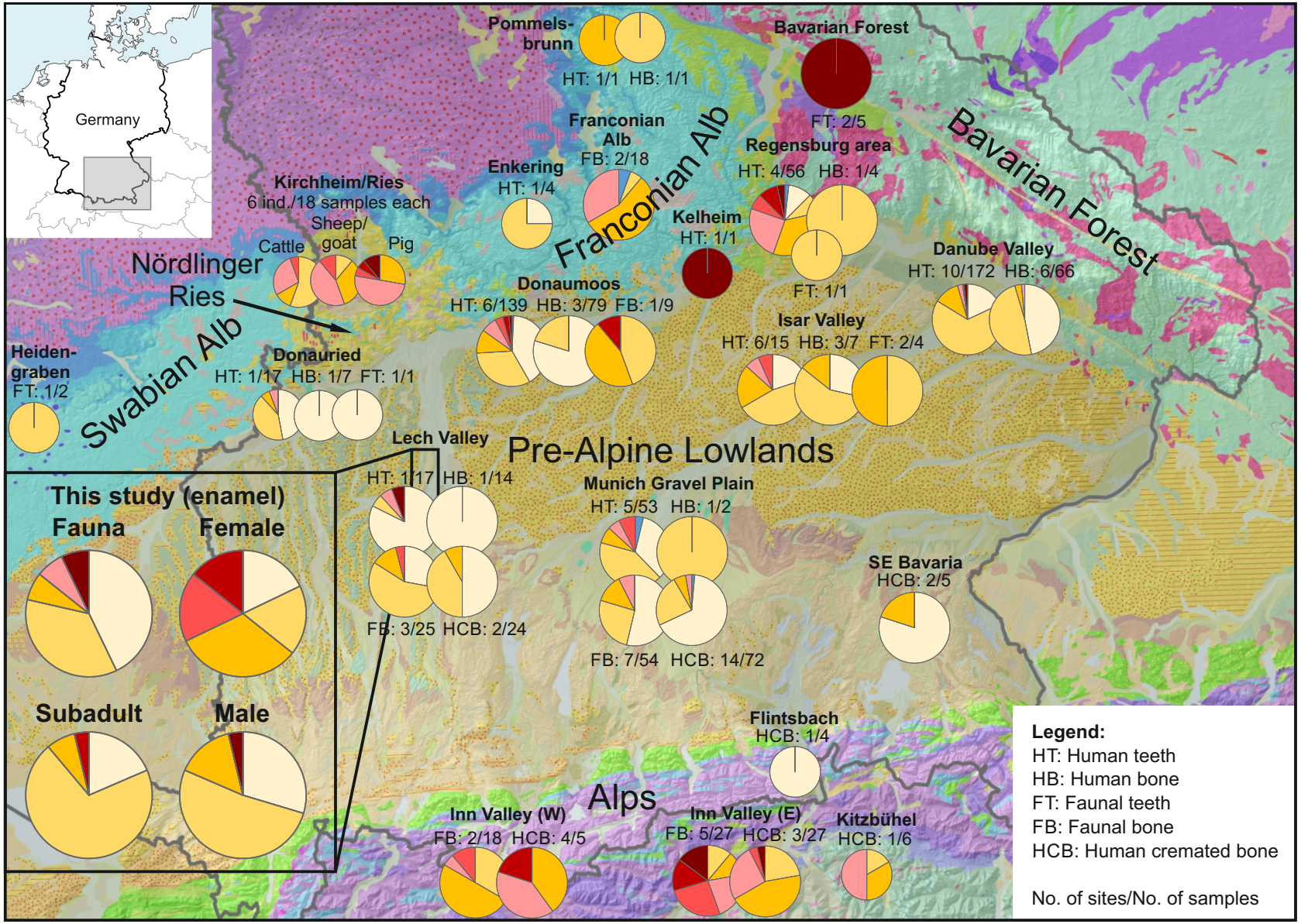


SI Appendix, Fig. S1: Geological map of southern Bavaria with a summary of published $^{87}Sr/^{86}Sr$ ratios of different human and faunal sample types (cf. Dataset S1, Tab. 7). Small pie charts: single sites; large pie charts: multiple sites. The charts of the data for this study summarize single analyses per individual or the earlier forming tooth of tooth pairs. (Produced using Copernicus data and information funded by the European Union - EU-DEM layers; Shuttle Radar Topography Mission – SRTM V2 3 arc-seconds, NASA; Geology 1:1.000.000, © Bundesanstalt für Geowissenschaften und Rohstoffe (BGR). Graphic: C. Knipper, S. E. Metz). Legend for geological units on next page.

Geology 1:1.000.000

Sedimentary Rocks

Cenozoic

Holocene
- limnic gravel
- bog lime
- fen
- fluviatile gravel
- aeolian sand, dune
- crenogenic gravel
- lacustrine clay (foorhills of the Alps)

Pleistocene
- loess, loess loam
- fluviatile gravel
- gravel of the glacial valleys
- glacial gravel
- sediment basin
- fluviatile gravel
- fluvioglacial to fluviatile gravel
- glacial gravel
- boulder clay
- glacial gravel
- fluviatile gravel
- fluviatile gravel

Weichsel-/Würm Cold Stage

Saale-/Riss Cold Stage

Elster Cold Stage

