The excavation of buried articulated Neanderthal skeletons at Sima de las Palomas (Murcia, SE Spain)

Michael J. Walker*[1], Mariano V. López-Martínez[2], Jon Ortega-Rodrigáñez[3], María Haber-Uriarte[4], Antonio López-Jiménez[5], Azucena Avilés-Fernández[6], Juan Luis Polo-Camacho[7], Matías Campillo-Boj[8], Jesús García-Torres[9], José S. Carrión García[10], Miguel San Nicolás-del Toro[11], Tomás Rodríguez-Estrella[12]

*corresponding autor

1 Área de Antropología Física, Departamento de Zoología y Antropología Física, Facultad de Biología, Campus Universitario de Espinardo, Universidad de Murcia, 30100 Murcia, Spain. E-mail: walker@um.es, mjwalke@gmail.com

2 Calle Pintor Joaquín 10 - 4º - I, 30009 Murcia, Spain. E-mail: marianolopez@hotmail.com

3 Área de Antropología Física, Departamento de Zoología y Antropología Física, Facultad de Biología, Campus Universitario de Espinardo, Universidad de Murcia, 30100 Murcia, Spain. E-mail: jonor@um.es, ventepalportus@yahoo.es

4 Área de Prehistoria, Departamento de Prehistoria, Arqueología e Historia Antigua, Facultad de Letras, Campus Universitario de La Merced, Universidad de Murcia, 30001 Murcia, Spain. E-mail: mariahaber@yahoo.es

5 Área de Antropología Física, Departamento de Zoología y Antropología Física, Facultad de Biología, Campus Universitario de Espinardo, Universidad de Murcia, 30100 Murcia, Spain. E-mail: antlop@um.es, aljsilver@gmail.es

6 Calle Trébol 2, 30739 San Javier, Murcia, Spain. E-mail azuavi@hotmail.com

7 Departamento de Química Analítica, Facultad de Químicas, Campus Universitario de Espinardo, Universidad de Murcia, 30100 Murcia, Spain. E-mail: jlpolo@um.es

8 Calle Bélmez 15, 03190 El Pilar de la Horadada, Alicante, Spain. E-mail: matitorero@hotmail.com

9 Calle Cibeles 32, 30120 El Palmar, Murcia, Spain. E-mail: jesusgator@hotmail.com

10 Área de Botánica, Departamento de Biología Vegetal, Facultad de Biología, Campus Universitario de Espinardo, Universidad de Murcia, 30100 Murcia, Spain. E-mail: carrion@um.es

11 Instituto de Patrimonio Histórico, Dirección General de Bellas Artes y Bienes Culturales, Consejería de Cultura de la Comunidad Autónoma de la Región de Murcia, Palacio de los Pacheco, Plaza Fontes 2, 30071 Murcia, Spain. E-mail: miguel.sannicolas@carm.es

12 Área de Geodinámica, Departamento de Ingeniería Minera, Geológica y Cartográfica, Universidad Politécnica de Cartagena, Avenida Alfonso XIII 52, 30203 Cartagena, Spain. E-mail: tomas.rodriguez@upct.es

Keywords: Neanderthal; articulated skeletons; Mousterian

Abstract

At Sima de las Palomas del Cabezo Gordo (Murcia, Spain) remains of several Neanderthals have been excavated recently. From about 50,000 years ago articulated parts of 3 adult skeletons (including skulls with mandibles, vertebral column, rib cages, shoulder blades, hip bones, upper and lower limbs, hands and feet, often in anatomical connexion) were excavated from the lower part of a cemented accumulation of scree and large stones (éboulis) sloping downwards and inwards into the cavity, along with burnt bones of large mammals and Mousterian implements. The excavation of the skeletons is the subject of this paper (palaeoanthropological skeletal descriptions is soon to be published elsewhere). Behind the cemented scree there accumulated a layer of finer sediment containing burnt animal bones, followed by more fine sediment that filled the cavity up to the overhanging rock roof and contained isolated teeth and unburnt bone fragments of Neanderthals, including 3 mandibles, as well as Mousterian implements and faunal remains, all dating from before 40,000 years ago. Altogether at

least 9 Neanderthals are represented by finds from the site (including 3 unstratified mandibles), ranging from babies to adults. Dating methods include radiocarbon, uranium-series, and optical luminescence. Pollen analysis implies conditions less severe than those of the Heinrich 4 cold oscillation at 40,000 years ago.

Introduction

The Sima de las Palomas (= the shaft of the pigeons/doves) is a vertical cave system of natural karstic shafts, reaching a maximum depth of 31 metres. The top of the main shaft overlooks a salt-water lagoon (called the Mar Menor = Lesser Sea) of the Mediterranean Sea, from 125 m above sea level on the south-facing flank of Cabezo Gordo (= Big Hill), which is an isolated hill of Permo-Triassic marble, rising up from the coastal plain to a height of 310 m above sea level (Figures 1, 2). In 1991 Juan Carlos Blanco-Gago, a nature-lover and conservationist, abseiled down the main 20-metre-deep shaft of the cave to inspect the birds nesting there. Hardly had he begun his descent than he plucked out of the rear wall of the shaft a small brecciated conglomerate mass that seemed to contain a fossil. After partial cleaning, this was seen by one of us (M.J.W) and by our lately deceased friend and co-director of excavations, the Barcelona palaeontologist Josep Gibert-Clols, to be the upper and lower jaws of a Neanderthal human face, crushed transversely due probably to sedimentary pressure. Our subsequent research has identified the remains of at least nine individuals; an inventory of 200 skeletal items with their anatomical identification has been published (Trinkaus *et al*. in Walker *et al*., 2008; Walker *et al*., 2010a,b). In this paper we limit our attention to the discovery and context of three Neanderthal individuals, buried with skeletal parts in anatomical connexion, which we began to excavate in 2005.

