Supplementary Information

Contents

SI 1- Archaeological context of newly reported individuals

Dates

In what follows, we give dates in one of two formats. If there is no direct radiocarbon date, we give a date based on archaeological context, in a format like "2500–1700 BCE". If there is a direct radiocarbon date, we give a date in a format like "95.4% CI calibrated radiocarbon age (Conventional Radiocarbon Age, Lab number)," using the prefix "cal" to indicate a date that is obtained from skeletal material for the same individual that yielded DNA (an example is "5983–5747 calBCE (6980±50 BP, Beta-226472)"). We calibrated all dates in OxCal 4.3[1] using the IntCal13 calibration curve[2].

We note that in the course of generating 62 new radiocarbon dates for this study, we found that two individuals (RISE568 and RISE569) from Brandysek for which shotgun sequencing data was originally reported in Allentoft et al. 2015[3] and labelled as being from the Bell Beaker culture, were in fact misattributed. Our direct radiocarbon dating supports a much later date for RISE569: 660-770 calCE (1300±30 BP, Poz-84461). Thus, these individuals have not been included in our analysis.

Galeria da Cisterna (Almonda karst system, Torres Novas, Portugal)

Contact person: João Zilhão

Galeria da Cisterna is a fossil karst spring of the River Almonda, which now flows ~5 m below ground at the base of a ~75 m high cliff. The length of this narrow, meandering passage is approximately 100 m, and its cross-section is in general less than 2×2 m. The current entrance was exposed in the 1920s by a landslide, which allowed access and limited archaeological work carried out between the years 1937 and 1942[4–6]. Three loci were identified and focused on in subsequent excavations: AMD1, AMD2 and AMD3.

The AMD2 locus, excavated in the years 1988–89, featured a shallow Holocene deposit containing funerary contexts with grave goods spanning the interval between the Early Neolithic and the Iron Age. The lack of internal stratigraphic differentiation of this Holocene deposit is primarily due to the repeated prehistoric and early historic human habitation of the site, compounded by the activity of burrowing animals. A set of typical Bell Beaker V-perforated ivory buttons and a small fragment of a gold spiral suggested

that a Bell Beaker component ought to exist among the human bone remains. This was eventually corroborated by direct radiocarbon dating to this period of four right first pedal phalanges[7,8]. Two produced genome-wide DNA:

- I0839/AMD2-F23-90: 2457–2206 calBCE (3847±29 BP, OxA-28859)
- I0840/AMD2-G18-187: 2456–2201 calBCE (3836±29 BP, OxA-28857)

Cova da Moura (Natural Cave, Torres Vedras, Portugal)

Contact person: Ana Maria Silva

The natural cave of Cova da Moura (Torres Vedras, Portugal) was discovered in 1930, with excavations undertaken in 1932 and in 1961[9–11]. This cave was used as collective burial place between 3700 and 2200 BCE (Middle Neolithic to the Copper Age), according to the results of seven radiocarbon dates obtained on human bones[12,13]. The human remains were found commingled and fragmented. The study of the human remains performed by Ana Maria Silva[12,14] indicated a minimum number of 90 individuals, both sexes, and 15 non-adults. In terms of material culture, Cova da Moura is by far the richest burial known in the region. Grave goods include limestone and bone idols, green stone pendants, gold artefacts, engraved slate plaques, bone, ivory, and variscite rabbit figurines, beads, and pre-Beaker and Beaker ceramics[9–11,15]. Further studies of this bone assemblage include isotopic analysis for dietary inferences[16] and mobility[17], as well as nonmetric dental traits to assess populations affinities[13]. We generated genome-wide DNA data from one individual:

- I4229/CDM3: 2289–2135 calBCE (3775±25 BP, PSUAMS-1750)

Paris Street (Cerdanyola del Vallès, Barcelona, Spain)

Contact person: Joan Francès Farré

During urban construction work at Paris Street in Cerdanyola del Vallès (Vallès Occidental, Barcelona province) in 2003, a large amount of skeletal material and associated pottery was unearthed. Follow-up excavation uncovered a Chalcolithic hypogeum with more than 9,000 human remains as well as lithic and ceramic material, the latter assigned to the Bell Beaker tradition[18].

The hypogeum displays several occupational phases. The oldest one presented an ash layer underlying the first inhumations that could have a ritualistic significance. Charcoal from that basal layer was dated to 2878-2496 calBCE (4110±60 BP, UBAR-817). The first funerary phase (UE-15) shows a large number of successive inhumations (minimal number of individuals 36) that are still in anatomical position, placed in lateral decubitus and with flexed knees. Seven arrow points were retrieved from this layer. A thin, upper layer (UE-5) probably represents a re-organization of the existing funerary space, prior to the second funerary phase (UE-2). At UE-5, two Bell Beaker vessels of maritime style were retrieved. The UE-2 layer comprises fewer inhumations, and all of them were accompanied by typical Bell Beaker vessels: three in Maritime style, and two in epi-Maritime style. There were also numerous additional pieces of diverse typology. Over this layer, a final one, labelled UE-3, contained two more skeletons arranged over riverbed pebbles with a Bell Beaker vessel of a regional style known as "Pyrenaic". A bone from this layer yielded the youngest date in the hypogeum of 2469-2206 calBCE (3870±45 BP, UBAR-860). We recovered ancient DNA data from 10 individuals:

- I0257/10362A: 2571–2350 calBCE (3965±29 BP, MAMS-25937)
- I0258/10367A: 2850–2250 BCE
- I0260/10370A: 2850–2250 BCE
- I0261/10378A: 2850–2250 BCE
- I0262/10381A: 2850–2250 BCE
- I0263/10385A: 2850–2250 BCE
- I0823/10360A: 2850–2250 BCE
- I0825/10394A: 2474–2300 calBCE (3915±29 BP, MAMS-25939)
- I0826/10400A: 2833–2480 calBCE (4051±28 BP, MAMS-25940)
- I1553/10388A: 2850–2250 BCE

Arroyal I (Arroyal, Burgos, Spain)

Contact person: Manuel A. Rojo Guerra

The site of Arroyal I was excavated by a research team from the University of Burgos in 2011–2012. The site is a megalithic grave with well-preserved structural elements: a rectangular chamber (3x3.5 m), a long corridor (6 m), and a stone mound. The grave was used as a collective burial during 400 years in the Late Neolithic (3300–2900 calBCE)[19]. The grave was then abandoned until the Chalcolithic when it was extensively remodelled: Neolithic layers were almost eliminated; the corridor was filled with rocks and sediment; the useful area inside the chamber was reduced when a stone wall was built; and a floor of limestone blocks was built inside the chamber. Several consecutive and isolated burials (9–10) were then introduced. The last one (Roy5) was a young individual buried with a set of 4 vessels (2 Bell Beakers and 2 carinated bowls) and surrounded by the long bones and skulls from previous burials. She represents the earliest observation of steppe-related genetic affinities in the Iberian Peninsula. Then the dolmen was closed using materials from the site (in secondary position) and, at the same time, the mound height was increased. Finally, an isolated pit grave (Roy4) was made inside the mound. We successfully analysed 5 individuals from this site:

- I0458/Roy1/SU25, Skull 1: 2458–2206 calBCE (3850±30 BP, UGA-15904)
- I0459/Roy2/UE25, Isolated human jaw: 2600–2200 BCE
- I0460/Roy3/SU25, Skull 2: 2461–2210 calBCE (3860±30 BP, UGA-15905)
- I0461/Roy4/SU19, Inhumation 1: 2348–2200 calBCE (3827±25 BP, MAMS-14857)
- I0462/Roy5/SU25, Inhumation 2: 2465–2211 calBCE (3870±30, UGA-15903); 2566–2346 calBCE (3950±26 BP, MAMS-25936)

Samples Roy1 and Roy3 were genetically first-degree relatives and belonged to different mitochondrial haplogroups, which points to a father-son relationship.

Camino de las Yeseras (San Fernando de Henares, Madrid, Spain)

Contact person: Corina Liesau, Patricia Ríos, Concepción Blasco, Pilar Prieto

Most of our knowledge about this site has been gathered from four excavation campaigns, three of which have been rescue archaeology interventions by different

companies. This has conditioned the information available about the site. The site of Camino de las Yeseras is one of the greatest Chalcolithic ditched enclosures (approximately 22ha.) in central Iberia. It is essential to our understanding of the Chalcolithic period: the Pre Beaker burials and the impact that Bell Beaker customs and funerary rituals had on the consolidation of social inequalities among the first metallurgical societies of the Central Iberian Peninsula[20,21].

Strategically located at the confluence of two important rivers, it was probably a central place located on a suitable and well-communicated landscape comprising two valleys for livestock and farming activities, and close to a rich resource catchment area where flint, salt, and clay are found. From the end of the fourth to the middle of the second millennia cal. BCE it was an important production and exchange centre of raw materials and objects. Since the second half of the third millennium cal. BCE, Bell Beaker burials are documented mainly on the south area of the site, and comprise different types of tombs, contemporaneous to other non-Bell Beaker ones, mainly collective burials with scarce grave goods.

Except for one collective Bell Beaker burial in a pit, three so-called *Funerary Areas* reveal the intentional delimitation of space and can be placed chronologically between the end of the third millennium and the first centuries of the second millennium cal BCE. Like pantheons, the huts with sunken floors at Camino de las Yeseras have two or more tombs excavated at the bases of their edges, as well as one deep hypogeum and one or several artificial caves. These pantheon-like structures were respected through time and reveal consecutive funerary and commensality activities within them. Although the sizes of the tombs are independent of the number of individuals buried within them, the hypogea include relevant prestige items such as ornaments in gold and ivory, and the covering of bodies with cinnabar. The artificial caves, on the other hand, include mainly Bell Beaker pottery of the Ciempozuelos incised style. The osteomorphological and size features noted on some of the Bell Beaker individuals suggest they had a peculiar appearance (e.g. gigantism, deformed head) when they were alive.

Sample I4245/RISE659 was obtained from a tomb with a double inhumation in a small artificial cave from *Funerary Area 2.* A 1–5-year-old child was inhumated at the far end of the cave and was covered by the body of a 20–30-year-old woman, carefully placed in supine position with the head to the left and flexed legs. The woman's head, which

rested on a pillow made with a grass fill, revealed an intentional cranial deformation from childhood. Both bodies are known to have decomposed within the infilled space. In terms of the grave goods, a small decorated cup was found on the child, whereas two bigger decorated inlayed cups had been placed between the breast and left arm of the woman. The child was radiocarbon dated to 1960–1740 calBCE (3525±40 BP, Ua-35021). No date is available for the woman, who was sampled for aDNA analysis, but the context suggests that both were interred at the same time:

- I4245/RISE695: 2280–1790 BCE

Sample I2247/RISE698 was obtained from a tomb with a collective inhumation in a small artificial cave from *Funerary Area 3*. At least four individuals have been identified, of which one is a mature female, two are adult mature men, and another adult is possibly also a male and the only complete skeleton documented in this tomb, while the others are secondary depositions, mainly skulls, mandibles and some long bones. The grave goods include a copper awl, one Bell Beaker, two incised cups, one undecorated vessel, one granite millstone and one sandstone mortar. The complete skeleton was radiocarbon dated to 2280–2030 calBCE (3650±40 BP, Beta 184837), but no radiocarbon date is available for the mature female sampled for aDNA analysis:

- I4247/RISE698: 2280–1790 BCE

Camino del Molino (Caravaca de la Cruz, Murcia, Spain)

Contact person: Joaquín Lomba Maurandi, Azucena Avilés Fernández, María Haber-Uriarte

The site of Camino del Molino was excavated in 2008 by archaeologists based at the University of Murcia. It is a multiple burial site with an extraordinary number of individuals (n=1,363 at minimum), deposited in a circular pit (7 m in diameter and 1.6 m deep), which was carved into the rock. The site is located 500 m away from a related settlement: Molinos de Papel. The majority of the human remains appear in irregular position, resulting from continuous post-depositional movements during the use of the site, relocating many of them to the center of the pit, and accumulations of skulls on the walls[22]. A total of 182 individuals were found in at least partial anatomical position, usually in crouched fetal position.

The anthropological examination of the skulls and the 182 complete skeletons indicates equal proportions of males and females (49.5% and 44.8%), of which 47.5% are young, 33.6% mature, and 4.5% aged. Signs of interpersonal violence are observed in 20 skulls (57% male). Accompanying the human remains there were 20 copper elements (19 punches, a fragment of a Palmela point and a dagger), 40 arrowheads and 60 flint knives (partially fragmented), 4 polished axes, retouched tabular flint (among them several daggers) and some punches and rods of bone, as well as partial remains of approximately 400 pottery vessels, 30 of which were intact. Of special interest is the presence of 50 skeletons of canis (6 lupus and the rest familaris). The whole burial ensemble is assigned to a Middle and Final Copper Age horizon. The 20 available radiocarbon dates indicate sequential use of the tomb between 2920–2870/2800–2780 and 2460–2190/2180–2140 calBCE (2 sigma). We successfully analyzed four individuals from this site, two of which have been radiocarbon dated. While the first individual corresponds to the time when Bell Beaker pottery was circulation in southeast Iberia, the other three belong the early-middle Copper Age:

- I0453/Cmol79: 2460–2140 calBCE (3830±40 BP, Beta-261524)
- I0455/Cmol123: 2900–2670 calBCE (4210±40 BP, Beta-261529)
- I0456/Cmol140: 2920–2340 BCE
- I0457/Cmol165b: 2920–2340 BCE

Hégenheim (Haut-Rhin, France)

Contact person: David Billoin and Anthony Denaire

The Hégenheim site is located at the left bank of the Rhine river, a few kilometers from the town of Basel. It was the focus of an emergency excavation during the summer of 2004, when an individual Bell Beaker burial next to a Merovingian necropolis was uncovered[23,24]. The burial consists of an oval pit, north-south oriented, 1.80 meters long and 1.30 meters wide. The skeleton was positioned at the bottom of the pit, in lateral decubitus position on the right side, with flexed knees and elbows. The position indicates that the body is in its primary arrangement. There is suggestive evidence that the grave was covered by perishable material (plausibly a wooden structure).

The grave goods are limited to a decorated vessel, placed in a functional position, just behind the head. It is a large beaker of the S profile and flat-bottomed: 24 cm in height and 20 cm in maximum diameter. The external colour grades from reddish to brown; the vessel is polished and decorated both externally and internally. The latter decoration is restricted to the first two centimeters at the edge and consists of four parallel lines impressed with an S-twisted cord. The external decoration covers all of the beaker except for a short, one-and-a-half centimeter band below the edge. It consists of a series of ten strips alternated with oblique impressions with a comb, limited above and below by a line made with a cord. The decoration can be attributed to a mixed maritime style, considered to be an early stage of the Bell Beaker tradition.

The Hégenheim individual (13-Grave9, I1392) is an adult mature individual who is genetically female. The spatial orientation and the grave goods are consistent with a female Bell Beaker burial.

- I1392/13-Grave9: 2832–2476 calBCE (4047±29 BP, MAMS-25935)

Rouffach – Rue de Pfaffenheim (Haut-Rhin, France)

Contact person: Philippe Lefranc and Anthony Denaire

The burial of Rouffach "Rue de Pfaffenheim"[25] was discovered in 2014 during prospecting and not subsequently pursued. It consists of a grave of a female over 30 years of age, south-north oriented. She was deposited on her back with knees flexed right and hands turned to the face. The pit does not show any clear differentiation to the surrounding sediments. The funerary goods include a small vessel of sinuous profile with a handle, placed in a functional position behind the body, about 10 cm from the left shoulder. Seventeen V-perforated bone buttons, all placed around the right hemithorax, were also found. These kind of grave goods, especially the non-decorated vessel, suggest that this burial corresponds to a late, evolved Bell Beaker phase, and the radiocarbon date on the skeleton confirms this attribution:

- I1391/12-GraveExcavataion2014: 2346–2133 calBCE (3795±35 BP, Poz-68164)

Sierentz - Les Villas d'Aurèle (Haut-Rhin, France)

Contact person: Luc Vergnaud

Villas d'Aurèle site is located in the municipality of Sierentz, on the left bank of the Rhine, 14 km away from the town of Mulhouse. The site is located on the summit of the Rhine river upper terrace. It was the subject of an emergency excavation in 2010, when the remnants of numerous structures from the Neolithic to the early Iron Age were uncovered. Four Bell Beaker burials, comprising a small funerary area of 55 m of length in a northwest-to-southeast axis were excavated[26,27].

Burial 68 (I1390): This well-preserved burial had a quadrangular shape with rounded corners, measuring 2.30 meters long by 1.80 meters wide. The walls were sub-vertical and the bottom was flat. Traces of lines of dark material and fragments of wood stakes, indicate that it originally contained wood, probably a structure around the body. The individual is an adult male, aged 30-59 years. He was lying of his left side, in a hyper-flexed position following a northwest-southwest axis (the head facing northwest). The body was accompanied with two decorated vessels, eight flint elements (three of them arrow points of concave base), a grooved sandstone, a stone wristguard, and a fragment of a wild boar tusk. The two vessels are beakers with an S-profile, of a beige colour and decorated with geometric, horizontal lines produced by a comb and with a cord. One vessel alternates bands of short horizontal and vertical lines with bands of incised diamonds while the other alternates oblique incised bands with herringbone patterns. The style of the pottery indicates a medium Bell Beaker phase, although the arrow points seem to suggest an Oriental tradition of the European Bell Beakers. There are two radiocarbon dates from this skeleton and we used the union for analyses:

- I1390/11-Grave68: 2566–2299 calBCE [2566–2524 calBCE (3910±35 BP, Poz-41227); 2489–2299 calBCE (3875±35 BP, Poz-41226)]

Burial 69 (I1389): This burial is well preserved, similar to burial 68. The shape of the grave is quadrangular with rounded corners, and measures 2.25 m long by 1.70 m wide. The remnants indicate a now-missing wooden structure around the body. The individual is a male with an age around 17-19 years. He was left lying at the center of the pit, in a flexed position over the left side of the body, along a northwest-to-southeast axis (the head facing northwest). Genetic data indicate that this individual is a first degree relative of individual I1390. They share both mitochondrial and Y-chromosome

haplogroups, which points to a sibling relationship (brothers). The funerary goods consist of two decorated vessels, thirteen flint elements (eight of them arrow points), a grooved sandstone, a fragment of marcasite and a pendant made of bone. The two beakers are very similar to those from burial 68, although the decorations are different. The style of the pottery also indicates a medium Bell Beaker phase. There are two radiocarbon dates from this skeleton and we used the union for analyses:

- I1389/10-Grave69: 2468–2278 calBCE [2481–2289 calBCE (3935±35 BP, Poz-41229); 2468–2278 calBCE (3925±30 BP, Poz-41228)]

Mondelange - PAC de la Sente (Moselle, France)

Contact person: Arnaud Lefebvre and Michiel Gazenbeek

This site is located in the Moselle valley, about 20 km north of the town of Metz. It was found during a rescue excavation in 2007 that uncovered 25 burials, nine of them dated to the later Bell Beaker tradition or to the transition to the Bronze Age[28,29].

Burial 487 (I1381): The grave has a rectangular shape with rounded corners, measuring 2 m long and 1.2 m wide, with a preserved depth of 40 cm and a west-east orientation. The individual is a 10-11-year-old juvenile that lies on his left side, facing west and showing upper and lower limbs hyper-flexed. There are numerous funerary elements within this grave, including Bell Beaker vessels at the eastern corner and a stone tool placed between the thorax and the right elbow.

Burial 515 (I1382): The grave has a rectangular shape, with a flat bottom and a west-east orientation. Three of the corners show semicircular digging that probably contained posts of 25 cm in diameter. The grave measures 2.4 m long and 1.3 m wide and is 0.8 meters deep. The filling is made of brownish sandy silt containing small pebbles. The individual was an adult male lying of his left side, facing west. The upper limbs are flexed, with the right hand over the left humerus and the left hand placed in front of the face. The lower limbs are also flexed with the knees oriented to the north. Genetic data indicate that this individual is a second-degree relative of I1381. There are numerous funerary elements within this grave. A stone wristguard is placed next to the left shoulder. Two vessels are placed close to the feet, one near the axis of the body and the other one next to the south wall. One flint arrow point was found between both vessels, at 10 centimeters over the bottom of the pit. The two beakers, one decorated and the

other not - with a peculiar morphology - suggest an evolved, late Bell Beaker phase, with oriental influences. The radiocarbon date from this skeleton is:

- I1382/3-Grave515: 2435–2136 calBCE (3805±35 BP, GrA-4468)

Marlens - Sur les Barmes (Haute-Savoie, France)

Contact person: Joël Serralongue and Pierre-Jérôme Rey

The Marlens - Sur les Barmes site is located in the French Alps, southeast of lake Annecy. It arose from an accidental discovery instead of systematic archaeological prospecting. The site is a crevice that opens at the bottom of a rocky wall, near massive fallen rock debris; the skeleton has been placed inside[30]. The entrance is a very narrow gallery that has a height of only 60 cm. The interior space measures 2.50 m by 1.50 m with an irregular height that reaches 1.70 m at the highest point. The walls consist of large, fractured blocks. The original cavity was enlarged by removing some blocks. The skull was found in a small cavity formed by a natural layout of small stones.

The individual (I1388) is a young male of about 24 years of age. It was associated with a fragment of a Bell Beaker vessel. The decoration is made by a combination of horizontal bands and radial elements including ladder and lattice patterns. This type of incised-printed decoration points to regional Bell Beakers, specifically to the group from the Rhone-Provence of a recent phase. The radiocarbon date from this skeleton is:

- I1388/9-Grave1: 2456–2135 calBCE (3805±40 BP, Lyon-3099)

La Fare (Forcalquier, France)

Contact person: Olivier Lemercier

The site of La Fare (Forcalquier, Alpes-de-Haute-Provence) is located in the south-east of France, in the Pre-Alps of the south about 80 km north of Marseilles. The site occupies the top of a vast promontory dominating the neighboring valleys. The site was excavated from 1991 to 1999 under the direction of André Müller, Olivier Lemercier and Robin Furestier[31].

Burial S14 is located on the margin of a small occupation of the regional Late Neolithic attributable to the Rhone-Ouvèze group. It presents itself as a vast oval pit 2.50m by 2.30m, oriented southeast-northwest and extended in its southern part by a basin of

0.50m long by 0.70m wide, forming an access step to the main pit. The pit accessible by a step under a monolith was probably covered with a floor, blocks and a mound. The body is placed on the bottom of the pit in the west half. It is strictly oriented north-south, head to the north. It is positioned on the left side, the upper and lower limbs flexed.

The archaeological furniture consists of six objects. A copper dagger blade was placed beside the head behind the skull. A small object in the shape of a bone reel was found on the bottom of the pit in front of the head. In the southern part of the pit, under the "access step", were three ceramic beakers, two of which were inverted in front of a small bench in the substrate and a little higher up in the sediment infiltration mass. One is an early Bell Beaker with mixed decoration (comb and cord), the other two are characteristic beakers of the Rhone-Ouvèze group. Screening of the entire sediment of the structure yielded only one small segmented bone pearl.

The skeleton is that of a man aged between 30 and 40 years, of the so-called "alpine" cranial architectural type, about 1.72 m and wounded by inclusion in the olecranon of a fragment of Flint causing ankylosis of the left elbow.

The skeleton is preserved in the Musée de Préhistoire des Gorges du Verdon (Quinson, Alpes-de-Haute-Provence). The radiocarbon date for this individual is:

- I2575/Grave S. 14: 2476–2211 calBCE (3895±40 BP, GrA-22988)

The dolmen of Villard (Lauzet-Ubaye, France)

Contact person: Aurore Schmitt

The tomb excavated during 4 months from 1980 to 1983[32] is located at an altitude of 1267 m near the Morgon relief. It is composed of a rectangular funerary chamber made of 6 slabs and a cover slab, an entrance corridor and a tumulus of around 12 m in diameter. A total 2575 human remains were discovered in the chamber. At least, 25 individuals (16 adults and 9 juveniles) were buried successively in the grave. Partial articulated bodies represent only 5% of the remains, as most of the bones are disarticulated. A single sedimentary layer was observed but two levels of human remains organization were distinguished[33]. Grave goods are scarce compared to the number of individuals: two incomplete Bell Beakers vessels, a copper dagger, a wrist-guard, few lithic tools and ornaments. The first radiocarbon date provided by a human

remain from the base of the funerary layer is in accordance with the grave goods (Ly 9995: 3895+/- 35)[33]. The second radiocarbon date, from the top of the layer (Ly 9994: 3515+/-40)[33], indicates that the tomb was, at least, reused during the middle Bronze age.

Two disarticulated cranium from the oldest funerary level were sampled:

- I3874/Vil-Lauz-1435: 2459–2242 BCE. Adult, genetically female.
- I3875/Vil-Lauz-1316: 2459–2242 BCE. Adolescent, genetically male.

Clos de Roque (Saint Maximin-la-Sainte-Baume, France)

Contact person: Aurore Schmitt

The preventive archaeological excavation in 2011 of the site of Clos de Roque at Saint-Maximin-la-Sainte-Baume revealed pre-and protohistoric human remains[34] over an area of 11200 m^2. The early period of the Middle Neolithic (4950–4450 BCE) is documented by 9 features. Four of them contained human remains but no grave goods[35]. We successfully analysed three individuals from this site:

- I4303/ST2009: 4680–4460 calBCE (5710±40 BP, Beta-321567). The burial has a sub-circular shape. The pit measures 1.7 m with a preserved depth of 0.8m. The individual is a man deceased after 40 years old. He was lying of her left side in a flexed position following a south-north axis (head at the south). Genetic data shows that he was a second-degree relative of I4304/ST2224.
- I4304/ST2224: 4710–4540 calBCE (5780±30, Beta-321569). The feature, probably a domestic pit, has a circular shape. It measures 1.1m and is preserved on 0.60 m. The individual is a male juvenile deceased between 6.5 and 10 years old. The skeleton is completely disarticulated.
- I4305/ST2215: 4690–4460 calBCE (5720±40 BP, Beta-321568). This feature has a sub-circular shape, measuring 1,60 m long and 1,38 m wide. It is 0.25 m deep. This burial is installed in a domestic pit. The individual is a young female lying on her back, lower limbs flexed on her left side. The orientation follows a south-north axis (head at the south).

Collet Redon (La Couronne-Martigues, France)

Contact person: Aurore Schmitt

The site is located close to the Mediterranean Sea and was excavated in 2014 and 2015. The collective tomb, made of stones, has a sub-quadrangular shape. Two sepulchral levels were discovered with at least 11 individuals. Only one subject is partially articulated. Apart from human remains, 6 pearls made in limestone were found. A bone from the lower level produced a date of 3501–3112 calBCE (4585±35 BP, Poz-80330). We successfully analysed one individual from this site:

- I4308/CL14-172: 3501–3112 BCE. A petrous temporal from the lower level. It belongs to an adult female.

Via Guidorossi (Parma, Italy)

Contact person: Maria Bernabò-Brea

The site of Via Guidorossi at Parma, in the Po plain, was excavated in 2009 and corresponds to an advanced Bell Beaker period, dated to 2200–1930 years calBCE[36]. Tomb number 1 contained two skeletons, labelled individuals A (US-8) and B (US-9). Both were placed into an excavated structure of about 2.2 x 2.2 meters, with an opening at the northeast corner.