Tertiary
- loam of the Alb
- Pliocene
- Miocene
- Eocene

Mesozoic

Cretaceous
- Cretaceous
- Upper Cretaceous

Jurassic
- Upper Jurassic
- Lower Jurassic

Triassic
- Triassic
- Keuper
- Upper Keuper
- Middle Keuper
- Feuerletten, Knollenmergel
- sandstone keuper
- gypsum keuper, Schilfsandstein
- Lower Keuper
- Muschelkalk
- Upper Muschelkalk
- Middle Muschelkalk
- Lower Muschelkalk
- Buntsandstein
- Upper Buntsandstein

Palaeozoic

Permian
- Zechstein
- Rotliegendes
- Upper Rotliegendes
- Lower Rotliegendes
- Upper Carboniferous
- Silurian

Proterozoic

- Younger Proterozoic

Astrobleme

- impact lithologies and displaced massifs
- displaced metamorphite
- suevite

Igneous Rocks

Volcanic

- basalt
- keratophyr
- diabase, spilite
- amphibolite

Dykite

- porphyroid granite

Plutonic

- granite
- gabbro
- granite
- granodiorite
- diorite
- orthogneiss
- meta-granite
- meta-granodiorite

Alpine Genesis and Molasse

Molasse

- Upper Freshwater Molasse
- Upper Marine Molasse
- Lower Freshwater Molasse
- Lower Marine Molasse

Helveticum

- Jurassic - Eocene
- Upper Cretaceous - Oligocene

Penninicum

- chalk - Eocene; flysch zone
- Bündner schist
- ophiolite
- Permian - Lower Triassic
- Older schist shell of the Tauern
- Aroser Schuppenzone