The 1991 discovery was an exceptional find of Neanderthal bones in anatomical connexion. Were more Neanderthal bones waiting to be found? If they were found to be in the same state of anatomical articulation that they had been in when death overcame them, then Sima de las Palomas would be become one of the most important Neanderthal sites in Europe. It has taken us more than a decade of painstaking archaeological excavation to begin to show that this is indeed the case.

First of all, though, daunting obstacles had to be overcome. Miners had wrought havoc in the cave a hundred years ago. Indeed, they seem to have been responsible for reopening the main shaft where the fossil was found, and for leaving a gaping hole, three metres wide at the top and 18 metres deep (Figures 3, 4). The shaft drops into the spacious main chamber, which also receives another shaft from the surface. This is shorter and was probably the one by which miners had first entered the cave system, after removing a small vein of iron ore, remnants of which can be seen on the hill-side beside the mouth of the shorter shaft. Later on they blasted a horizontal tunnel to have easy access to the main chamber from the hill-side, probably around the year 1900. Their blasting probably destabilized and led to collapse of the brecciated fill of the main shaft.

We surmise that the miners withdrew water from another natural karstic shaft that is deeper down inside the cave system, although today it is dry. A narrow dry gully descends the hill-side steeply from below the entrance to the horizontal tunnel. It could have been fed by an intermittent spring when the water level in the cave system was high, all trace of which succumbed to the miners' activity. Above the tunnel entrance the concave sweep of the hill-side is broad and shallow with no sign of an erstwhile spring (although one of us, T.R-E. does not rule out its possibility). There are indications that sediments above and below the floor of the main chamber were laid down or reworked by water and there seems to be three-dimensional network of joints and bedding-planes that probably facilitated intermittent movement of water deep in the cave when the level of water inside was relatively high, although at other times the deep part of the system was dry because stalactites and stalagmitic flow-stone developed there. Nevertheless, considerations of the hydrogeology and structural geology of the hill imply that it is unlikely that the cave system fed a permanent spring, and instead that rain-water entering into the cave mainly drains away within it to feed deeply-lying aquifers.

Water was much needed by miners in an arid climate to wash iron ore that was dug out of the hill-side, mainly in open quarries. Magnetite, pyrite and ferrous hydroxide occur in shallow veins, as well as copper (Colodrón *et al*., 1994). No veins of metal ore are visible in the walls of the cave, and although today there is no water within the cave it is hard to explain what had led miners to undertake so much work inside it other than a search for water and its extraction. Apart from water in another cave on the hill-side, simply called Water Cave (Cueva del Agua) (Figure 2), there are no springs on the hill-side nowadays. Records from 1913 say there had been over fifteen mining concessions for iron ore on the hill-side, all of which would have needed water every working day (de Gálvez-Cañero, 1913).

Cabezo Gordo underwent considerable faulting during the Mesozoic. This is related both to its mineral significance for miners and to the karstic erosion of fissures, of which several on the hill became filled later on with fossiliferous breccia. One group of faults aligned between N100 and N165E includes a dextral fault that crosses the Sima de las Palomas with an orientation of N160E (Figure 2). Another group of sinistral shear faults is aligned between N20-25E and N-S, and a N-S example traverses the horizontal mine tunnel and main chamber. Normal faults that have a W-E alignment are particularly associated with veins of metal ore, as is an inverse fault with an alignment of N110E that crosses the track a few metres before it reaches the entrance to the horizontal tunnel. .

The miners removed over eighty percent of stones, breccia and sediments that had filled the main chamber up to the roof, to which a small hanging remnant of conglomerate is cemented, close to where the main shaft opens out to form the main chamber. Reopening the main shaft must have ruptured a thin calcrete crust of stalagmitic flowstone that had formed over the sedimentary fill at the mouth of the shaft. The flowstone still covers conglomerate cemented to the marble bed-rock of the hill-side that forms a small vertical lip, or sill, over which one must clamber to gain access to the top of the main shaft. The flowstone covers the outer side of the conglomerate on the sill and a trace of it can be seen on the rock-face behind and above the mouth of the main shaft, thus undoubtedly it sealed the conglomerate fill before mining reopened the shaft (Figure 4). The miners left behind a column of breccia plastered against the rear rock wall of the main shaft. Archaeological excavation could not begin until a scaffolding tower was erected in 1994 inside the main chamber to reach the top of the main shaft (Figure 3).

In order to put up a tower, however, it was necessary first to clear and sieve many tons of mine rubble inside the main chamber and horizontal tunnel, as well as around the entrance to the tunnel on the hill-side. This task produced many human fossils as well as stone tools and animal fossils. These were important evidence that helped us to get the necessary support of the Murcian regional authorities, who provided us with scaffolding materials and also installed security gates. We carried the scaffolding up the hill-side in July heat of 45 degrees Celsius, and helped a skilled rigger from the "Ulma" scaffolding company to put up the tower inside the main chamber. Once built, we began to excavate into sediment that had accumulated up to the rock roof overhanging the shaft.

We chose a place where the sediment seemed to have suffered from some natural erosion. All sediment excavated is lowered down in buckets on an aerial ropeway from the top of our tower down to the floor of the main chamber. Here it is put in labelled bags and carried down the hill-side, to be taken around the hill in our vehicles to the "Cabezo Gordo SL" marble-cutting factory. It recycles its water and lets us use it to wash the sediment over our four sets, in each case, of three 90-cm-diameter stainless-steel geological sieves, nested in decreasing order mesh-sizes (of 8 mm, 6 mm and 2 mm, respectively).

