is at least 50,000 years old, might have belonged to one of the earliest humans to live in Siberia.

Dr. Paabo and his colleagues isolated a small bundle of DNA from the bone's mitochondria, the energy-generating structures within our cells. Dr. Paabo and his colleagues were surprised to discover that the Denisova DNA was markedly different from that of either humans or Neanderthals. "It was a great shock to us that it was distinct from those groups," Dr. Paabo said in an interview.

Dr. Paabo and his colleagues immediately set about to collect all the DNA in the Denisova finger bone. Once they had sequenced its genome, they sent the data to researchers at Harvard Medical School and the Broad Institute in Cambridge, Mass., to compare with other species.

The Massachusetts scientists concluded that the finger bone belonged to a hominin branch that split from the ancestors of Neanderthals roughly 400,000 years ago. Dr. Paabo and his colleagues have named this lineage the Denisovans.

Next, the researchers looked for evidence of interbreeding. Nick Patterson, a Broad Institute geneticist, compared the Denisovan genome to the complete genomes of five people, from South Africa, Nigeria, China, France and Papua New Guinea. To his astonishment, a sizable chunk of the Denisova genome resembled parts of the New Guinea DNA.

"The correct reaction when you get a surprising result is, 'What am I doing wrong?' " said Dr. Patterson. To see if the result was an error, he and his colleagues sequenced the genomes of seven more people, including another individual from New Guinea and one from the neighboring island of Bougainville. But even in the new analysis, the Denisovan DNA still turned up in the New Guinea and Bougainville genomes.

If the Denisovans did indeed have a range spreading from Siberia to South Asia, they must have been a remarkably successful kind of human. And yet, despite having the entire genome of a Denisovan, Dr. Paabo cannot say much yet about what they were like. "By sequencing my complete genome, there's very little you could predict about what I look like or how I behave," he said.

One solid clue to what the Denisovans looked like emerged in January. Dr. Paabo and his team had flown to Novosibirsk to share their initial results with Dr. Derevianko. Dr. Derevianko then presented them with a wisdom tooth from Denisova.

Bence Viola, a paleoanthropologist in the Department of Human Evolution at the Max Planck Institute of Evolutionary Anthropology, who was at the meeting, was flummoxed. "I looked at it and said, 'Ah, O.K., this is not a modern human, and it's definitely not a Neanderthal,'" said Dr. Viola. "It was just so clear."

The tooth had oddly bulging sides, for one thing, and for another, its large roots flared out to the sides. Back in Germany, Dr. Paabo and his colleagues managed to extract

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some mitochondrial DNA from the tooth. It proved to be a nearly perfect match to that of the Denisova finger bone.

That match offers some hope that if researchers can find the same kind of tooth on a fossil skull, or perhaps even a complete skeleton, they'll be able to see what these ghostly cousins and ancestors looked like in real life.

Dr. Bustamante also thinks that other cases of interbreeding are yet to be discovered. "There's a lot of possibility out there," he said. "But the only way to get at them is to sequence more of these ancient genomes."