Pennine-Eastern Alpine Schuppenzone

- Jurassic

Eastern Alpine

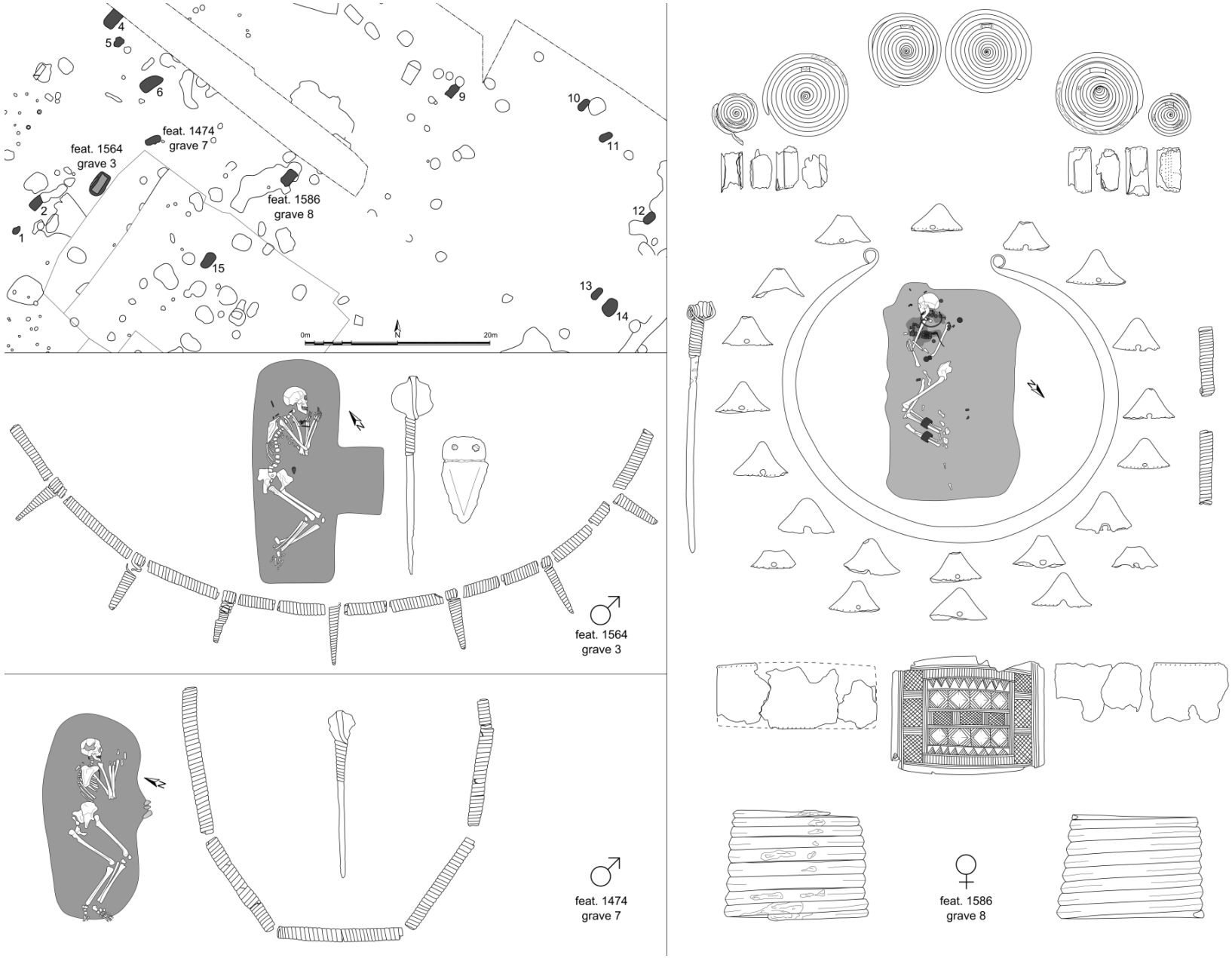
- Jurarassic - Cretaceous
- Jurarassic
- Upper Triassic
- Middle Triassic
- Permian - Lower Triassic
- Palaeozoic
- porphyroid
- greenschist
- Early Palaeozoic (quartz phyllite)
- mica schist
- paragneiss
- amphibolite

