Mammuthus sp. (Early and Middle Pleistocene Mammoths)

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Lessons Learned

Mammoths, *Mammuthus* sp., are iconic megafauna species that came to symbolize the Ice Age. However, the typical Late Pleistocene forms, which we know as the woolly and Columbian mammoths, were only the youngest offshoots on the mammoth evolutionary tree. The time window during which mammoths acquired traits that made them adapted to the cold environment has now become clearer thanks to genomic data from three Early and Middle Pleistocene mammoths. Two of these, identified as steppe-mammoths and called Krestovka and Adycha, lived >1 million years ago (Mya) and represent two independent genetic lineages. The third mammoth, Chukochya, is a 650 000-year-old early representative of the woolly mammoth, which descended from the Adycha lineage. Analyses of gene variants, previously identified as underlying cold adaptation in the woolly mammoth, showed that more than 80% of these were already present in the Adycha genome, that is, before woolly mammoths evolved. This includes genes potentially involved in thermal sensation, hair growth, and circadian rhythms.

Fun fact about the Genome

One of the key genes in the evolution of the mammoth lineage is *TRPV3*, which encodes a temperature-sensitive transient receptor channel. The *TRPV3* gene was essential for cold adaptation due to its pleiotropic action, affecting at the same time thermosensation, hair growth, and build-up of fat deposits. Previous studies showed that mice...
with TRPV3 knockout prefer colder temperatures. Interestingly, of the four substitutions observed in the TRPV3 gene in the Late Pleistocene woolly mammoths, we observed only two in the early woolly mammoth (Chukochya) and its ancestor (Adycha).

**Declaration of Interests**

There are no interests to declare.

**Literature**