Individual A was a ~30-year-old woman placed in a south-north orientation, while individual B (I2478), the best preserved of both and the one successfully analysed in this study, was a 30-40-year-old male. This skeleton was placed with flexed legs on his left side, with his left arm also flexed and the right one extended. He was oriented north-south, with the head pointing north and the face looking to the east. Two Bell Beaker vessels, one decorated with incised triangles in a central band and the other undecorated, were placed at his feet, while two additional vessels were located close to the opening of the funerary structure. The decorated pottery is similar to objects found in other Bell Beaker Italian sites such as Rubiera (Reggio Emilia). Some lithic implements, including a remarkable knife, were found between the legs of individual B. The only similar lithic knife in a Bell Beaker context has been found at Fosso Conicchio near Viterbo. The radiocarbon date for individual B is:

- I2478/Tomb1, ind B: 2200–1930 calBCE (3671±40 BP, LTL-5035A)

A second tomb, excavated in a sub-quadrangular form, contained three more skeletons, labelled A (US-12), B (US-13) and C (U-14), all of them placed in flexed position. Individuals A and C were 60 and 50 year-old males, respectively, while individual B, who was lying between them and in inverted orientation (north-south), was a 15- to 18-year-old young female. Several decorated Bell Beaker vessels were located within this second grave. The bipolar orientation of the Guidorossi burials – south-north for females and north-south for males, all facing to the east – points to traditions found in central European Bell Beaker sites, such as those from lower Austria and Moravia.

Oostwoud-Tuithoorn (West Frisia, Netherlands)

Contact person: Harry Fokkens

In 1956 and 1957, two burial mounds were excavated at Oostwoud-Tuithoorn, with additional research in 1963, 1966 and 1978[37–39]. Both burial mounds were located on a levee or crevasse splay of a large tidal creek system, about 40 km inland. The silt and clay sediments in which the skeletons were embedded provided an excellent context for bone preservation. After approximately 800 BCE the area was submerged until the building of dykes after 1000 CE. There is plenty of settlement evidence in the area from Late Vlaardingen/ Late Corded Ware groups, but few Bell Beaker associated remains. The Oostwoud-Tuithoorn burials are in that sense unique, even though they probably represent a much more extensive but difficult to detect settled landscape.

The sequence at this site starts with skeleton 575, dated between 2579–2284 calBCE (3945±55 BP, GrN-6650C). After a few decades, the site was likely converted into arable land. The next stage is the erection of Tumulus II, in which 11 individuals were buried between 2200 and 1900 calBCE: eight male individuals (skeletons 127, 228, 229, 233, 235, 236, 239, 242) and three female individuals (skeletons 243, 247 and possibly 232)[38]. Genetic data indicate that skeletons 228, 236 and 242 are second- or third-degree relatives. Several phases of mound extension have become visible through bundles of prehistoric plough marks that surround a circular or oval mound. The arable land underlying and around the burial mound contained many Bell Beaker and pot beakers sherds (Bell Beaker settlement ware). In essence, this dates all skeletons buried in mound II to older than approximately 1900 BCE. The male individuals were all buried on their left side, facing south. The three females were buried on the right side, facing

west or north. All individuals were laid down in a crouched position typical for Beaker burials. Apart from occasional flint artefacts no burial gifts were present.

In the Early Bronze Age, between 1900 and 1700 BCE probably, at 20 m distance, a second burial mound (Tumulus I) was raised in which two skeletons have been interred, probably in the already existing barrow (skeletons 230 and 231). Both skeletons were buried in a manner typical for the Middle Bronze Age, stretched on their backs. Both are dated between 1880 and 1650 calBCE (3440±40 BP, GrA-17225 and 3450±BP, GrA-17226). The burial mound was surrounded by a circle of 80 cm wide pits with a diameter of approximately 20 m. Probably at the same time a 35 m long alignment of almost identical pits was dug in connection with the older mound (Tumulus II). The stratigraphy of the arable land, the graves and the pit circles and alignments demonstrate that the Oostwoud-Tuithoorn burial mounds constituted a small persistent place, a burial ground that was used intermittently but consistently, probably by several generations of a local group of inhabitants. We successfully analysed nine individuals from this site:

- I4067/skeleton 127-M1: 1945–1692 calBCE (3500±50 BP, GrA-15602)
- I4068/skeleton 228-M3: 2300–1900 BCE
- I4069/skeleton 229-M4: 2188–1887 calBCE (3640±50 BP, GrA-6477)
- I4070/skeleton 230 barrow I-M7: 1881–1646 calBCE (3440±40 BP, GrA-17225)
- I4071/skeleton 231 barrow I-M10: 1883–1665 calBCE (3450±40 BP, GrA-17226)
- I4073/skeleton 236-M13: 2196–1903 calBCE (3660±50 BP, GrA-15598)
- I4074/skeleton 242-M14: 2278–1914 calBCE (3690±60 BP, GrA-15597)
- I4075/skeleton 243-M15: 2300–1900 BCE
- I4076/skeleton 247-M18: 2300–1900 BCE

The skeletons are stored in the provincial depot of the province of Noord-Holland at Castricum. We thank the staff of the depot and archaeologist R. van Eerden, archaeologist of the province of Noord-Holland, for the kind permission to sample the Oostwoud skeletons. Sampling (E. Altena) and first analysis of the skeletal remains (B. Veselka) was made possible by a grant from the Leiden University Fund/Bakels Fund.

Unterer Talweg 58-62 (Augsburg, Germany)

Contact person: Philipp W. Stockhammer, Ken Massy

The site of "Unterer Talweg 58-62" is situated in Haunstetten, a quarter of Augsburg to the very south of the city and approximately 1.6 km south of the cemetery of Hugo-Eckener-Straße, from which individuals are also included in this study. The cemetery was excavated in 2007 and consists only of two burials, a single burial (Feature 67) and a double burial (Feature 68) lying close to each other. Each was originally covered by a small tumulus with a surrounding ditch. Genetic data from two individuals from the double grave (Feature 68) were included. The double burial was placed in a rectangular shallow pit below a tumulus of diameter approximately 3.15 m. Skeleton 1 was a male individual, placed in contracted position on his left side with head pointing to the north adjacent to him. Skeleton 2 was placed in the opposite direction – following the sex-specific burial norms of the Beaker Complex in Southern Germany. The two individuals seem to have been interred at the same time, which also fits the radiocarbon dates:

- E09537_d/Feature 68 Skeleton 2: 2464–2212 calBCE (3870±30 BP, MAMS-29075)
- E09538/Feature 68 Skeleton 1: 2471–2300 calBCE (3909±29 BP, MAMS-29074)

Close to the back of the male individual, a bowl was placed in the burial pit and a wrist-guard was placed on one of his lower arms. A decorated Bell Beaker was found close to the back of the female individual. Seen from a stylistic and relative chronological perspective, the beaker and the wrist-guard point to a rather early time within the Beaker Complex, which is also consistent with the radiocarbon dates.

Unterer Talweg 85 (Augsburg, Germany)

Contact person: Philipp W. Stockhammer, Ken Massy

The site of "Unterer Talweg 85" (due to a change of the street numbers after the excavation, the site is sometimes also known as "Unterer Talweg 49") is situated in Haunstetten, a quarter of Augsburg to the very south of the city and only 300 m north of Unterer Talweg 58-62, from which individuals are also included in this study. The cemetery consists of two small groups of burials, group I with 5 graves and group II with 2 graves, both situated roughly 20 m apart from each other. Group I, the so-called northern group, was excavated in 2001. Three single burials were radiocarbon dated and

their 2 sigma ranges fall between 2465 and 2152 calBCE[40]. We obtained genetic data from the dentine of the individual in grave I/3 (feat. 1343). This was a male individual in contracted position with an arrowhead and several pieces of flint as grave goods.

- E09569/Grave I/3: 2397–2149 calBCE (3819±24, MAMS-18949)

Hugo-Eckener-Straße (Augsburg, Germany)

Contact person: Philipp W. Stockhammer, Ken Massy

The site of "Hugo-Eckener-Straße" was excavated in 2010, when the city of Augsburg in Bavaria opened new land for construction. It is situated roughly 2.3 km north of the cemetery Unterer Talweg 58-62, from which individuals are also included in this study. The cemetery comprises 11 graves, nine of which are single and two of which are double burials, all clearly attributable to the Beaker Complex. This is a typical size for cemeteries of the Beaker Complex in southern Germany and can be understood as the burial place of a nearby hamlet. The individuals were all placed in contracted positions with the respective orientation of their head depending on their sex (males: contracted position on the left side of the body with the head in the north and a view to the east; females: contracted position on the right side of the body with the head in the south and a view to the east) and the graves were arranged in a north-northeast/south-southwest oriented row. Individuals of ten of the graves were radiocarbon dated with their 2 sigma ranges lying between 2562 and 2039 calBCE[40]. Genetic results from dentine of three individuals (graves 3, 8, 10) were included in this study:

Grave 3 (Feature 168) contained a female individual. In front of the lower leg of the woman, an undecorated Bell Beaker was placed together with a stone with worked surface (marks of polishing and picking).

Grave 8 (Feature 180) contained a double burial from which skeleton 1, a male individual with his head pointing to the NE. Parts of the lower body were missing and it was obviously buried together with a female individual (skeleton 2) as the female body was partly placed directly on the male one. There are no burial goods nor is there any evidence of later disturbances of the burials.

Grave 10 (Feature 190) contained a female individual in canonical position. A cup with a handle from its rim was situated in front of the upper leg/knee of the individual.

The radiocarbon dates for individuals from this site with genome-wide data are:

- E09568_d/Grave 8 Skeleton 1: 2461–2210 calBCE (3860±25 BP, MAMS-18918)
- E09613_d/Grave 3: 2289–2141 calBCE (3788±23 NP, MAMS-18913)
- E09614_d/Grave 10: 2268–2046 calBCE (3748±19 BP, MAMS-18921)

Bruck (City of Künzing, County of Deggendorf, Bavaria, Germany)

Contact person: Volker Heyd

This site is a cemetery of 9 graves, excavated in 1990 in a rescue excavation by the county archaeologist of Deggendorf, Karl Schmotz. In an area of 40 x 20 m there were 7 inhumations as well as one inurned cremation and another cremation with ashes shattered in the burial pit. A total of 8 out of the thus 9 graves are arranged in a single, approximately 28 m long, northwest-southeast oriented line (only grave 1 is off this line, approximately 20 m away to the west). Following bio-anthropological determinations as well as archaeological criteria, based on the gender differentiated burial custom of the Bell Beaker East Group and equipment rules, the graveyard yields burials of 4 men, 4 women and one child. Chronologically all graves belong to the middle phase A2 of the southern German Bell Beaker chronology[41]. Outstanding are grave 8, a senile man buried in the centre of a circular ditch, perhaps indicating a mound, and grave 9, a metal craftsman. We successfully analysed two individuals from this site:

- I3604/Obj. 278, grave 9: 2300 BCE. Left-sided crouched (slightly bent to the back) burial in a 0.9 x 1.5 m sized and approximately 0.75 m deep rectangular grave-pit. Inventory consists of 2 (1 larger and 1 smaller) metope-decorated Bell Beakers behind the back, wristguard, 4 flint arrow-heads, 2 flints and copper awl. These were piled together between feet and grave-pit, and probably originally deposited in a bag. The grave contains a metalworker's kit consisting of larger gravel-stone, arrow-shaft smoother, trapezoid-formed cobblestone, adze fragment with intentionally flattened edge, sandstone, 2 flint arrow-heads and at least 5 boar's tusks. Scientific analysis of the stones and adze showed that gold and copper were worked with them. Anthropological analysis indicates that this an adult man.

- I3607/Obj. 335, grave 7: 2300 BCE. Left-sided crouched burial in a 0,95 x 1,4 m sized rectangular grave-pit; inventory consists of decorated handled Bell Beaker behind the head and 2 flint arrow-heads.

Alburg (Lerchenhaid-Spedition Häring, City of Straubing, Bavaria, Germany)

Contact person: Volker Heyd

The site is a cemetery of 18 graves, excavated in 1982 in a rescue excavation by the State Heritage Office. The excavation completely dug out this graveyard of c. 10 x 30 m. Almost all graves are laying in long rows, oriented north-south. Only grave 5 is off one of these rows, and it could not be established whether this really belongs to the cemetery. Individual grave pits are dug in the Löss soil underground with sizes of up to 1,4 x 0,8 m, orientation always along the cardinal axis of north-south. All graves, except no. 10, contain single burials and follow the typical gender differentiated burial custom of the Bell Beaker East-Group[42] with men laying crouched on their left-hand side with heads in the north; and women on their right-hand side with heads in the south; all burials are thus facing east. Altogether there are 8 left- and 8 right-hand sided crouched burials, encompassing men, women, 3 adolescents and 5 children. All graves belong chronologically to the later, *Begleitkeramik (accompanying pottery)* -dominated phases A2b, B1 and B2 of the southern German Bell Beaker chronology[43].

Only grave 9 – the earliest grave of the cemetery – yields a broad metope-decorated Bell Beaker and grave 18 a non-decorated handled Beaker, while all others are characterised by various forms of cups, jars, plates and bowls. The early graves 9 and 16, and grave 8, are isotopically determined as outliers[44]. Additional equipment consists of bow-shaped bone/boar's tusk pendants; V-perforated bone/antler buttons; a bone pin; arrowheads; and other flints; deer teeth, as well as other animal bones as grave offerings. The cemetery stands out due to 6 graves, all belonging to women, yielding many V-formed perforated bone/antler buttons, amongst these 29 pieces in grave 6 alone and 22 pieces in grave 15, here laid out "in a U-formed line from the clavicle to the lower departure of the sternum and then upwards again to the other clavicle", most of them with the perforated side facing upward. We successfully analysed thirteen individuals from this site:

590 • I3601/Grave 15: 2300–2150 BCE. Right-sided crouched burial; anthropologically
591 adult woman.

592 • I3602/Grave 16: 2300–2150 BCE. Right-sided crouched burial; anthropologically
593 adult woman.

594 • I3600/Grave 14: 2300–2150 BCE. Left-sided crouched burial; anthropologically a
595 young adult; inventory includes four-footed plate/bowl.

596 • I3599/Grave 13: 2300–2150 BCE. Left-sided crouched burial; anthropologically
597 adult man. Genetic data show that he is a first-degree relative of I3588/Grave 2, likely
598 his brother.

599 • I3588/Grave 2: 2300–2150 BCE. Left-sided crouched burial; anthropologically
600 adult man.

601 • I3589/Grave 3: 2300–2150 BCE. Left-sided, N-S oriented, crouched burial;
602 inventory consists of bone pin, 5 decorated bow-shaped bone pendants, 2 fragmented
603 boar's tusks and 11 flints, all deposited behind the back; anthropologically adult man.

604 • I3590/Grave 4: 2300–2150 BCE. Right-sided crouched burial; anthropologically
605 adult; inventory includes cup with an incised decoration. Genetic data show that she is a
606 first-degree relative of I3593/Grave 6.

607 • I3594/Grave 9: 2300–2150 BCE. Half-way supine with flexed legs, half-way
608 slightly right-hand side crouched burial, south-north oriented; inventory consists of
609 broad metope-decorated beaker, 10 V-formed perforated bone buttons and 3 flints;
610 anthropologically adult woman. Genetic data show that she is a first-degree relative of
611 I3597/Grave 12.

612 • I3592/Grave 8: 2300–2150 BCE. Right-sided crouched burial; anthropologically
613 adult woman.

614 • I3593/Grave 6: 2300–2150 BCE. Right-sided crouched burial; anthropologically
615 adult woman.

616 • I3597/Grave 12: 2300–2150 BCE. Left-sided crouched burial; anthropologically an
617 infant.

- I3587/Grave 1: 2300–2150 BCE. Left-sided crouched burial without skull (probably intentionally removed); anthropologically a child; inventory includes 6 deer teeth.
- I3596/Grave 11: 2300–2150 BCE. Left-sided crouched burial; anthropologically a child; inventory includes four-footed plate/bowl, decorated with incisions on the rim.

Irlbach (County of Straubing-Bogen, Bavaria, Germany)

Contact person: Volker Heyd

The site is a cemetery of 24 graves, excavated in 1987-89 in a rescue excavation by the county archaeologist of Straubing-Bogen, Karl Böhm. Most graves are badly damaged by ploughing, and likely several more were completely destroyed prior to the excavations. As a consequence, many single finds are not attributable to individual graves. The Irlbach cemetery might originally have yielded 30 graves, on an overall area of 60 x 30 m; this makes it the largest cemetery in Bavaria/southern Germany to date. Following the occupation plan, the cemetery consists of three grave groupings: A western part with 6, a central part with 14, and an eastern part with 3 graves plus one more isolated grave (no. 6). Particularly in the central part, many graves are arranged in north-south oriented rows. Individual grave pits are dug in the Löss soil underground, often quite shallow, with orientation always along the cardinal axis of north-south. Due to additional erosion all graves, except of nos. 10 and 22, are in various degrees damaged by ploughing. The majority of graves, except number 17 and potentially 12 and 13 too, follow the typical gender differentiated burial custom of the Bell Beaker East-Group. Altogether there are 10 left and 10 right-hand sided crouched burials, encompassing men, women, 4 adolescents and 4 children. Particularly remarkable are the graves no. 2, representing a double inhumation of a woman and a child; no. 14 as it yields the only tanged copper dagger; no. 17 as this anthropologically securely determined woman should be lying on the right instead of the left-hand side; and numbers 20 and 22 as intentionally disturbed in antiquity, with grave 22 having seen the removal of a copper object.

Chronologically, all graves belong to the later, so-called *Begleitkeramik* (accompanying pottery) -phases A2b, B1 and B2 of the southern German Bell Beaker chronology[45], with graves nos. 5 and 10 of the central group likely being the founding graves (phase A2b). There is however not a single decorated Bell Beaker in this cemetery. The four

graves of the eastern grave group are the latest interred, also representing the latest Bell Beaker stage (phase B2) in Bavaria. Two of them, nunmbers 6 and 11, and grave 16 of the western group, are isotopically determined as outliers[44]. The equipment is characterised by only one undecorated Beaker (grave 7), but various forms of many cups, plates and bowls. Additional equipment consists of bow-shaped bone/boar's tusk pendants from 4 graves; V-perforated bone/antler buttons from 3 graves; a flint from grave 9; non-local gravel-stones from 4 graves; as well as animal bones as grave offerings from 6 graves. We successfully analysed 3 individuals from this site:

- I4248/RISE916, grave 3: 2500–2000 BCE. Left-sided crouched burial; anthropologically adult man.

- I4249/RISE917, grave 4: 2500–2000 BCE. Right-sided crouched burial; anthropologically an infant.

- I4250/RISE918, grave 5: 2500–2000 BCE. Right-sided crouched burial; anthropologically infant

Manching-Oberstimm (Gde. Manching, Kr. Pfaffenhofen a.d. Ilm, Bavaria, Germany)

Contact person: Karl-Göran Sjögren

The site, also called Oberstimm Ost, is located on a terrace near the Danube in the region of Ingolstadt in upper Bavaria. It was discovered in 1982 when a roman military camp and a Hallstatt period settlement were excavated, which had been located by air photography[46–48].

Four Bell Beaker graves were found, three of which formed a northwest-southeast line (graves 1-3). The graves were oriented along this line and consisted of rectangular pits, probably with internal wooden cist constructions. Graves 1 and 2 contained male burials while graves 3 and 4 contained females. The male burials were surrounded by circular ditches, ca 5-6 m in diameter.

Unusually, the male in grave 1 was buried in a 'female' position, that is, on his right side in contracted position and the head towards the south. The other burials followed common Bell Beaker conventions regarding sex differentiation. The two male burials were relatively richly furnished and contained archery equipment as well as copper

objects and pottery. Grave 1 had a wrist plate and a hafted copper awl, also considered as a female attribute, and a bone button. The grave also contained three pottery vessels, of which one was a metope-decorated beaker and one a bowl. Grave 2 had a copper dagger, a wrist plate and a bundle of arrowheads. Two vessels were also found, a metope-decorated beaker and a large bowl, approximately 50 cm in diameter. Grave 3 had seven amber buttons with V-perforations and three vessels, of which two decorated beakers and a cup with handle.

The grave sampled here was grave 4 (RISE556). This grave was located a couple of meters to the west from the line formed by the other graves. It contained the skeleton of an adult woman, lying on her right side with the head to the south. In the grave were a series of amber and bone beads and buttons, some with V-drilled holes, and a beaker with metope decoration.

- I4123/RISE556/F0003/Grave 4: 2500–2000 BCE

No direct 14C dating has been performed. Measurement of Sr87/Sr86 isotope ratios were performed by Gisela Grupe and T. Douglas Price on tooth and bone samples from graves 1, 2 (males) and 4 (female). The results suggest that the two males may have been locals, while the female was non-local and had spent her early years in an area with more radiogenic bedrock[49,50].

Distillery Cave (Oban, Argyll and Bute, Scotland)

Contact person: Ian Armit

Distillery Cave is located at around 12 m above present sea-level, at the foot of cliffs in the modern town of Oban[51] (Canmore ID 23064)[52]. It was discovered during building work in 1890 and later destroyed during the construction of a distillery complex in the early part of the twentieth century. The cave was relatively small, measuring some 3 m wide and 3 m high at its mouth, some 4 m deep, and lessening to around 1.3 m high at the rear. Concentrations of marine shell were recovered as well as objects of flint and bone, one of which has produced an Early Bronze Age radiocarbon date[53]. Human remains, representing at least 12 individuals, were recovered, ranging in age from infants to mature adults[53]. It is unclear whether they represent disturbed burials or the deposition of disarticulated human remains. There is no surviving contextual

information that might be used to associate the human remains with any of the material artefacts found in the cave. Three human petrous bones were successfully analyzed:

- I2660/GENSCOT29: 3514–3353 calBCE (4631±29 BP, SUERC-68703)
- I2691/GENSCOT30: 3701–3640 calBCE (4881±25 BP, SUERC-68704)
- I2659/GENSCOT28: 3762–3644 calBCE (4914±27 BP, SUERC-68702)

Macarthur Cave (Oban, Argyll and Bute, Scotland)

Contact person: Ian Armit

Macarthur Cave is located at the foot of cliffs in the modern town of Oban, where it was discovered during quarrying operations in 1894 (Canmore ID 23066)[52]. Although the blasting associated with these works caused such damage that it is difficult to determine the original size or shape of the cave (which cannot now be traced and may have been entirely destroyed), it seems to have been a minimum of around 10 m deep by 6 m wide[54]. Human bone representing a minimum of four individuals was recovered, at least some of which appears to have been disarticulated[51,53,54]. Radiocarbon dating has shown that, although there are material artefacts of Mesolithic age within the cave, some of the human remains date to the Middle Iron Age[53]. Two human metacarpals were successfully analyzed for ancient DNA and proved to derive from the same adult male individual. One of these was dated, giving a surprisingly early, Neolithic date:

- I2657/GENSCOT26: 3952–3781 calBCE (5052±30 BP, SUERC-68701)

Dryburn Bridge (East Lothian, Scotland)

Contact person: Ian Armit

Dryburn Bridge is an Iron Age enclosed settlement on the East Lothian coastal plain that also contains evidence for burials of an Early Bronze Age date[55] (Canmore ID 58802)[52]. These burials comprised two well-built stone cists, each containing two crouched individuals. Cist 1 contained the skeletal remains of a crouched inhumation (Burial 5), with the disarticulated remains of a second individual (Burial 4) lying over their pelvic region; both were adult males. Cist 2 contained a further crouched inhumation of an adult male (Burial 10) along with the disarticulated remains of a child

of around 6–8 (Burial 11). A Beaker vessel was found resting on the slabs above Cist 2. Two human bones were successfully analyzed for ancient DNA:

- I2567/GENSCOT14, Burial 5, Cist 1: 2275–1884 calBCE [2131–1884 calBCE (3615±40 BP, SUERC-4072); 2275–2024 calBCE (3725±35 BP, SUERC-4083)]
- I2568/GENSCOT15, Burial 10, Cist 2: 2287–2039 calBCE (3755±35 BP, SUERC-4078)

Eweford Cottages (East Lothian, Scotland)

Contact person: Ian Armit

This is an Early Bronze Age cist grave that contained the contracted skeleton of an adult male, lying on his side and accompanied by a flint knife (Canmore ID 57670)[52]. A boulder adorned with prehistoric cup-marks was found nearby but may not be associated with the cist. The cist was a chance find and was excavated in 1975 by Helen Nisbet, but not published at that time. The individual was found to have suffered from rickets. The skeleton was radiocarbon dated to 2140–1916 calBCE (3650±40 BP, SUERC-5318) and this result was published in 2007[56] (there is a confusion in this publication where the location of the cist is mistakenly attributed, in the volume's appendix, to the nearby site of Eweford West). One molar from this individual was successfully analyzed for ancient DNA:

- I2569/GENSCOT17: 2140–1916 calBCE (3650±40 BP, SUERC-5318)

Longniddry, Evergreen House (East Lothian, Scotland)

Contact person: Ian Armit

Several Bronze Age burials were exposed during landscaping work on Evergreen House, Longniddry, on the East Lothian coastal plain in 2000 (Canmore ID 182426)[52]. Rescue excavation revealed three crouched inhumations (Skeletons 2, 3 and 4), one of which (an elderly female, Skeleton 3) was contained in a stone cist, along with further disturbed, disarticulated bones[57]. The three complete burials were clustered tightly together, though in separate graves and on separate alignments. In total, at least five adults, both male and female, were represented. The remains are likely to have formed part of a larger Bronze Age burial ground and it is indeed possible, based on the

presence of concentrations of large stones, that the three excavated inhumations may have lain under a single (now almost vanished) cairn. Initial problems in the radiocarbon dating were resolved through redetermination by the dating laboratory[58]. Three adult human petrous bones were successfully analyzed for ancient DNA from each of the three most complete skeletons:

- I2573/Skeleton 4/GENSCOT21: 1501–1302 calBCE (3144±37 BP, OxA-16486)
- I2653/Skeleton 2/GENSCOT22: 1500–1300 BCE
- I2654/Skeleton 2/GENSCOT23: 1500–1300 BCE

Pabay Mor, Isle of Lewis (Western Isles, Scotland)

Contact person: Ian Armit

A crouched burial of Middle Bronze Age date was excavated in 2002 in eroding sand dunes on the small island of Pabay Mor off the west coast of Lewis (Canmore ID 237343)[52]. The body of a mature adult male, damaged by erosion, was aligned north-south, lying on its right side with legs very tightly flexed[59]. Although there was no apparent cist, the burial was marked by a stone on its west side. The burial, although disturbed, was apparently associated with a small pottery vessel, a polished pebble and a piece of worked pumice. The disarticulated mandible of an infant was also recovered. A human molar from this individual was successfully analyzed for ancient DNA:

- I2655/GENSCOT24: 1442–1273 calBCE (3105±35 BP, SUERC-9172)

Stenchme, Lop Ness, Sanday (Orkney, Scotland)

Contact person: Ian Armit

A crouched human burial was excavated in 2000 from eroding coastal sand dunes on the island of Sanday, Orkney (Canmore ID 306622)[52]. The Early Bronze Age burial lay in a stone cist measuring 1.3 m north-south by 0.9 m east-west, and was apparently associated with lithics and pottery (https://canmore.org.uk/site/306622/sanday-stenchme). A human petrous bone was successfully analyzed for ancient DNA:

- I2981/GENSCOT80: 2009–1497 calBCE [1741–1497 calBCE (3320±50 BP, AA-51418); 2009–1696 calBCE (3520±40 BP, AA-43651)]

Quoyness (Orkney, Scotland)

Contact person: Alison Sheridan

This is a Neolithic, Maeshowe-type passage tomb (Canmore ID 3395)[52], located on the eastern shore of the island of Sanday in the Orkney archipelago. It was first excavated in 1867 by local antiquary James Farrer, then in 1951–2 Vere Gordon Childe undertook limited excavation of the cairn and platform[60,61]. The monument consists of a central rectangular chamber and long narrow passage (orientated south-east) enclosed within a sub-circular cairn; the cairn is surrounded by a platform. The chamber has a tall, steeply-corbelled roof rising to a height of 4 m, and six cells project from it. The cairn consists of a pear-shaped core with a thick surrounding casing and a secondary outer casing. The surrounding platform, 41 m by 32 m, slopes up to the outer limit of the cairn. Finds comprise human and animal bones, pottery, a fine polished bone pin, two ground slate objects, several stone discs, two stone Skaill knives, two rectangular slate objects, a cut tip of a deer antler, a rectangular piece of whalebone and a broken piece of pumice. The human remains were found in the outer section of the passage, in four of the cells, and in a pit set into the chamber floor, covered with a flagstone. Remains of 12 to 15 skulls were found, and the other bones comprised the remains of at least 10 adults of both sexes, two or three children over 10 years old, and probably two under 7 years old. Two adult left petrous temporals (GENSCOT03 and GENSCOT04) were submitted for ancient DNA analysis, but only GENSCOT03, a male, produced results. The radiocarbon date for this individual is:

- I2631/GENSCOT03: 3098–2907 calBCE (4384±36 BP, SUERC-68633)[62]

There are four other radiocarbon dates for human remains from Quoyness. Two (2899–2626 calBCE (4190±50 BP, SRR-752) from a tibia and 3020–2679 calBCE (4265±50 BP, SRR-753) from a femur) were obtained during the 1970s for Colin Renfrew[60,63]. One from a rib (3336–3096 calBCE (4487±18 BP, MAMS-14921/S-EVAA-24027)) was obtained in 2012 for Michael Richards[64]. One from an adult tibia was obtained in 2016 as part of PhD research based at the SUERC radiocarbon dating laboratory but its details have not yet been released.