Transgressive Layers above the Eastern Alpine Nappes

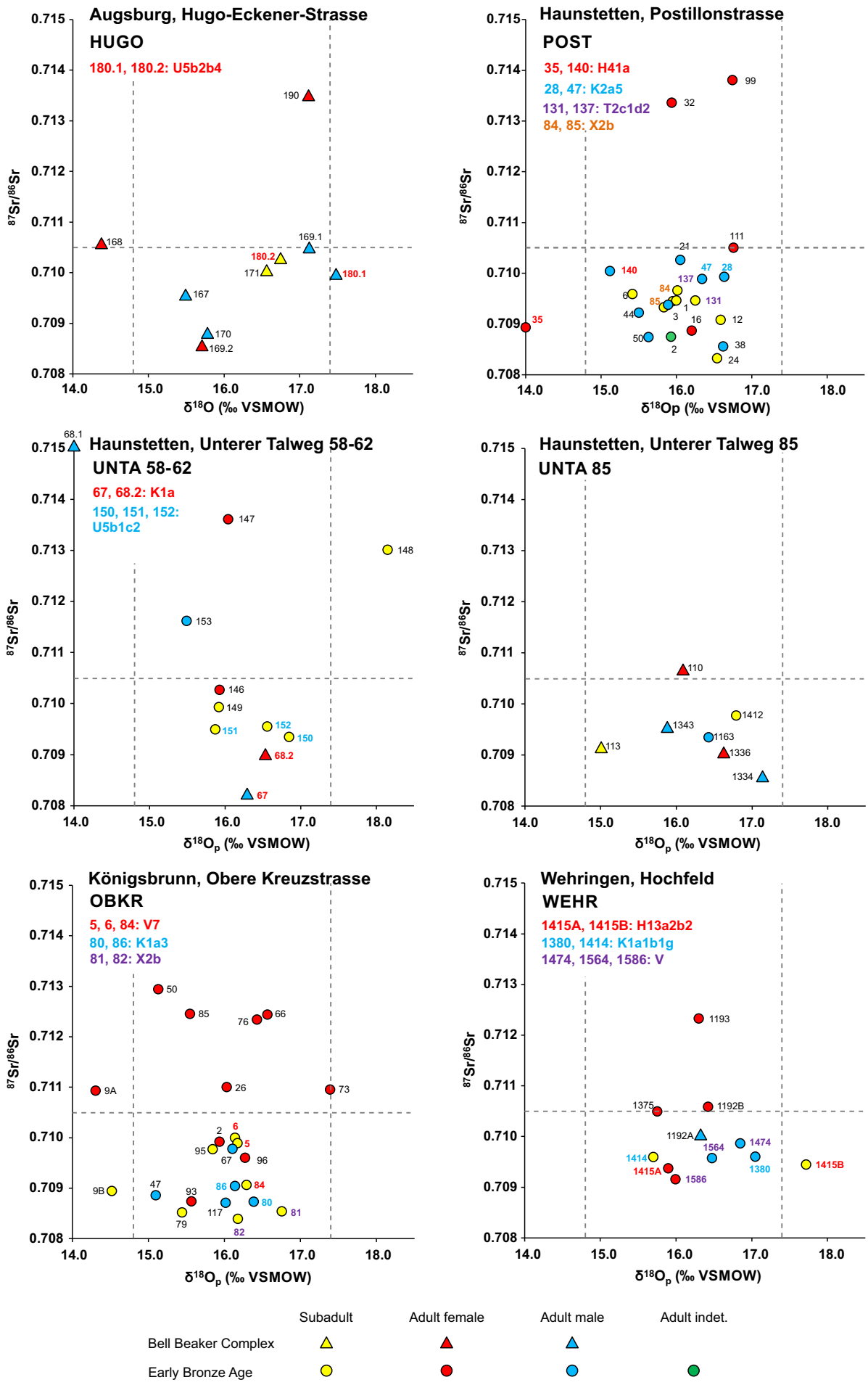
- Gosau (Upper Cretaceous - Tertiary)

