

# Mammoths might have declined due to mineral starvation

October 28 2015

---



A fragment of the calf skull. Credit: ©TSU

At the end of the Pleistocene, mammoths of Northern Eurasia used to experience chronic mineral hunger. They became extinct due to geochemical stress arising from deep abiotic changes in ecosystems.

Most likely, they were receiving insufficient amounts of essential chemical elements. This hypothesis was developed by TSU paleontologists and based on a large-scale, 15-year research project. Detailed information was published in *Archaeological and Anthropological Sciences*. Sergei Leshchinsky, head of the Laboratory of Mesozoic and Cenozoic continental ecosystems at Tomsk State University is the first author.

Researchers around the world seek the causes of the extinction of the most prominent late Pleistocene megafauna, the mammoths. One theory holds that the species declined due to changes in microclimate and anthropogenic pressure, and possibly the simultaneous effect of both factors. There are other much less popular theories of their extinction: infectious diseases or the impacts of celestial objects. However, little research exists exploring geochemical environmental changes where mammoths lived.

Investigating the remains of late mammoths, researchers frequently find obvious signs of skeletal diseases such as osteoporosis, osteofibrosis, osteomalacia (softening and bending of bones), arthrosis, and other joint diseases, according to Leshchinsky. He emphasizes that articular surfaces of extremity bones in some individuals appear to be damaged and mutilated by these diseases. Osteoporosis was observed in 90 percent of specimens in separate collections.

These diseases resulted in significant trauma in the animals, which suffered sprains and fractures, even at very low loads. Mammoths with broken limbs or spines could not find food in sufficient quantities and could not follow the herd. Such individuals died quickly, hunted by predators. As a result, nature was stronger than the giant animals, and mammoths became extinct.

From 2003 to 2013, Leshchinskiy analyzed over 23,500 bones and teeth

of mammoths in Northern Eurasia to identify the symptoms of enzootic diseases. The destructive changes were revealed with the help of a magnifying glass ( $\times 10$ ), in polished sections and histological sections under a stereomicroscope (magnification up to  $200\times$ ) and a scanning electron microscope (magnification up to  $10,000\times$ ), as well as by roentgenoscopy and densitometry.

Lechinsky investigated [mammoth](#) bones and teeth discovered in beast solonetz lacustrine-alluvial localities of Russia, Poland and the Czech Republic.

The beast solonetz is the Russian term for a ground surface area characterized by a high content of certain macro- and micro-elements; as such, it has a broader interpretation than "salt lick," "mineral lick" and "mineral source." Within the confines of the beast solonetz, animals eat soil and rocks and drink mineralized water from springs to maintain homeostasis, which is equivalent to the definition of "lithophagy."

Most chemical elements are necessary for animals to maintain the health of bones, muscles, skin, sensory systems, and others. Mineral starvation can result in mass deaths.

Lithophagy or geophagy as practiced by primates is a common phenomenon; there is little doubt, therefore, that the mammoth was the largest of all lithophages in the Late Pleistocene of Northern Eurasia. This assertion is also confirmed by the frequent availability of mineral substances in the gastro-intestinal tracts of mammoth carcasses and their coprolites, sometimes reaching 90 percent of their mass.



Sergei Leshchinsky on Krakow Spadzista Street. Credit: ©TSU

Acute mineral starvation became widespread in mammoths and other large mammals. Mammoths' particular vulnerability to mineral starvation is reflected by specific mammoth "cemeteries" of the late Pleistocene.

TSU researchers found widespread destructive changes in [mammoth bones](#) and teeth in up to 70 percent or more of the remains in different collections. In most cases, multiple conditions due to mineral starvation accompany one another, which may indirectly show the same causes. The most common disease observed is osteoporosis. Researchers note rarefaction in all age groups including infant mammoths, which means that disease development began in the prenatal period, since females suffered from mineral starvation. Above all, since bone resorption in osteoporosis may be mild, the real proportion of remains with signs of osteodystrophy is likely to be higher than can be detected via superficial examination.

Why did mammoths and other [large herbivores](#) with large skeletons experience strong geochemical stress during the Pleistocene?

At that time, there was a considerable expansion of acidic and acidic gley geochemical landscapes, resulting in a drastic deficiency of Ca, Mg, Na, P, I, Co, Cu, Se, Zn and other vital [chemical elements](#). The change in habitat is closely associated with the drastic replacement of favourable Ca-Mg-Na landscapes with acidic and acidic-gley ones.

Acidic-gley landscapes reached maximum range by the end of the Pleistocene, and are still the predominant landscape in most of Northern Eurasia today. This transition can be explained by the general neotectonic lift, which was subsequently followed (17-10 ka BP) by changes in the macroclimate, which became more humid and warmer. As a result, coastal lowlands were flooded and central areas were

swamped (degrading permafrost being one of the reasons). The soils of the high plains and foothills were heavily leached due to a lowering of the ground water levels and increased precipitations. In this situation, only rare best solonetz landscapes could have served as geochemical oases where the large herbivores could satisfy their mineral hunger. However, by the early Holocene, there may have been an insufficient number of these oases to support the viability of isolated mammoth populations. A similar abiotic scenario may prevail for North America, where mammoths went extinct at the same time.

Mammoth body size decrease and massive destructive changes in their bones and teeth indicate the negative impact of the abiotic environment. Osteoporosis, osteomalacia, and diseases of the joints indicate a metabolic disorder of alimentary nature.

The analysis of the clinical picture of the diseases deserves special attention—how rapidly did the disturbances in homeostasis and the formation of osteodystrophy occur in unfavourable geochemical conditions? Based on this study, it appears that the destructive changes developed rapidly. Extensive bone pathologies such as those found in the Taymyrskiy mammoth or in the Shestakovo-Kochegur, Berelyokh, Lugovskoe and Krakow Spadzista Street mammoth populations are incompatible with a long developmental period. Conditions of smaller and fewer geochemical oases and winter drinking water restricted to snow or acidic swampy-ground waters suggests that the "later" mammoths may have suffered from chronic mineral deficiency for six to 10 months a year.

"It is highly probable that these severe conditions lasted for more than 15 thousand years and may have proven fatal for the largest representatives of the terrestrial fauna at high latitudes," Leshchinskiy said. The woolly rhinoceros and cave bear may have suffered the same fate. Other large herbivores like bison, horses and deer, have overcome the Holocene

border, perhaps due to greater mobility, although with a significant reduction of habitat and population size. Large cats and hyenas likely went extinct due to drastic reduction of nutritional resources at the time of the disintegration of the single "mammoth" ecosystem.

The very high percentage of skeleton pathologies suggests a high murrain among mammoths, irrespective of anthropogenic impact, which could not lead to species extermination throughout its huge territory. Man was a witness and one of the participants in the natural process of the Pleistocene megafauna's extinction.

**More information:** Sergey Leshchinskiy. Enzootic diseases and extinction of mammoths as a reflection of deep geochemical changes in ecosystems of Northern Eurasia, *Archaeological and Anthropological Sciences* (2014). [DOI: 10.1007/s12520-014-0205-4](https://doi.org/10.1007/s12520-014-0205-4)

Provided by National Research Tomsk State University

Citation: Mammoths might have declined due to mineral starvation (2015, October 28) retrieved 25 April 2024 from <https://phys.org/news/2015-10-mammoths-declined-due-mineral-starvation.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.