Point of Cott (Orkney, Scotland)

Contact person: Alison Sheridan

This is a Neolithic chamber tomb comprising a stalled chamber set within a large horned cairn (Canmore ID 2756)[52], located beside a cliff on the northeast coast of the island of Westray in the Orkney archipelago. It was excavated by John Barber and Eoin Halpin in 1984 and 1985 in response to the threat of destruction through coastal erosion[60,65]. The chamber is divided into four compartments or 'stalls' by jamb-stones, the rear compartment being divided into two cist-like structures. The chamber (around 8.5 m long) is linked to the horned forecourt (16 m wide) by a short passage, and the cairn – over 31 m long – is roughly trapezoidal with concave long sides; the entrance is aligned south-south-east. Apart from human remains, finds comprise sherds of several round-based pots, 71 pieces of flaked flint, a piece of pumice (possibly deposited naturally), two pieces of worked stone and seven pebbles, and 16 beads (probably constituting a necklace) made from the teeth of killer whale, pilot whale and sperm whale. Over 600 fragments of disarticulated human bone were found, representing a minimum of 13 individuals. The partial remains of at least five adults, two subadults and five infants were found in the chamber and passage. The remains of two infants (one neonatal) were found inserted into the north end of the cairn. Six adult bone fragments (from ribs and radii from two adults) found in the upper levels of the collapse of the core-cairn surrounding the chamber may be disturbed from the chamber, rather than secondary deposits. Two individuals were successfully analyzed for ancient DNA: GENSCOT79, dentine from a lower molar tooth from a male of indeterminate age from compartment 3 and GENSCOT78, a petrous temporal from a juvenile female from compartment 1 (the outermost compartment):

- I2796/GENSCOT79: 3700–3380 calBCE (4856±33, SUERC-69074) (adjusted to allow for a slight marine offset: Brian Tripney, pers. comm.)
- I2980/GENSCOT78: 3361–3102 calBCE (4530±33 BP, SUERC-69073)[62]

There are nine other dates from human bone from Point of Cott, and nine dates for animal bone, mostly not from single-entity individuals[65–68] (https:www.canmore.org.uk/c14index/2756, accessed April 2017). Seren Griffiths has Bayesian-modelled the start of the dated human remains deposition at *3620–3390 cal BCE* at 95% probability, and its end at *3010–2670 cal BCE* at 95% probability. Another

similar exercise undertaken by Alex Bayliss et al.[68] has concluded that the primary period of human deposition in the monument was between *3800–3380 cal BCE* and *3010–2545 cal BCE*, at 95% probability in each case. The newly-obtained date for individual I2980 fits within this range, while that for individual I2796 appears to be somewhat earlier.

Isbister (Orkney, Scotland)

Contact person: Alison Sheridan

This is a Neolithic chamber tomb that combines features of both stalled cairns and Maeshowe-type passage tombs, and is located close to cliffs at the southern end of South Ronaldsay in the Orkney archipelago (Canmore ID 9554)[52]. It was dug into by the local farmer, Ronald Simison, in 1958, 1976–79 and 1982, and limited excavation was undertaken by Roy Ritchie from the Inspectorate of Ancient Monuments in 1958. Additional, small-scale excavation was undertaken for Orkney Islands Council in 1987, and there was clearly some digging into the chamber prior to 1958[60,69–74]. The monument is popularly-known as 'The Tomb of the Eagles' (but see below on the date of the eagle remains). The chamber, 8.2 m long, is divided into five segments by four pairs of transversely-set orthostats, with the end compartments being wider than the rest of the chamber. There are also three side-cells. The passage leads from the mid-point of the chamber (and roughly at right-angles to it) to the outside of the roughly oval cairn, and is orientated ENE. The cairn is encased around its western half by a roughly D-shaped rubble mound edged by a semi-circular wall, and an earlier wall, termed a 'hornwork', extends NNE from the cairn. The numerous material finds, which include fragments of 45 round-based pots including several Unstan bowls, fragments of a flat-based pot, and several friable, shell-tempered sherds, are catalogued in ref. [60,71]. A wide variety of faunal remains were found, including those of white-tailed sea eagles which radiocarbon dating has shown to relate to secondary deposition during the second half of the third millennium, long after the monument was constructed[75]. Abundant human remains were found – over 15,000 fragments[71] – with some sealed below the floor slab of the south end compartment, some in the cells, many on the floor of the chamber, many filling the chamber, and many unstratified. A few bones were found outside the monument. Meticulous re-examination of these bones by David Lawrence[73,74] concluded that Chesterman's initial MNI estimate of 341 was a gross over-estimation,

with the actual figure likely to be around 85. Ten bones were successfully analyzed for ancient DNA, and nine of these have been radiocarbon-dated (with the tenth failing due to insufficient collagen for dating); details of their sample numbers and radiocarbon dates are as follows:

- I2630/GENSCOT02: 2581–2464 calBCE (3999±32 BP, SUERC-68632)
- I2932/GENSCOT70: 2571–2348 calBCE (3962±29 BP, SUERC-68721)
- I2933/GENSCOT71: 3011–2886 calBCE (4309±29 BP, SUERC-68722)
- I2934/GENSCOT72: 3330–2910 calBCE (4466±33 BP, SUERC-69071). The calibrated result has been adjusted for minor marine offset; recalibration undertaken by Brian Tripney.
- I2935/GENSCOT73: 3336–3012 calBCE (4451±29 BP, SUERC-68723)
- I3085/GENSCOT74: 3339–3027 calBCE (4471±29 BP, SUERC-68724)
- I2977/GENSCOT75: 3009–2764 calBCE (4275±33 BP, SUERC-69072)
- I2979/GENSCOT77: 3334–2942 calBCE (4447±29 BP, SUERC-68726)
- I2629/GENSCOT01: 3180–2780 BCE
- I2978/GENSCOT76: 3336–3024 calBCE (4464±29 BP, SUERC-68725)

There are a further 28 radiocarbon dates (including six replicate determinations) for human bone from Isbister, plus four dates (including one replicate determination) for animal bone[62,64,66,68,74–76]. These are consistent with the dates obtained for the GENSCOT project and indicate an initial, main period of use during the late fourth millennium into the beginning of the third, followed by episodes of secondary funerary use during the first half of the third millennium, the third quarter of the third millennium, and (from a 'cist' in the 'hornwork') the mid-second millennium. Bayesian-modelling of the dates by Bayliss et al.[68] places the date range for the initial, main period of use at *3380–3105 cal BC*E(start) to *3080–2835* cal BCE (end), both at 95% probability. Note that the individual represented by individual I3085 (GENSCOT74) had previously been radiocarbon-dated[74]: 4507±37 BP (OxA-25624); the result is not significantly different from the newly-obtained date.

Holm of Papa Westray North (Orkney, Scotland)

Contact person: Alison Sheridan

This is a Neolithic chamber tomb of stalled cairn type (Canmore ID 3243)[52], located on the small island of Holm of Papa Westray, in the Orkney archipelago. The stalled chamber has four compartments plus a cell opening off its inner end; the monument is orientated north-west[60,77,78]. The cairn is rectangular and measures around 11.8 by 6.3 m; the chamber is linked to one end of the cairn by a short passage. It was excavated by George Petrie in 1854, and more thoroughly by Anna Ritchie in 1982–3. Finds include round-based pottery from inside the monument, plus Grooved Ware and coarse Beaker from secondary activity outside the cairn; tools of flint, chert and quartz; a stone pounder, stone pot lids and stone Skaill knives; a bone bead, points and a whalebone object; and pumice. Animal remains of various species were found, including those of sheep that had eaten seaweed as part of their diet[79]. Human remains were found inside the chamber, with a few in the entrance passage and the forecourt; an MNI of 9–10 was estimated, comprising both sexes and adults and children. Four individuals were successfully analyzed for ancient DNA; details of their sample numbers and radiocarbon dates are as follows:

- I2650/GENSCOT10: 3500–3360 calBCE (4754±36 BP, SUERC-68642)*
- I2636/GENSCOT08: 3520–3362 calBCE (4651±33 BP, SUERC-68640)
- I2651/GENSCOT11: 3330–3090 calBCE (4525±36 BP, SUERC-68643)*
- I2637/GENSCOT09: 3510–3340 calBCE (4697±33 BP, SUERC-68641)*

* indicates that the calibrated result has been adjusted for minor marine offset; recalibration undertaken by Rick Schulting.

Sixteen additional radiocarbon dates exist for Holm of Papa Westray North, of which five are from human remains, two are from Orkney vole and nine are from other animals[58,66–68,80–83]. The dates indicate funerary use within the second half (mainly the third quarter) of the fourth millennium; Bayliss et al.[68] have Bayesian-modelled the start of human deposition at *3685–3375 cal BC*, and its end at *3370–2795 cal BC*, at 95% probability. The new dates fit well within this time range.

Tulloch of Assery A (Highland (Caithness), Scotland)

Contact person: Alison Sheridan

This is a Neolithic chamber tomb, located at the northern end of Loch Calder, near Thurso in the former county of Caithness (Canmore ID 7934)[52]. It comprises two Orkney-Cromarty-Hebrides-style passage tomb chambers set within a short-horned cairn, the passage of the southern chamber facing south and that of the northern chamber facing north. The northern chamber has two 'platforms' or bench-like features. Along with the nearby chamber tombs of Tulloch of Assery B and Tulach an t'Sionnaich, it was excavated by John Corcoran in 1961, in advance of work to convert Loch Calder into a reservoir, thereby partly submerging the monument (The southern chamber had been almost completely emptied at some point prior to 1961[84,85]). The artefactual finds include an oblique arrowhead of grey flint, three flint flakes, two flint blades and two flint chips, of which one is probably natural rather than knapped. A fragment of rock crystal was also found, along with 19th and 20th century artefacts. The remains of between nine and 11 people (of both sexes and including adolescents as well as adults) were found in six discrete deposits within the northern chamber. One sample of human bone – a petrous temporal from an adult male – was successfully analyzed for ancient DNA:

- I2635/GENSCOT07: 3653–3390 calBCE (4796±37 BP, SUERC-68639)[62]

Two other radiocarbon dates had previously been obtained from human remains from this monument[85,86]: bone from the south-west 'bench' in the northern chamber was dated to 3702–3378 calBCE (4800±60 BP, GU-1338) – an almost identical result to the new date – while bone from the tightly-contracted, articulated skeleton of an adult, probably male, found near the centre of the chamber, produced a date of 1437–1127 calBCE (3055±60 BP; GU-1329), confirming it to be a Middle Bronze Age secondary deposit. The early to mid-fourth millennium dates provide important evidence for the date of short-horned cairns.

Tulloch of Assery B (Highland (Caithness), Scotland)

Contact person: Alison Sheridan

This is a Neolithic chamber tomb, located at the northern end of Loch Calder, near Thurso in the former county of Caithness, located just 30 m SW of Tulloch of Assery A (Canmore ID 7907)[52]. It comprises a three-compartment stalled chamber with a long, curving entrance passage set asymmetrically within a circular cairn 29 m in diameter. Like its neighbours Tulloch of Assery A and Tulach an t'Sionnaich, it was excavated by John Corcoran in 1961, in advance of work to convert Loch Calder into a reservoir[84,85]. Finds include the remains of 13 vessels of Early Neolithic modified Carinated Bowl pottery, from a layer of burnt material clearly predating the construction of the chamber, plus two flint points, possibly arrowheads; a base of a leaf-shaped flint arrowhead; the tip of a chert arrowhead (found embedded within a human vertebra); a flint scraper and various flakes, fragments, cores and split pebbles of flint; three fragments of rock crystal and two rounded quartz pebbles; and a bone 'scoop'. Some of the lithic finds were discovered in the burnt layer below the paving of the chamber (together with small fragments of unidentifiable burnt bone). A few animal bones of various species were found in the chamber and passage (with a small number found below the paving). Human remains from a minimum of five individuals were found, mostly heaped up on a layer of slabs in the centre of the innermost compartment of the chamber. The individuals comprise two adults. One of these was aged around 48 to 54 and was the person who was probably killed by the arrow that landed in the lower back. There was also a smaller individual aged around 36 to 38. There was also a child (represented by a phalange from a foot) from the central compartment; a young adult (represented by a molar tooth) from the outer compartment; and a foetus or neonate (represented by half a mandible) from the passage. One sample of bone from the oldest adult (who appears to be the person who had been killed by the arrow), a petrous temporal, was successfully analyzed for ancient DNA and was found to be female:

- I2633/GENSCOT05: 3766–3642 calBCE (4911±32 BP, SUERC-68634)

Six other dates had previously been obtained for this monument, five from animal bone and one from charcoal, and including three from beneath the paving of the chamber floor[85,86]. All of those dated samples are of unidentified species, and are unlikely to have been single-entity samples. Thus, the results should be treated with caution. While

the latest date, from animal bone from the chamber filling, suggests secondary activity during the second half of the third millennium, 2458–2042 calBCE (3795±60 BP, GU-1337), the others suggest that there may have been some mixing of material in antiquity between that from the burnt layer beneath the chamber floor paving and that on the chamber floor. Charcoal from the burnt layer produced a date of 3772–3383 calBCE (4840±65 BP, GU-1339); animal bone from below the paving produced dates of 3635–3139 calBCE (4655±60 BP, GU-1336; adjustment is required for a possible slight marine offset) and 3096–2145 calBCE (4095±165 BP, GU-1335). Animal bone from the chamber floor produced dates of 3942–3644 calBCE (4965±60 BP, GU-1332) and 3637–3342 calBCE (4670±65 BP, GU-1333).

Tulach an t'Sionnaich (Highland (Caithness), Scotland)

Contact person: Alison Sheridan

This is a Neolithic passage tomb (Canmore ID 7901)[52], orientated SSW, whose associated cairn has a complex, multi-period history of construction that ended in it becoming a long cairn with a heel-shaped cairn at its southern, higher end[84,85]. The monument lies 215 m and 270 m respectively east of the two Tullochs of Assery, at the north end of Loch Calder, and it was excavated by Corcoran in 1961 and 1963 as part of the same fieldwork initiative. The small, squarish chamber and passage had initially been encased within a small round cairn, but this was subsequently enlarged and converted to a heel-shaped cairn with a straight façade and (probably) short projecting horns. The façade blocks the passage entrance. In a third phase of construction, the heel-shaped cairn was enlarged and a long, rectangular 'tail' was added, converting the monument into a long cairn some 58 m long (it would be worth revisiting this part of the constructional sequence to double-check whether the long tail was indeed added at this stage, or whether it had been an earlier addition). Finds were few, comprising sherds from two Early Neolithic pots, sherds from a Beaker, sherds from a Bronze Age pot used as a cinerary urn and part of a medieval or later pot; a dozen flint chips and flakes (including one possibly used as a scraper), several scorched; and a pitchstone flake. Bones from various animals were found in the chamber and in the upper levels of the cairn, and remains of terrestrial and marine mollusca were found among the material that had been deliberately deposited to fill the chamber. Remains of six human individuals were found, including the cremated bones of one (possibly female, possibly

adult) from the secondary, Bronze Age deposit in front of the heel-shaped cairn[75]. The others were all from the lowest layer in the chamber, and comprised the remains of an adult, probably male, in his early thirties; a young adult, probably female; a relatively old individual (represented by a mandible fragment); fragments of a possible fourth individual; and two fragments possibly from an infant. A petrous temporal from an adult male (presumably the individual in his early thirties) yielded ancient DNA:

- I2634/GENSCOT06: 3704–3535 calBCE (4851±34 BP, SUERC-68638)

Three radiocarbon dates – one from human bone, two from animal bone (unidentified species) – were obtained by Niall Sharples in the mid-1980s[86]: human bone from the chamber floor was dated to 3634–3361 calBCE (4685±60 BP, GU-1334), while animal bone from the filling of the chamber duly post-dated this: 2917–2620 calBCE (4210±60 BP, GU-1330) and 2872–2465 calBCE (4055±70 BP, GU-1331). In addition, the cremated remains from the Bronze Age pot were dated in 2005: 2201–1980 calBCE (3705±35 BP, GrA-28611)[75]. These confirmed the suspected Early Bronze Age date of this secondary deposit.

Clachaig (North Ayrshire, Scotland)

Contact person: Alison Sheridan

This is a chamber tomb of Clyde type (Canmore ID 39676)[52], located on the south coast of the Isle of Arran[87,88]. The chamber is divided into two segments by sill-stones and overlapping side-slabs, and there may originally have been more: the insertion of a cist during the Early Bronze Age may have destroyed further chamber segments. The associated cairn is roughly oval, but there may originally have been a concave forecourt façade, now obscured by cairn slip (or deliberate infill). The monument was excavated by Thomas Bryce in 1900. Finds comprised a complete Early Neolithic decorated bipartite bowl, a large part of an Early Neolithic lugged jar, and a stone axehead from the chamber's compartments, with sherds of an Early Bronze Age Food Vessel and a flint knife from the cist. Bones from ox and pig, many from young animals, and possibly lamb bones were found in the chamber and a young pig's upper jawbone was found in the cist. The human remains consisted of the remains of 14 individuals, of both sexes and including adults and children, in the chamber and fragmentary remains of a

further individual in the cist. A petrous temporal belonging to adult female skull 'B' from the chamber was successfully analyzed for ancient DNA:

- I2988/GENSCOT60: 3517–3362 calBCE (4645±29 BP, SUERC-68711)

This individual had already been radiocarbon-dated in 2004, along with three others from the chamber (namely Bryce's 'A', 'C' and 'D'[89]). The previous date for 'B' differs little from the new date: 3627–3363 calBCE (4670±40 BP, GrA-25617). The date for individual 'A' is 3658–3384 calBCE (4800±40 BP, GrA-25616); that for individual 'C' is 2570–2310 calBCE (3949±36 BP, UB-6897) – clearly a secondary deposit – and that for individual 'D' is 3632–3373 calBCE (4708±37 BP, UB-6898).

Raschoille Cave (Oban, Scotland)

Contact person: Clive Bonsall

Raschoille Cave is a small cave on the west coast of Scotland, near the town of Oban. The cave, eroded in Precambrian slates and phyllites, lies about 13 meters above sea level and close to the altitudinal limit of the Holocene marine transgression. During the Neolithic, when relative sea level was still several meters higher than today, the cave occupied a position at the edge of a sheltered marine embayment. The cave entrance was exposed in 1984 when talus deposits were cleared during construction work. A rescue excavation was undertaken by members of the local archaeological society.

The uppermost deposits within the cave consist mainly of loose angular slate debris derived from mechanical breakdown of the roof and walls of the cave. Within these stony deposits the excavators recognized several stratigraphic units ('layers I–VII'), based on variations in the size and alignment of the rock fragments, the amount of interstitial soil material, the degree of compaction of the material, and the presence/absence of calcareous coatings or deposits within the material. It is debatable, however, whether these 'layers' have any real chronological value.

Archaeological remains were found mainly in layers II–V, with the greatest concentration of material in layers III–IV. They comprised disarticulated human bones and small numbers of animal bones, fish bones, marine shells, and carbonized plant remains. Since no articulated groups of human bones were recovered, most likely their presence in the cave was the result of secondary burial of excarnated remains.

Part of the human bone assemblage from Raschoille Cave was examined by Kathleen McSweeney and Laura Bonsall at Edinburgh University. This sub-assemblage comprised a total of 1046 bone fragments and teeth, from at least 10 individuals, including both adults and children. AMS ^{14}C measurements on postcranial bones from different individuals were obtained from the Oxford Radiocarbon Accelerator Unit, and range from 4980±50 to 4535±50 BP / *c*. 3800–3200 calBCE[90], which date the burial activity in Raschoille Cave to the earlier part of the Neolithic in western Scotland.

The petrous temporal bones from six individuals (from layers III and IV) were selected for ancient DNA analysis:

- I3133/ORC_III_10.4: 3800–3200 BCE
- I3134/ORC_III_17.21: 3800–3200 BCE
- I3135/ORC_III_19.1: 3800–3200 BCE
- I3137/ORC_IV_17.19: 3800–3200 BCE
- I3136/ORC_III_21.3: 3800–3200 BCE
- I3138/ORC_IVa_87.6: 3800–3200 BCE

Great Orme Mines (Llandudno, Wales)

Contact person: Nick Jowett

Situated on a limestone outcrop rising to the west of the Victorian seaside town of Llandudno in North Wales, the Great Orme bronze age copper mines were discovered in 1987 during a reclamation scheme of a derelict 19th century mine site. Over 5 miles of tunnels have been discovered dating between 1860–900 BCE. During excavation on surface at the mine site in 1991, an almost complete human mandible was discovered in a mixed context, probably an ancient burial disturbed by 19th century miners. The radiocarbon date, 1693–1600 calBCE, makes the mandible contemporary with the main phase of mining activity on the Great Orme. One tooth from this mandible yielded ancient DNA:

- I1775/GOM245: 1693–1600 calBCE (3344±27 BP, OxA-14308)

North Face Cave (Llandudno, Wales)

Contact person: Nick Jowett

Situated on a limestone outcrop rising to the east of the Victorian seaside town of Llandudno in North Wales, the Little Orme's North Face Cave was excavated between 1962 and 1976 by John Blore. The partial remains of four human skeletons from individuals between 4–18 years old were recovered along with a single amber bead. In 2015, a section of human maxilla was found within material disturbed by potholers at the end of the cave. The maxilla was a close match to one of the previously discovered mandibles. A section from the maxilla was dated to 1415–1228 calBCE. One tooth from this mandible was consider for genetic analysis:

- I2574/NFC07151: 1415–1228 calBCE (3065±36 BP, SUERC-62072)

Hasting Hill (Sunderland, Tyne and Wear, England)

Contact person: Chris Fowler

The round barrow at Hasting Hill sits on the summit of a limestone hill overlooking the remains of an Early Neolithic causewayed enclosure and a cursus monument. The approximately 12 m diameter barrow was excavated in 1912 by C.T. Trechmann[91,92] who located nine different burial features including four short cists, two square cists, a grave, a stone lined pit, and two 'unurned' deposits of cremated bone. The different burial modes, grave goods, and radiocarbon dates from two of these burials, along with different depths of the burials depicted in Trechmann's illustration, suggest periodic burial at the barrow over several centuries[93]. Five of the burials were accompanied by Food Vessels. All that currently remains of the burials are two displays in Sunderland Museum, in which the cists (described by Trechmann[92] as 'secured entire') have been reconstructed and the human remains are stored. The cists are Trechmann's finds 9 and 12, and the flexed burials in each matches the description of those from the excavation.

Find 12 was a short cist oriented northwest-southeast and located at the northeast periphery of the barrow. The skeleton of an infant was lying on its right side on the bedrock at the base of the cist, with its head to the southeast and a Food Vessel placed behind its head. A flint knife and an 'ox tooth' were also recovered, although their location with respect to the skeleton is not recorded. Recent osteological analysis

identified the infant as about one year old at death, genetically male. An ulna from this individual was radiocarbon dated:

- I2421/TWCMS Sk2008-3075, find 12: 1931–1756 calBCE (3524±28 BP, OxA-26256)[94]

Find 9 was a short cist oriented east-west[92]. The excavator focused his description on a flexed skeleton of an adult male, lying on his right on the limestone bedrock with his head to the west and his arms raised so his hands covered his face (two other burials at the site had arms and hands positioned in this way, which is only recorded in one other case in Northeast England). A flint knife was placed in front of the forearm, a vessel in front of the face, and a bone pin or point behind the shoulders. The cist also contained 5 periwinkle shells, fish, bird and animal bones (see below) and an antler tine pick. The vessel is unusual, with a high-bellied s-profile Beaker shape, but is coarse and decorated with diagonal stab marks. Analysis of a metacarpal from this adult male did not yield ancient DNA. A left rib yielded a radiocarbon date of 2194–1977 calBCE[93]. However, recent osteological analysis suggests a more complex use of the 'Find 9' cist, identifying eight weathered (bleached and cracked) bones from a child approximately 5 years old at death, and the cremated remains of an adult[94]. Further examination during aDNA sample selection located two unburnt adult teeth not from the flexed burial. Trechmann's report mentions that that this cist contained what he thought were 'some bird bones and a few calcined mammalian (non-human) bones...'[92], but the human remains identified recently are not mentioned. Although it cannot be excluded that remains from other burials were intermixed with the cists put on display in the museum, it seems likely that the newly-identified remains were not recognised as human by the excavator. Taking this as the simplest explanation, the radiocarbon date of 2465-2209 calBCE from the tooth (sample I2612) suggests earlier use of this cist; it is possible the flexed burial was placed into an already-old burial feature. Since the radiocarbon date places this individual within the Beaker period, we used the label BB_Britain for analysis. The aDNA identifies the tooth as from a woman:

- I2612/TWCMS Sk2008-1953, find 9: 2465–2209 calBCE (3865±35 BP, Poz-83492)

Hexham Golf Course (Hexham, Northumberland, England)

Contact person: Chris Fowler

Recovered in 1921, the human remains were found in a short cist oriented north-south on a natural prominence. No artefacts were located, nor were any other archaeological features noted. Recent osteological analysis identified the individual as approximately 22–28 years old at death[94]. Some of the remains show signs of exposure to high temperatures. Ancient DNA analysis reveals the sex as female. The radiocarbon date confirms an Early Bronze Age date for this burial:

- I2609/MOA 1956.46 Box 136: 2023–1772 calBCE (3560±40 BP, Poz-83423)

Reaverhill (Barrasford, Northumberland, England)

Contact person: Chris Fowler

The short cist at Reaverhill was situated on the summit of a hill, oriented northeast-southwest, and was excavated in 1964. Smaller stones were packed into voids between the solid side and cover slabs, and the base was gravel subsoil without paving. The cist yielded a copper alloy flat-riveted dagger blade, with all 3 rivets present, and the partial remains of an adult that were 'in disorder'[95]. The ancient DNA analysis confirms the osteological sex identification of male, and anthropological analysis suggests that he was about 30–40 years old at death[94]. The radiocarbon date for this individual is:

- I2618/MOA 1964.2 Box 102A: 2135–1951 calBCE (3660±28 BP, OxA-26254)

Summerhill (Blaydon, Tyne & Wear, England)

Contact person: Chris Fowler

A series of short cists are recorded spread over several hundred metres at Blaydon, and at least five were excavated in the 1930s[94]. Cists 3 and 4 at Summerhill were excavated in 1938[96]. One set of remains from the excavation of cists 3 and 4 is stored in the Great North Museum although it is not certain whether these remains, which yielded aDNA sample I2610, are from cist 3 or 4. Cist 3 contained a Food Vessel and a flexed skeleton oriented north-northeast to south-southwest, lying on its left. Cist 4 contained a Beaker and a burial oriented east-west, also laying on its left. Osteological analysis identified

the remains as a female who was approximately 18 years old at death, and ancient DNA confirms the sex attribution. The radiocarbon date for this individual is:

- I2610/MOA 1973.4H Box 167D, 1: 1936–1746 calBCE (3515±35 BP, Poz-83498)

The radiocarbon date would be late for the style of Beaker in cist 4, but fall within the known currency of Food Vessels.