Ten seasons of excavation were required before we were just above the 1991 find-spot (Walker *et al.*, 2008). As already mentioned, we are able to undertake excavation during only three weeks a year at each of our two sites during the annual summer university vacation. Moreover, at Sima de las Palomas two other matters vied for our attention. First, during several seasons we had to continue sieving mine rubble around the mine-tunnel entrance in order to retrieve significant finds and to make the entrance safe from falling stones. Secondly, in a safe corner of the main chamber we excavated into its floor in order to inspect deep sediments and explore a possibility – which our efforts refuted- that there might once have been a blocked-up natural passage lying deeply and leading out towards the hill-side. We called this our "lower cutting" to distinguish it from our "upper cutting" at the top of the shaft. We also now have an "intermediate cutting" which takes the form of a small step, or ledge, in the breccia column where it slopes towards the foot of the main shaft, about five metres above the floor of the main chamber.

Stratigraphy and chronology of the upper cutting

We had to begin our excavation of the upper cutting by making just enough space to get our arms underneath the overhanging rock that was touching the top of the sedimentary fill; thereafter we removed arbitrary horizontal spits for as long as this uppermost sediment remained uniform and showed no litho-stratigraphical change. We had chosen to start where the exposed upper sediment seemed to have undergone some natural erosion recently, in order to minimize unintentional damage and take maximum advantage of the eroded nook. We proceeded cautiously downwards, just in case the sediment had been formed in sloping layers rather than horizontally. With beginner's luck, it showed features typical of horizontal formation in the nook. The upper sediment is light beige in colour and has a gritty feel when rolled between thumb and forefinger. It contains angular stone clasts, probably washed from the hill-side into the cave or derived from its roof and walls. Sub-aerial components of the deposit probably entered through interstices of the poorly-consolidated cemented breccia of "conglomerate A" to be described below.

After removing a depth of almost two metres, a metre across, and 60 cm inwards, we had turned the eroded nook into a tall open "box" or vertical "coffin". This gave us two high walls in which to inspect the way the uppermost sediment had formed, although the third one was much smaller owing to the steeply falling roof formed by the overhanging rock of the hill-side. The availability of only two useful vertical sections for stratigraphical inspection demanded that considerable pains had to be taken and manual excavation proceeded slowly with the great care.

Whereas the horizontal lie of the uppermost sediments was seen clearly in the E wall (at the "back" of our box, with respect to the open shaft), there was a hint in its left-hand or N wall that stones had tumbled downwards and inwards from the cave mouth and had formed an ancient stony slope, over which horizontal formation of the aforementioned uppermost sediment had taken place afterwards. This hint was to be corroborated amply by later excavation (Figures 5, 6, 7). There were also signs, in the form of thin vertical white sheets (sinters), conspicuous both in the rock tumble and in the adjacent sediment, that calcium had been precipitated from water percolating down through them. This must have dripped from the overhanging roof after the uppermost sediment had filled the cavity up to it.

The nook where we had begun the excavation is at the top of an almost vertical wall of brecciated sediment, dropping straight down to the floor of the main chamber 18 metres below, which was another reason for choosing to start there. However, it was over two metres away horizontally from the find-spot of the 1991 fossil in the breccia. A few metres below that spot the breccia must have been removed by mining activity which had exposed the bare rock wall of the shaft.

Our long-term excavation strategy had to be that of extending our box northwards beyond the rim of the open shaft, so that eventually we would be able to change direction and make a further extension westwards until we were above the spot where the first Neanderthal fossil had been removed. Constrained by the rock walls of the shaft, the area of our excavation would take on an L shape, the limbs of which would be about 3 metres long and between 1 and 2 metres broad, around the top of the scaffolding tower which filled the top of the open karstic shaft.

However, the 1991 find had been made almost 3 metres below the rock overhang, and in order to reach that depth we first had to remove a considerable amount of the overlying upper sediment, all of which was excavated carefully by hand and then washed on the geological sieves. Scattered in no apparent order throughout this upper sediment were several human fossil teeth and bone fragments, as well as animal bones and Levalloiso-Mousterian artifacts (Figures 6, 8). The laser level is particularly useful in determining the vertical coordinates of finds and sedimentary features (the site is too small, alas, for our GPS-aided "total station" to be deployed). Accuracy and precision were of crucial importance, given that the L shape of the excavated area meant that during the early years of our excavation programme there were only two permanent vertical stratigraphical sections or profiles. The third vertical section was but a temporary ("standing") section which disappeared when the excavated area was extended.

In the NE part of the excavated area the upper sediment gave way to a feature comprising a noteworthy thickness (up to 30 cm) of dark-grey sediment, designated the "upper grey layer" (Figures 6, 7), from which some burnt animal bones were excavated, although most nearby human bones do not show traces of having been burnt. This grey layer fanned outwards and slightly downwards as ephemeral, diffuse patches that sometimes were discontinuous both longitudinally and vertically, giving an appearance of gently downward-sloping, irregular fusiform lenses of grey sediment interspersed with beige sediment. They were present only in a more or less triangular area in the northern and eastern part of the cutting.

X-ray fluorescence analysis conducted by one of us (J.L. P-C.) points to high levels of tin, arsenic and most especially copper in the grey sediment, in contrast to the surrounding beige sediment, although both show high levels of silicates on the one hand, and unexpectedly low levels of iron on the other. The metals can have come only from detritus washed down the hill-side into the shaft. Perhaps heat generated by the burning responsible for the burnt bones in the upper grey layer could have favoured concentration of metals were it to have involved refraction from heated marble in a confined space. Nevertheless, we have no way of knowing whether the burning took place inside our outside the excavated area, or both at different times. A possibility cannot be ruled out that burnt refuse and ashy sediment may have been dumped at the back of the shelter when fire-places beside the mouth were cleared away.

