

Biomaterials

Topic: Human Migration and Mobility as Detected from the Analysis of Biological Materials

236 Alkaline-earth Ratios in Teeth as Indicators of Human Mobility

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Barium and strontium levels in calcified tissues are recognized as reflecting dietary, and hence environmental, levels, but most attempts to infer diet from these have been equivocal. Two major reasons for disappointing dietary results are that quite different diets can yield similar Sr/Ca and Ba/Ca ratios and different regions can have enormously different Ba/Ca and Sr/Ca for the same diet. Rephrasing this, variability in Ba/Ca and Sr/Ca between regions can exceed variability within regions. This, essentially a restatement of the “provenience postulate”, implies that the ratios can be used as geographic indicators.

Because tooth enamel retains the chemical signature of early childhood, analyses of Ba and Sr in enamel can potentially identify human immigrants and when augmented with other geographic indicators such as lead and strontium isotopic analyses, can also constrain and possibly identify the original provenience of individuals.

237 Strontium Isotopes and Europe’s First Farmers: Migration and the Linearbandkeramik in Central Europe

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One of the most important questions concerning the transition from hunter-gatherers to farmers is how agriculture spread, whether through the arrival of colonists or adoption by indigenous groups. The first agriculture in central Europe appeared about 5500 BC and is associated with an archaeological culture known as the Linearbandkeramik (LBK). Archaeological data such as lithic and ceramic typology, house structure, and burial pattern are insufficient to resolve the question of colonization vs. adoption.

We have analyzed human bone and tooth enamel from LBK cemeteries in Germany and France to evaluate the possibility of migration. Strontium and lead isotope ratios in tooth enamel are a signal of the place of birth; values in bone are a signal of the place of death. Measurement of strontium and lead isotopes has involved the use of TIMS and ICP-MS. Information on bioavailable strontium and lead was obtained by assays of modern fauna in the area around each site.

Our results from the LBK cemeteries of Flomborn, Schwetzingen, Dillingen, Vaihingen and others suggests that migration was an important component in the spread of agriculture during this period. An important question regarding the origin of the migrants will be discussed. Additional information on differences in gender, status, and burial ritual is also available from this project and will be presented. Our study documents the importance of archaeometric approaches to questions regarding residence change in prehistory and the utility of strontium isotope analysis in such investigations.

238 **Mobility, Diet, and Diagenesis Trace Elemental Analyses of Faunal Remains from Southern Germany**

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The comparison of the $^{87}\text{Sr}/^{86}\text{Sr}$ ratios in tooth enamel and bone of the same individual is so far the most successful method to study human migration in the past. But areas with similar isotopic signatures can be quite large and in southern Germany there are only small isotopic differences between several kinds of sedimentary bedrock, on which most of the prehistoric settlements are situated. So it would be very useful to combine this method with other regional tracers.

In this paper I want to show that regional differences in tooth enamel, dentin, and bone from archaeological fauna from southern Germany do exist. Remains from pigs but also sheep teeth and bone from ten sites dating to the Linearbandkeramik (LBK), the oldest Neolithic culture in that area (5600-4900 BC), were analyzed using ICP-MS. All of the LBK sites are situated on loess. In addition material from four late Neolithic and Roman sites in other geological settings were investigated. In all three materials - enamel, dentin, and bone - there are differences in the trace elemental ratios from different sites that go beyond the ranges caused by different diets. Local geographic differences are more clearly seen in the Sr/Ca ratio, while Ba/Ca reflects dietary influences better. As dentin and bone show much higher numbers than tooth enamel of the same individuals the influence of diagenesis has to be discussed, as well.

Knowing the local ranges of the trace elemental composition in mammalian hard tissues could be used in the future to recognize immigrants to a certain area. Trace elemental ratios in foreign individuals should be either above or below the local ranges made up by analyzing animal remains from different species. Other possibilities are in providing comparative data for dietary investigations or indications of diagenetic influences.

