Walking the mammoth

A reanalysis of isotope ratios in a 17000 years old tusk to reconstruct the life trajectory of a woolly mammoth

Matthieu Pluntz¹, Juliette Meyniel², Hervé Perdry²

¹ NeuroDiderot, Inserm & Université Paris-Cité, Paris
² CESP, Inserm & Université Paris-Saclay, Villejuif

Elephantid tusks grow throughout the whole animal's life. Their isotopic composition reflect their alimentation, creating a record of their surrounding environment. In 2021, Matthew J. Wooller *et al* obtained the strontium and oxygen isotope ratios along the tusk of Kik, a mammoth who lived in Alaska 17000 years ago. Using isotopic maps of Alaska, they reconstructed a path consisting of 1133 successive positions, corresponding to the putative path followed by Kik along the 28 years of his life, with a time resolution of nine days.

This path was obtained with a Monte Carlo method, consisting in generating a large number of random walks based on strontium isotope ratios, and keeping among them the path which best matched the oxygen isotope ratio. The resuting path fits reasonnably well the strontium isotopic profile along the tusk, but fits poorly the oxygen isotopic profile.

We reanalyze these data using a Hidden Markov Model with the geographic position of Kik as hidden state. The transition probabilities are those of a Gaussian random walk truncated at a distance of 100 km. This truncature makes the transition matrix sparse, which mitigates the large number of hidden states (more than 20000), and makes the problem computationally tractable. The observed states are the isotopic ratios, with emission probabilities computed from the ratios given by the isotopic maps.

We obtain paths that fit well both the strontium and oxygene isotopic profile. They differ notably from the path obtained by Wooller *et al*, generating intriguing hypotheses on Kik's death.

References

Wooller MJ et al (2021) Lifetime mobility of an Artic woolly mammoth Science 373:806-808