At its western edge the grey sediment abutted onto a very steep brecciated scree slope or partly-cemented rock tumble (with some of the stones weighing up to 50 kg) that must have been displaced downwards and inwards from the cave mouth (see below) (Figure 5). Sediment in it was cemented to the stones and contained Neanderthal skeletal parts in anatomical connexion. The irregularly-cemented sedimentary feature is now called "conglomerate A", following identification in 2009 of "conglomerate B" lying more deeply which has a uniformly weathered upper surface (see below) (Figures 6, 7). Despite considerable –albeit irregular- cementation within it, the talus slope of conglomerate A did not have the kind of uniformly altered or weathered surface covering it, let alone a stalagmitic flowstone crust sealing it, such as might well have developed were it to have been exposed to the elements over a long period of time; however, neotectonic activity, which is widespread in the region, could have hindered their development. Nevertheless, it is plausible to infer that the upper grey layer of sediment represents an episode *after* the talus slope of scree had formed. Just *how long* after is a matter that will be considered below.

In the NE corner of our cutting the thickest part of the upper grey layer covered a large, thin, flat marble slab (60 x 40 cm in area) that lay above unburnt sediment. The slab lay somewhat away from the conglomerate A and although it is tempting to see it as perhaps having less to do with conglomerate A than with the upper grey layer with which it was in immediate contact, this is only a conjecture. Sediment from the upper grey layer immediately overlying the slab was dated to 54,700±4700 years ago at Oxford University using optically stimulated luminescence (Schwenninger, 2008).

That date may be compared to uranium-series determinations APSLP-1 and APSLP-6 of, respectively, 54,100±3850 and 51,000±1250 years ago, obtained at Bristol University using laser ablation multicollector mass spectrometry on a Neanderthal human bone and an animal bone, respectively, both of which came from the scree of conglomerate A. These two samples "*show near uniform uranium concentration and U-series date profiles, which is indicative of the bones having reached equilibrium with the burial environment relatively rapidly… However, these dates must be treated as of unknown accuracy, since a change in the geochemistry of the burial environment will result in the bone rapidly re-equilibrating, which may include further uptake of uranium (leading to underestimated apparent dates) or the loss of uranium (leading to older apparent dates)*" (Pike, 2008).

From what seems to have been a deep position in brecciated scree within the main shaft, there is a uranium-thorium determination on an aragonite crystal extracted from the breccia column of 56,000 +13000 -10000 years ago (Sánchez-Cabeza *et al*., 1999). The crystal was removed from the wall of breccia inside the main shaft in 1994, from about one metre below the find-spot of the 1991 fossil, before excavation of the upper cutting had begun. Finally, mention may be made of an electron spin resonance determination on a bone with adherent breccia. taken from the mine rubble before the excavations had begun, which first was published as either 83,000 or 42,000 years ago, depending on whether background irradiation were to have been 1 or 2 Gray per thousand years, respectively (Gibert *et al*., 1994), but which, following Schwenninger's determination of background irradiation as 1.32 Gray/ky, might correspond perhaps to about 69,000 years ago (ESR determinations were published on two other bones with adherent breccia from the mine rubble of 146,000 or 73,000 years ago and 532,000 or 266,000 years ago, respectively; whereas the second seems to be anomalous, the first now might be recalculated to around 122,000 years ago, which is of the same order of magnitude as uranium-thorium determinations of around 117,000 and 124,000 years ago on aragonite crystals from a deep position in the exposed breccia in the main shaft roughly 15 metres below the top of the breccia in the upper cutting: Sánchez-Cabeza *et al*., 1999). Here in the main chamber there are indications that the lowest five metres of sediment in the breccia column were either laid down under water or at least underwent reworking by water at some time in the Pleistocene, and excavation in our “lower cutting” reinforces that interpretation.

At the top of the main shaft, the chronological interpretation of our upper cutting is complicated by three other dates. They were determined on three samples which were removed barely 30 cm above those which have given ranges of 54,700±4700, 54,100±7700 and 51,000±2500 years ago. The three other dates imply that the uppermost part of the same upper grey layer of sediment has a minimum age of 44,000-40,000 years ago. These dates are as follows. A uranium-series determination APSLP-1 of 43,800±1500 years ago was obtained from a bone fragment at Bristol University (Pike, 2008), and two AMS radiocarbon dates were obtained at Oxford from burnt bone from separate find-spots, namely, OxA-10666 of 34,450±600 BP (calibrated 2-sigma range 40,950-37,622) and OxA-15423 of 35,030±270 BP (calibrated 2-sigma range 40,986-38,850 years ago) (Higham, 2008). Given that palaeopalynological analysis points to mild conditions (Carrión *et al*., 2003) it is reasonable to infer that the finds come from a time before the severely cold Heinrich 4 oscillation that took place at about 40,000 years ago. The three dates imply a time before 40,000 years ago and possibly around 50,000.

Thus there is here a puzzling matter, because the upper grey layer contained no clear-cut stratigraphical break within it that might have separated the two groups of dates. Moreover, because the talus slope of the cemented, albeit poorly-consolidated, conglomerate A did not offer a uniformly altered surface, it might be wondered whether there was no great temporal separation from the upper grey layer of sediment abutting on to it. It was mentioned earlier that there were also signs, in the form of thin vertical sinters in both the partly-cemented breccia or rock tumble of conglomerate A and in the adjacent sediment, that calcium had been precipitated from water which must have dripped from the roof overhanging our upper cutting after the uppermost sediment had filled the cavity, and it was remarked also that a thin calcrete crust of stalagmitic flowstone sealed the entire fill, covering conglomerate A at the lip or sill of bed-rock, over which access is gained to the shaft today (Figure 4). It is very likely that precipitation caused the cementation of conglomerate A after the uppermost sediment had accumulated beside it, and perhaps before the entire deposit had become sealed by flowstone; it might well have taken place in late glacial or even post-glacial times. As already mentioned, sub-aerial components of the uppermost sediment doubtless have entered the deposit through interstices in the poorly-consolidated conglomerate A that served as a filter.