Miscellaneous

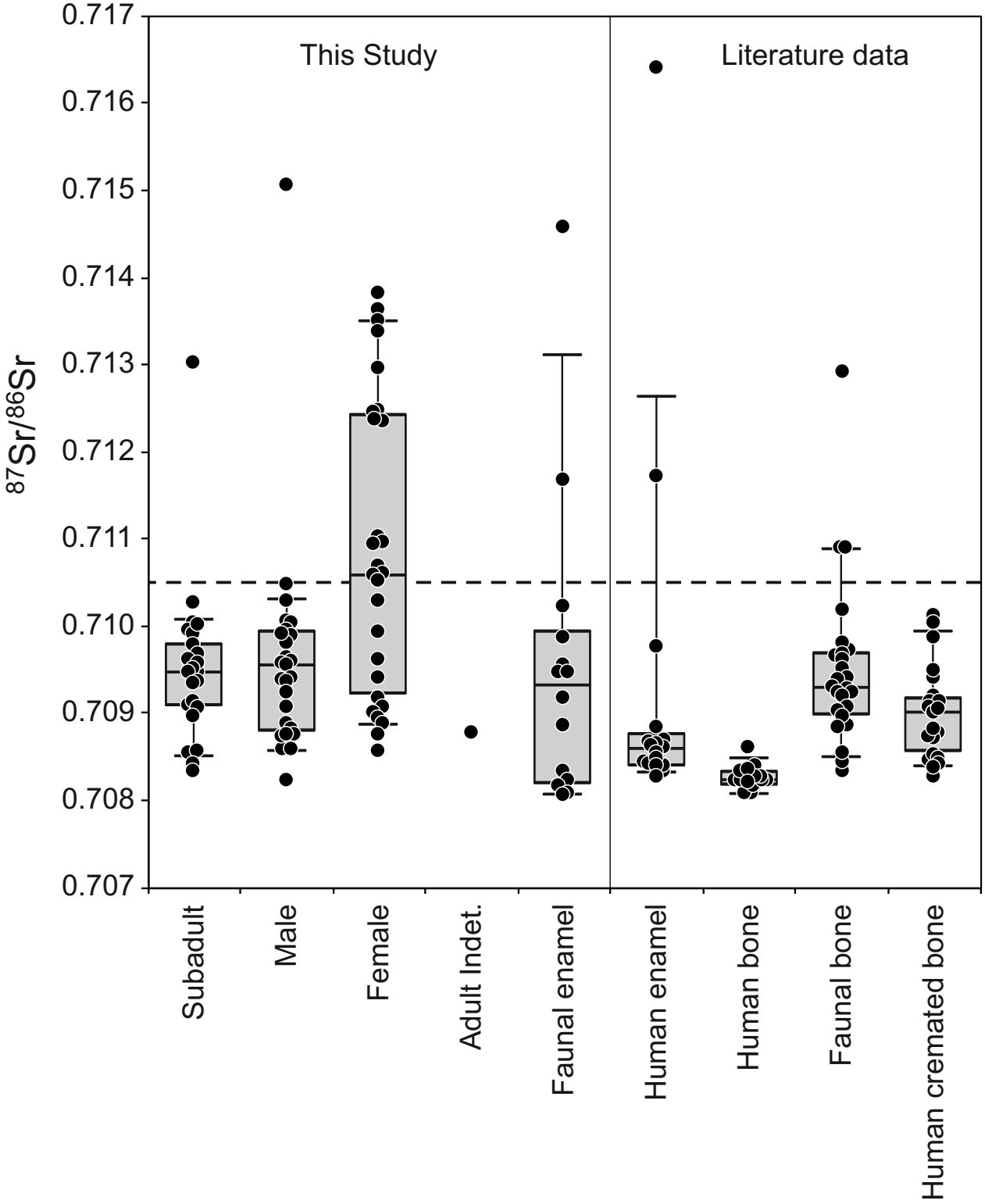
- waters



SI Appendix, Fig. S2: Archaeological characteristics of three individuals with shared mtDNA haplotypes from Wehringen-Hochfeld (Graphic: K. Massy).



SI Appendix, Fig. S3: Scatter plots of $\delta^{18}O$ and $^{87}Sr/^{86}Sr$ ratios according to the investigated sites. The feature numbers of individuals with shared mtDNA haplotypes are highlighted with fat labels in the same colour. The hatched lines indicate the local ranges for both isotope ratios (cf. SI Appendix, Fig. S4 and SI Appendix, Fig. S5). Data plotted on the y-axis lack $\delta^{18}O$ data (Graphic: C. Knipper).



