



Isotopic reconstruction of ancient human migrations: A comprehensive Sr isotope reference database for France and the first case study at Tumulus de Sables, south-western France

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Strontium isotope ratios ($87\text{Sr}/86\text{Sr}$) can be used for the reconstruction of human and animal migrations across geologically different terrains. Sr isotope ratios in rocks are a product of age and composition and thus vary between geologic units. From the eroding environment Sr is transported into the soils, plants and rivers of a region. Humans and animals incorporate Sr from their diet into their bones and teeth, where it substitutes for calcium. Tooth enamel contains Sr isotope signatures acquired during childhood and is most resistant to weathering and overprinting, while the dentine is often diagenetically altered towards the local Sr signature. For the reconstruction of human and animal migrations the tooth enamel $87\text{Sr}/86\text{Sr}$ ratio is compared to the Sr isotope signature in the vicinity of the burial site and the surrounding area.

This study focuses on the establishment of a comprehensive reference map of bioavailable $87\text{Sr}/86\text{Sr}$ ratios for France. In a next step we will compare human and animal teeth from key archaeological sites to this reference map to investigate mobility. So far, we have analysed plant and soil samples from ~ 200 locations across France including the Aquitaine basin, the western and northern parts of the Paris basin, as well as three transects through the Pyrenees Mountains. The isotope data, geologic background information (BRGM 1:1M), field images, and detailed method descriptions are available through our online database iRhum (<http://rses.anu.edu.au/research/ee>). This database can also be used in forensic studies and food sciences.

As an archaeological case study teeth from 16 adult and 8 juvenile individuals were investigated from an early Bell Beaker (2500-2000 BC) site at Le Tumulus des Sables, south-west France (Gironde). The teeth were analysed for Sr isotope ratios using laser ablation ICP-MS. Four teeth were also analysed using solution ICP-MS, which showed a significant offset to the laser ablation results. This requires further detailed investigation. Nevertheless, the teeth showed clear differences between enamel and diagenetically overprinted dentine, which suggests mobility. Unfortunately, the sandy sediment units in the close vicinity of Le Tumulus des Sables show large variations in their $87\text{Sr}/86\text{Sr}$ ratios so it is currently not possible to distinguish between migration from outside of the Médoc region from mobility within the region based solely on Sr isotope ratios.

The case study illustrates the importance of detailed reference maps, which are required for any isotope studies used for the reconstruction of migrations. Other isotope data, such as O and Pb, will complement the investigation at Tumulus de Sables and may enable us to tie down the range of mobility of the humans that were buried at Le Tumulus des Sables.