Were the temporal separation to have been brief between the deposition of conglomerate A on the one hand, and the deposition of the upper grey layer along with overlying sediment on the other, then an accommodative interpretation might be that the discontinuity between the upper grey layer and the brecciated scree of conglomerate A need not affect the uranium-series dates from the latter, provided that the OSL determination may be presumed to be rather older than otherwise should be considered the appropriate age of the lower part of the upper grey layer. Alternatively, the radiocarbon determinations and the late uranium-series one of 43,800 could be giving too recent an estimate of age owing to undetected contamination, a possibility which has not been ruled out by Thomas Higham with regard to the radiocarbon estimates (in conversation with M.J.W. in 2010). A third possibility is that both the early uranium-series dates and the OSL date may be too ancient. Likely episodes of infiltration by water (see below) might well have led to inaccuracy and unreliability of geophysical and geochemical estimates of age.

Excavation in 2008 and 2009 has established that conglomerate A, i.e. the brecciated scree containing articulated human remains, lay on top of another, lower, layer of grey sediment. This “lower grey layer” was continuous and occupied the entire excavation area (Figures 6, 7, 8). It reached its greatest depth in the SE corner. It contained large stones that seem to have undergone alteration on their surface because several have acquired a hard, grey “skin” all over. This “skin” stands out sharply against the red core of many fractured stones (which itself is in marked contrast to the usually light-grey marble blocks in conglomerate A). Adhering to the grey “skin” of some of these altered stones is blackish sediment that feels “greasy” when touched with a finger.

Whereas the upper grey layer contained undoubtedly burnt lagormorph bones, analyzed and dated at the Oxford radiocarbon laboratory, the lower grey layer seems to be more complicated. Anthracological investigation of putative botanical remains refuted that interpretation and subsequent microscopy points to microbial biogenic processes as having been responsible for the formation of large elongated masses of calcium carbonate deposits that are seen to have a tubular filiform structure when examined under the microscope (which showed that we were mistaken in our initial impression that they were calcined wood or bone). They appear to have been formed under conditions which imply presence of temporary infiltration by water that can only have entered from the hill-side above (we thank Ernestina Badal-Garcia of Valencia University and Rafael Arana-Castillo and Francisco Torrella-Mateu of Murcia University for their studies on samples). Energy-dispersal X-ray (EDX) analysis with the scanning electron microscope and X-ray diffraction analysis conducted by one of us (T.R-E.) show that the masses contain less phosphorus and organic carbon than the surrounding sediment which also contains more potassium. One implication is that the surrounding sediment contains components that may have resulted form combustion of organic materials before those masses had formed, although presence in the surrounding sediment of silica, mica, quartz, and even the metal titanium, is compatible with their origin on the hill-side in detritus washed into the cave by rain.

The lower grey layer and the altered stones covered a bed of rock-hard, brecciated conglomerate, conglomerate B (Figures 6, 7, 8). It has a rough, weathered surface, occupies the whole excavation area, and slopes downwards from NW to SE. It appears to be a heavily cemented cryoclastic breccia comprising very small angular chips of stone and bone fragments. Conceivably, it was formed under cold arid conditions, with ephemeral calcium carbonate-rich surface water (e.g. melt-water) and rapid precipitation. No doubt the inward and downward slope of conglomerate B favoured accumulation of rain-water sporadically. Plausibly, it was formed during a cold period, perhaps about 60,000 years ago at the time of the transition between marine isotope stages 4 and 3. The lower grey layer followed the lay of the slope of conglomerate B and was deepest in the SE corner of our cutting (in contrast to the smaller upper grey layer which was thickest in its NE corner). The underlying rock-hard conglomerate B is a bed that is scarcely more than 25 cm thick in the wall of the main shaft, where it has been undercut because some looser breccia below it was dislodged, no doubt by mining activity.

The lower grey layer on top of it contained only sparse finds, albeit of considerable interest. They include thin, flat Levallois points with retouched edges made on dark (probably burnt) chert and with astonishing delicacy on translucent rock crystal. Whereas the articulated Neanderthal bones in the brecciated scree on top of this lower grey layer showed no traces whatsoever of having been burnt, we have long been intrigued by numerous burnt human and animal bones that we had identified when sieving the rubble thrown out of the cave by miners a hundred years ago and strewn on the hill-side; they include fragments of two Neanderthal mandibles (Walker *et al*., 2010a). Our attention had been drawn to the presence of several horse bones in the rubble, some of which had been burnt, in contrast to their paucity in the upper sediment excavated hitherto. It is possible that the thickest part of the lower grey layer was destroyed when mining reopened the main shaft.