SI Appendix, Fig. S4: Box plots of $^{87}Sr/^{86}Sr$ ratios of human and faunal samples from the Lech valley analysed in this study and of teeth and bones from the Bell Beaker Complex cemetery of Augsburg-Universität (1), of faunal bones from Wehringen, Schwabmünchen, and Pestenacker and cremated human bones from Kleinaitingen and Königsbrunn (2) (cf. Dataset S1, Tab. 6 and Dataset S1, Tab. 7; Graphic: C. Knipper).

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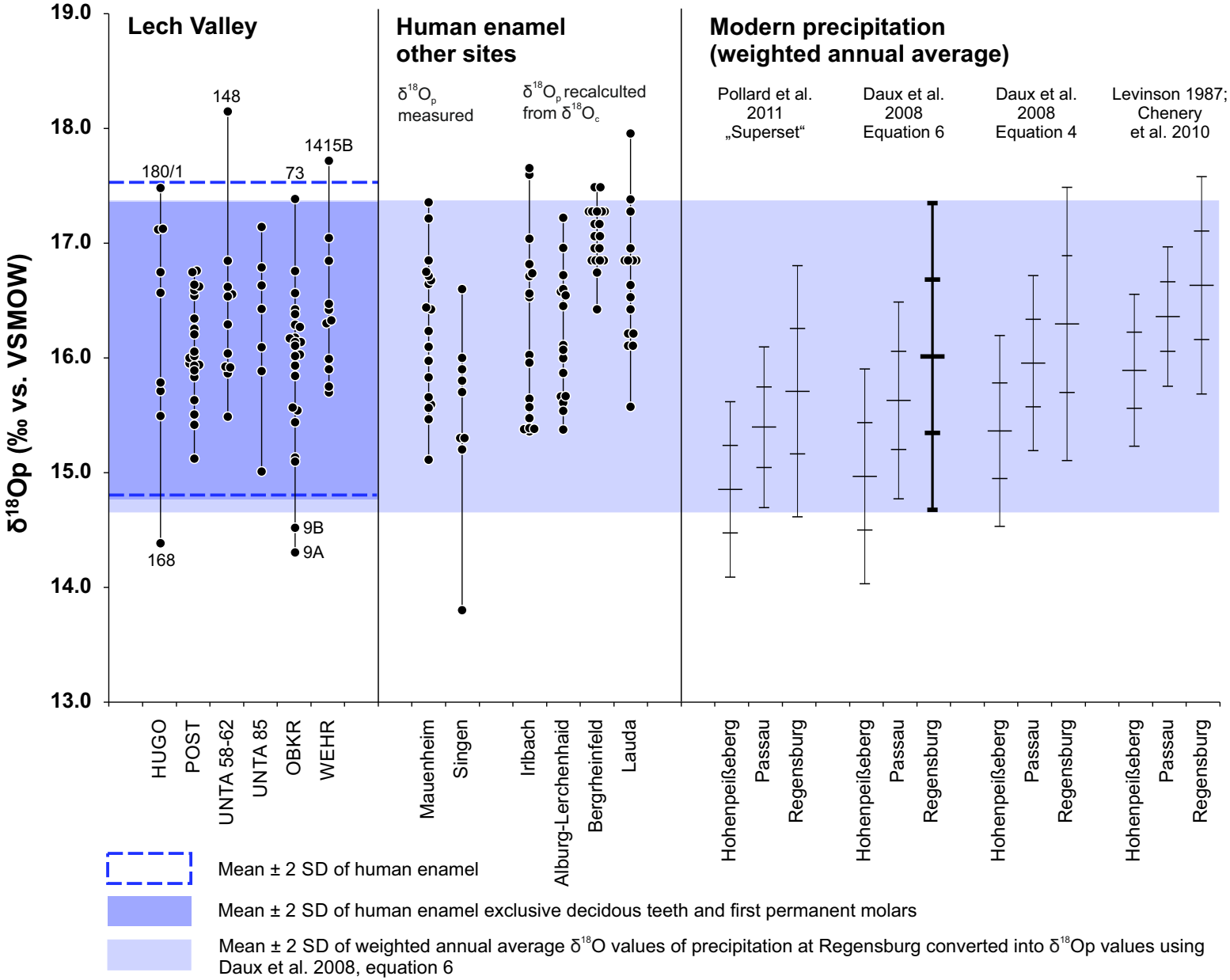