239 **Strontium Isotope Analysis and Migration in the South Central Andes: Tiwanaku Colonization of the Osmore Drainage**

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During the Middle Horizon (AD 600-1000), the site of Tiwanaku in Bolivia exerted influence over all of the South Central Andes, and Tiwanaku-style artifacts and architecture are found at a variety of sites in the region. However, the nature of Tiwanaku influence and, more specifically, the presence of Tiwanaku colonies in the South Central Andes have been much debated. While archaeologists have traditionally used artifact, biodistance, mortuary textile and architectural analyses to explore the nature of Tiwanaku influence, the presence of immigrants from the Tiwanaku heartland has not yet been demonstrated in these proposed Tiwanaku colonies.

Strontium isotope analysis of archaeological human teeth and bone from both coastal and mid-valley sites in the Osmore Drainage of southern Peru has identified immigrants to the proposed Tiwanaku colony of Chen Chen. In addition, strontium isotope analysis will also elucidate the nature of Tiwanaku influence on the coast of Peru, where new radiocarbon dates have shown that the coastal Chiribaya polity was in fact contemporaneous with Tiwanaku occupation of the Osmore Drainage and may consist of Tiwanaku immigrants.

240 Isotopic Tracing of the Neolithic Alpine Iceman – Clues to His Origin and Migration

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In 1991, a perfectly preserved mummified Neolithic human body with its entire equipment was discovered in a high-altitude Alpine glacier in northern Italy. For the first time, a ~5300 year old mummy (“Iceman”) was found outside a burial site, which provided the opportunity to investigate circumstances of ‘real’ life during the late Neolithic.

Here we utilize isotope geochemistry to answer some of these questions. Using tooth enamel and bone, information can be obtained about both the earliest childhood and the last ~10-20 years of adult life, because human hard tissues form at different ontogenetic stages. Especially enamel allows unique insights into the Iceman’s childhood.

Enamel fragments from three Iceman teeth have been analyzed. Both radiogenic (Sr, Pb, Nd) and stable isotopes (O, C) are investigated. Soils from approximately contemporaneous sites were sampled for comparison. Radiogenic isotopes allow reconstruction of the local geological background. Stable isotopes provide information about altitude and/or position relative to the main Alpine watershed.

High spatial-resolution laser-ablation ICPMS profiles reveal element distributions essentially similar to modern human teeth except of La, Ce, Nd (LREE), whose ~100-fold enrichment towards the outer enamel surface may reflect post-mortem interaction with melt water and precludes the derivation of an in-vivo Nd isotopic signal. Both other radiogenic tracers, Sr and Pb, show in-vivo concentrations of 87ppm and 0.1ppm, respectively.

Strontium isotopic compositions of the canine, two premolars and two hipbone samples were determined utilizing three sequential leaching steps for each sample. All enamel fragments are characterized by virtually similar and high $^{87}\text{Sr}/^{86}\text{Sr}$ ratios of 0.7203-0.7206, consistent with the compositions of crystalline gneisses and schists close to the finding site. Sites overlying bedrock built up by limestone from further south or north can clearly be excluded as the Iceman’s childhood area. Among the three teeth, enamel mineralized during a ~2-3 year interval and during this early period, the food source for the Iceman must have remained essentially constant. Two compact hipbone samples have lower $^{87}\text{Sr}/^{86}\text{Sr}$ ratios of 0.7175 and 0.7181. Hence, the Iceman used food from a different region during the last ~1-2 decades of his life.

First results from oxygen isotope analyses revealed a difference of ~1 ‰ in $d^{18}\text{O}$ between enamel and bones, which preliminarily implies that the Iceman must have spent his childhood at lower altitudes than his later adult life. $d^{18}\text{O}$ -analyses of river waters from valleys north and south of the finding site are currently underway for further calibration.

241 Archaeological Insect Evidence for Trade and Storage in Egypt

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Recent work on material from New Kingdom Amarna as well as other Egyptian sites has not only considerably expanded our knowledge of the history of the insect fauna of Egypt but also provided information on early trade routes and contacts. The monastic site at Kom el Nana in Middle Egypt provides the first evidence for pests of stored products the first evidence for pests of stored products in the Byzantine period. The research has provided the earliest records of insects that live together with Man such as pests of stored products.

Certain species in the faunas suggest contacts with Africa to the south and India to the east, whilst by a very tenuous route the human flea extends the connection to South America.

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