Articulated Neanderthal skeletons

The brecciated scree or partly-cemented tumble of stones and rocks (éboulis) of conglomerate A, has given dates of 55,000-50,000 years ago (Figures 5, 6, 7). Apart from a small area close to the SP-92 skeleton, by and large it contained relatively fewer Mousterian artifacts than did the sediments overlying the upper grey horizon. Articulated skeletal parts of two adult Neanderthal individuals and a juvenile or child have been excavated in it (SP-92, SP-96 and SP-97: Figures 9, 10, 11, 12). The skeleton of SP-96 is 85% complete (Figures 9, 10). They were found embedded in breccia containing many stones, all of which formed a conglomerate cemented by calcium carbonate into masses of varying hardness, some of them as hard as concrete (Figures 5, 11). This made manual excavation of the bones very difficult indeed. Wherever possible bones were exposed and recorded before removal. Sometimes conglomerate masses became loose and had to be detached. These masses of rock-hard breccia containing bone were removed whole, after careful measurements and many photographs had been taken, so that in the laboratory they could be restored to their original relative positions. The separation of human bones from conglomerate masses in which they were embedded is a painstaking laboratory procedure. Manual and sometimes chemical methods are used to remove the cemented calcareous matrix from the delicate human fossils it encloses; bone thereby exposed is consolidated by impregnation. Cleaning is still in progress in order that sex, age, and pathologies can be defined for the three skeletons SP-92, SP-96 and SP-97.

The first of the three skeletons with articulated parts to be excavated from conglomerate A was SP-92 (Figure 13). Its lower extremities were uncovered low down in the rock tumble of conglomerate A in 2005, in what is now the western part of the upper cutting. Among or close to these remains there was a scatter of 9 retouched Mousterian artifacts, 12 unretouched flakes and over 100 knapping spalls and fragments of flint, calcite and quartz, but no arrangement of these was discerned with regard to the disposition of the bones, and two burnt equid talus bones were found also. Breccia cement was removed from the bones in the laboratory in 2006 and 2007. Both femurs are present, the left fibula, most of the left foot, with metatarsals and phalanges in anatomical articulation, 3 vertebrae (lumbar and thoracic), sacrum and a large part of ilium, about half of the left hand, with metacarpals and phalanges in anatomical articulation, and the elbow joint with the distal part of the humerus in articulation with the heads of the ulna and radius.

The right bicondylar femoral length of 394±10 mm (Walker *et al.*, 2010b) implies an individual perhaps 1520 mm tall if female or 1560 mm if male. It is likely the transversely-crushed maxillae and mandible in anatomical connexion that were found in 1991 by Juan Carlos Blanco-Gago came from SP-92 (they are labelled SP-1 or CG-1 in published inventories). Greater damage was suffered by the left side of the mandible than the right side, on which perhaps the head was lying when crushing took place. Because some of the bones were projecting from the wall of sediment that formed the western side of the upper cutting, it was necessary to extend the cutting westwards and this led to the discovery of SP-96 at a higher level than SP-92 and SP-97.

SP-97, excavated from conglomerate A in 2008, is of a 7-10-year-old child and extraction of its bones from the conglomerate is proceeding in the laboratory (Figures 11, 12). It lay below SP-96, behind SP-92, in the western part of the L-shaped excavation area. The skull which is undergoing cleaning is still partly covered with brecciated cement but the mandible, maxillae and other facial bones are preserved. The left arm and fore-arm are complete, with bones in anatomical articulation. Part of the right upper extremity can be seen, as well as ribs, phalangeal bones, pelvis, sacrum and metatarsals. Cleaning of the bones is still underway.

SP-96, excavated from conglomerate A in 2007, is the most complete of the three skeletons, but it has taken two years of laboratory cleaning to bring it to a state which is only now beginning to permit its study; and cleaning is still not complete (Figure 10). It was found when we were extending the western part of the L-shaped upper cutting in order to complete the excavation of SP-92 (Figure 5). It lay in an inclined position (Figure 9) above SP-97 and SP-92. SP-96 is the skeleton of an adult who was lying on its left side with both arms folded upwards at the elbows such that the hands were together beside the transversely-crushed skull that clearly retains several teeth although its cleaning is not yet finished.

Most of the cervical and thoracic vertebrae of SP-96 are present, together with many ribs and the right scapula and clavicle. Left and right humeri, ulnae and radii are present, and most of both hands. Enough of the pelvis and sacrum are preserved to show SP-96 to be a young adult female. The left and right femurs are present as well as a tibia and fibula. Lying transversely behind the left femur, the right femur was found as if it had been drawn up behind it. Tibial and femoral lengths are, respectively, 290-295 mm and 375-385 mm; they give a characteristically Neanderthal value for the crural index of 76.6-80.0. The individual stood no more than 1500 mm tall.

SP-96 seems to have lain on its side with the head at a higher level than the legs, and with both hands raised close to the skull. It is worth remarking that hands raised close to the head are documented for several Mousterian skeletons, namely, es-Skhul 4 and 7, Shanidar 7 and Le Régourdou, whilst Shanidar 4, Amud and Qafzeh 10 had one hand close to the head (Defleur, 1993, p. 233); of those, Shanidar, Régourdou and Amud are Neanderthals; this is an aspect of burial that some Neanderthals and some early non-Neanderthal humans had in common.

The articulated skeletons, site-formation processes and conglomerate A

Regarded in terms of their relative depths, the most complete skeleton, SP-96, must have been introduced after SP-97 and SP-92. It lay slightly closer to the cave mouth and the hill-side than they did. The presence of articulated human bones at different depths and situations in conglomerate A raises a matter of taphonomical interest about their relationship to its formation.

Perhaps SP-96 was introduced when some stones already had accumulated over SP-92 and SP-97. It is likely that the hands and arms of SP-96 were raised to beside its face before the rigor mortis had set in that may well have set the position of its right thigh. More rocks then accumulated over SP-96, which could have caused the skull to become crushed.

It is hard to envisage how a person lying there alive in such a posture might have become covered by rocks that fell down accidentally in a rock chute. Nevertheless, we ourselves have been trapped in the upper cutting during a sudden thunderstorm when water poured down the hillside and was funnelled into the shaft as a waterfall. A possibility cannot be ruled out that SP-96 met accidental under similar conditions. A slip of the foot on wet rock at the top of the low cliff that overhangs the cave mouth (where it forms a right-angled corner, "cut back", as it were, into the hillside above it) could have led to a fall of 6 or 7 metres onto the scree slope within, and to injuries so severe that burial under stones raining down occurred before escape was possible.

