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(Sub-)seasonal mobility reconstruction via spatially-resolved Sr+O isotope analysis of teeth – a novel tool to unravel past transhumance?

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Vertical transhumance is a subsistence strategy typical of many mountain ranges including the European Alps. It remains unclear, however, when this form of landscape use started to be practised in the Alps [1], which became relevant also in the context of the discovery and societal role of the Neolithic Alpine Iceman (Ötzi). It was early on suggested that Ötzi may have been involved in some form of early transhumance [2, 3], which however has more recently been questioned on the basis of pollen found in animal dung at the Iceman's discovery site [4].

Mammal teeth mineralize sequentially over several years. Their bioapatite forms an archive of the environment via isotopic signals incorporated through ingested nutrition and water. This represents a direct means of reconstructing intra-annual mobility, provided the information in sequentially forming teeth is not strongly attenuated and can be analysed at high-spatial resolution. Spatially-resolved isotope ratio analyses by laser-ablation and secondary-ion mass spectrometry (LA-MC-ICPMS, SIMS) are suitable techniques for Sr [5] and O-isotopes at the μm (sub-mm) scale, respectively. Natural Sr-isotopic variation occurs due to changing rock type (soil) (e.g. [6]), whereas the O-isotopic composition of precipitation varies systematically during the seasons. However, the isotopic signals may get attenuated during the complex two-stage enamel mineralization process, whose effect can be minimized by our specific sampling strategies, namely closest to the enamel-dentine-junction.

We have used animal teeth (mostly cattle, some sheep/goat) from several Late Neolithic to the Late Bronze Age sites in South Tyrol/Alto Adige (Eastern Alps, N Italy) in order to directly evaluate intra- and intertooth variability of their enamel Sr and O isotopic compositions. Moreover, sequentially forming molars of the same individual allow a continuous assessment of 2-3 years of that animal's life.

We find that most teeth show remarkable intra-tooth Sr isotopic variability that may imply regular changes in grazing location. Crucially, SIMS (SHRIMP) in-situ δ18O profiles allow unequivocal identification of summer/winter growth domains and also the quantification of the seasonal δ18OPO4 range. This facilitates the calculation of the corresponding summer-winter $\delta 18OH_2O$ composition and in turn a comparison to local meteoric water. Because South Tyrol is characterized by variable geology, we characterize the bioavailable Sr-isotopic composition via non-anthropogenically influenced grass samples in several valleys in South Tyrol, in order to evaluate whether only local or more regional mobility is recorded. All corresponding results will be presented.

1. Gleirscher, P., 1985: Der Schlern, 1985. 59: p. 116-124.
2. Spindler, K., 2000: Der Mann im Eis. ed2000, München: Goldmann Verlag. 416.
3. Bortenschlager, S., 2000: The Iceman's environment, in The Iceman and his natural environment, Springer. p. 11-24.
4. Oeggl, K., A. Schmidl, and W. Kofler, 2009: Vegetation History and Archaeobotany 18: p. 37-46.
5. Müller, W. & Anczkiewicz, R., 2016: Journal of Analytical Atomic Spectrometry 31: 259-269.
6. Müller, W., et al., 2003: Origin and Migration of the Alpine Iceman. Science 302: 862-866.