Trumpington Meadows (Cambridge, England)

Contact person: Christopher Evans

The site was located alongside the River Cam on the southern fringes of the village of Trumpington, to the south of the university town of Cambridge. The excavations were conducted in 2010–11 and identified funerary activity and associated settlement remains from the Neolithic, Bronze Age, Iron Age and Anglo-Saxon periods.

The Beaker burial, F.1596, comprised two individuals buried in a sub-rectangular grave, toe-to-toe, each with a fineware Beaker set close to their heads. Oriented north–south, the grave was approximately 2.5 m long and 1 m wide. The bodies had been laid out so that their positions almost exactly mirrored each other. Both were in a tightly crouched position with their heads at opposite ends, each facing west and their feet intermingled. It is not possible to say which individual was placed first: Burial 1 (Skeleton 3383), a female aged 16–18yrs, was at the north of the grave, lying crouched on her right side; Burial 2 (Skeleton 3384), a male 17–20yrs old, lay in the southern end crouched on his left side. Their backs formed a straight line, parallel to the edge of the cut, suggesting that they were interred at the same time. Both skeletons had elements that appear to that have been displaced, possibly the result of differential post-mortem decomposition or delayed burial. Genetic analysis determines that they are second-degree relatives, for example niece-uncle, nephew-aunt or maternal half-siblings. The direct radiocarbon dates for the skeletons are:

- I3255/TRM10, skeleton [3383]: 2136–1951 calBCE (3661±31 BP, SUERC-49482)
- I3256/TRM10, skeleton [3384]: 2204–2029 calBCE (3722±31 BP, SUERC-49483)

Over Narrows (Needingworth Quarry, Cambridgeshire, England)

Contact person: Christopher Evans

A small Beaker cemetery underlay a Collared Urn-associated Bronze Age round barrow (part of the Low Grounds barrow-group), located on one of the mid-stream *Over Narrows* ridges where the River Great Ouse debouches into the fenland marshes. Its main series of burials occurred within a deep pit-grave. First was F.1080 (Skeleton 5487, I2454), an adult female, 18–25 years of age. Lying crouched on her right side (head to the north), she had a jet bead necklace and a Beaker placed by her head. The pit-grave had, thereafter, been recut and an adult female, over 40 years old (F.1079, Skeleton 5486, I2455), was interred in a tightly crouched position with her head to the west. Both females were successfully analyzed for ancient DNA.

Two infants were inserted into the feature's upper profile, with a third laid out within a discreet pit beside (F.1074 & F.1075). Off to one side was a separate burial, F.1068 (Skeleton 5451), a young female adult of 17–20yrs. Lying crouched on her right side (head to the northwest), she was accompanied by a fineware Beaker.

We obtained genome-wide ancient DNA data from two individuals:

- I2454/OVE08 feature F.1080 skeleton 5487: 2200–1980 calBCE (3703±28 BP, OxA-24595)

- I2455/OVE08, feature F.1079 skeleton 5486: 2130–1910 calBCE (3631±28 BP, OxA-24594)

Dairy Farm (Willington, Bedfordshire, England)

Contact person: Christopher Evans

The Willington landscape shows extensive occupation from the Upper Palaeolithic and into the Saxon era. The Dairy Farm site comprises a steep clay landfall from 32 m to 21 m over the level of the river and this plateaus at 20–21 m over 1st and 2nd terrace gravels along the valley of the River Great Ouse. Now covered by thick alluvium, the lowest areas of the valley comprised small islands formed by small meandering channels broken off from the main Ouse channels. This is illustrated at Dairy Farm with an island that lies between the Ouse and Gadsey Brook. The island was clearly habitable during the Late Mesolithic to Late Neolithic, as documented by surface artefacts.

Access to the island declined in the Early Bronze Age, although elsewhere in the landscape there are examples of Neolithic and earlier Bronze Age ceremonial and funerary earthworks set upon such islands. A number of similar such funerary earthworks are known at Dairy Farm, but as protected ancient monuments these were not a part of the excavation program.

Only limited Late Neolithic-Early Bronze Age flintwork has been found, and Beaker pottery was confined only to the two known burials. Contemporary settlement activity has, therefore, not been identified. The burials were both situated in proximity to the monuments, but were shallow 'flat' graves with no obvious above-ground markers. A mature adult male, F.66 (I2452), was found crouched on his left side, with a healed compound fracture to the right femur. A notched flint dagger lay at the head, with a fineware Beaker close to the feet. This individual was successfully analyzed with ancient DNA. The other, F.192, was an unsexed adult in poor condition. Crouched on its right side, the individual was accompanied with a copper alloy pin and a near-complete Beaker vessel (fineware).

The radiocarbon date for the individual analyzed in this study is:

- I2452/BEDFM2009.12, feature F.66 skeleton 186: 2277–1920 calBCE [2277–2030 calBCE (3735±35 BP, Poz-83405); 2195–1920 calBCE (3700±30 BP, Beta-444979)]

West Deeping (Lincolnshire, England)

Contact person: Christopher Evans

A 2007 investigation of the Middle Bronze Age field system and settlements at West Deeping, close to the fen-edge in South Lincolnshire, revealed three Early Bronze Age burials in close proximity. Of these, Burial 5 (F.320, I2453) contained a remarkable series of grave goods. Tightly crouched within a shallow grave, the sub-adult lay on its left side, with the knees on the chest, facing west. Five barbed-and-tanged arrowheads, a flint flake, and a flake knife accompanied the body. A length of worked red deer antler and a strip of cattle-sized rib bone were also present, with their position indicating that they may have been attached to the back of the deceased. Their association with the arrowheads suggests that they may have been archery-related, perhaps part of a bow or as a quiver stiffener, or else as a pressure-flaker for the manufacture of barbed-and-tanged arrowheads. While the burial lacked a Beaker (as did the other two graves, both

of which had flint implements and, one, both a bone and antler pin), the accompanying finds – especially the arrowheads – suggest a 'Beaker-type' assemblage. The radiocarbon date for this individual is:

- I2453/CQWDO7, feature F.320 skeleton 1126: 2289–2041 calBCE (3760±35 BP, Poz-83404)

Windmill Fields, Ingleby Barwick (Stockton-on-Tees, County Durham, England)

Contact person: Thomas Booth

The Windmill Fields site is an area of the Ingleby Barwick housing development in the valley of the River Leven, on the southern edge of Stockton-on-Tees (NZ 4460 1255). It was excavated in 1996 by Tees Archaeology in advance of construction[97]. The excavations revealed a flat grave cemetery including six burials containing the remains of at least 11 individuals. A diverse series of funerary traditions were represented by these burials and radiocarbon dating of the human remains suggested that there was a broad correlation between tradition and chronology, covering the Beaker period to the Early Bronze Age. The oldest remains from the site had been disarticulated and placed in a wooden cist. This style of deposition was followed by a tradition of unaccompanied single articulated burial, then single articulated burial with grave goods.

Disarticulated unaccompanied incomplete skeletons representing two adult males (Sk 3 and Sk 4) were recovered from the remains of a wooden cist. Histological analysis of bone from Sk 3 suggested that these individuals had probably been excarnated[98]. Sk 3 and Sk 4 produced radiocarbon dates of 2397-2043 calBCE (2-sigma OxA-8652) and 2279-1982 calBCE (2-sigma, OxA-8728) respectively.

A middle adult female (Sk 1) and a young-middle adult male (Sk 2) were recovered unaccompanied from earthen graves. Sk 1 and Sk 2 had been disturbed by a digger, but reconstructions of their positions suggested that Sk 1 had been buried flexed on their right side with their head to the southwest whilst Sk 2 was buried lightly flexed on their left side with their head to the southwest. Histological analysis of a femur from Sk 2 suggested that this individual had originally been mummified. Radiocarbon dating of Sk 1 produced a date of 2289-2036 calBCE (2 sigma, OxA-8650). Individual Sk 2 was analysed with aDNA:

- I1767/Sk2: 2200–1970 calBCE (3705±35 BP, OxA-8651)

A complete articulated skeleton of an older adult female (Sk 7) was recovered from another earthen grave. This burial had been disturbed by ploughing and it was difficult to gauge its position and the original placement of the accompanying artefacts. Grave goods included a piece of hematite and Beaker-style pottery. Individual Sk 7 was analysed with aDNA:

- I1765_d/Sk7: 2330–2040 calBCE (3780±40 BP, OxA-8729)

A complete articulated skeleton of a middle adult male (Sk 5) was found in an earthen grave with a piece of hematite and a stone mace head. They were buried flexed on their left side with their head to the east. Histological analysis of the bone suggested that this was a primary inhumation. The radiocarbon date from this skeleton placed it later in the Early Bronze Age at 1736-1614 calBCE (2-sigma, UB-7173).

The remains of a young-middle adult female (Sk 6) had been buried in a tightly flexed position on their right side with their head to the west. This was a rich burial containing two copper alloy bangles, 41 tubular copper alloy beads, 25 v-perforated jet buttons, one biconical jet bead and 75 small jet rings. Histological analysis of the bone suggested that this was a primary inhumation. This skeleton produced an Early Bronze Age radiocarbon date of 2029-1900 calBCE (2-sigma, UB-4174). The burial was accompanied by disarticulated incomplete remains (mostly consisting of crania and long bones) of an additional four individuals (Sk 8).

Staxton Beacon (Staxton, North Yorkshire, England)

Contact person: Oliver Craig

Staxton Beacon is a cemetery site located on the North Yorkshire wolds, near the village of Staxton, and consists of a combination of round barrows and flat graves. A flat grave cemetery was excavated by Stead in 1957, whilst one of the round barrows (Staxton Beacon) was excavated by Manby in 1958-9[99,100]. The barrow included ten inhumations and a cremation along with the remains of a partially-burnt wooden structure. The burial tradition and grave furniture suggested that all individuals interred in the Stanton Beaker barrow dated to the Beaker or Early Bronze Age period. Palaeogenetic data from Burial 11 are included in the current study:

- I1770/Burial11: 2400–1600 BCE

Yarnton (Oxfordshire, England)

Contact person: Gill Hey

Yarnton is a large gravel extraction quarry situated in the Upper Thames Valley, approximately 5 miles north of Oxford. Archaeological excavations took place between 1990 and 1998, during which time evidence of prehistoric settlement, burial and landscape development was investigated, including inhumation burials of early (Beaker) and middle Bronze Age date[101].

Beaker period skeletons 8772, 8633, 8784 and 8779 were found on the Summertown-Radley gravel terrace overlooking the floodplain of the Thames, the first three of which were placed in and around an earlier Neolithic U-shaped enclosure. Burial 8772 was an adult female more than 45 years of age, who had been placed in a deep grave within the entrance to the enclosure. She lay semi-crouched, on her left side, with her head to the south-east, in a wooden coffin or on a bier. There were no grave goods. An infant (8633), 12-14 months old, also positioned south-east to north-west, had been buried just 2m away.

Skeleton 8784 lay in a shallow grave 6m south of the enclosure. The body was disturbed and not so well preserved but is believed to be an adult aged upwards of 18 years, and possibly female (confirmed with aDNA data). The head lay to the south. Thirty-five metres to the east was burial 8779, a neonate which had been placed in the top of a pit with Beaker pottery, worked flint, a polished bone point, animal bone and charred plant remains. The body had been disturbed but was articulated, and it is uncertain whether the pit deposit was related to the death of this newborn or whether the body was one of a number of symbolically-charged objects placed within the pit. We obtained genome-wide ancient DNA data from four individuals:

- I2443/SK 8772 (YCF 95), 2: 2290–1980 calBCE (3740±40 BP, OxA-8868)
- I2445/SK 8633 (YCF 95): 2137–1930 calBCE (3650±35 BP, Poz-83407)
- I2446/SK 8784 (YCF 95): 2460-2140 calBCE (3815±40 BP, OxA-8807)
- I2447/SK 8779 (YCF 95): 2400–2040 BCE

Abingdon Spring Road cemetery (Abingdon, Oxfordshire, England)

Contact person: Tim Allen

Skeleton 3036 came from Abingdon Spring Road cemetery, approximately 1km north-west of Abingdon town centre, Oxfordshire, at NGR 448700 197620 on the Summertown/Radley terrace of the Thames gravels[102]. It lay within a grave numbered 3037 that was orientated north-south, was sub-rectangular, and was 1.60m long 0.96m wide and survived 0.14m deep. Skeleton 3036 was crouched in the central part of the grave, measuring 1.16m from head to toes. It was lying on its right side with the head to the south, and with the knees flexed, the right arm with the elbow out in front of the body, and the left arm folded and the hand in front of the face. The skeleton was that of an adult female of 20-24 years of age. A copper awl was positioned just below the upper legs parallel to them. The radiocarbon date for this individual is:

- I2450/SK 3036 (ABSRC00): 2460–2200 calBCE (3841±40 BP, NZA-15865; 3834±45 BP, NZA-15866).

Amesbury Down (Wiltshire, England)

Contact person: Alistair Barclay

The site of Amesbury (Boscombe) Down is part of a large-scale housing development that has taken place in several phases since the 1990s. It is located on an area of chalk downland to the south-east of Amesbury and just outside the boundary of the Stonehenge World Heritage Site. Excavations by Wessex Archaeology between 1993 and 2015 has revealed Neolithic monumental features, Beaker and other Early and Middle Bronze Age burials and funerary deposits, numerous prehistoric pit deposits (Powell and Barclay forthcoming). Some of the discoveries are of international importance and include the Beaker burials known as the 'Amesbury Archer' and the 'Boscombe Bowmen'[103]. The site forms part of the wider Stonehenge monumental and funerary landscape.

In total ten burials from the site of Amesbury Down are included in this study. This represents approximately 20% of the total number of individuals excavated from an overall total of just over 30 graves. The date range of these burials goes from the final Neolithic to the end of the early Bronze Age and includes a significant number of

Beaker burials including a few of British Chalcolithic date. A number of the early Beaker burials have rich and important grave assemblages. The site has some of the best evidence from Britain for early Beaker non-local connections indicated by isotopic (strontium/oxygen) analysis and material culture providing direct links with mainland Europe – in particular the 'Amesbury Archer'.

Burial 25004 is one of the individuals from the collective burial known as the 'Boscombe Bowmen', a type of burial that is unique to the site and generally difficult to parallel in Wessex and Britain as a whole. The grave, which had been disturbed and truncated by road construction and a service trench, produced the skeletal remains from a minimum of nine individuals of which four were articulated. Grave goods include eight beakers, seven of All-Over-Cord (AOC) type and one of Cord-Zoned-Maritime (CZM) type, a boar's tusk 'scoop', worked flints and an antler pendant. Because of the nature of the grave it is difficult to directly associate any of the grave goods with a particular individual with complete confidence. Among the British individuals dated to after 2400 calBCE in our dataset, the skeleton from burial 25004 has the lowest amount of steppe-related ancestry. The radiocarbon date for this individual is:

- I2416/25004: 2460–2200 calBCE (3845±27 BP, OxA-13624)

The 'Boscombe Bowmen' grave was later marked by a Bronze Age barrow, which in turn became the focus for a small cemetery. Burial 25217 was placed in a grave just east of this barrow. It contained the crouched skeleton of a probable subadult male ('Amber boy') who was buried with a 'necklace' of over 80 small cylindrical amber beads. The skeleton was directly dated by NZA-32497 (Powell and Barclay forthcoming):

- I2639/25217: 1600–1430 calBCE (3225±25 BP, NZA-32497)

Burial 1238, known as the 'Companion', was found 3 m east from the burial of the 'Amesbury Archer' and contained the remains of an adult male[103] (Powell and Barclay forthcoming). The burial included a pair of gold hair ornaments, a boar's tusk and five worked flints. The skeleton is directly dated by OxA-13562:

- I2565/1238: 2470–2140 calBCE (3829±38 BP, OxA-13562)

Burial 6033 (adult female) was found in a large chambered grave (6012) at the centre of round barrow 6203 (Powell and Barclay forthcoming). The burial had been disturbed in antiquity and was found in a partially articulated state. The grave also contained an

antler tine, a flint arrowhead and a knife, and sherds of Beaker pottery. The skeleton is directly dated by NZA-32788:

- I2418/6033: 2440–2200 calBCE (3835±25 BP, NZA-32788)

Burial 5289 was one of a pair (with 5292) from closely spaced graves (Powell and Barclay forthcoming). Both contained single tightly crouched burials of a similar early Bronze Age date. Burial 5289 was that of an adult male and contained no Beaker material culture. The radiocarbon date for this individual is:

- I2596/5289: 2280–2030 calBCE (3739±30 BP, NZA-32484)

Burial 12134 was made in a large chamber cut into the natural chalk (Powell and Barclay forthcoming). No evidence for a barrow was found, although it is possible that the grave was marked by an earthen mound as two further burial deposits were added in the Early Bronze Age, both associated with Food Vessels. At its base the chamber, part of grave 12125, contained the burial of an adult male associated with a long-necked 'Southern' style Beaker. The skeleton was directly dated by NZA-32494:

- I2598/12134: 2140–1940 calBCE (3664±30 BP, NZA-32494)

Burials 13382 and 13385 were found near the western edge of the overall site and close to a timber post setting of Late Neolithic date. Both burials are considered to belong to the Beaker culture, although only one (13385) contained a Beaker. Burial 13385 was that of an adult male and contained a long necked Beaker of 'Southern' style. The skeleton was directly dated by NZA-32490:

- I2566/13385: 2210–2030 calBCE (3734±25 BP, NZA-32490)

Burial 13382 also contained the remains of a male adult, which was directly dated:

- I2457/13382: 2480–2031 calBCE [2480-2280 calBCE (3890±30 BP, SUERC-36210), 2200-2031 calBCE (3717±28 BP, SUERC-69975)]

The upper grave fill was cut by a secondary grave, which contained a cremation burial (adult male) with a Food Vessel. A fragment of cremated human bone was directly dated by 1750-1620 calBCE (3390±25 BP, NZA-32509).

Burials 62027 and 62014 were found in the southern part of the site (Powell and Barclay forthcoming). Burial 62014 was made in a cylindrical grave pit (62004) and

was immediately south of pit 62025 that contained burial deposit 62027. Burial 62014 is unusual in that the body had been placed on a deposit of burnt domestic material that included charred grain, quernstone, a range of broken Beaker vessels, worked bone, flintwork and daub. It is a non-typical Beaker funerary burial and has been identified as a 'domestic' burial – one of two that occur at Amesbury[104]. The burial is that of a probable male juvenile (9-11 yr) and is directly dated by SUERC-54823:

- I2459/85684_62014: 2460–2140 calBCE (3829±30 BP, SUERC-54823)

Two similar radiocarbon dates were obtained on short-lived plant remains from the underlying deposit. The dates are consistent with the British Chalcolithic and are similar to those obtained for burials 25004 and 1238 (see above).

Burial 62027 included a skull and was recovered from grave-like pit 62025, which may represent a revisited burial deposit that was manipulated in antiquity. The skull is directly dated by SUERC-53041:

- I2460/62027: 2030–1820 calBCE (3575±27 BP, SUERC-53041)

Porton Down (Wiltshire, England)

Contact person: Alistair Barclay

The site is located on Porton Down, 1.5 km east of the village of Porton and to the north-east of Salisbury. It was excavated during 2011 and 2015 by Wessex Archaeology[105]. Burial 5108 (subadult female) was crouched and had the remains of a neonate placed over its shoulder and right arm. No grave goods were present. Ancient DNA data shows that the subadult female is the daughter of I2457/13382, who was excavated in Amesbury Down (5 km apart from Porton Down). A radiocarbon date was obtained from this female individual (SUERC-43374):

- I2600/5108: 2140-1940 calBCE (3646±27 BP, SUERC-43374)

The grave (5110) was a metre to the west of the central grave complex (5171) within a segmented ring-ditch. Radiocarbon dates indicate that both the ditch and the primary burial are of early Beaker or British Chalcolithic date. The ring-ditch contained a small cemetery of Beaker and early Bronze Age date and is noteworthy for its relatively high proportion of female and immature individuals. Other than pots, including Beakers, few of the burials contained grave goods.

MOD Boscombe Down, Amesbury (Wiltshire, England)

Contact person: Alistair Barclay

The site is located within the area of MOD Boscombe Down and on part of what is known as Amesbury Down and forms part of the wider Stonehenge landscape[106]. The airfield contains numerous barrows and is just south of the Newton and Earl's Farm barrow groups and east of the important funerary landscape of Amesbury Down and its important Beaker burials (the 'Amesbury Archer' and the 'Boscombe Bowmen'). The burial, 62260_39, was found during the groundworks for a new fire hydrant. It had been badly disturbed but appeared to have been placed in a small oval grave that was covered by a cairn of flint nodules. The grave contained the burial of an adult male (35-45 yr) and four flint flakes. A radiocarbon date, NZA-28700, indicates that the burial was made towards the end of the early Bronze Age and after Beakers had gone out of use:

- I2464/62260_39: 1750–1610 calBCE (3379±30 BP, NZA-28700)

East Kent Access (Phase II) (Thanet, Kent, England)

Contact person: Alistair Barclay

The burials were found by Oxford Wessex Archaeology (Joint Venture) in excavations ahead of the construction of the East Kent Access Phase II road scheme (EXEKA09)[107]. Thanet is a former island on the most eastly point of Kent, an area well-known for its concentration of barrows. The three sampled burials are from two of ten barrows investigated on the route of the roadscheme, a number of which belong to larger barrow cemeteries.

Two of the burials, 126005 and 246136, were found within the interior of barrow 216090 (Zone 21) and are of early Bronze Age date. Burial 246136 contained the crouched skeleton of a probable female subadult/adult (16-19 yr) as well as a triple conjoined miniature Food Vessel, an amber button and a copper alloy pin. Burial 126005 contained the crouched remains of a probable female adult (40-55 yr). The third burial, 136128, was one of a series of burials found within barrow 134097/193125 (Zone 13). The grave (136129) contained the crouched skeleton of a probable adult male (35-45 yr). Radiocarbon dating (SUERC-40713, 40290 and 40721) indicates that all three are similar in date and post-date the main period of Beaker use:

- I2601/EXEKA09_126005: 1960–1750 calBCE (3535±35 BP, SUERC-40713)
- I2602/EXEKA09_136128: 1900–1690 calBCE (3490±30 BP, SUERC-40290)
- I2463/EXEKA09_246136: 1930–1740 calBCE (3505±35 BP, SUERC-40721)

Totty Pot (Cheddar, Somerset, England)

Contact person: Thomas Booth

Totty Pot is a cave in the Mendip Hills located around 5km east of Cheddar village (ST 4825 5358)[108]. The cave was discovered by Christopher Hawkes in 1960 and was excavated by Hawkes, Willie Stanton and Wessex Cave Club between 1960 and 1965. The excavations uncovered a substantial collection of human and faunal bones as well as a small lithic assemblage dating typologically to the Mesolithic. A small excavation undertaken in 1998 by Gardiner and the University of Bristol found further Mesolithic stone tools as well as a few small sherds of pottery dating to Beaker, Bronze Age and Romano-British periods[109].

Unfortunately around half of the human bone assemblage was destroyed and the extant collection consists of just sixty identified elements. Representation of smaller skeletal elements as well as a lack of cortical weathering or scavenger gnawing suggests that individuals had been deliberately interred in the cave soon after death and decomposed *in situ*. At least six, but more likely seven, individuals are represented amongst the remains: three or four adults (possibly two males and two females), an older child (around 10-years-old) and two young children (2-3 and 3-6-years-old).

An adult left humerus and left femur (TP 1) produced radiocarbon dates in the earlier Late Mesolithic (7445-7080 calBCE (2-sigma combined, BM-2973, OxA-16457))[110]. However, radiocarbon dates from a further five long bones produced dates spread through the Neolithic. An adult left femur (TP 6, 3630-3370 calBCE, 2-sigma, OxA-16458) dated to the Early Neolithic. A right ulna from a 2-3-year-old child (TP 2004.9/419, 3355-3035 calBCE (2-sigma, OxA-16462)) an adult left femur (2004.9/68, 3340-3025 calBCE (2 sigma, OxA-16459)) and a right femur from a 3-5-year-old child (TP'63, 3335-2930 (2-sigma, OxA-16461)) produced dates in the Middle Neolithic. A left femur from a 10-year-old child (TP 2004.9/257) dated to the Late Neolithic was analyzed with aDNA:

- I3049/TP 2004.9/257: 2830–2461 calBCE (4008±39 BP, OxA-16460)

Eton Rowing Course (South of Boveney Court, Buckinghamshire, England)

Contact person: Tim Allen

Skeleton 5587 was found at the Eton Rowing Course on gravel terrace deposits on the north bank of the river Thames (NGR 493533 177530), south of Boveney Court, Buckinghamshire. It lay within a grave on the north edge of a natural hollow that contained an extensive early Neolithic midden deposit, and which continued to receive material in the middle and late Neolithic and the Beaker period[111]. The grave was orientated ENE-WSW, and was 1.47m long and up to 0.66m wide, with a squared western end and a more pointed eastern end. Skeleton 5587 was tightly crouched in the central part of the grave, measuring 0.84m from head to toes. It was lying on its right side with the head to the west, and with the knees drawn up and the arms folded, the hands in front of the face. The skeleton was that of an adult female of 25-30 years A sheep/goat mandible and a pike vertebra were recovered from the area between the ribs and arms, and five flint flakes or blades were also recovered from the grave fill. The radiocarbon date for this individual is:

- I2605/SK 5587 (DBC 96): 3632–3373 calBCE (4710±35 BP, Poz-83483)

Banbury Lane (Northampton, Northamptonshire, England)

Contact person: Oliver Craig

The Banbury Lane site is located to the southwest of Northampton (SP 725 582) and was excavated by Northamptonshire Archaeology in 2012 in advance of a new housing development[112]. The main feature was a Neolithic triple-ditched circular enclosure monument. A large pit had been dug through the entranceway of the central ditch and was found to contain the disarticulated and disordered remains of at least 145 individuals (Burial 1)[113]. The disarticulated remains of at least two young children had been deposited in the outermost ditch around the same time (Burial 2). A later satellite burial consisting of an unaccompanied single articulated adult skeleton was recovered around 30m to the southwest of the monument (Burial 3).

The remains from Burial 1 were tightly packed, with large bones (crania and long bones) located towards the bottom and smaller bones placed towards the top of the pit.

Osteological analysis suggested that Burial 1 included remains from adults and children, although there was a bias towards young adult males. Refitting of bones and bone fragments found that the remains of single individuals were distributed throughout the deposit. Small bones of the hands and feet were almost completely absent. These features suggested that the remains from Burial 1 had originally decomposed elsewhere before they were transported to the triple-ditched monument. Possible scenarios include primary interment in a tomb or long barrow, primary inhumation or excarnation. A radiocarbon date obtained from a deer antler located beneath Burial 2 and relating to the construction of the monument, was younger than dates obtained from Burials 1 and 2, supporting suggestions these bones had been curated elsewhere for a time. The positioning of the burial pit in the entranceway of the internal ditch suggested that Burials 1 and 2 were taken to represent acts of closure, effectively decommissioning the monument.