On the other hand, it is hardly likely that three individuals (SP-96, SP-97, SP-92) met similar fates on separate occasions, whereas had they been together at the same time a considerable stretch of the imagination is needed in order to envisage them helplessly succumbing to a common fate by accident. Therefore alternative conjectures might be that SP-96 was introduced as a corpse and laid out on the scree slope, after which more rocks and stones were either piled on it or fell on it later on (or both), and that introduction had likewise taken place previously of SP-97 and SP-92. The transverse crushing of the skulls might imply that rocks fell or were dropped on to the human remains from a height. Movement of the scree doubtless explains the presence of stones among the bones, many of which are cemented to stones by calcium carbonate precipitated from water that later on percolated downwards, to solidify conglomerate A.

Further cleaning of the bones may throw light on pathology and allow computer-assisted tomography and other investigative techniques to be employed. Whatever the cause of death, the skeletal parts of the three individuals did not undergo the scattering that otherwise might well have taken place had predatory and scavenging animals rummaged through them. So far, neither cut nor gnaw marks have been seen on any of the Neanderthal bones.

The completeness of the articulated SP-96 skeleton brings to mind a remark made by Anne-Marie Tillier, namely, "*La présence du squelette ou d´une grande partie du squelette en connexion n´est pas un phénomène naturel et il ne semble pas indispensable de mettre en évidence une structure artificielle pour envisager un depôt volontaire du corps…*" (Tillier, 1982; cf. Pettit, 2002 for similar remarks) In like vein, Erik Trinkaus, in response to Robert Gargett´s scepticism about some allegedly intentional Neanderthal burials, commented that several Neanderthal articulated skeletons "*managed to be preserved in highly accessible Upper Pleistocene rock-shelters and caves in near-anatomical position and over-all skeletal-part frequencies identical to those of recent cemetery samples… These partial skeletons retain many fragile elements largely intact, despite the ubiquitous presence of carcass-destroying carnivores…the lack of evidence in most cases for sufficiently rapid natural sedimentation rates to shield them from scavengers, and the absence of comparably preserved nonhominid skeletons in similarly accessible Upper Pleistocene locales*" (Trinkaus, 1989).

At Sima de las Palomas we have found remains of *Panthera pardus* cf. *lunellensis* and the large *Crocuta crocuta* cf. *spelaeus*, not to mention lynx, badger, fox and wolf. At least one *Panthera* bone had been burnt thoroughly, suggesting that Neanderthals could despatch and dispose of large felids. Unburnt bones of two articulated panther paws lay embedded in small blocks of breccia that were removed in 2009, close to SP-92 and SP-97 and slightly below SP-96, in an area where the rest of the animal's skeleton was conspicuous by its absence notwithstanding its proximity to the human skeletons (perhaps the paws had been cut off and kept by a Neanderthal; alas, we have no way of knowing!). Three horse talus bones, two of which were burnt, were also found in this area, one in articulation with the calcaneum.

As our excavation progressed in the early campaigns, we could see in temporary ("standing") sections how the cemented rock tumble of conglomerate A had fanned outwards and downwards from the cave mouth. Some of these sections have been illustrated in earlier publications (Walker *et al*., 1999; Walker and Gibert, 1999). It hardly reached the NW corner of our excavation area at all, and thus the direction of the partial cone of scree was unrelated to the slope of the lower grey layer and underlying, lower conglomerate B; it was also much steeper and did not reach the E section of our cutting.

The puzzle of the incomplete overhang

So where exactly did it come from? Some further remarks are in order here. The marble rock of the hill-side overhanging the excavated area of our upper cutting offers an appearance compatible with a sudden loss of an enormous volume of displaced stone. This brought about its present aspect, mentioned earlier, of a right-angled corner, "cut back", as it were, into the hillside in the form of a precipitous vertical cliff, behind and above the mouth of the main shaft (Figure 4). The surrounding hill-side slopes steeply at about 45 degrees, against the dip which varies from 30 to 65 degrees. The two rock-faces of the corner are about two metres long and up to three in height. They enclose the northern and eastern sides of our rectangular horizontal security grille above the mouth of the main shaft and upper cutting.

Did a natural rock-fall here contribute to conglomerate A? Might it have taken place long before conglomerate A was formed and therefore had nothing to do with its formation? Might the rock have been removed only recently and artificially by miners or quarrymen? We shall argue that the second alternative is the most likely one, and after that we shall consider where the components of conglomerate A most likely came from. First, though, the possibility will be examined that recent mining or quarrying produced the right-angled corner by removal of rock.

We have remarked already that when excavation of the upper cutting began in 1994 the sedimentary fill was touching the rock overhanging the main shaft. It included, most particularly, the fine sediment of sub-aerial origin containing Neanderthal bones and teeth together with well-made Levalloiso-Mousterian points and scrapers. This sediment had backed up inside the cave behind the scree slope of conglomerate A. The scree had served no doubt as a coarse filter, regardless of whether the palaeoanthropological and Palaeolithic components in the fine sediment were due to human dumping of refuse or whether they were washed in by rain.