SI Appendix, Fig. S5: Oxygen isotope data of BBC and EBA individuals from the Lech Valley sorted by site, other cemeteries in southern Germany (1-4) and weighted annual average values of modern precipitation (5) converted into δ^{18}Op values using different regression equations (6-9) (Graphic: C. Knipper).

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SI Appendix, Text S1: Rationale und laboratory methods of strontium and oxygen isotope analyses

Strontium isotope analysis

Strontium isotope ratios ($^{87}Sr/^{86}Sr$) of tooth enamel reflect the geological conditions of the area from which food and drink were sourced during childhood (1-6). Provided that the majority of foodstuffs were grown locally, the method can identify individuals who were non-local to the site where their skeletal remains were found. The alkaline earth metal strontium has four stable isotopes (^{84}Sr, ^{86}Sr, ^{87}Sr and ^{88}Sr) of which ^{87}Sr is radiogenic and results from radioactive decay of the isotope ^{87}Rb (rubidium). Depending on the rubidium content of a rock and its age, the amount of ^{87}Sr – expressed as the $^{87}Sr/^{86}Sr$ ratio – varies among geological units between about 0.7000 and 0.7500 and occasionally above. When rocks and soils weather, strontium is released into water and becomes biologically available. Due to their similar ionic radii and chemical properties, strontium can substitute for calcium and is transferred through food chains without any significant isotope fractionation. The analytical method used here corrects against any mass dependent fractionation and therefore the presented $^{87}Sr/^{86}Sr$ ratios do not show any source effects. Depending on the strontium concentrations of the ingested matter, plant-based food often contributes more strontium than water and meat. In animals and humans, strontium is primarily incorporated into hydroxyapatite ($Ca_{10}(PO_4)_6OH_2$), the inorganic component of teeth and bones. Because the enamel of tooth crowns forms during certain time intervals in childhood, does not remodel afterwards and is very resistant to post-mortem alteration, it is a persisting archive of strontium that goes back to the early years of a person's or animal's life. Deviation of $^{87}Sr/^{86}Sr$ ratios of teeth from the local baseline values or breaks in the data distribution from a single site or delimited area can indicate migrant individuals.

Strontium isotope analysis was carried out on human second permanent molars or on other teeth if second molars were not available. Faunal comparison samples were selected depending on availability. High-crowned molars of cattle and sheep/goats were sampled near the apex and near the cervix to identify possible isotopic variation along the crown. Enamel chips were separated from the crowns using a diamond-coated cutting disc attached to a dental drill. All surfaces and adhering dentine were removed thoroughly with a diamond-coated burr, and the resulting chips ground in an agate mortar. 10-12 mg of enamel powder were then pre-cleaned in an ultrasonic bath using de-ionised H_2O and 0.1 M acetic acid buffered with Li-acetate (pH 4.5) and afterwards ashed (3 h, 850°C) (7). Sr separation using Eichrom Sr-Spec resin was done under clean-lab conditions following the procedures described in Knipper (7). Sr concentrations were determined by Quadrupole-Inductively Coupled Plasma-Mass Spectrometry (Q-ICP-MS) and $^{87}Sr/^{86}Sr$ ratios by High-Resolution Multi Collector-ICP-MS (Neptune) at the Curt-Engelhorn-Centre for Archaeometry in Mannheim, Germany. Raw data were corrected according to the exponential mass fractionation law to $^{88}Sr/^{86}Sr = 8.375209$. Blank values were lower than 10 pg Sr during the whole clean lab procedure. The NBS 987

and Eimer & Amend (E & A) standards run along with the human samples yielded $^{87}Sr/^{86}Sr$ ratios of 0.71024 ± 0.00003, 2 σ; n = 9 and 0.70801 ± 0.00005, 2 σ; n = 26, respectively. The NBS 987 and Eimer & Amend (E & A) standards run along with the faunal comparison samples yielded $^{87}Sr/^{86}Sr$ ratios of 0.71024 ± 0.00001, 2 σ; n = 5 and 0.70802 ± 0.00002, 2 σ; n = 6, respectively.

