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Actualité
Paléontologie humaine

L'homme de Denisova, nouveau cousin ?

Une troisième espèce humaine, contemporaine de l'homme de Néandertal et de l'homme moderne, aurait été identifiée par les gènes contenus dans un os de la main découvert en Sibérie.

François Savatier

Out of Africa ? Oui, l'espèce humaine a essaimé à partir de l'Afrique, mais quand ? Un fossile daté d'environ 40000 ans retrouvé en Sibérie complique l'énigme : le séquençage des gènes qu'il contenait suggère qu'il appartient à un hominidé, qui n'était ni un Néandertalien ni un homme moderne.

Le fossile provient de l'Altaï sibérien, et plus précisément de la grotte de Denisova, une grande cavité très riche en traces et artefacts préhistoriques, car elle a été occupée pendant 125 000 ans. Johannes Krause et ses collègues, de l'Institut Max-Planck de Leipzig et de diverses universités européennes et américaines, viennent de séquencer entièrement l'ADN mitochondrial contenu dans l'un des rares fossiles humains de la grotte de Denisova, un os isolé appartenant à un doigt.

L'ADN mitochondrial est issu des mitochondries, des organites cellulaires. Il contient environ 16 000 bases. Pour analyser le génome mitochondrial de la nouvelle espèce, les chercheurs ont appliqué une méthode d'amplification spécifique de séquences d'ADN (PCR modifiée), mise au point récemment pour séquencer l'ADN mitochondrial des Néandertaliens sans craindre les contaminations.

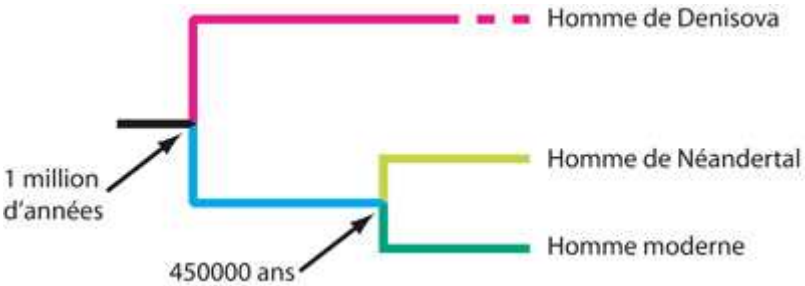
La comparaison de la séquence obtenue – la séquence complète de l'ADN mitochondrial de l'individu – a révélé qu'elle différait trop de l'ADN mitochondrial des Néandertaliens et des hommes modernes pour qu'on puisse conclure que l'individu séquencé appartenait à l'une de ces espèces. Or le fragment osseux provient d'une strate de la grotte datée entre 48 000 et 30 000 ans avant le présent… Ainsi, à une époque où des hommes modernes et des hommes de Néandertal vivaient en Sibérie, le bout de doigt de Denisova suggère fortement qu'une troisième espèce humaine y vivait aussi ! Chose remarquable, ce serait la première fois qu'une espèce humaine est découverte seulement à partir de ses gènes.

Mais de quelle espèce s'agit-il ? Les ancêtres des Néandertaliens et des hommes modernes ont divergé en Afrique, il y a environ 450 000 ans, avant que certains de leurs descendants ne quittent le continent, il y a quelque 250 000 ans pour les premiers et 100 000 ans pour les seconds. Les chercheurs ont établi un nouvel arbre phylogénétique du genre *Homo* intégrant la nouvelle espèce probable. L'ancêtre commun des Néandertaliens, de l'homme moderne et de l'homme de Denisova aurait vécu il y a environ un million d'années. Dans ce cas, il est impossible que l'homme de Denisova descende d*e Homo erectus,* puisque celui-ci a migré vers l'Eurasie 900 000 ans avant que ne vive cet ancêtre commun, soit il y a 1,9 million d'années. Il semble donc qu'une vague humaine passée inaperçue jusqu'à aujourd'hui aurait quitté l'Afrique il y a un million d'années environ.