Human remains from the top and bottom layers of Burial 1 produced consistent Middle Neolithic radiocarbon date ranges of 3360-3100 calBCE (2-sigma – unpublished) and 3360-3090 calBCE (2-sigma). Burial 2 produced a date range of 3340-3020 calBCE (2 sigma), consistent with the dates from Burial 1. Burial 3 produced a Late Neolithic date of 2860-2500 calBCE (2-sigma). All of the remains from Banbury Lane that were analysed with aDNA came from Burial 1:

- I0518/NBL11_2016.1: 3360–3100 BCE
- I0519/NBL11_2011.2: 3360–3100 BCE
- I0520/NBL11_2002.1: 3360–3100 BCE

Canada Farm (Sixpenny Handley, Dorset, England)

Contact person: Thomas Booth

Canada Farm is located on Cranborne Chase, near the village of Sixpenny Handley. The site originally consisted of a round barrow funerary monument surrounded by a two-phase penannular ditch, although the barrow mound has since been ploughed away[114,115]. It was excavated in 2009 by Martin Green due to fears that it would eventually erode away. Nine post holes located immediately to the northwest of the ring ditch indicated the former presence of a circular wooden structure, possibly a mortuary house or excarnation platform. The excavations identified a central grave pit containing

a single inhumation burial (F1). Four satellite inhumation burials (F4, F5, F6, F8) and a cremation inhumation (C1) had been cut into the second phase ditch, whilst one (F3) was located just outside. Superficially, the completeness and correct anatomical articulation of all of the skeletons suggested that they had been buried intact soon after death. However, osteological and microscopic analysis suggested that most of the bodies had been manipulated post mortem and that there had been a significant delay between their deaths and final burial.

F1 included the remains of a 25-30-year-old male on his left side facing east. The remains had probably been interred inside a wooden coffin, and were accompanied by a boar's tusk, an antler pendant or toggle, a flint flake and a Middle Rhine/Wessex style Beaker. The skeleton was complete and mostly articulated, however the mandible had been removed and placed in the northwest corner of the coffin. The proximal articular ends of both humeri were slightly out of anatomical articulation. Signs of carnivore-gnawing on some of the bones confirmed that there must have been a delay between this individual's death and burial. Two radiocarbon dates obtained from this skeleton (2620-2470 calBCE (2-sigma) and 2470-2290 calBCE (2-sigma)) were statistically inconsistent with one another. It has yet to be resolved which of these dates is likely to be most accurate, although both dates place the death of the individual at the beginning of the Beaker period in Britain. Both dates are anomalously early when compared to the typology of the accompanying Beaker pot, suggesting that the period between death and burial was likely to have been a century or more. The correct anatomical articulation of the skeleton inferred the persistence of substantial soft tissue. This observation, as well as results from the histological analysis of the femur from this skeleton, were consistent with this individual having been mummified previously.

Burial F3 was located just outside the ditch phases and included the unaccompanied remains of 12-13-year-old possible female buried supine with their legs flexed to the right and their head to the southwest. Osteological and microscopic analysis identified artificial drill holes in long bone diaphyses and epiphyses suggesting that the body had been subject to significant post mortem manipulation. Histological analysis of these bones indicated that the body had decomposed normally and that the drill holes may represent holes for dowels used to peg the decomposing body together. A Middle Bronze Age radiocarbon date was obtained from this skeleton (1620-1500 calBCE (2-sigma, NZA-34642)).

Burial F4 was cut into the second phase barrow ditch and contained the unaccompanied remains of an 18-19 -ear-old male buried supine and tightly flexed with their head to the southwest. Osteological examination found probable cut marks on the neck of the right scapula, indicating that this individual had also been manipulated post mortem. This Middle Bronze Age individual was analysed with aDNA:

- I3082/Burial F4: 1500–1390 calBCE (NZA-34643)

Burial F5 was also cut into the second phase ditch adjacent to F4. It included the remains of a 10-12-year-old possible male interred supine with their legs tightly flexed to the left and their head to the northeast. Drill holes similar to those found throughout the F3 skeleton were observed on a metacarpal from F5. Histological analysis of the tibia suggested F5 had been subject to similar post mortem treatment as F3. The F5 skeleton has not been radiocarbon dated but its proximity to F4 and similarity to F3 in terms of funerary treatment suggested that it dates to the Middle Bronze Age.

Burial F6 was cut into the second phase ditch and contained the unaccompanied remains of a 3-4 year-old child flexed on its left side with its head to the northeast. There was no osteological evidence for post mortem manipulation of the kind observed in the other skeletons and histological analysis was consistent with this individual having been buried intact soon after death. This skeleton has not been radiocarbon dated but was assumed to date to the Middle Bronze Age.

Burial F8 included the unaccompanied remains of a 17-25-year-old individual of indeterminate sex. The skeleton had been severely plough-damaged, making it difficult to determine its original position. Osteological analysis found no evidence for any additional post mortem treatment. Histological analysis of a long bone from this individual was consistent with them having been buried intact soon after death. This skeleton has not been radiocarbon dated but is assumed to date to the Middle Bronze Age.

Samborzec (Małopolska, Poland)

Contact person: Piotr Włodarczak

The site was located on the loess upland in the vicinity of the Vistula valley (western Małopolska; SE Poland). The excavations were conducted in the 1960s[116]. A complex of small cemeteries dated to the late and final Neolithic has been found (Złota, Corded

Ware and Bell Beaker graves). The cemetery from the Bell Beaker period consisted of 10 graves. The features were linearly structured and oriented on the N-S axis. Grave pits presented simple rectangular constructions without any additional outer elements. The deceased were lying in contracted position, males to the left side and women to the right side. Their equipment was typical for the Eastern group of the Beaker complex.

Anthropologically, the skeletons from Samborzec show very characteristic morphological traits distinguishing them from other Neolithic and Early Bronze groups from SE Poland. The skulls are classified as short or very short. Their main characteristic is the shape of the back part, namely the distinct flattening of the upper part of the occipital bone and of an area of the parietal bone[117]. Such a morphology suggests that this population was genetically foreign to the territory of Małopolska. We obtained genome-wide ancient DNA data from three individuals:

- I4251/RISE1122/grave no. 7: 2837-2672 BCE (3990±60 BP, Ki-7926). Male inhumation burial (25-30 years) with northwest-southeast orientation, located on the left side. The grave goods consisted of two vessels (bowl and unornamented cup), a flint blade dagger and a flint scraper.

- I4252/RISE1123/grave no. 1: 2463-2142 BCE (3820±50 BP, Ki-7921). Child inhumation burial (11-13 years; genetically male) with northeast-southwest orientation, located on the left side. There was a ceramic bowl and an undecorated cup.

- I4253/RISE1124/grave no. 13: 2571-2208 BCE (3920±60 BP, Ki-7929). Male inhumation burial (25-30 years), with N-S orientation, located on the left side. The only element of equipment was a ceramic bowl, posed in the northern part of the grave.

Budakalász, Csajerszke (M0 Site 12) (Hungary)

Contact person: András Czene

The burial site of Budakalász is situated 1 km north of the boundary of Budapest, on the right side of the Danube. A total of 4 hectares of the cemetery area were excavated in 2005–2006 and 3 more acres were surveyed by sounding trenches around the excavated part of the cemetery. In this area, 943 graves from the Bell Beaker period have been found. Most graves are cremation graves with the ashes in urns. The 58 inhumed burials usually follow a north-south orientation, and occasionally a south-north one. The

deceased usually lay on their side, in a slightly contracted position. The most frequent types of grave goods are bowls and jugs laid by the feet. Copper objects, daggers, wrist-guards, arrow heads were usually placed by the arm. Ongoing stable isotope analyses and radiocarbon dates will be published in separate studies (Czene in prep., Kulcsár et al. in prep).

Grave 276 (I3528, GEN 85): Skeletal male burial with north-south orientation, located on the left side, legs bent at the knees. At the southern part of the grave vessels and two stone artefacts were found.

- I3528/GEN85/Grave276: 2559–2301 calBCE (3931±31 BP, DeA-11507)

Grave 597 (I3529, GEN 86): Skeletal male burial (female according to geneti sex) with a south-north orientation, located on the right side, legs bent at the knees. A vessel was placed at the legs and two small bone buttons with V-shape perforation were found at the neck and at the inner part of the right arm.

- I3529/GEN86/Grave597: 2500-2200 BCE

Budapest-Békásmegyer, Királyok útja (former Vöröshadsereg útja) (Hungary)

Contact person: Anna Endrődi, Gabriella Kulcsár

The site is situated in northern part of Budapest, on the western bank of the Danube River. Rózsa Kalicz-Schreiber uncovered 154 burials of the cemetery between 1960 and 1983, at Budapest, Békásmegyer–Királyok útja. The cemetery, according to her estimates, had originally contained between 200-300 hundred graves. Inurned burials dominated in the investigated cemetery section covering an area of 7700 m^2. The inhumation burials of the Békásmegyer cemetery contained jugs of the southern type rather than the Bell Beakers type. No more than four of the 30 inhumation graves yielded genuine Bell Beakers, while five contained various elements of the Beaker package such as stone wrist-guards, stone arrow-heads and bone buttons with V-shaped perforation. Jugs of the southern, Somogyvár–Vinkovci/proto-Nagyrév type were deposited in 15 inhumation burials; nine inhumation graves did not contain any grave goods. Eighteen of the 28 scattered cremation burials contained genuine Bell Beakers, while three yielded locally made copies or bowls with a stamped rim. New radiocarbon dates were generated for three burials of the Budapest–Békásmegyer cemetery. The

individuals taken from inhumation burials yielded roughly similar dates for the cemetery section: 3845±36 BP (Grave 193; DeA-2875), 3831±35 BP (Grave 432a; DeA-2876), 3874±33 BP (Grave 445; DeA-2877). A Bayesian analysis of the three AMS dates from the cemetery dates its use to approximately 2410–2220 calBCE[118].

Grave 219/B (I2364, GEN 10a): Double burial excavated in 1966. Two individuals were lying on their right side in contracted position, without grave goods. Individual B is an adult male. The radiocarbon date for this individual is:

- I2364/GEN_10a, Grave 219/B: 2470–2060 calBCE [2295–2060 calBCE (3779±28 BP, DeA-6749); 2470–2285 calBCE (3883±29 BP, DeA-7216)]

Grave 452 (I2365, GEN 11a): Burial of an adult male lying of his left side, in contracted position, excavated in 1982. The skeleton was incomplete, and oriented north-northwest to south-southeast, with hyper-flexed legs. Pottery grave goods (a Bell Beaker, an urn, a bowl, and a jug) were situated beside the lower leg, at the southern part of the grave pit. Other grave goods include an arrowhead, and two stone tools.

- I2365/GEN_11a/Grave452: 2465-2205 calBCE [2465-2205 calBCE (3858±32 BP, DeA-6762); 2465-2213 calBCE (3858±32 BP, DeA-7220)]

Szigetszentmiklós, Felső Ürge-hegyi dűlő (Hungary)

Contact person: Róbert Patay

The cemetery is located in the northwestern part of Csepel Island near Budapest. The archaeological investigation of the site was conducted between 2006 and 2007. A total of 716 features were uncovered, amongst them 218 burials of the Bell Beaker period. One remarkable feature of this burial ground is the unusually high proportion of inhumation burials: 102 graves of the 218 excavated graves were inhumations. Another element of the central European funerary tradition could also be documented in the Szigetszentmiklós cemetery, namely inhumation performed according to strict rites. The proportion of the deceased laid on the right and the left side was roughly equal and they were oriented either northeast-southwest or southwest-northeast. Anthropological analysis of the skeletal remains indicated that men were always interred on their left side, while women were laid to rest on their right side, with the face turned toward the east in the case of both male and female burials. A comparable burial practice was observed in cemeteries of the Bell Beaker East Group in central Europe.

A series of five AMS radiocarbon dates from the cemetery can be subjected to Bayesian analysis. If we assume that the graves represent a single phase, the time span of the use of the cemetery can be placed to approximately 2420–2190 calBCE[118,119].

Grave 49 (I2741, GEN 20): Male individual lying of his left side, in contracted position. The rectangular shaped grave pit, oriented northeast–southwest, was enclosed by a round ditch. Grave goods include a Bell Beaker, a bowl, a stone wrist-guard and a dagger. The radiocarbon date for this individual is:

- I2741/GEN_20, Grave 49: 2458–2154 calBCE (3835±35 BP, Poz-83641)

Grave 133 (I2786, GEN 56): Male individual lying of his left side, in contracted position. The rectangular shaped grave pit, oriented northeast–southwest, was enclosed by a round ditch. Grave goods include a bowl, a jug, and a stone silex. The radiocarbon date for this individual is:

- I2786/GEN_56, Grave 133: 2459–2206 calBCE (3850±35 BP, Poz-83639)

Grave 552 (I4178, GEN 58): Male individual lying on his left side, in contracted position. The rectangular shaped grave pit, oriented northeast–southwest, was enclosed by a round ditch. Grave goods include a Bell Beaker, and a bowl.

- I4178/GEN_58/Grave552: 2500-2200 BCE

Grave 688 (I2787, GEN 59): Male individual lying of his left side, in contracted position. The rectangular shaped grave pit, oriented northeast–southwest, was enclosed by a round ditch. Grave good include a small jar. The radiocarbon date is:

- I2787/GEN_59/Grave 688: 2458–2202 calBCE (3840±35 BP, Poz-83640)

SI 2- Experimental procedures

In the Methods section we describe the experimental protocol followed for samples that were processed at Reich's lab, Harvard Medical School, Boston. In this note we described lab procedures for samples that were partially or completely processed at other labs (Supplementary Table 1):

Libraries built at the Laboratory of Archaeogenetics of the Institute of Archaeology, Research Centre for the Humanities, Hungarian Academy of Science, Budapest

Beaker period teeth and petrous bone samples from Hungary were taken under sterile conditions in the Hungarian Museums and anthropological collections. Eight samples were cleaned and powdered in Budapest, at the Laboratory of Archaeogenetics of the Institute of Archaeology, Research Centre for the Humanities, Hungarian Academy of Sciences, following published protocol[120]. DNA was extracted from 0.08-0.11g powder via published methods[121], using High Pure Viral NA Large Volume Kit columns (Roche)[122]. DNA extractions were first tested by PCR, amplifying the np 16117-16233 fragment of the mitochondrial genome, and visualized on a 2% agarose gel. DNA libraries were prepared from clean and successful extraction batches using "UDG-half" repairing method[123]. We included milling (hydroxylapatite blanks to control for cleanness) and extraction negative controls in every batch of libraries. Barcode adapter ligated libraries were amplified with TwistAmp Basic (Twist DX Ltd.), purified with Agencourt AMPure XP (Beckman Coulter), and checked on 3% agarose gel[124]. Library concentration was measured on Qubit 2.0 fluorometer. After the initial quality control analysis, promising libraries were shipped to Reich's lab.

Libraries built at the National History Museum, London

DNA extractions and library preparations were conducted in a dedicated ancient DNA laboratory at the National History Museum (London). We used approximately 25mg of finely drilled bone powder and followed the DNA extraction protocol described in Dabney *et al*. (2013)[121] but replaced the Zymo-Spin V column binding apparatus with a high pure extender assembly from the High Pure Viral Nucleic Acid Large Volume Kit (Roche). Library preparations followed partial uracil–DNA–glycosylase treatment[123] and a modified version of the Meyer and Kircher (2010)[125] protocol: the initial DNA

fragmentation step was not required and all clean-up steps used MinElute PCR purification kits (Qiagen). The index PCR step included double indexing[126], the polymerase AmpliTaq Gold and the addition of 0.4mg/mL BSA. The index PCR was set for 20 cycles with three PCR reactions conducted per library. Amplified libraries were then shipped to Reich's lab

Libraries built at the Australian Centre for AncientDNA, University of Adelaide

Libraries were prepared following the same protocol as in Haak et al. (2015)[124] and shipped to Reich's lab.

Libraries built at the Centre for GeoGenetics, Natural History Museum, University of Copenhagen

The sampled teeth were prepared for Next Generation Sequencing following standard procedures in the dedicated ancient DNA clean lab at Centre for GeoGenetics, Natural History Museum, University of Copenhagen. We specifically targeted the root cementum layer and combined this with a 'pre-digestion' step[127] prior to silica-in-solution DNA isolation, optimized at recovering very short DNA fragments[3]. Double-stranded, blunt-ended libraries were prepared as in Meyer and Kircher (2010)[125] with modifications outlined previously[127], and shipped to Reich's lab.

Libraries built at the Institute for Archeological Sciences in Tübingen

Sampling was performed in the cleanroom facilities at the Institute for Archeological Sciences in Tübingen on teeth selected from the human remains from the Lech Valley, Bavaria, Germany. The teeth were treated with ultraviolet (UV) light from all sides for 10 min to reduce surface DNA contamination and then sawed transversally at the border of root and crown before sampling dentine powder from the inside of the crown with a sterile dentistry drill. Between 40 and 120 mg powder were used for each DNA extraction following an established protocol[121], resulting in 100µl of DNA extract for each sample.

An initial screening was performed by converting 20ul of extract into double-stranded next-generation sequencing libraries[125,126] which were shotgun-sequenced and sequenced after enrichment for human mitochondrial DNA[128].

For those samples that showed sufficient human DNA preservation and a low rate of modern contamination on the mtDNA, uracil–DNA–glycosylase (UDG) treated libraries[123] were prepared out of the 60 ul of DNA extract. These libraries were enriched for a targeted set of ~1.2 million nuclear SNPs (1240k SNP set)[124,129].

Enriched libraries were paired-end sequenced on a HiSeq4000 at the IKMB in Kiel, Germany, using 2x150+2x8 bp reads.

SI 3- Y-chromosome analysis

We performed Y-chromosome haplogroup analysis on all the male individuals in the study, and here provide an overview of the results. Overall, Y-chromosome haplogroups are highly correlated with steppe ancestry proportions in the nuclear genome.

Iberian individuals with enough data to produce a reliable Y-chromosome haplogroup determination belonged to haplogroups I2a2 and G2 (Supplementary Table 3), both present in high frequencies in European Neolithic farmers[124,130–132] and also in Iberian Copper Age populations. Haplogroup G2 probably entered Europe from the Near East during the Neolithic expansion, and haplogroup I2a2 was likely introduced into the Neolithic population through admixture with European hunter-gatherers. Two Iberian individuals belonged to haplogroup R1b but likely not to R1b-L23 and therefore not to R1b-S116/P312. Similar R1b haplogroups were present in low frequencies in Europe during the Neolithic period, as they have been previously observed in both central Europe (I0559) and Iberia (I0410)[124].

Outside Iberia, Beaker Complex individuals present a striking uniformity in paternal lineages, with 37 out of 44 males (excluding relatives) belonging to haplogroup R1b (Supplementary Table 3). Where R1b downstream mutations could be determined (n=22), all but one were derived for the R1b-S116 mutation. One male belonged to R1b-U106 and was excavated in The Netherlands, a place with relatively high frequencies of R1b-U106 in present-day populations. Six individuals outside Iberia without R1b Y-chromosomes were excavated in Hungary (n=4), Germany (n=1) and England (n=1). Interestingly, most of these individuals presented low amounts of steppe ancestry in the nuclear genome as compared to other individuals from the same regions (Figure S1).

Another striking observation is the haplogroup composition of Neolithic males in Britain (n=25), who displayed entirely I2a2 and I2a1b haplogroups. Thus, there is no evidence at all for a contribution to Neolithic farmers in Britain of the Y chromosome haplogroups (e.g., G2) that were predominant in Anatolian farmers and in Linearbandkeramik northern European farmers.

We detect 10 males who belonged to R1b-L21/M529, all of them dated to the Beaker and Bronze Age periods and excavated in Britain. This matches the high frequency of this clade in modern populations from the British Isles.

We finally comment on three individuals with uncertain attributions:

-Sample I0261 can be assigned to haplogroup R1b1a based on mutations R1b1a:L1345:21558298G->T; R:F652:23631629C->A and R:M651:9889199G->A. Haplogroups I, G, R1a and R1b1a1a2a can be excluded due to the presence of ancestral alleles for I (CTS11979:23401471C->T), G (M3600:21954611G->A, PF3134:15275200C->G), R1a (L145:14138745C->A) and R1b1a1a2a (L23:6753511G->A). Thus, it seems that I0261 belonged to R1b, but not to the R1b-S116/P312 (R1b1a1a2a1a2) clade that is present in most of the Beaker Complex individuals outside Iberia.

-Sample I0257 can be assigned to haplogroup R1b1 based on derived alleles at mutations R1b1 (L1349: 22722580T->C) and R (P224:17285993C->T, L1347:22818334C->T). Haplogroups I, G and H can be excluded due to the presence of ancestral alleles for I (CTS2193:14214481G->T, PF3641:7688470 T->C, PF3660:8466652G->A), G (CTS1283:7309873T->G, CTS2016.1:14155765G->A, CTS2125:14190447A->G, CTS4761:15802681C->T, CTS9011:18615020A->T, M3474:7930724C->A, PF3134:15275200G->C) and H (M2942:17887908A->G). This individual and I0261 could belong to the same haplogroup, but for I0257 we cannot exclude any R1b1 subclade.

SI 4- *f*-statistics

We computed *f*-statistics on the *HOIll* dataset using ADMIXTOOLS[133] using default parameters. We computed standard errors using a weighted block jackknife approach[134] over 5 Mb blocks.

f_4-statistics

To increase statistical power to detect allele frequency differences, we grouped Beaker Complex individuals excavated in nearby sites and presenting similar population affinities. Specifically, we grouped individuals that satisfied the following conditions:

- They were excavated in sites separated by less than 150 kilometers.

- They did not significantly differ with regard to statistic f_4(Mbuti, Test; Yamnaya_Samara, Anatolia_Neolithic), using 1.5 standard errors as our criterion (Figure S1a). We found that this f_4-statistic is highly sensitive to ancestry differences between Beaker Complex individuals, and is mainly affected by different levels of steppe-related ancestry, which is the main cause of genetic differentiation in our dataset.

- They were processed using the same UDG treatment. We do not co-analyze non-UDG-treated and UDG-treated individuals.

We then recomputed the statistic f_4(Mbuti, Test; Yamnaya_Samara, Anatolia_Neolithic) (Figure S1b) with the new grouping scheme in Table S1. We used this scheme for f_4-statistics, outgroup f_3-statistics and *qpAdm/qpWave* analysis.

Details on notable results from f-statistic analysis reported in the main manuscript

Presence of steppe ancestry in two individuals from Arroyal I (Burgos, northern Spain)

We show in Table S2 f_4-statistics of the form f_4(Mbuti, Test; Iberia_Chalcolithic_MIR, BB_Spain_Arr2). Several populations are asymmetrically related to Iberia_Chalcolithic_MIR and BB_Spain_Arr2 (individuals I0461 and I0462). Two populations with steppe-like ancestry, EHG (Z=3.5) and Yamnaya_Kalmykia.SG (Z=3.2), are significantly closer to BB_Iberia_Arr2 than to Iberia_Chalcolithic_MIR. In Table S2 we find BB_Spain_Arr1 (individuals I0459 and I0460) and Iberia_Chalcolithic_MIR to be symmetrically related to ancient West Eurasian populations. This confirms the visual impression from PCA (Extended Data Fig. 1a) and supports separation of Arroyal I individuals into two groups, BB_Spain_Arr2 with

steppe ancestry and BB_Spain_Arr1 without. To our knowledge, the BB_Spain_Arr2 individuals represent the oldest observation of steppe ancestry in Iberia.

Ancestry heterogeneity in Haut-Rhin (France)

In Table S2 we show that BB_France_Heg (one individual from Hégenheim) and BB_France_HAR (two individuals excavated a few kilometers from Hégenheim) are not symmetrically related to ancient West Eurasians. Populations with steppe-related ancestry such as EHG (Z=6.3) or Yamnaya_Samara (Z=8.2) share more alleles with BB_France_HAR than with BB_France_Heg, documenting very different population affinities in individuals excavated from nearby sites.

Steppe ancestry in Beaker Complex individuals from southern France

We tested for symmetry between Beaker Complex individuals from southern France (BB_France_Mar and BB_France_AHP) and Middle and Late Neolithic individuals from the same region (France_MLN). Steppe populations share more alleles with both BB_France_Mar (Table S2) and BB_France_AHP (Table S2) than with France_MLN. This observation suggests that the arrival of the Beaker Complex in southern France was mediated by migrants with steppe genetic affinities.

Population discontinuity in northern Italy

Our Beaker Complex individual from Parma is slightly shifted towards populations with steppe ancestry in the PCA (Fig 1b). We tested for symmetry between BB_Italy_Par and Remedello_CA[3] (Table S2), a culture preceding the Beaker Complex in northern Italy. Several steppe-like populations such as EHG (Z=4.6) or Yamnaya_Samara (Z=3.9) share more alleles with BB_Italy_Par than with Remedello_CA, indicating that our Italian Beaker Complex individual harbors a steppe-related ancestry component not present in the previous Remedello culture.

Ancestry heterogeneity at Szigetszentmiklós-Felső-Ürge hegyi dűlő (Hungary)

The Carpathian Basin represents the easternmost limit of the Beaker Complex distribution. Our data set includes four individuals from the Szigetszentmiklós-Felső-Ürge hegyi dűlő site in Hungary with very different genetic affinities (Extended Data Fig. 1; Figure S1). To illustrate this, we tested for symmetry between the most extreme individuals: BB_Hungary_Szi1 and BB_Hungary_Szi3 (Table S2). The analysis supports high genetic differentiation between these two individuals, with steppe populations sharing more alleles with BB_Hungary_Szi3 than with BB_Hungary_Szi1.

SI 5- *qpGraph* analysis

In this section we model the relationships between populations in an Admixture Graph framework with the software *qpGraph* in ADMIXTOOLS[133], using the *HOIll* dataset. This software takes as input an admixture graph and fits admixture proportions and drift paths to the genetic data, trying to match as closely as possible the observed *f*-statistics and reporting the difference between observed and predicted *f*-statistics.

Investigating the relationship among Neolithic/Chalcolithic European populations

Before the arrival of steppe ancestry, most of Europe was inhabited by closely related populations with the same ancestry components: one component derived from Anatolian farmers and the other from European hunter-gatherers. This does not mean, however, that European Neolithic farmers from different parts of Europe were undifferentiated from a genetic point of view.

We began by exploring whether Middle/Late Neolithic and Chalcolithic (Copper Age) populations share more affinity with any Early Neolithic population, computing f_4-statistics of the form f_4(Mbuti, Test; EN1, EN2) (Fig. 2b and Table S3). All the Iberian populations (including Beaker associated groups) show genetic affinity to Iberia_EN, indicating some degree of continuity through the Neolithic and Copper Age periods. In Hungary, continuity is also supported by Hungary_LCA sharing more alleles with Hungary_EN than with other Early Neolithic populations. Interestingly, Neolithic populations from Britain, Ireland and southern France share significantly more alleles with Iberia_EN than with central European Early Neolithic populations. However, the data point to a complex pattern of relationships among these populations. For instance, our Scotland_Neolithic population (the Neolithic group with highest quality data) shares significantly more alleles with both Iberia_EN (|Z|=4.916) and Hungary_EN (|Z|=5.807) than with LBK_EN, and it is symmetrically related to Iberia_EN and Hungary_EN (|Z|=0.627).

To verify that these observations were not driven by different proportions of hunter-gatherer admixture, we modelled population relationships with *qpGraph*. We designed a simple admixture graph that includes Anatolia_Neolithic, Iberia_EN, LBK_EN and WHG (Figure S2a), and fit our populations of interest as a mixture of WHG and ancestry related to either LBK_EN or Iberia_EN (Figure S2b). Models fitting

populations from Iberia, southern France and Britain as a clade with LBK_EN show a poor fit to the data (Figure S2c), even though the differences in WHG ancestry proportion (higher in Iberia_EN than in LBK_EN) are explicitly modelled. In contrast, these populations can be well modelled as a clade with Iberia_EN (Figure S2c). We next added Hungary_EN into the admixture graph (Figure S3a) and fit our populations of interest as a mixture of WHG and ancestry related to either LBK_EN, Iberia_EN or Hungary_EN (Figure S3b). Most Iberian groups and England_Neolithic are consistent with being a clade with Iberia_EN but not with LBK_EN or Hungary_EN (Figure S3c). Two populations (France_MLN and Scotland_Neolithic) that show genetic affinity to both Iberia_EN and Hungary_EN in f_4-statistics (Table S3) cannot be well modelled as a simple clade with any of the three Early Neolithic populations. In both cases, the fit improves when they are modelled as having ancestry from both a clade related to Iberia_EN and Hungary_EN (Figure S4). To generate confidence intervals for the ancestry proportion from the Iberia_EN-related clade, we computed the approximate log-likelihood of the admixture graph model[133] for a grid of values from 0 to 1 in increments of 0.01 (Extended Data Fig. 3). We integrated the interpolated likelihood surface and used this to compute a 95% central confidence interval. We obtained a 95% confidence interval of 51.3–70.8% Iberia_EN-related ancestry for Scotland_Neolithic and 61.7–84.2% for France_MLN.