Oxygen isotope analysis

Oxygen isotope analysis served as an analytical approach to identify non-local individuals independent of the prevailing geological conditions. The method builds on spatial variation of the isotopic composition ($^{18}O/^{16}O$ expressed as $\delta^{18}O$ in ‰ vs. V-SMOW [Vienna-Standard Mean Ocean Water]) of the oxygen bound in meteoric water ($\delta^{18}O_{mw}$), which is taken up by animals and humans via drinking water and food. The $\delta^{18}O_{mw}$ values in precipitation, ground and surface water depend on temperature, altitude, latitude, and distance from the ocean, and therefore differ regionally (8, 9). In mammalian teeth and bones, oxygen is bound to the phosphate fraction ($\delta^{18}O_p$) or the structural carbonate ($\delta^{18}O_c$) of the hydroxyapatite. Its light stable isotopes fractionate during metabolic processes and incorporation into the biological hard tissues. However, due to the constant body temperatures of mammals, this happens at constant rates and linear regression equations can be used to estimate the isotopic composition of the imbibed water from the oxygen isotope ratios found in teeth and bones (10-13). In order to identify non-local individuals, the data from a site or study area can be tested for outliers, compared with previously existing datasets, or converted to $\delta^{18}O_{mw}$ values and compared to the isotopic composition of modern meteoric water. Interpretations of $\delta^{18}O$ data also have to consider that short-term climatic changes (14), breastfeeding in early childhood when the analysed enamel was formed (15) and preparation of food and drink (16) may cause isotope data similar to what would be considered indication for a non-local origin.

In this study, we focussed on $\delta^{18}O_p$ values. In order to avoid breast feeding effects, sampling concentrated on second permanent molars whose enamel forms between about three and seven years of age (17, 18). In all cases, oxygen and strontium isotope analyses were carried out on aliquots of the same enamel powder following the procedure described in Knipper (19). 10 mg of enamel were pre-treated with 1.8 ml of 2.5 % NaOCl for 24 h and rinsed three times with suprapure water. The preparation of silver phosphate (Ag_3PO_4) followed the method described by Dettman (20) and modified by Tütken (21). 800 µl of 2 M HF were added to the pre-treated samples, shaken and left to react over-night. After vortexing and centrifuging, the solutions were transferred into new sample tubes and the CaF residues left behind. A few drops of bromothymol blue indicator were added, and the HF neutralized with about 140 µl of 25 % NH_4OH solution. The addition of 800 µl of 2 M $AgNO_3$ solution caused the dissolved phosphate ions to precipitate immediately as yellow Ag_3PO_4 crystals. These were washed and sonicated five times for 10 min and dried over-night at 50°C. Ag_3PO_4 was

analysed in triplicates using a TC-EA at 1450°C coupled to a High Performance Stable Isotope Ratio Mass Spectrometer (IsoPrime100) at the Department for Applied and Analytical Palaeontology at the University of Mainz. Raw data were normalized against IVA silver phosphate with $\delta^{18}O$ = 21.7 ‰ (certificate no: BN 180097). Ag_3PO_4 that was precipitated from NBS 120c prepared along with the samples gave $\delta^{18}O$ values of 22.2 ± 0.2 ‰ (n = 18), which is in the range of values reported by Vennemann (22) and well comparable with earlier published data (19). The in-house standards of synthetic hydroxyapatite (HAP) gave 17.1 ± 0.1 ‰ (n = 21) and Roman pig bones from the site of Dangstetten (SUS-DAN) gave 14.2 ± 0.2 ‰ (n = 21).

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