Cette découverte est plus qu'inattendue, et certains préhistoriens répugnent encore à la considérer comme certaine sur la seule base de l'ADN mitochondrial. Pour mieux apprécier la distance génétique entre la probable nouvelle espèce, *Homo neanderthalensis* et *Homo sapiens*, les chercheurs ont entrepris d'extraire de l'ADN nucléaire de l'os du doigt. Toutefois, pour vraiment convaincre les préhistoriens, il faudrait leur trouver un fossile plus complet d'homme de Denisova...

Johannes Krause/Institut Max-Planck

La grotte de Denisova est située dans un endroit sauvage de l'Altaï sibérien. Elle a été occupée par des hommes durant 125 000 ans et contient de nombreuses traces de leurs passages, dont quelques fragments de fossiles humains.



François Savatier/Pour la Science

L'ancêtre commun aux deux espèces humaines connues et à la nouvelle espèce découverte dans la grotte de Denisova aurait vécu il y a un million d'années environ

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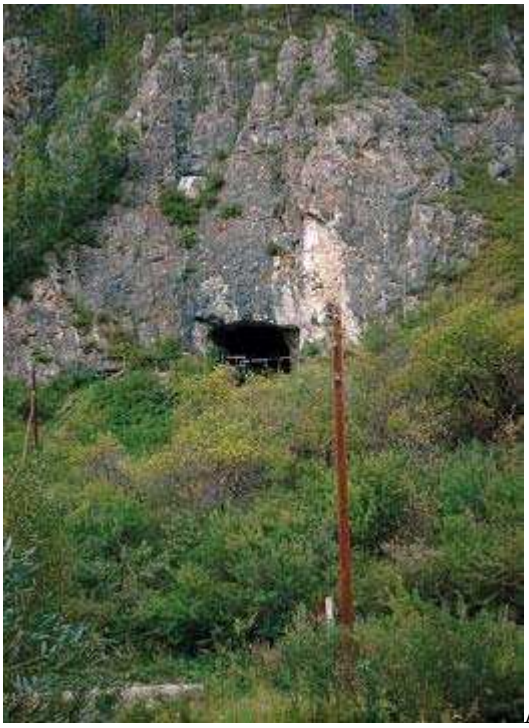
News

Fossil finger points to new human species

DNA analysis reveals lost relative from 40,000 years ago.

Rex Dalton

In the summer of 2008, Russian researchers dug up a sliver of human finger bone from an isolated Siberian cave. The team stored it away for later testing, assuming that the nondescript fragment came from one of the Neanderthals who left a welter of tools in the cave between 30,000 and 48,000 years ago. Nothing about the bone shard seemed extraordinary.


A finger bone found in Denisova Cave in Siberia could add a branch to the human family tree.B. VIOLA

Its genetic material told another story. When German researchers extracted and sequenced DNA from the fossil, they found that it did not match that of Neanderthals — or of modern humans, which were also living nearby at the time. The genetic data, published online in Nature[1], reveal that the bone may belong to a previously unrecognized, extinct human species that migrated out of Africa long before our known relatives.

"This really surpassed our hopes," says Svante Pääbo, senior author on the international study and director of evolutionary genetics at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. "I almost could not believe it. It sounded too fantastic to be true."

Researchers not involved in the work applauded the findings but cautioned against drawing too many conclusions from a single study. "With the data in hand, you cannot claim the discovery of a new species," says Eske Willerslev, an evolutionary biologist and director of the Centre for GeoGenetics at the University of Copenhagen.

> “I almost could not believe it. It sounded too fantastic to be true.”

