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Provenance of butchered human individuals discovered in the exceptional Neolithic site of Herxheim, SW Germany: Evidence from phosphate oxygen isotope analysis of human teeth

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The Neolithic settlement of Herxheim in Rhineland-Palatinate, Germany, is a spectacular and unique archaeological site of the terminal phase of the Bandkeramik culture (LBK). In a double trench-shaped pit-enclosure surrounding a settlement on loess substrate the butchered human skeletal remains of more than 500 individuals were found. They had been systematically dissected and their bones had been defleshed and, in most cases, smashed into small fragments. These skeletal remains were buried in association with high-quality ornamented pottery displaying different decoration styles of the terminal LBK, associated with eight different regions up to 400 km away from Herxheim. The pottery had obviously been intentionally smashed to pieces before being disposed of in the pit rings with the human skeletal remains. The pots date from the very latest phase of the LBK, from approximately 5000 to 4950 BC. The multi-regional origin of the pottery indicates the trans-regional exchange of LBK-groups from these eight areas with the population of Herxheim, and/or an according mobility of humans at the time.

To determine the provenance of the manipulated individuals from Herxheim we analysed the enamel phosphate oxygen isotope composition (δ^{18}Op) of teeth from 45 individuals. The δ^{18}Op values enable to characterize the $\delta^{18}OH_2O$ values of the ingested drinking water during the period of enamel mineralization, ranging from birth to about 14 years of age. Different molars (M1, M2 and M3) of the same individuals were analyzed to determine the $\delta^{18}OH_2O$ values of the drinking water ingested during their childhood and early youth. The enamel δ^{18}Op values of all analyzed molars (n=86) cover a large range from 15.4 to 20.2‰. Drinking water $\delta^{18}OH_2O$ values calculated from these data using an empirical δ^{18}Op-$\delta^{18}OH_2O$-regression for modern humans (Daux et al., 2008) range from -10 to -6‰. These values are typical for precipitation in central Europe including the provenance areas (Belgium to Bohemia) of the pottery found in association with the skeletal remains. Only one individual yielded significantly higher $\delta^{18}OH_2O$ values of -5.4 to -3.4‰, therfore had clearly ingested more ^{18}O-enriched water, during enamel mineralization, likely from more southern areas. Furthermore, about 30 to 50% of the Herxheim individuals could be identified as non-locals as they ingested water deviating from the local $\delta^{18}OH_2O$ range of -8.2+/-1‰. Some of these individuals were probably born and raised in upland areas as their teeth record lower $\delta^{18}OH_2O$ values between -9 and -10‰. This supposition is further corroborated by enamel strontium isotope data indicating that during their childhood many of the tested individuals did not live on loess, the typical substrate for LBK settlements, including Herxheim, but instead were raised on crystalline bedrock (Turck et al., 2012). Hence it is likely that these individuals came to Herxheim from upland areas that are typically composed of such crystalline rocks. Both the oxygen and the strontium isotope data clearly indicate a strong mobility as well as different provenance areas of the humans interred in the pit-enclosure of Herxheim.

References

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