Late Quaternary vegetation dynamics in interior Alaska revealed by sedimentary ancient DNA (sedaDNA) from lake sediment and unfrozen (loessic) archaeological sediments

Mary Edwards1,2, Charlotte Clarke1, Nancy Bigelow2, Peter Heintzman3, Ben Potter4, Inger Alsos3, and Joshua Reuther4,5
1School of Geography and Environmental Science, University of Southampton, Southampton, United Kingdom
2Alaska Quaternary Center, University of Alaska Fairbanks, Fairbanks, USA
3The Arctic University Museum of Norway, UiT- The Arctic University of Norway, Tromsø, Norway
4Department of Anthropology, University of Alaska Fairbanks, Fairbanks, USA
5University of Alaska Museum of the North, University of Alaska Fairbanks, Fairbanks, USA

About 14,000 years ago, on the cusp of major environmental changes that affected the distribution of animals, vegetation cover and hydrology, humans entered interior Alaska for the first time. A sedimentary ancient DNA (sedaDNA) record from a lake in the Tanana valley, which lies close to several of the oldest dated archaeological sites, documents plant community changes over the past ca. 15,000 years and makes an important contribution towards resolving late MIS-2 floristic composition of the northern, ice-free region of northwest North America. Macroscopic charcoal and sediment properties provide further information on changes in climate and fire regimes.

For sedaDNA analysis, we amplified a short locus of the plant chloroplast genome in all samples, and a total of 167 vascular plant and 14 bryophyte taxa were detected in the lake sedaDNA record. A rich herbaceous flora, including taxa typical of open tundra habitats, dominates the record until ca. 14,000 cal yr BP; diverse grass taxa are present, and Salicaceae is recorded in every sample in this period. This flora continued (though with compositional changes) as a dominant element in the following period, which was also characterized by the presence of shrub and/or tree birch, and which ended with the establishment of coniferous forest ca. 10,000-11,000 yr BP. This last change is also reflected in sediment organic content, sedimentation rate, and the addition of a diverse range of shrubs, sub-shrubs, boreal forbs, spore-plants and aquatic macrophytes, all reflecting profound alterations in both terrestrial and lacustrine plant communities. Macro-charcoal is present in all floristic zones, with higher concentrations afterca. 14,000 yr BP, indicating that both deciduous and evergreen woody communities burned.

This lake record provides a picture of key landscape-scale changes experienced by early human populations. SedDNA results obtained from contemporaneous cultural and non-cultural layers at nearby archaeological sites in the Tanana Valley can provide further complementary information on natural resource use by early human communities in response to a changing environment. The loessal sediments at these archaeological sites present challenges to sedaDNA studies, including
anthropogenic disturbance of the matrix, rootlet penetration, and unfrozen conditions for around four months of the year that may accelerate bacterial degradation and fragmentation of DNA. We present here some preliminary results from these archaeological localities.