These observations suggest that Neolithic populations from both Britain and southern France derive part of their ancestry from the Mediterranean route of Neolithic expansion. We caution, however, that the relationships between Neolithic European populations are likely very complex, including multiple admixture events[135], and that the available ancient DNA data are still sparse (especially for the Early Neolithic period). As a consequence, the admixture graph models presented here likely represent a simplification of the true history relating these populations.

SI 6- *qpAdm* analysis

In this section we aim to fit the ancestry of our populations/individuals of interest into genetic models with estimated mixture coefficients. We use the knowledge gained in previous sections to investigate different models under the framework described in Haak et al[124] and implemented in *qpAdm* (https://github.com/DReichLab). These methods relate a *Test* population to a set of *Outgroup* populations via a set of *Reference* populations. If the *References* share different amounts of genetic drift with the *Outgroups*, mixture coefficients can be estimated without having to explicitly model the relationship between the *Outgroups* and the *References*.

We carried out the analysis on the *HOIll* dataset and used a basic set of 9 *Outgroups*: Mota, Ust_Ishim, MA1, Villabruna, Mbuti, Papuan, Onge, Han, Karitiana. These populations are located in informative places of the phylogeny and are unlikely to have contributed directly to our *Test* populations.

Steppe ancestry in Beaker Complex individuals

With PCA, ADMIXTURE and *f*-statistics, we learned that our newly reported individuals reside along the Yamnaya-European Neolithic axis of genetic differentiation. Thus, we tried to model them as a mixture of Yamnaya_Samara + Anatolia_Neolithic + WHG (Table S4). These values were used for Fig. 2a. Many populations can be explained by a mixture of Anatolia_Neolithic + WHG without any contribution from Yamnaya_Samara, indicating a lack of steppe-related ancestry.

Investigating hunter-gatherer admixture in Neolithic/Chalcolithic Europe

A possible cause of genetic differentiation in Neolithic Europe is the presence of differential affinity to hunter-gatherer individuals from different regions[135]. To investigate this, we added ElMiron and GoyetQ116-1 to the 9 *Outgroups* set and modelled Neolithic and Chalcolithic Europeans as a mixture of Anatolia_Neolithic, LaBraña1 (a Mesolithic hunter-gatherer from Spain) and KO1 (a hunter-gatherer from Hungary found in a Neolithic context). This analysis reveals a striking pattern of more LaBraña1-related hunter-gatherer ancestry in Iberian populations (Table S5; Extended Data Fig. 2), especially in Iberia_EN and Iberia_MN where the hunter-gatherer ancestry is modelled as 100% LaBraña1-related. If we use Loschbour instead of KO1 as a source

we obtain similar results (Table S6), with the hunter-gatherer component in central European populations residing beyond Loschbour in the LaBrañа1-Loschbour cline.

Testing possible sources for Neolithic ancestry in Beaker Complex individuals

To understand the ancestry of Beaker Complex individuals we wished to characterize their Neolithic ancestry component, with a particular focus on determining whether Beaker Complex individuals outside Iberia had Iberia-related ancestry.

We learned in the previous section that, before the emergence of the Beaker Complex, populations from Iberia and central Europe harboured some degree of genetic differentiation. We thus took advantage of these differences and designed a *qpAdm* analysis to test the fit of different Neolithic/Copper Age populations as a source for the Neolithic component in Beaker Complex individuals. To increase power, we first split our Beaker Complex dataset into two groups: individuals from Iberia and individuals from outside Iberia. Then, we modelled their ancestry as a mixture of Yamnaya_Samara and one of the following Neolithic/Copper Age populations:

-Iberia_MN
-Iberia_Chalcolithic_MIR
-Iberia_Chalcolithic_ALA
-Germany_MN
-Globular_Amphora_LN
-Hungary_LCA
-TRB_Sweden_MN
-France_MLN

We used the basic set of 9 *Outgroups* and added LBK_EN, Iberia_EN, LaBrañа1 and ElMiron in order to increase our ability to detect differences in Iberia-related affinity. We show in Table S7 mixture proportions and P-values for the different models. For Beaker Complex in Iberia, populations outside Iberia are strongly rejected as sources and only Iberian populations (Iberia_MN, Iberia_Chalcolithic_MIR) show a good fit. The other Chalcolithic Iberian population, Iberia_Chalcolithic_ALA, fails as a source likely because it harbours more hunter-gatherer ancestry (Extended Data Fig. 2) than do other Iberian populations. In contrast, for Beaker Complex individuals outside Iberia, models using Iberian populations as a source for their Neolithic ancestry are rejected. We obtain a good fit for Globular_Amphora_LN and TRB_Sweden_MN, two

populations with a hunter-gatherer component close to KO1 on the cline defined by LaBrañа1-KO1 (Extended Data Fig. 2; Table S5), and beyond Loschbour on the cline defined by LaBrañа1-Loschbour (Table S6). Other central European populations such as Germany_MN or Hungary_LCA are rejected, but their fit can be improved by adding KO1 as a third source (Table S8), suggesting that the true admixing population likely had more hunter-gatherer ancestry than either Germany_MN or Hungary_LCA.

The magnitude of population turnover in Britain associated with the Beaker Complex

In this section we modelled the ancestry of Beaker Complex and Bronze Age individuals from Britain as a mixture of continental Beaker Complex (represented by our Beaker Complex individuals from Tuithoorn- Oostwoud, the Netherlands) and Neolithic Britons, adding Anatolia_Neolithic and Yamnaya_Samara to the 9 *Outgroups* to increase the power to distinguish between the two sources of ancestry (Table S9). In Figure 3a we show admixture proportions for individuals with more than 100,000 SNPs, ordered in chronological order (from left to right).

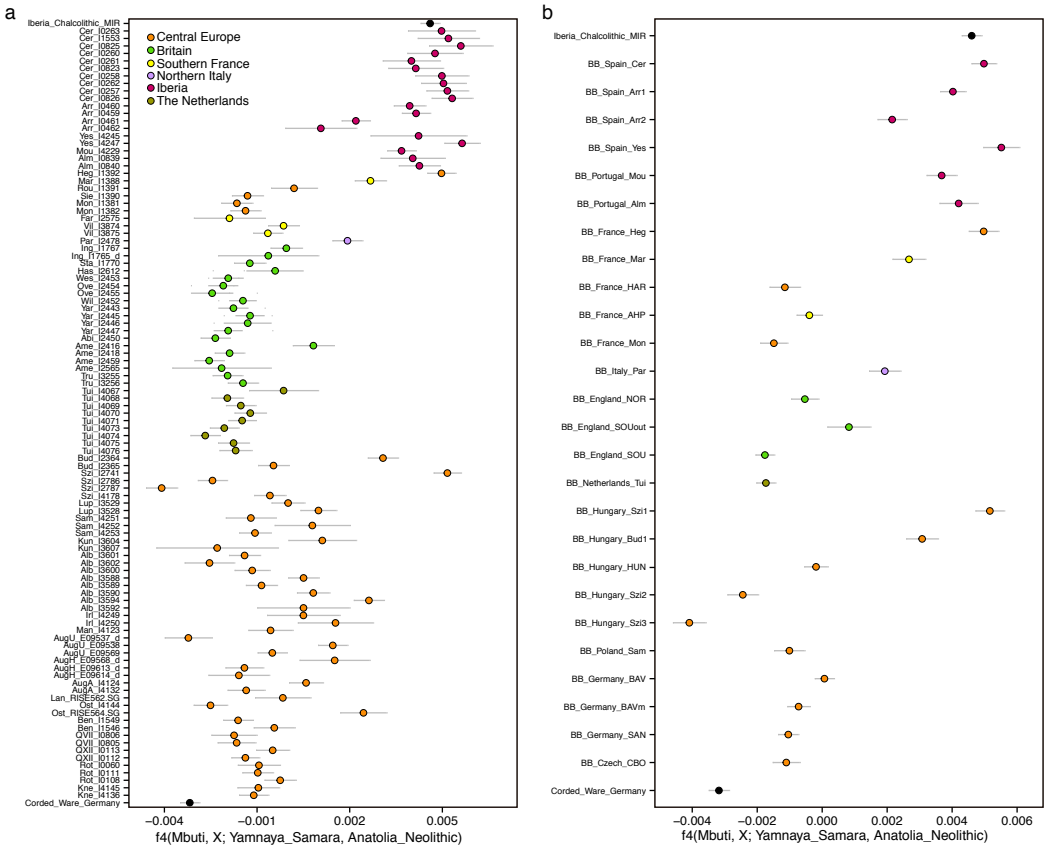
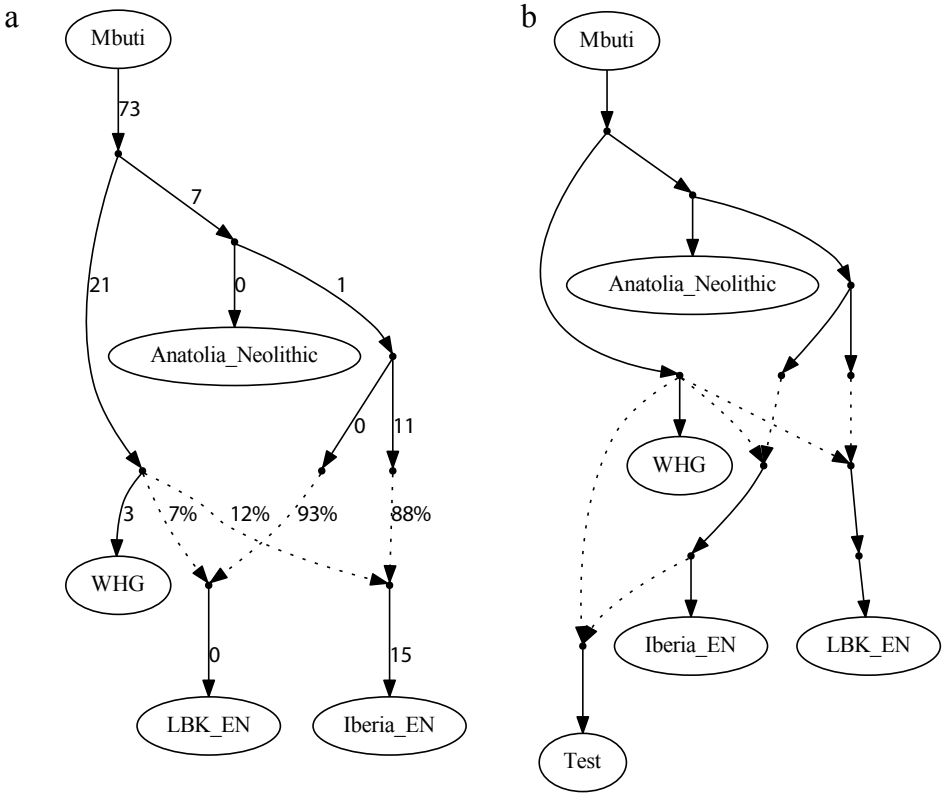


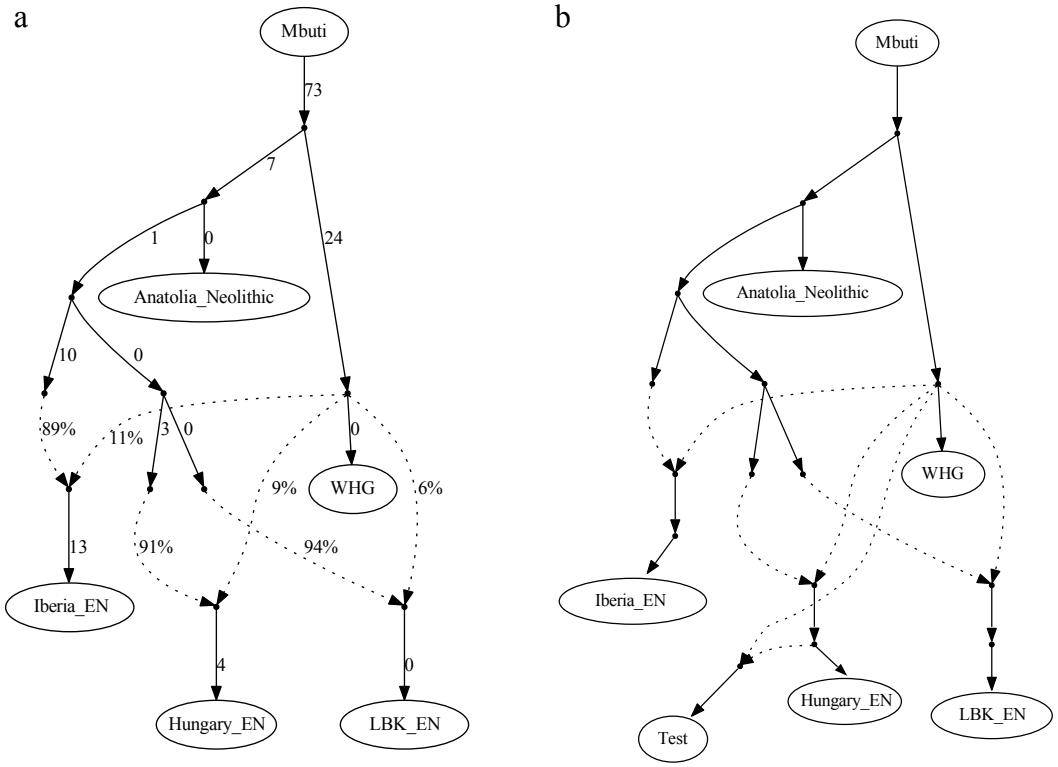
Figure S1. *f*-statistics of the form f_4(Mbuti, Test; Yamnaya_Samara, Anatolia_Neolithic) measuring steppe affinities (more affinity to Yamnaya results in lower values of the statistic). **a**, Individually for each Beaker Complex individual. **b**, Using the grouping scheme in **Table S1**. Error bars represent ±1.5 standard errors.



c

Test	Z-score	
	LBK_EN	Iberia_EN
Iberia_MN	-9.209	-2.189
Iberia_Chalcolithic_POR	-4.43	1.87
Iberia_Chalcolithic_MIR	-7.245	-1.154
Iberia_Chalcolithic_MUR	-3.806	-1.792
Iberia_Chalcolithic_ALA	-10.126	-3.183
France_MLN	-6.779	-2.826
Globular_Amphora_LN	-2.11	-1.627
Germany_MN	-2.794	-1.419
Hungary_LCA	-2.287	-2.286
TRB_Sweden_MN	0.757	0.731
England_Neolithic	-4.829	-1.395
Ireland_MN.SG	-2.95	1.597
Scotland_Neolithic	-10.45	-2.741
BB_France_Heg	1.922	1.928
BB_Hungary_Szi1	-1.775	1.076
BB_Portugal_Mou	-3.998	2.371
BB_Portugal_Alm	-2.746	1.556
BB_Spain_Yes	-5.298	1.669
BB_Spain_Cer	-6.306	2.117
BB_Spain_Arr1	-5.133	-1.867
BB_France_Bur	-6.536	-2.091

Figure S2. Modelling the relationships between Middle Neolithic/Copper Age and Early Neolithic European populations. a, Admixture graph that models the relationships between Anatolia_Neolithic, Iberia_EN, LBK_EN and WHG. All *f*-statistics agree between the model and data to within |Z|=1. **b,** Fitting *Test* populations with their farmer ancestry as a clade with Iberia_EN or LBK_EN (here with Iberia_EN as an example). **c,** Z-scores for the worst-fitting *f*-statistic when inserting the test population into the model in (b) (highlighted if |Z|>3).



c

Test	Z-score		
	LBK_EN	Iberia_EN	Hungary_EN
Iberia_MN	-9.003	-2.093	-9.004
Iberia_Chalcolithic_POR	8.243	5.37	8.299
Iberia_Chalcolithic_MIR	-7.216	1.747	-7.22
Iberia_Chalcolithic_MUR	-4.075	-2.044	-4.074
Iberia_Chalcolithic_ALA	-9.456	-5.265	-9.712
France_MLN	-6.618	-3.719	-6.688
Globular_Amphora_LN	-3.302	-3.407	-2.112
Germany_MN	3.482	-2.079	3.52
Hungary_LCA	-3.178	-3.178	-2.449
TRB_Sweden_MN	1.591	1.603	1.596
England_Neolithic	-4.749	-1.663	-4.762
Ireland_MN.SG	5.23	3.829	5.249
Scotland_Neolithic	-9.466	-7.664	-9.876
BB_France_Heg	2.031	2.049	2.082
BB_Hungary_Szi1	3.245	3.203	-1.993
BB_Portugal_Mou	-4.314	3.184	-4.315
BB_Portugal_Alm	-2.793	1.631	-2.807
BB_Spain_Yes	-5.326	1.619	-5.326
BB_Spain_Cer	-6.43	-2.233	-6.435
BB_Spain_Arr1	6.442	2.359	6.442

Figure S3. Adding Hungary_EN to the admixture graph model. a, Admixture graph that models the relationships between Anatolia_Neolithic, Iberia_EN, LBK_EN, Hungary_EN and WHG. All *f*-statistics agree between the model and data to within |Z|=2. **b,** Fitting *Test* populations with their farmer ancestry as a clade with Iberia_EN, LBK_EN or Hungary_EN (here with Hungary_EN as an example) **c,** Z-scores for the worst-fitting *f*-statistic when inserting the test population into the model in (b) (highlighted if |Z|>3).

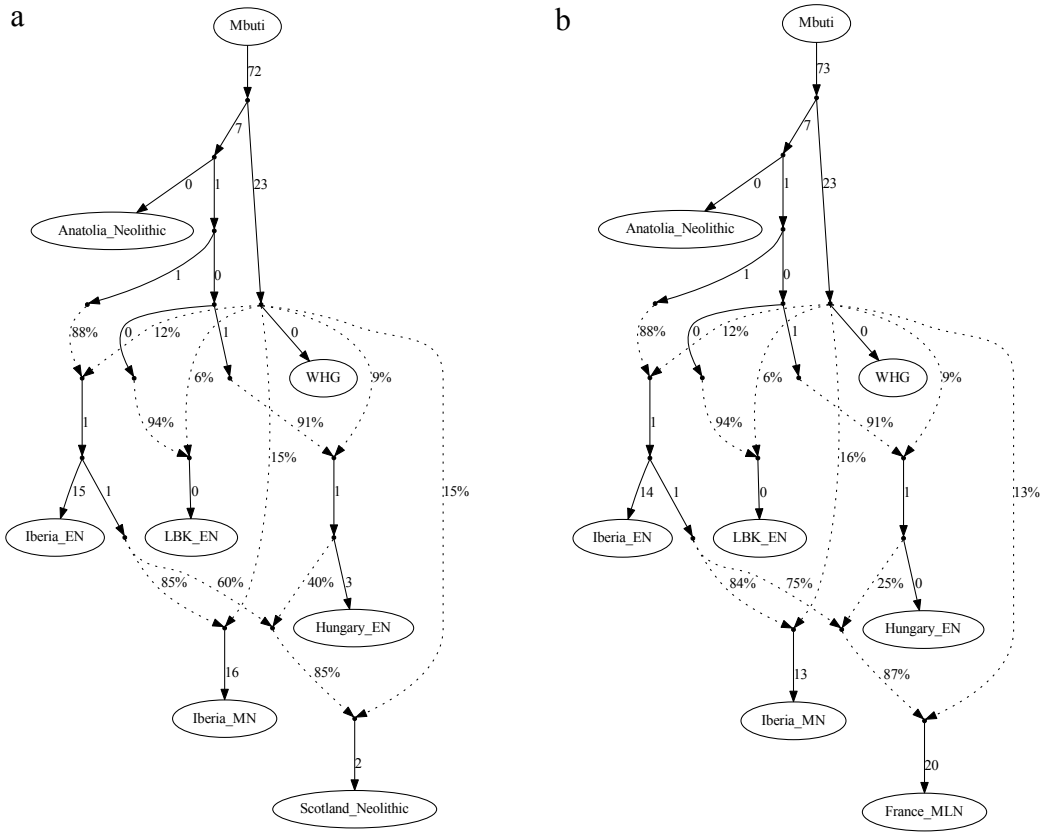


Figure S4. Admixture graphs fitting **a**, Scotland_Neolithic and **b,** France_MLN as a mixture of sources related to both Iberia_EN and Hungary_EN, plus WHG. Worst-fitting Z-score is -2.796 for **a** and -2.609 for **b**.

Table S1. Grouping scheme based on ancestry and geographic location.

ID	SiteID	Label
I0263	Cer	BB_Spain_Cer
I1553	Cer	BB_Spain_Cer
I0825	Cer	BB_Spain_Cer
I0260	Cer	BB_Spain_Cer
I0261	Cer	BB_Spain_Cer
I0823	Cer	BB_Spain_Cer
I0258	Cer	BB_Spain_Cer
I0262	Cer	BB_Spain_Cer
I0257	Cer	BB_Spain_Cer
I0826	Cer	BB_Spain_Cer
I0458	Arr	BB_Spain_Arr1
I0460	Arr	BB_Spain_Arr1
I0459	Arr	BB_Spain_Arr1
I0461	Arr	BB_Spain_Arr2
I0462	Arr	BB_Spain_Arr2
I4245	Yes	BB_Spain_Yes
I4247	Yes	BB_Spain_Yes
I4229	Mou	BB_Portugal_Mou
I0839	Alm	BB_Portugal_Alm
I0840	Alm	BB_Portugal_Alm
I1392	Heg	BB_France_Heg
I1388	Mar	BB_France_Mar
I1391	Rou	BB_France_HAR
I1390	Sie	BB_France_HAR
I1389	Sie	BB_France_HAR
I1381	Mon	BB_France_Mon
I1382	Mon	BB_France_Mon
I2575	Far	BB_France_AHP
I3874	Vil	BB_France_AHP
I3875	Vil	BB_France_AHP
I2478	Par	BB_Italy_Par
I1767	Ing	BB_England_NOR
I1765_d	Ing	BB_England_NOR
I1770	Sta	BB_England_NOR
I2612	Has	BB_England_NOR
I2453	Wes	BB_England_SOU
I2454	Ove	BB_England_SOU
I2455	Ove	BB_England_SOU
I2452	Wil	BB_England_SOU
I2443	Yar	BB_England_SOU
I2445	Yar	BB_England_SOU

I2446	Yar	BB_England_SOU
I2447	Yar	BB_England_SOU
I2450	Abi	BB_England_SOU
I2416	Ame	BB_England_SOU outlier
I2418	Ame	BB_England_SOU
I2459	Ame	BB_England_SOU
I2565	Ame	BB_England_SOU
I3255	Tru	BB_England_SOU
I3256	Tru	BB_England_SOU
I4067	Tui	BB_Netherlands_Tui
I4068	Tui	BB_Netherlands_Tui
I4069	Tui	BB_Netherlands_Tui
I4070	Tui	BB_Netherlands_Tui
I4071	Tui	BB_Netherlands_Tui
I4073	Tui	BB_Netherlands_Tui
I4074	Tui	BB_Netherlands_Tui
I4075	Tui	BB_Netherlands_Tui
I4076	Tui	BB_Netherlands_Tui
I2364	Bud	BB_Hungary_Bud1
I2365	Bud	BB_Hungary_HUN
I2741	Szi	BB_Hungary_Szi1
I2786	Szi	BB_Hungary_Szi2
I2787	Szi	BB_Hungary_Szi3
I4178	Szi	BB_Hungary_HUN
I3529	Lup	BB_Hungary_HUN
I3528	Lup	BB_Hungary_HUN
I4251	Sam	BB_Poland_Sam
I4252	Sam	BB_Poland_Sam
I4253	Sam	BB_Poland_Sam
I3604	Kun	BB_Germany_BAV
I3607	Kun	BB_Germany_BAV
I3601	Alb	BB_Germany_BAV
I3602	Alb	BB_Germany_BAV
I3600	Alb	BB_Germany_BAV
I3599	Alb	BB_Germany_BAV
I3588	Alb	BB_Germany_BAV
I3589	Alb	BB_Germany_BAV
I3590	Alb	BB_Germany_BAV
I3594	Alb	BB_Germany_BAV
I3592	Alb	BB_Germany_BAV
I3593	Alb	BB_Germany_BAV
I3597	Alb	BB_Germany_BAV
I4249	Irl	BB_Germany_BAV

I4250	Irl	BB_Germany_BAV
I4123	Man	BB_Germany_BAVm
E09537_d	AugU	BB_Germany_BAV
E09538	AugU	BB_Germany_BAV
E09569	AugU	BB_Germany_BAV
E09568_d	AugH	BB_Germany_BAV
E09613_d	AugH	BB_Germany_BAV
E09614_d	AugH	BB_Germany_BAV
I4124	AugA	BB_Germany_BAVm
I4132	AugA	BB_Germany_BAVm
RISE562.SG	Lan	BB_Germany_BAVm
I4144	Ost	BB_Germany_BAVm
RISE564.SG	Ost	BB_Germany_BAVm
I1549	Ben	BB_Germany_SAN
I1546	Ben	BB_Germany_SAN
I0806	QVII	BB_Germany_SAN
I0805	QVII	BB_Germany_SAN
I0113	QXII	BB_Germany_SAN
I0112	QXII	BB_Germany_SAN
I0060	Rot	BB_Germany_SAN
I0111	Rot	BB_Germany_SAN
I1530	Rot	BB_Germany_SAN
I0108	Rot	BB_Germany_SAN
I4145	Kne	BB_Czech_CBO
I4136	Kne	BB_Czech_CBO

Table S2. Z-scores of statistics of the form f_4 (Mbuti, Test, Pop1, Pop2). Negative values indicate that Test is closer to Pop1 than to Pop2, and the opposite for positive values. Significant values are highlighted (Z>3 in green, Z<-3 in red).