If further work does support the initial conclusions, the discovery would mark the first time that an extinct human relative had been identified by DNA analysis. It would also suggest that ice-age humans were more diverse than had been thought. Since the late nineteenth century, researchers have known that two species of Homo — Neanderthals and modern humans — coexisted during the later part of the last ice age. In 2003, a third species, Homo floresiensis, was discovered on the island of Flores in Indonesia, but there has been no sign of this tiny 'hobbit' elsewhere. The relative identified in Siberia, however, raises the possibility that several Homo species ranged across Europe and Asia, overlapping with the direct ancestors of modern people.

The Siberian site in the Altai Mountains, called Denisova Cave, was already known as a rich source of Mousterian and Levallois artefacts, two styles of tool attributed to Neanderthals. For more than a decade, Russian scientists from the Institute of Archaeology and Ethnology in Novosibirsk have been searching for the toolmakers' bones. They discovered several bone specimens, handling each potentially important new find with gloves to prevent contamination with modern human DNA. The bones' own DNA could then be extracted and analysed.

When the finger bone was discovered, "we didn't pay special attention to it", says archaeologist Michael Shunkov of the Novosibirsk institute. But Pääbo had established a relationship with the Russian team years before to gather material for genetic testing from ice-age humans. After obtaining the bone, the German team extracted the bone's genetic material and sequenced its mitochondrial DNA (mtDNA) — the most abundant kind of DNA and the best bet for getting an undegraded sequence from ancient tissue.

After re-reading the mtDNA sequences an average of 156 times each to ensure accuracy, the researchers compared them with the mtDNA genomes of 54 modern humans, a 30,000-year-old modern human found in Russia and six Neanderthals. The Denisova Cave DNA fell into a class of its own. Although a Neanderthal mtDNA genome differs from that of Homo sapiens at 202 nucleotide positions on average, the Denisova Cave sample differed at an average of 385 positions.

The differences imply that the Siberian ancestor branched off from the human family tree a million years ago, well before the split between modern humans and Neanderthals. If so, the proposed species must have left Africa in a previously unknown migration, between that of Homo erectus 1.9 million years ago and that of the Neanderthal ancestor Homo heidelbergensis, 300,000 to 500,000 years ago.

Study author Johannes Krause, also at the Max Planck Institute in Leipzig, says that the researchers are now generating nuclear DNA sequences from the bone with the hope of sequencing its entire genome. If they are successful, it would be the oldest human genome

sequenced, eclipsing that of the 4,000-year-old Eskimo from Greenland that Willerslev and his colleagues reported last month[2].

A complete genome might also enable the researchers to give the proposed new species a formal name. They had originally planned to do so on the basis of the mtDNA genome. But they opted to wait until more bones are found — or until the DNA gives a clearer picture of its relationship to modern humans and Neanderthals.

Willerslev emphasizes that, on its own, the mtDNA evidence does not verify that the Siberian find represents a new species because mtDNA is inherited only from the mother. It is possible that some modern humans or Neanderthals living in Siberia 40,000 years ago had unusual mtDNA, which may have come from earlier interbreeding among H. erectus, Neanderthals, archaic modern humans or another, unknown species of Homo. Only probes of the nuclear DNA will properly define the position of the Siberian relative in the human family tree.

Anthropologists also want to see more-refined dating of the sediments and a better description of the finger bone itself. "I haven't seen a picture of the bone, and would like to," says Owen Lovejoy, an anthropologist at Kent State University in Ohio. "The stratigraphic age for the bone is 30,000 to 48,000 years old, but the mtDNA age could be as old as H. erectus," says Lovejoy. "That doesn't tell us much about human evolution unless it truly represents a surviving ancient species."

The cave has yielded few clues about the culture of the Siberian hominin, although a fragment of a polished bracelet with a drilled hole was found earlier in the same layer that yielded the bone[3].

Pääbo suspects that other human ancestors — and new mysteries — may emerge as geneticists grind up more ancient bones for sequencing. "It is fascinating that molecular studies make a contribution in palaeontology where there is little or no morphology preserved," he says. "It is clear we stand just in the beginning of many fascinating developments."