Test	f_4(Mbuti, Test; Iberia_Ch_MIR, BB_Spain_Arr2)	f_4(Mbuti, Test; Iberia_Ch_MIR, BB_Spain_Arr1)	f_4(Mbuti, Test; BB_France_Heg, BB_France_HAR)	f_4(Mbuti, Test; France_MLN, BB_France_Mar)	f_4(Mbuti, Test; France_MLN, BB_France_AHP)	f_4(Mbuti, Test; BB_Italy_Par, Remedello_CA)	f_4(Mbuti, Test; BB_Hungary_Szi1, BB_Hungary_Szi3)
AfontovaGora3	3.011	0.053	6.744	1.182	7.176	-3.053	6.799
Anatolia_Chalcolithic	-2.541	0.341	0.007	0.223	-2.643	-0.441	-2.214
Anatolia_Neolithic	-5.038	-0.452	-6.048	-2.034	-11.522	3.439	-10.585
Anatolia_Neolithic_Boncuklu	-2.045	0.439	-2.883	-1.363	-6.451	1.801	-5.143
Anatolia_Neolithic_Kumtepe	-0.340	0.995	-0.382	-0.468	-3.392	0.912	-3.236
Anatolia_Neolithic_Tep_Cif	-1.600	0.068	-2.538	-0.111	-6.323	2.809	-6.390
Armenia_Chalcolithic	-2.224	0.505	1.244	0.757	-1.399	-0.064	-1.327
Armenia_EBA	-0.513	-0.976	1.682	-0.491	-1.550	-0.725	-0.806
Armenia_MLBA	0.402	0.807	1.406	0.400	0.084	-1.917	1.039
Bichon	-1.938	2.247	0.145	1.081	-1.928	-0.358	-1.898
Germany_MN	-2.977	0.634	-3.370	-0.482	-6.846	2.067	-7.829
CHG	2.281	2.102	3.098	0.621	2.498	-2.023	4.127
Corded_Ware_Estonia.SG	-0.952	0.354	1.686	0.326	0.412	-0.618	1.240
Corded_Ware_Germany	1.358	0.132	5.461	2.208	3.766	-3.408	3.777
Corded_Ware_Germany.SG	2.178	2.068	3.200	-0.908	3.047	0.881	3.439
Corded_Ware_Poland.SG	0.509	0.523	0.922	-0.708	0.153	0.334	1.194
EHG	3.540	1.413	6.261	1.629	5.765	-4.609	8.210
ElMiron	-0.589	0.017	0.309	-0.705	-3.123	0.998	-1.799
England_EBA	-1.754	-1.954	5.323	0.064	0.600	-4.739	1.352
England_EMBA	-1.382	-0.828	1.546	0.190	0.507	-2.121	0.740
England_MBA	-1.867	-1.197	1.139	0.279	0.188	-1.727	-0.178
England_Neolithic	-4.517	-0.708	-3.198	-1.969	-7.192	1.714	-6.631
Globular_Amphora_LN	-3.989	-0.401	-2.301	-1.874	-7.597	1.035	-8.263
GoyetQ116-1	-0.207	-0.819	1.438	-0.338	-0.890	-2.180	-0.140
Greece_Early_Neolithic	-1.235	1.729	-4.487	0.748	-5.668	4.519	-5.694
Greece_Final_Neolithic	-1.998	1.412	-4.787	-1.498	-6.249	3.160	-5.947
Greece_Late_Neolithic	-2.191	1.416	-3.540	-2.233	-5.145	5.645	-6.893
Alberstedt_LN	1.490	0.264	-0.256	0.142	-0.276	0.125	0.102
BattleAxe_Sweden.SG	-1.723	-0.634	3.248	0.453	1.116	-1.030	1.226
BenzigerodeHeimburg_LN	0.221	-0.193	2.991	1.243	-0.712	-2.879	-0.119
Germany_Bronze_Age.SG	-0.572	0.092	-0.520	0.554	-0.538	0.485	-3.774
Halberstadt_LBA	0.485	0.306	1.061	0.458	0.669	-1.675	-1.359
Karsdorf_LN	0.900	0.598	2.464	-0.410	2.696	-1.322	1.632
Nordic_BA.SG	-1.258	0.556	0.557	0.063	-1.378	0.888	0.048
Nordic_LBA.SG	-0.086	0.477	-0.276	1.676	-1.787	-1.729	-0.287
Nordic_LN.SG	-0.101	0.408	2.244	-0.125	-0.299	-0.899	1.832
Nordic_MN_B.SG	0.839	1.711	2.635	0.429	1.795	1.450	2.497
Starounetice_EBA.SG	0.149	-0.841	1.759	1.777	-0.094	0.713	-0.091
Unetice_EBA	-0.112	0.565	3.975	0.130	0.795	-2.292	1.653
Unetice_EBA.SG	0.343	0.916	3.379	1.235	0.764	-0.997	2.357
Hungary_BA	-3.436	1.471	0.867	0.509	-2.742	-0.875	-2.299
Hungary_CA	-3.955	-1.668	-3.439	-0.471	-5.276	2.017	-6.150
Hungary_EN	-6.034	-1.774	-4.549	-1.676	-9.486	1.449	-10.501
Hungary_LCA	-5.550	-0.078	-4.586	-2.051	-9.845	2.262	-9.802
France_MLN	-6.267	-2.057	-4.011	-	-	1.945	-8.502
Iberia_Bronze_Age.SG	0.641	1.410	-1.582	-1.894	-2.927	0.610	-3.858
Iberia_Chalcolithic_ALA	-7.150	-1.577	-4.562	-2.618	-11.287	1.982	-9.482
Iberia_Chalcolithic_MIR	-	-	-4.479	-3.315	-11.460	1.280	-10.556
Iberia_Chalcolithic_MUR	-3.292	0.511	-3.432	0.270	-3.843	1.262	-4.064
Iberia_Chalcolithic_POR	-3.621	1.927	-3.533	-2.457	-8.470	5.619	-8.469
Iberia_EN	-5.016	-0.710	-4.506	-2.314	-11.363	3.377	-10.063
Iberia_EN.SG	-4.806	-0.277	-3.410	-0.522	-6.073	3.586	-8.658
Iberia_MN	-6.400	-0.056	-4.413	-3.746	-10.647	2.772	-10.287

Iran_Chalcolithic	-2.741	0.148	1.399	0.337	-1.590	-1.023	-0.743
Iran_IA	1.339	1.755	-0.747	0.772	-1.518	0.525	-0.324
Iran_Late_Neolithic	-0.113	-0.343	0.546	0.705	0.282	-2.002	1.400
Iran_Mesolithic	-0.723	0.598	2.207	-0.463	1.174	0.015	1.356
Iran_N	1.952	0.960	2.639	1.609	2.402	-1.155	3.518
Ireland_BA.SG	1.954	1.002	3.447	0.937	0.915	0.534	2.685
Ireland_MN.SG	-3.401	0.819	-3.283	-1.054	-5.418	2.996	-7.291
Israel_Natufian	-3.801	-1.268	-0.675	-1.184	-6.461	1.360	-5.272
Kostenki14	0.907	1.223	2.252	-0.905	-1.868	-1.995	-0.195
LBK_EN	-5.069	-0.571	-5.581	-1.576	-10.519	3.842	-11.080
Levant_BA	-3.449	-1.013	-1.526	-1.243	-5.450	-0.106	-4.008
Levant_N	-4.634	-1.883	-3.754	-0.960	-9.027	1.086	-5.511
MA1	0.783	0.429	4.935	0.540	4.924	-4.054	5.065
TRB_Sweden_MN	-1.510	-0.477	-3.961	0.305	-5.824	2.002	-6.375
mota	0.710	1.505	1.755	-0.745	-2.437	0.885	-0.564
Remedello_CA	-2.234	1.320	-1.696	-0.922	-7.586	-	-7.655
Russia_EBA	2.804	1.967	4.139	0.642	2.551	-0.839	5.056
Samara_Eneolithic	2.990	1.679	6.458	3.264	6.603	-3.234	7.290
Scotland_EBA	-1.901	-1.618	2.551	-0.048	0.875	-3.263	1.051
Scotland_MBA	-2.060	-0.666	4.046	2.012	0.950	-3.102	1.125
Scotland_Neolithic	-6.644	-2.311	-4.612	-2.501	-11.560	1.559	-11.194
SHG	0.236	1.959	5.003	1.174	2.385	-1.715	3.247
Ust_Ishim	-1.149	0.500	2.735	-0.677	-0.760	-0.631	1.248
Vestonice16	-0.765	-1.524	0.920	-0.277	-0.602	-2.186	0.457
Villabruna	-1.570	0.412	0.694	-1.090	-2.606	-0.902	-2.227
Wales_BA	-1.011	-1.659	3.381	-0.645	-0.936	-1.929	1.572
WHG	-2.670	1.411	1.914	-0.858	-1.323	-1.058	-1.837
Yamnaya_Kalmykia.SG	3.179	1.400	6.243	2.403	6.580	-2.618	10.079
Yamnaya_Samara	2.830	1.350	8.197	3.974	7.745	-3.904	9.981
BB_Czech_CBO	-1.879	-1.467	1.124	1.097	-1.223	-1.626	-0.244
BB_England_NOR	-2.558	-1.320	2.819	1.012	0.854	-2.710	-0.376
BB_England_SOUout	-1.949	-0.411	1.435	-1.566	-2.005	-0.192	-2.173
BB_England_SOU	-0.353	-0.095	4.635	1.039	1.879	-4.293	2.614
BB_France_AHP	-0.223	0.105	3.729	1.007	-	-2.580	-0.721
BB_France_Heg	-4.488	-1.465	-	-1.948	-7.816	-0.047	-5.328
BB_France_Mar	-2.681	-0.700	-1.191	-	-3.525	-0.669	-3.083
BB_France_Mon	-0.098	-0.452	2.713	1.638	1.399	-2.554	2.542
BB_France_HAR	-0.155	0.733	-	0.771	1.561	-2.225	2.092
BB_Germany_BAV	-3.004	-1.418	2.198	0.384	-1.006	-3.422	0.472
BB_Germany_BAVm	0.086	0.067	1.492	2.856	1.580	-0.825	0.856
BB_Germany_SAN	-1.307	1.717	3.383	0.288	-0.137	-1.846	0.785
BB_Hungary_Szi1	-4.071	-1.770	-3.493	-2.143	-7.657	0.844	-
BB_Hungary_Bud1	-1.337	0.589	-1.829	-1.167	-3.647	2.144	-4.314
BB_Hungary_HUN	-0.568	1.428	1.270	-0.702	-1.103	-1.391	-0.832
BB_Hungary_Szi2	0.440	0.493	3.145	0.272	1.784	-0.970	2.508
BB_Hungary_Szi3	1.761	-0.599	3.683	1.321	1.532	-4.379	-
BB_Italy_Par	-2.660	0.428	0.249	-0.028	-1.667	-	-2.747
BB_Netherlands_Tui	-1.650	-0.949	4.111	1.253	1.374	-3.872	3.353
BB_Poland_Sam	-0.325	0.752	1.209	0.403	1.235	-0.559	1.772
BB_Portugal_Alm	-3.295	-0.850	-1.304	-2.282	-5.613	0.990	-2.576
BB_Portugal_Mou	-4.211	-0.597	-1.037	-1.670	-7.267	0.789	-4.544
BB_Spain_Arr1	-3.325	-	-1.024	-0.589	-5.765	0.715	-7.101
BB_Spain_Arr2	-	0.452	1.419	-1.228	-2.070	0.886	-2.835
BB_Spain_Cer	-3.939	0.894	-2.031	-1.429	-7.908	1.822	-6.978
BB_Spain_Yes	-2.176	-0.383	-3.430	-1.355	-5.787	1.081	-3.065

Table S3. *f*-statistics of the form f_4(Mbuti, Test; EN1, EN2). "EN" refers to Early Neolithic populations.

	EN1-EN2 Iberia_EN-LBK_EN		EN1-EN2 LBK_EN-Hungary_EN		EN1-EN2 Iberia_EN-Hungary_EN	
Test	f_4	**Z**	f_4	**Z**	f_4	**Z**
Iberia_MN	-0.001438	-6.54	0.000124	0.758	-0.001358	-5.645
Iberia_Chalcolithic_POR	-0.000832	-3.755	-0.000475	-2.909	-0.001309	-5.59
Iberia_Chalcolithic_MIR	-0.001057	-5.664	0.000137	0.913	-0.000899	-4.389
Iberia_Chalcolithic_MUR	-0.001405	-3.162	0.000232	0.716	-0.001076	-2.129
Iberia_Chalcolithic_ALA	-0.001202	-6.057	0.000669	4.487	-0.000531	-2.503
France_MLN	-0.001077	-4.426	0.00058	3.317	-0.000514	-1.999
Globular_Amphora_LN	-0.000103	-0.441	0.000473	2.886	0.000323	1.301
Germany_MN	-0.000102	-0.427	-0.000186	-1.049	-0.000255	-1.023
Hungary_LCA	0.000353	1.898	0.000306	2.103	0.000625	3.153
TRB_Sweden_MN	-0.000021	-0.074	-0.000145	-0.729	-0.000146	-0.488
England_Neolithic	-0.00079	-3.014	0.000061	0.313	-0.000707	-2.615
Ireland_MN.SG	-0.000557	-1.82	-0.000565	-2.728	-0.001137	-3.638
Scotland_Neolithic	-0.000841	-4.916	0.000792	5.807	-0.000116	-0.627
BB_France_Heg	-0.00005	-0.166	0.000157	0.766	0.000138	0.458
BB_Hungary_Szi1	-0.000059	-0.194	0.000315	1.471	0.000298	0.929
BB_Portugal_Mou	-0.000907	-3.249	0.000286	1.36	-0.000686	-2.247
BB_Portugal_Alm	-0.000986	-2.324	0.000394	1.321	-0.000691	-1.497
BB_Spain_Yes	-0.001448	-3.597	0.000002	0.007	-0.001486	-3.68
BB_Spain_Cer	-0.000982	-3.77	0.000416	2.216	-0.000657	-2.38
BB_Spain_Arr1	-0.000928	-3.495	-0.000187	-0.957	-0.001104	-3.943

Table S4. Modelling populations as a mixture of Yamnaya_Samara, Anatolia_Neolithic and WHG. Table shows mixture proportions for each source population with standard errors, and P-values for the associated model.

	Mixture proportions						
Test	**Yamnaya Samara**	**SE**	**Anatolia Neolithic**	**SE**	**WHG**	**SE**	**P-value**
BB_Spain_Cer			0.748	0.017	0.252	0.017	0.548
BB_Spain_Arr1			0.730	0.021	0.270	0.021	0.400
BB_Spain_Arr2	0.178	0.055	0.627	0.056	0.194	0.025	0.013
BB_Spain_Yes			0.794	0.029	0.206	0.029	0.541
BB_Portugal_Mou			0.805	0.024	0.195	0.024	0.611
BB_Portugal_Alm			0.752	0.031	0.248	0.031	0.236
BB_France_Heg			0.808	0.025	0.192	0.025	0.449
BB_France_Mar	0.173	0.063	0.617	0.061	0.211	0.027	0.994
BB_France_HAR	0.489	0.055	0.359	0.054	0.153	0.024	0.250
BB_France_AHP	0.509	0.043	0.295	0.041	0.195	0.018	0.552
BB_France_Mon	0.513	0.046	0.346	0.045	0.141	0.02	0.733
BB_Italy_Par	0.301	0.057	0.566	0.058	0.133	0.026	0.109
BB_England_NOR	0.428	0.043	0.389	0.042	0.184	0.019	0.356
BB_England_SOU	0.561	0.024	0.270	0.023	0.169	0.011	0.815
BB_England_SOU outlier	0.307	0.085	0.477	0.086	0.216	0.037	0.996
BB_Netherlands_Tui	0.557	0.027	0.255	0.026	0.188	0.012	0.259
BB_Hungary_Szi1			0.784	0.024	0.216	0.024	0.348
BB_Hungary_Bud1	0.157	0.056	0.689	0.057	0.154	0.024	0.170
BB_Hungary_HUN	0.449	0.035	0.385	0.033	0.166	0.016	0.478
BB_Hungary_Szi2	0.565	0.059	0.322	0.059	0.114	0.024	0.631
BB_Hungary_Szi3	0.743	0.058	0.211	0.058	0.047	0.024	0.094
BB_Poland_Sam	0.462	0.062	0.383	0.06	0.155	0.024	0.071
BB_Germany_BAV	0.421	0.027	0.431	0.026	0.148	0.011	0.830
BB_Germany_BAVm	0.431	0.04	0.453	0.039	0.116	0.016	0.010
BB_Germany_SAN	0.481	0.027	0.358	0.028	0.161	0.012	0.661
BB_Czech_CBO	0.467	0.054	0.391	0.053	0.143	0.023	0.890
England_Neolithic			0.747	0.021	0.253	0.021	0.011
Scotland_Neolithic			0.705	0.009	0.295	0.009	0.591
England_EBA	0.525	0.029	0.314	0.028	0.161	0.012	0.065
England_EMBA	0.470	0.065	0.397	0.062	0.133	0.026	0.209
England_MBA	0.510	0.058	0.323	0.055	0.167	0.027	0.473
Scotland_EBA	0.465	0.037	0.327	0.037	0.209	0.017	0.710
Scotland_MBA	0.516	0.034	0.314	0.034	0.170	0.014	0.270
Wales_BA	0.490	0.058	0.358	0.057	0.151	0.023	0.464
France_MLN			0.709	0.019	0.291	0.019	0.206
Iberia_Chalcolithic_MUR			0.742	0.032	0.258	0.032	0.469
Previously published							
Iberia_Chalcolithic_MIR			0.727	0.012	0.273	0.012	0.280
Iberia_Chalcolithic_POR			0.780	0.014	0.220	0.014	0.602
Iberia_Chalcolithic_ALA			0.669	0.012	0.331	0.012	0.331
Globular_Amphora_LN			0.730	0.016	0.270	0.016	0.188
Iberia_MN			0.752	0.015	0.248	0.015	0.433
Germany_MN			0.807	0.018	0.193	0.018	0.544
TRB_Sweden_MN			0.755	0.023	0.245	0.023	0.318
Hungary_LCA			0.844	0.009	0.156	0.009	0.611
Ireland_MN.SG			0.787	0.025	0.213	0.025	0.360
Corded_Ware_Germany	0.707	0.031	0.181	0.031	0.112	0.014	0.516

Table S5. Mixture proportions for the model Anatolia_Neolithic + LaBrañá1 + KO1.

		Mixture proportions					
Test	**P-value**	**Anatolia Neolithic**	**SE**	**LaBrañá1**	**SE**	**KO1**	**SE**
Iberia_EN	3.91E-01	0.882	0.017	0.133	0.048	-0.015	0.047
Iberia_MN	9.17E-01	0.686	0.017	0.319	0.048	-0.005	0.048
Iberia_Chalcolithic_ALA	9.92E-02	0.618	0.013	0.219	0.041	0.163	0.041
Iberia_Chalcolithic_MIR	5.83E-01	0.681	0.012	0.190	0.035	0.130	0.035
LBK_EN	3.95E-02	0.944	0.009	-0.004	0.027	0.059	0.027
Germany_MN	2.19E-01	0.790	0.019	0.024	0.055	0.186	0.055
Globular_Amphora_LN	1.77E-01	0.707	0.018	0.036	0.047	0.257	0.045
Hungary_LCA	4.07E-01	0.833	0.01	-0.004	0.028	0.171	0.028
TRB_Sweden_MN	6.52E-01	0.731	0.025	-0.012	0.075	0.281	0.072
Britain_Neolithic	7.12E-01	0.673	0.01	0.104	0.025	0.223	0.025
France_MLN	2.31E-01	0.666	0.02	0.166	0.057	0.168	0.057

Table S6. Mixture proportions for the model Anatolia_Neolithic + LaBrañá1 + Loschbour.

		Mixture proportions					
Test	**P-value**	**Anatolia Neolithic**	**SE**	**LaBrañá1**	**SE**	**Loschbour**	**SE**
Iberia_EN	4.85E-01	0.870	0.021	0.178	0.071	-0.048	0.056
Iberia_MN	9.34E-01	0.680	0.021	0.345	0.071	-0.025	0.056
Iberia_Chalcolithic_ALA	5.36E-01	0.676	0.016	0.100	0.057	0.224	0.046
Iberia_Chalcolithic_MIR	2.58E-01	0.714	0.014	0.155	0.051	0.131	0.041
LBK_EN	2.23E-02	0.960	0.011	-0.013	0.037	0.054	0.03
Germany_MN	2.71E-01	0.843	0.024	-0.052	0.086	0.208	0.069
Globular_Amphora_LN	2.01E-01	0.795	0.024	-0.096	0.078	0.301	0.06
Hungary_LCA	1.90E-01	0.883	0.013	-0.061	0.045	0.179	0.036
TRB_Sweden_MN	3.12E-01	0.816	0.036	-0.104	0.119	0.288	0.092
Britain_Neolithic	3.18E-01	0.735	0.01	0.021	0.037	0.244	0.031
France_MLN	3.06E-01	0.724	0.026	0.069	0.092	0.207	0.073

Table S7. Modelling Beaker Complex (BC) populations as a mixture of Yamnaya_Samara and different Neolithic/Copper Age populations. P-values > 0.05 are highlighted.

			Mixture proportions		
Test	**Neolithic source**	**P-value**	**Yamnaya Samara**	**Neolithic source**	**SE**
BC Iberia combined	Iberia_MN	1.99E-01	0.120	0.880	0.016
	Iberia_Chalcolithic_MIR	2.50E-01	0.100	0.900	0.014
	Iberia_Chalcolithic_ALA	1.49E-05	0.133	0.867	0.014
	Germany_MN	1.25E-08	0.122	0.878	0.02
	Globular_Amphora_LN	3.00E-06	0.090	0.910	0.016
	Hungary_LCA	2.39E-41	0.187	0.813	0.014
	TRB_Sweden_MN	4.69E-03	0.062	0.938	0.022
	France_MLN	1.42E-03	0.127	0.873	0.017
BC outside Iberia combined	Iberia_MN	5.36E-13	0.481	0.519	0.011
	Iberia_Chalcolithic_MIR	3.18E-08	0.477	0.523	0.01
	Iberia_Chalcolithic_ALA	7.24E-09	0.487	0.513	0.009
	Germany_MN	2.29E-12	0.483	0.517	0.013
	Globular_Amphora_LN	1.40E-01	0.434	0.566	0.01
	Hungary_LCA	3.70E-39	0.538	0.462	0.009
	TRB_Sweden_MN	2.88E-01	0.422	0.578	0.015
	France_MLN	1.46E-04	0.475	0.525	0.012

Table S8. Modelling Beaker Complex (BC) populations as a mixture of Yamnaya_Samara, KO1 and different Neolithic/Copper Age populations. P-values > 0.05 are highlighted.

			Mixture proportions					
Test	**Neolithic source**	**P-value**	**Yamnaya Samara**	**SE**	**Neolithic source**	**SE**	**KO1**	**SE**
BC Iberia combined	Iberia_MN	1.47E-01	0.118	0.017	0.876	0.02	0.005	0.018
	Iberia_Chalcolithic_MIR	3.19E-01	0.107	0.015	0.915	0.018	-0.023	0.016
	Iberia_Chalcolithic_ALA	7.71E-02	0.160	0.015	0.925	0.019	-0.085	0.018
	Germany_MN	7.47E-05	0.086	0.021	0.824	0.022	0.090	0.018
	Globular_Amphora_LN	1.47E-06	0.093	0.017	0.916	0.02	-0.009	0.018
	Hungary_LCA	2.71E-17	0.106	0.015	0.744	0.015	0.150	0.015
	TRB_Sweden_MN	2.65E-03	0.061	0.023	0.935	0.028	0.004	0.023
	France_MLN	7.49E-04	0.127	0.019	0.873	0.023	-0.001	0.022
BC outside Iberia combined	Iberia_MN	5.66E-13	0.472	0.012	0.510	0.012	0.018	0.011
	Iberia_Chalcolithic_MIR	1.82E-08	0.473	0.011	0.519	0.011	0.008	0.009
	Iberia_Chalcolithic_ALA	1.55E-07	0.498	0.01	0.532	0.012	-0.030	0.011
	Germany_MN	9.42E-02	0.445	0.012	0.469	0.012	0.085	0.01
	Globular_Amphora_LN	1.90E-01	0.429	0.011	0.555	0.012	0.015	0.01
	Hungary_LCA	1.66E-01	0.459	0.009	0.433	0.008	0.108	0.007
	TRB_Sweden_MN	6.10E-01	0.412	0.015	0.558	0.016	0.030	0.013
	France_MLN	3.69E-04	0.465	0.012	0.510	0.013	0.026	0.013

Table S9. Modelling Beaker Complex (BC) and Bronze Age individuals from Britain as a mixture of BB_Netherlands_Tui and Britain_Neolithic.

			Mixture proportions			
Individual	**Population**	**P-value**	**BB_Netherlands Tui**	**Britain Neolithic**	**SE**	**SNPs covered**
I2416	BB_England_SOUout	9.99E-01	0.617	0.383	0.052	136956
I2418	BB_England_SOU	5.55E-01	1.033	-0.033	0.039	656573
I2443	BB_England_SOU	1.93E-01	1.023	-0.023	0.042	806658
I2445	BB_England_SOU	5.72E-01	0.921	0.079	0.04	854563
I2446	BB_England_SOU	1.50E-01	0.925	0.075	0.064	83832
I2447	BB_England_SOU	9.14E-01	1.010	-0.010	0.039	702581
I2450	BB_England_SOU	6.67E-01	1.065	-0.065	0.041	734749
I2452	BB_England_SOU	7.86E-01	0.967	0.033	0.039	913255
I2453	BB_England_SOU	2.96E-01	1.028	-0.028	0.042	610725
I2454	BB_England_SOU	7.28E-01	1.059	-0.059	0.041	818929
I2455	BB_England_SOU	8.01E-01	1.060	-0.060	0.058	120698
I3255	BB_England_SOU	9.25E-01	1.021	-0.021	0.042	861509
I3256	BB_England_SOU	5.22E-01	0.977	0.023	0.041	843389
I2459	BB_England_SOU	8.62E-01	1.110	-0.110	0.043	519046
I2565	BB_England_SOU	5.42E-01	1.084	-0.084	0.144	14794
I1765_d	BB_England_NOR	8.40E-01	1.018	-0.018	0.141	13484
I1767	BB_England_NOR	7.27E-01	0.757	0.243	0.04	729987
I1770	BB_England_NOR	5.43E-01	0.908	0.092	0.041	483474
I2612	BB_England_NOR	4.74E-01	0.969	0.031	0.074	55173
I2421	England_EBA	5.25E-01	0.919	0.081	0.041	393274
I2457	England_EBA	9.18E-01	0.995	0.005	0.043	718630
I2460	England_EBA	7.31E-01	1.206	-0.206	0.112	23341
I2463	England_EBA	6.17E-01	0.955	0.045	0.046	234559
I2464	England_EBA	3.76E-01	0.983	0.017	0.08	52649
I2566	England_EBA	3.96E-01	1.002	-0.002	0.044	485091
I2596	England_EBA	2.76E-01	1.033	-0.033	0.046	354928
I2598	England_EBA	8.16E-01	1.002	-0.002	0.061	85900
I2601	England_EBA	3.43E-01	0.861	0.139	0.045	296184
I2602	England_EBA	9.25E-01	0.901	0.099	0.044	419770
I2609	England_EBA	4.85E-01	0.959	0.041	0.046	273312
I2610	England_EBA	8.81E-01	0.882	0.118	0.066	78777
I2618	England_EBA	2.16E-01	0.956	0.044	0.043	643010
I2567	Scotland_EBA	1.01E-01	0.967	0.033	0.041	589224
I2568	Scotland_EBA	4.75E-02	0.809	0.191	0.041	570382
I2569	Scotland_EBA	6.96E-01	0.937	0.063	0.098	23665
I2981	Scotland_EBA	1.17E-03	0.906	0.094	0.042	788384
I2639	England_EMBA	4.89E-01	0.953	0.047	0.041	579584
I3082	England_MBA	4.25E-01	0.847	0.153	0.038	582197
I2574	Wales_BA	5.58E-01	0.906	0.094	0.065	77807
I1775	Wales_BA	5.71E-01	0.886	0.114	0.042	410642
I2573	Scotland_MBA	4.42E-02	0.943	0.057	0.041	611500
I2653	Scotland_MBA	5.41E-01	0.926	0.074	0.041	574585
I2654	Scotland_MBA	2.02E-01	1.031	-0.031	0.043	518165
I2655	Scotland_MBA	4.67E-01	0.849	0.151	0.041	835188
	BC and EBA combined	4.58E-01	0.972	0.028	0.017	
	MBA combined	3.61E-01	0.931	0.069	0.02	

References

1. Bronk Ramsey, C. Bayesian Analysis of Radiocarbon Dates. *Radiocarbon* **51,** 337–360 (2009).
2. Reimer, P. J. *et al.* Intcal13 and marine13 radiocarbon age calibration curves 0 – 50,000 years cal bp. *Radiocarbon* **55,** 1869–1887 (2013).
3. Allentoft, M. E. *et al.* Population genomics of Bronze Age Eurasia. *Nature* **522,** 167–172 (2015).
4. Zilhão, J. *O Paleolítico Superior da Estremadura portuguesa*. (Colibri, 1997).
5. Zilhão, J. From the Mesolithic to the Neolithic in the Iberian peninsula. In *Europe's First Farmers* 144–182 (Cambridge University Press, 2000). doi:10.1017/CBO9780511607851.007
6. Zilhão, J. The Early Neolithic artifact assemblage from the Galeria da Cisterna (Almonda karstic system, Torres Novas, Portugal). In *De Méditerranée et d'ailleurs. Mélanges offerts à Jean Guilaine* 821–835 (Archives d'Écologie Préhistorique, 2009).
7. Martins, H. *et al.* Radiocarbon dating the beginning of the Neolithic in Iberia: new results, new problems. *J. Mediterr. Archaeol.* **28,** 105–131 (2015).
8. Zilhão, J. Beaker People without Beaker Pots: the Chalcolithic Funerary Context from the Galeria da Cisterna (Almonda Karst System, Torres Novas, Portugal). In *Del neolític a l'edat del bronze en el Mediterrani occidental. Estudis en homenatge a Bernat Martí Oliver. Serie de Trabajos Varios 119, València, Servicio de Investigación Prehistórica* 379–386 (2016).
9. Belo, A. R., Trindade, L. & Veiga Ferreira, O. Gruta da Cova da Moura (Torres Vedras). In *Comunicações dos Serviços Geológicos de Portugal, XLV* 391 – 418 (1961).
10. Gallay, G. & Spindler, K. Archaeologische und Anthropologische

Betrachtungen zu den Neolithisch-Kupferzeitlichen Funden aus der Cova da Moura /Portugal. *Madrider Mitteilungen* **11,** 35 – 58 (1970).

11. Spindler, K. Cova da Moura. In *Madrider Beitraege 7. Deutsches Archaeologisches Institut, Madrid. Mainz am Rhein, Verlag Philipp von Zabern* (1981).
12. Silva, A. M. Antropologia Funerária e Paleopbiologia das populações Portuguesas (litorais) do Neolítico Final/Calcolítico. (Coimbra, Universidade de Coimbra, 2002).
13. Irish, J., Lillios, K., Waterman, A. & Silva, A. M. 'Other possibilities'? Assesing regional and extra-regional dental affinities of populations in the Portuguese Estremadura to explore the roots of Iberia's Late Neolithic-Copper Age. *J. Archaeol. Sci. reports* **11,** 224 – 236 (2017).
14. Silva, A. M. Portuguese Populations of the Late Neolithic and Chalcolithic Periods exhumed from Collective burials: an overview. *Anthropologie* **XLI/1-2,** 55–64 (2003).
15. Thomas, J. T. Fashioning identities, forging inequalities: Late Neolithic/Copper Age personal ornaments of the Portuguese Extremadura. *Eur. J. Archaeol.* **14,** 29–59 (2011).
16. Waterman, A., Tykot, R. & Silva, A. M. Stable Isotope Analysis of diet-based social differentiation at Late Prehistoric Collective burials in southwestwern Portugal. *Archaeometry* **58,** 131 – 151 (2016).
17. Waterman, A., Peate, D. W., Silva, A. M. & Thomas, J. T. In search of homelands: using strontium isotopes to identify biological markers of mobility in Late Prehistoric Portugal. *J. Archaeol. Sci.* **42,** 119–127 (2014).
18. Francès, J., Guàrdia, M., Majó, T. & Sala, Ò. L'hipogeu calcolític del carrer de París Cerdanyola del Vallès. *Trib. d'Arqueologia* 315–333 (2007).

19. Carmona Ballestero, E. & Arnaiz Alonso, M. Stratigraphic events and 'Cycles of use' in the dolmen of Arroyal I. In *Biografías Megalíticas. Proceeddings of XVII World UISPP Congress* (eds. Rojo Guerra, M. & Tejedor-Rodríguez, C.) (2015).
20. Liesau, C., Blasco, C., Ríos, P. & Vega, J. Un espacio compartido por vivos y muertos: El poblado calcolítico de fosos de Camino de las Yeseras (San Fernando de Henares, Madrid). *Complutum* **19,** 97–120 (2008).
21. Blasco, C., Liesau, C. & Ríos, P. *Yacimientos calcolíticos con campaniforme de la región de Madrid: Nuevos estudios*. (Patrimonio Arqueológico de Madrid, 6. Universidad Autónoma de Madrid, 2011).
22. Lomba Maurandi, J., López Martínez, M., Ramos Martínez, F. & Avilés Fernández, A. El enterramiento múltiple , calcolítico , de Camino del Molino (Caravaca , Murcia). Metodología y primeros resultados de un yacimiento excepcional. *Trab. Prehist.* 143–159 (2009). doi:10.3989/tp.2009.09025
23. Billoin, D. Le Néolithique final : la sépulture campaniforme d'Hégenheim. In *10000 ans d'histoire ! Dix ans de fouilles archéologiques en Alsace* 31–42 (Musées de la ville de Strasbourg, 2009).
24. Billoin, D., Jeunesse, C., Denaire, A. & Thiol, S. Une nouvelle sépulture campaniforme à Hégenheim (F-Haut-Rhin). In *Du Néolithique final au Bronze ancien dans le Nord-Est de la France. Actualité de la recherche* 31–42 (APRAA, 2010).
25. Lefranc, P., Denaire, A. & Chenal, F. Une sépulture tardive du Campaniforme régional à Rouffach « Rue de Pfaffenheim » (Haut-Rhin). *Rev. Archéologique l'Est* **65,** 269–278 (2016).
26. Vergnaud, L. The Bell Beaker funeral group from Sierentz « les

Villas d'Aurèle » (Haut-Rhin, France). In *Current researches on Bell Beakers. Proceedings of the 15th International Bell Beaker Conference: From Atlantic to Ural (5th-9th May 2011, Poio, Spain)* 51–59 (Galician ArcheoPots, 2013).

27. Vergnaud, L. Les sépultures campaniformes de Sierentz « Les Villas d'Aurèle » (Haut-Rhin). In *Données récentes sur les pratiques funéraires néolithiques de la plaine du Rhin supérieur* 173–210 (Archaeopress, 2014).
28. Lefebvre, A., Gazenbeek, M. & Pernot, P. Les sépultures campaniformes du site de Mondelange « La Sente » (Moselle). Résultats préliminaires. *Internéo* **7,** 187–201 (2008).
29. Lefebvre, A. Les sépultures du Néolithique final / bronze ancien en Lorraine: vers l'émergence de nouvelles problématiques. In *Du Néolithique final au Bronze ancien dans le Nord-Est de la France. Actualité de la recherche* 103–118 (APRAA, 2010).
30. Serralongue, J. & Rey, P.-J. La sépulture campaniforme de Marlens, Sur les Barmes. *La Rev. Savoisienne* **145e année,** 41–46 (2005).
31. Lemercier, O. *et al.* La sépulture individuelle campaniforme de La Fare (Forcalquier, Alpes-de-Haute-Provence). In *Les sépultures individuelles campaniformes en France* (eds. Salanova, L. & Tcheremissinoff, Y.) 145–199 (Paris: CNRS, 2011, 2011).
32. Sauzade, G. Caractérisation chronoculturelle du mobilier funéraire en Provence au Néolithique final et au Bronze ancien. Evolution des rites funéraires liés à l'inhumation individuelle ou collective et distribution chronologique des sépultures. *Préhistoires Méditerranéennes* **2,** 71–103 (2011).
33. Schmitt, A. & Bizot, B. Retour d'expériences sur l'étude de trois assemblages osseux issus de sépultures collectives néolithiques. *Bull. Mémoires la Société d'anthropologie Paris* **28,** 190–201 (2016).

34. Remicourt, M. *et al.* Les occupations pré- et protohistoriques du Clos de Roque à Saint-Maximin-la-Sainte-Baume dans le Var. In *Chronologie de la Préhistoire récente dans le Sud de la France – Actualité de la recherche. Toulouse : Archives d'Ecologie Préhistorique* 523–548 (2014).
35. Schmitt, A. & Bizot, B. Les inhumations du site du Clos de Roque (Saint-Maximin-la-Sainte-Baume) : de nouvelles données sur les traditions funéraires du début du Néolithique moyen dans le midi de la France. *Bull. archéologiques Provence* (2017).
36. Bernabò-Brea, M. & Mazzieri, P. Nuovi dati sul campaniforme in Emilia. In *L'Età del Rame. La pianura padana e le Alpi al tempo di Ötzi* 503–524 (Compagnia della Stampa, 2013).
37. Van Giffen, A. . Settlement traces of the Early Bell Beaker Culture at Oostwoud (N.H.). *Helinium* **1,** 233–228 (1961).
38. Fokkens, H., Veselka, B., Bourgeois, Q., Olalde, I. & Reich, D. Excavations of Late Neolithic arable burial mounds and a number of well-preserved skeletons at Oostwoud-Tuithoorn; a re-analysis of old data. *Analecta Praehist. Leiden.* **47,** (2017).
39. Lanting, J. & van der Plicht, J. De 14C-chronologie van de Nederlandse pre- en protohistorie IV: bronstijd en vroege ijzertijd. *Palaeohistoria* **43–44,** 117–262 (2002).
40. Stockhammer, P. W. *et al.* Rewriting the central european early bronze age chronology: Evidence from large-Scale radiocarbon dating. *PLoS One* **10,** 1–32 (2015).
41. Heyd, V. Die Spätkupferzeit in Süddeutschland. *Saarbrücker Beiträge zur Altertumskd. 72. Bonn Habelt* **2,** 68 (2000).
42. Turek, J. & Cerný, V. Society, gender and sexual dimorphism of the Corded Ware and Bell Beaker populations. In *Bell Beakers Today. Pottery, people, culture, symbols in prehistoric Europe* (ed. Nicolis,

F.) 601–612 (Proceedings of the International Colloquium Riva del Garda (Trento, Italy), 11–16 May 1998 (Trento), 2001).

43. Heyd, V. Die Spätkupferzeit in Süddeutschland. *Saarbrücker Beiträge zur Altertumskd. 72. Bonn Habelt* **2,** 64–65 (2000).
44. Bertemes, F. & Heyd, V. 2200 BC – Innovation or Evolution: Genesis of the Danubian Early Bronze Age. In *2200 BC – A climatic breakdown as a cause for the collapse of the old world?* (eds. Meller, H., Risch, R., Jung, R. & Arz, H. W.) 561–578 (7th Archaeological Conference of Central Germany, October 23–26, 2014 in Halle (Saale), 2015).
45. Heyd, V. Die Spätkupferzeit in Süddeutschland. *Saarbrücker Beiträge zur Altertumskd. 72. Bonn Habelt* **2,** 72–73 (2000).
46. Rieder, K. H. Ein Bestattungsplatz der Glockenbecherzeit aus Oberstimm, Gemeinde Manching, Landkreis Pfaffenhofen, Oberbayern. *Das Archäologische Jahr Bayern* 40–41 (1982).
47. Schwarz, M. Studien zur Sozialstruktur der Glockenbecherkultur im Bereich der Ostgruppe auf der Grundlage der Grabfunde. *Saarbrücker Beiträge zur Altertumskd.* **85,** 317 (2008).
48. Heyd, V. Die Spätkupferzeit in Süddeutschland. *Saarbrücker Beiträge zur Altertumskd. 72. Bonn Habelt* **122,** (2000).
49. Price, T. D., Knipper, C., Grupe, G. & Smrcka, V. Strontium Isotopes and Prehistoric Human Migration: The Bell Beaker Period in Central Europe. *Eur. J. Archaeol.* **7,** 9–40 (2004).
50. Grupe, G. *et al.* Mobility of Bell Beaker people revealed by strontium isotope ratios of tooth and bone: a study of southern Bavarian skeletal remains. *Appl. Geochemistry* **12,** 517–525 (1997).
51. Turner, W. On human and animal remains found in caves at Oban, Argyllshire. *Proc. Soc. Antiq. Scotl.* **29,** 411–438 (1895).
52. Canmore – The online catalogue to Scotland's archaeology,

buildings, industrial and maritime heritage www.canmore.org.uk.

53. Saville, A. & Hallén, Y. The ‘Obanian Iron Age’: human remains from the Oban cave sites, Argyll, Scotland. *Antiquity* **68,** 715–723 (1994).
54. Anderson, J. Notice of a cave recently discovered at Oban, containing human remains, and a refuse-heap of shells and bones of animals, and stone and bone implements. *Proc. Soc. Antiq. Scotl.* **29,** 211–230 (1895).
55. Dunwell, A. Cist burials and an Iron Age settlement at Dryburn Bridge, Innerwick, East Lothian. *Scottish Archaeol. Internet Reports* **24,** (2007).
56. Lelong, O. & MacGregor, G. The Lands of Ancient Lothian: Interpreting the Archaeology of the A1. *Edinburgh Soc. Antiq. Scotl.* (2007).
57. Baker, L. A Bronze Age burial ground at Longniddry, East Lothian. *Proc. Soc. Antiq. Scotl.* **133,** 125–136 (2003).
58. Sheridan, J. & Higham, T. The redating of some Scottish specimens by the Oxford Radiocarbon Accelerator Unit (ORAU). *Discov. Excav. Scotl.* **3,** 202–204 (2006).
59. Barrowman, R. & Innes, L. A Bronze Age Burial from Pabay Mor, Isle of Lewis., Western Isles. *Scottish Archaeol. Internet Reports* **24,** (2009).
60. Davidson, J. L. & Henshall, A. S. *The Chambered Cairns of Caithness*. (Edinburgh: Edinburgh University Press, 1989).
61. Childe, V. G. Re-excavation of the chambered cairn of Quoyness, Sanday, on behalf of the Ministry of Works in 1951–52. *Proc. Soc. Antiq. Scotl.* **86,** 121–39 (1952).
62. Armit, I. In prep. (2017).
63. Switsur, V. R. & Harkness, D. D. The radiocarbon dates. In

Investigations in Orkney (ed. Renfrew, C.) 70–72 (London: Society of Antiquaries of London, 1979).

64. Sheridan, J. A. *et al.* Radiocarbon dates associated with the Scottish History and Archaeology Department, National Museums Scotland, 2011/12. *Discov. Excav. Scotl.* **13,** 200–2 (2012).
65. Barber, J. *The Excavation of a Stalled Cairn at the Point of Cott, Westray, Orkney*. (Scottish Trust for Archaeological Research, 1997).
66. Griffiths, S. Beside the ocean of time: a chronology of Neolithic burial monuments and houses in Orkney. In *The Development of Neolithic House Societies in Orkney* (eds. Richards, C. & Jones, R.) 254–302 (Oxford: Windgather Press, 2016).
67. Martínková, N. *et al.* Divergent evolutionary processes associated with colonization of offshore islands. *Mol. Ecol.* **22,** 5205–5220 (2013).
68. Bayliss, A., Marshal, P., Richards, C. & Whittle, A. The Late Neolithic timescape of Orkney: islands of history. *Submitted*
69. Ritchie, P. R. A chambered cairn at Isbister, South Ronaldshay, Orkney. *Proc. Soc. Antiq. Scotl.* **92,** 25–32 (1959).
70. Hedges, J. W. An archaeodemographical perspective on Isbister. *Scottish Archaeol. Rev.* **1,** 5–20 (1982).
71. Hedges, J. W. *Isbister, a Chambered Tomb in Orkney*. (Oxford: British Archaeological Reports (British Series 115), 1983).
72. Hedges, J. W. *Tomb of the Eagles*. (John Murray, 1984).
73. Lawrence, D. M. Neolithic mortuary practice in Orkney. *Proc. Soc. Antiq. Scotl.* **136,** 47–60 (2006).
74. Lawrence, D. M. & Lee-Thorp, J. New radiocarbon dates from Isbister, Orkney. *Discov. Excav. Scotl.* **13,** 203–4 (2012).
75. Sheridan, J. A. The National Museums' of Scotland radiocarbon dating programmes: results obtained during 2004/5. *Discov. Excav.*

Scotl. **6,** 182–3 (2005).

76. Renfrew, A. ., Stenhouse, M. J. & Switsur, V. R. The radiocarbon determinations. In *Isbister, a Chambered Tomb in Orkney* 61–71 (Oxford: British Archaeological Reports (British Series 115), 1983).
77. Petrie, G. Description of antiquities in Orkney recently examined, with illustrative drawings. *Proc. Soc. Antiq. Scotl.* **2,** 56–62 (1857).
78. Ritchie, A. *On the Fringe of Atlantic Europe: excavation of a chambered cairn on the Holm of Papa Westray, Orkney*. (Edinburgh: Society of Antiquaries of Scotland, 2009).
79. Balasse, M. & Tresset, A. A key to the adaptation of Neolithic husbandry in the Orkneys: contribution of seaweed to the sheep diet at the Holm of Papa Westray, revealed through stable isotope analysis (13C and 18O) of teeth. In *On the Fringe of Atlantic Europe: excavation of a chambered cairn on the Holm of Papa Westray, Orkney* 74–83 (Edinburgh: Society of Antiquaries of Scotland, 2009).
80. Schulting, R. J. Holm of Papa Westray North. *Discov. Excav. Scotl.* **4,** 168 (2004).
81. Sheridan, J. A. & Higham, T. The re-dating of some Scottish specimens by the Oxford Radiocarbon Accelerator Unit (ORAU): results received during 2007. *Discov. Excav. Scotl.* **8,** 225 (2007).
82. Ashmore, P. J. Radiocarbon dates. In *On the Fringe of Atlantic Europe: excavation of a chambered cairn on the Holm of Papa Westray, Orkney* (ed. Ritchie, A.) 59–66 (Edinburgh: Society of Antiquaries of Scotland, 2009).
83. Schulting, R. J. & Richards, M. Radiocarbon dates and stable isotope values on human remains. In *On the Fringe of Atlantic Europe: excavation of a chambered cairn on the Holm of Papa Westray, Orkney* (ed. Ritchie, A.) 66–74 (Edinburgh: Society of Antiquaries of Scotland, 2009).

84. Corcoran, J. X. W. P. Excavation of three chambered cairns at Loch Calder, Caithness. *Proc. Soc. Antiq. Scotl.* **98,** 1–75 (1966).
85. Davidson, J. L. & Henshall, A. . *The Chambered Cairns of Orkney*. (Edinburgh: Edinburgh University Press, 1991).
86. Sharples, N. M. Radiocarbon dates from three chambered tombs at Loch Calder, Caithness. *Scottish Archaeol. Rev.* **4,** 2–10 (1986).
87. Bryce, T. On the cairns of Arran – a record of exploitations with an anatomical description of the human remains discovered. *Proc. Soc. Antiq. Scotl.* **36,** 74–181 (1902).
88. Henshall, A. S. *The Chambered Tombs of Scotland,Volume 2*. (Edinburgh: Edinburgh University Press, 1972).
89. Schulting, R. J. Clachaig. *Discov. Excav. Scotl.* **5,** 167 (2004).
90. Bonsall, C. Raschoille Cave, Oban. *Discov. Excav. Scotl. 1999* **112,** (1999).
91. Trechmann, C. T. Recent finds of prehistoric remains at Hasting Hill, near Offerton. *Antiq. Sunderl.* **14,** 1–5 (1912).
92. Trechmann, C. T. Prehistoric burials in the County of Durham. *Archaeol. Aeliana (2nd Ser.* **11,** 119–76 (1914).
93. Fowler, C. *The Emergent Past: A relational realist archaeology of Early Bronze Age mortuary practices*. (Oxford: Oxford University Press, 2013).
94. Gamble, M. & Fowler, C. A re-assessment of human skeletal remains in Tyne and Wear Museums: results and implications for interpreting Early Bronze Age burials from Northeast England and beyond. *Archaeol. Aeliana* **42,** 47–80 (2013).
95. Jobey, G., Smith, D. & Tait, J. An Early Bronze Age burial on Reaverhill Farm, Barrasford, Northumberland. *Archaeol. Aeliana* **43,** 65–75 (1965).
96. Bulmer, W. Note on two more cists at Summerhill, Blaydon. *Proc.*

Soc. Antiq. Newcastle Upon Tyne **16,** 260–263 (1939).

97. Annis, R. S. *et al.* An unusual group of early Bronze Age burials from Windmill Fields, Ingleby Barwick, Stockton-on-Tees. *Tees Archaeology unpublished report* (1997).
98. Booth, T. J., Chamberlain, A. & Parker Pearson, M. Mummification in Bronze Age Britain. *Antiquity* **89,** 1155–1173 (2015).
99. Stead, I. M. The excavation of Beaker burials at Staxton, East Riding, 1957. *Yorkshire Archaeological Journal* **40,** 129–144 (1959).
100. Manby, T. G. Staxton Beacon: A Bronze Age barrow in East Yorkshire. *Unpublished report* (1998).
101. Hey, G., Bell, C., Dennis, C. & Robinson, M. Yarnton Neolithic and Bronze Age settlement and landscape. *Thames Valley Landscapes Monograph* **39,** Oxford (2016).
102. Allen, T. G. & Kamash, Z. Saved from the Grave: Neolithic to Saxon discoveries at Spring Road Municipal Cemetery, Abingdon, Oxfordshire, 1990-2000. 9–12 (2008).
103. Fitzpatrick, A. P. *The Amesbury Archer and the Boscombe Bowmen: Bell Beaker burials on Boscombe Down, Amesbury, Wiltshire*. (Wessex Archaeology monogr 27, 2011).
104. Barclay, A. J. & Bradley, P. J. The significance of quernstones – defining Bell Beaker 'domestic' burials at Amesbury Down, Wiltshire. In *Written in Stone: Papers on the Function, Form, and Provenancing of Prehistoric Stone Objects in memory of Fiona Roe* (Southampton Monographs in Archaeology, 2017).
105. Andrews, P. *et al.* An Early Beaker funerary monument at Porton, Wiltshire. *Wiltshire Archaeological & Natural History Magazine* **109,** 38–82 (2016).
106. Manning, A., McKinley, J. I. & Barclay, A. Early Bronze Age burial remains from Boscombe Down Airfield, Amesbury, Wiltshire.

Wiltsh. Archaeol. Nat. Hist. Mag. **103,** 309–312 (2010).

107. Andrews, P., Booth, P., Fitzpatrick, A. P. & Welsh, K. *Digging at the Gateway: Archaeological landscapes of south Thanet - The Archaeology of the East Kent Access (Phase II). Volume 2: The Finds, Environmental and Dating Reports*. (Oxford Wessex Archaeology monogr 8, 2015).
108. Schulting, R. ., Gardiner, P. J., Hawkes, C. J. & Murray, E. The Mesolithic and Neolithic human bone assemblage from Totty Pot, Cheddar, Somerset. *Proceedings of the University of Bristol Speleological Society* **25,** 75–95 (2010).
109. Gardiner, P. J. The Mesolithic-Neolithic transition in south-west England. (University of Bristol unpublished PhD thesis, 2001).
110. Ambers, J. & Bowman, S. Radiocarbon measurement from the British Museum: datelist XXVI. *Archaeometry* **45,** 531–540 (2003).
111. Allen, T. *et al.* Opening the Wood, Making the Land. The Archaeology of a Middle Thames Landscape: Mesolithic, Neolithic and Early Bronze Age. *Oxford Archaeol. Thames Val. Landscapes Monogr.* **38,** 337–342 (2013).
112. Holmes, M. Archaeological excavation on land off Banbury Lane, Pineham, Northampton: assessment report and updated project design. *Northamptonshire Archaeology Unpublished Report 12/133* (2012).
113. Caffell & Holst. Osteological analysis, Banbury Lane, Pineham, Northampton, Northamptonshire. *York Osteoarchaeology Ltd. Report No. 1713* (2013).
114. Green, M. Cursus continuum: further discoveries in the Dorset Cursus environs, Cranborne Chase, Dorset. In *Image, Memory and Monumentality, Archaeological Engagements with the Material World* (eds. Jones, A. ., Pollard, J., Allen, M. J. & Gardiner, J.)

(Prehistoric Society Research Paper 5., 2012).

115. Smith, M. J. *et al.* Holding on to the past: Southern British evidence for mummification and retention of the dead in the Chalcolithic and Bronze Age. *Journal of Archaeological Science: Reports* **10,** 744–756 (2016).
116. Budziszewski, J. & Włodarczak, P. *Kultura pucharów dzwonowatych na Wyżynie Małopolskiej*. (Kraków: Instytut Archeologii i Etnologii PAN, 2010, 2010).
117. Budziszewski, J., Haduch, E. & Włodarczak, P. Bell Beaker culture in south-eastern Poland. In *The Northeast Frontier of Bell Beakers: Proceedings of the symposium held at the Adam Mickiewicz University* (eds. Czebreszuk, J. & Szmyt, M.) 155–181 (BAR International Series 1155, Oxford: Archaeopress 2003, 2003).
118. Fischl, K. P., Kiss, V., Kulcsár, G. & Szeverényi, V. Old and new narratives for the Carpathian Basin around 2200 BC. In *2200 BC - A climatic breakdown as a cause for the collapse of the old world? 7th Archaeological Conference of Central Germany.* (eds. Meller, H., Arz, W. H., Jung, R. & Risch, R.) 503–524 (2015).
119. Patay, R. Bell Beaker Cemetery and Settlement at Szigetszentmiklós: First Results. In *Transitions to the Bronze Age. Interregional Interaction and Socio-Cultural Change in the Third Millennium BC Carpathian Basin and Neighbouring Regions.* (eds. Heyd, V., Kulcsár, G. & Szeverényi, V.) 287–317 (2013).
120. Szécsényi-Nagy, A. *et al.* Tracing the genetic origin of Europe's first farmers reveals insights into their social organization. *Proc. R. Soc. B-Biological Sci.* **282,** 1–9 (2015).
121. Dabney, J. *et al.* Complete mitochondrial genome sequence of a Middle Pleistocene cave bear reconstructed from ultrashort DNA fragments. *Proc. Natl. Acad. Sci. U. S. A.* **110,** 15758–63 (2013).

122. Lazaridis, I. *et al.* Genomic insights into the origin of farming in the ancient Near East. *Nature* **536,** 1–22 (2016).
123. Rohland, N., Harney, E., Mallick, S., Nordenfelt, S. & Reich, D. Partial uracil – DNA – glycosylase treatment for screening of ancient DNA. *Philos. Trans. R. Soc. London B* (2015). doi:10.1098/rstb.2013.0624
124. Haak, W. *et al.* Massive migration from the steppe was a source for Indo-European languages in Europe. *Nature* **522,** 207–211 (2015).
125. Meyer, M. & Kircher, M. Illumina Sequencing Library Preparation for Highly Multiplexed Target Capture and Sequencing. *Cold Spring Harb. Protoc.* http://dx.doi.org/10.1101/prot5448 (2010). doi:http://dx.doi.org/10.1101/prot5448
126. Kircher, M., Sawyer, S. & Meyer, M. Double indexing overcomes inaccuracies in multiplex sequencing on the Illumina platform. *Nucleic Acids Res.* **40,** 1–8 (2012).
127. Damgaard, P. B. *et al.* Improving access to endogenous DNA in ancient bones and teeth. *Sci. Rep.* **5,** 11184 (2015).
128. Maricic, T., Whitten, M. & Pääbo, S. Multiplexed DNA sequence capture of mitochondrial genomes using PCR products. *PLoS One* **5,** e14004 (2010).
129. Fu, Q. *et al.* DNA analysis of an early modern human from Tianyuan Cave, China. *Proc. Natl. Acad. Sci. U. S. A.* **110,** 2223–7 (2013).
130. Keller, A. *et al.* New insights into the Tyrolean Iceman's origin and phenotype as inferred by whole-genome sequencing. *Nat. Commun.* **3,** 698 (2012).
131. Gamba, C. *et al.* Genome flux and stasis in a five millennium transect of European prehistory. *Nat. Commun.* **5,** 5257 (2014).
132. Skoglund, P. *et al.* Genomic Diversity and Admixture Differs for Stone-Age Scandinavian Foragers and Farmers. *Science* **201,** 786–

792 (2014).

133. Patterson, N. *et al.* Ancient admixture in human history. *Genetics* **192,** 1065–93 (2012).
134. Busing, F. M. T. A., Meijer, E. & Van Der Leeden, R. Delete- m Jackknife for Unequal m. *Stat. Comput.* **9,** 3–8 (1999).
135. Lipson, M. *et al.* Parallel ancient genomic transects reveal complex population history of early European farmers. *bioRxiv* (2017).