What needs to be stressed is that, before mining reopened the main shaft, the cave already was filled up to its roof with Pleistocene scree and fine sediment. In other words, if miners and quarrymen had cut the right-angled cliff above the cave *after* reopening the main shaft, the rock should have fallen down onto the floor of the main chamber, whereas had they done so *beforehand* they would have had no other alternative than to have thrown it down the hill-side, given that the cave already was full up to the roof with sediment (as remarked earlier, a small hanging remnant of conglomerate is cemented to the roof of the main chamber close to where the main shaft opens out into it), in *neither* case could any of that rock have contributed to conglomerate A were miners or quarrymen to have been responsible. If they were, they left no traces. Despite the rectangular form of the corner, its rock-faces do not show any traces of pick-marks, let alone the bore-holes for charges of dynamite that, by contrast, are much in evidence in the horizontal entrance tunnel into the main chamber.

It is within the bounds of possibility that the shaft became filled up completely long *after* natural collapse of part of the overhang had been brought about by one of the many violent earth tremors that still afflict the region. The rock-faces of the right-angled corner of the low cliff above the cave mouth bear traces of the stalagmitic flowstone crust that had sealed the uppermost sediments and which clearly still covers conglomerate breccia cemented on a small vertical lip or sill of marble bed-rock that forms the front of the mouth of the shaft on the hill-side. Not only is the sill too far out from the low precipice of the right-angled corner for it to have received rocks from any *downward* collapse, but moreover the stalagmitic flowstone, on both the rock-face and covering the conglomerate on the sill over which we clamber down into the cave, implies that any such collapse had taken place *before* the conglomerate breccia was deposited on the sill. It is a vestige of the apex of the cone of brecciated scree (éboulis) or cemented rock tumble that is conglomerate A. The logical inference is that there had been collapse *long before* conglomerate A began to form. The collapse can only have been downwards into the main shaft. Probably rocks from it were largely removed by miners from deep in the erstwhile breccia fill of the main chamber, though some may still be present lying deeply in the column of breccia near the base of the main chamber.

The conglomerate breccia adhering to the marble rock sill can be regarded, therefore, as being all that remains of the apex of the cone of the cemented rock tumble of conglomerate A that contained the articulated Neanderthal skeletons. It slopes downwards and inwards, and impinged little, if at all, on our N and E sections, whereas these should have shown the greatest accumulation of rocks and slabs had there been collapse of overhanging rock at the time when sediment built up in that part of the upper cutting. Furthermore, the slope of any rubble cone brought about by such a collapse should have been downwards and outwards from the NE part of the upper cutting. Even though some of the marble blocks in the cemented rock tumble of conglomerate A weighed up to 50 kg, the smaller size of most of the brecciated scree, and the restricted area available for its cone inside the cave, would imply extraordinary fragmentation of the overhanging bed-rock to a perhaps unlikely degree. It therefore is more likely that its natural collapse had taken place in the very distant past, leaving internal traces lying only very deeply in the sedimentary fill of the main shaft, and doubtless largely removed by miners.

So where did the rocks in conglomerate A come from? The conglomerate adhering to the rock sill and brecciated scree of conglomerate A that contains the Neanderthal articulated skeletons we have excavated may have their origin in loose rocks and slabs lying on the hill-side above the cave mouth. They could well have entered where the hill-side offers a small slope, or chute, down towards the cave above the northern end of the small vertical lip or sill of bed-rock which forms the front of the mouth of the shaft. Heavy thunderstorms and sheet-wash could have displaced rocks and stones, some of which may have been swept downwards behind the rock sill, such that some rained down inside and formed a talus of scree within the cave, instead of being carried down the hill-side away from it.

The purpose of the foregoing discussion, despite its complexity, is to show that there are no convincing reasons to think that the articulated skeletons have been excavated at the site in a situation any different from that in which they lay fifty-thousand years ago. This is important, because the stratigraphical findings at excavation do not show evidence of such human impingements as burial pits, stone-linings or covering slabs, much less grave goods. It is not even possible to infer that the lower grey horizon might represent intentional preparation of an area on which to lay out the dead. It must be borne in mind that no more than half of the area at the top of the main shaft has been available for excavation, following reopening of the shaft by mining activity and resulting collapse of much of the sedimentary fill. All the same, the most economical interpretation is that the articulated skeletons represent corpses that were introduced intentionally and became covered by the rock tumble and scree that became cemented as conglomerate A. This contrasts markedly with the scattered remains of at least another half-a-dozen Neanderthals in the fine sediment that afterwards accumulated within the cave behind it.

Conclusion

Articulated Neanderthal skeletons SP-92, SP-96 and SP-97 dating from around 50,000 years ago at Sima de las Palomas del Cabezo Gordo have been excavated in a heavily cemented deposit, conglomerate A, that was partly covered before 40,000 by loose, fine sediments with a sub-aerial origin in which there were scattered human, animal and Palaeolithic remains. The context and situation of the three skeletons, which are undergoing cleaning and preparation in the laboratory, have been described briefly and considered here from the standpoint of their chronology and site-formation processes.

Acknowledgements

Excavation of the articulated Neanderthal skeletons was made possible thanks to financial assistance from the University of Murcia (Proyecto Propio 12441/2009), the Fundación Séneca of the Comunidad Autónoma de la Región de Murcia (Proyecto 05584/ARQ/07), the Dirección General de Investigación of the Ministerio de Educación y Ciencia (Proyecto CGL2005-02410/BTE) and the Dirección General de Investigación of the Ministerio de Ciencia y Tecnología (Proyecto BOS-2002-02375). We thank the owners of the Cabezo Gordo estate and the Cabezo Gordo SL company, and also the Mayor and Corporation of Torre Pacheco, for their cooperation and assistance. We recall with sadness the enthusiasm of the late Josep Gibert-Clols who co-directed research at Sima de las Palomas with one of us (M.J.W.) until his death in 2007. We thank Juan Carlos Blanco-Gago for information he has given us, and we thank all the helpers from many countries who have taken part in the field research, particularly Arthur Vincent Lombardi and Phillip Habgood. The authors of the paper were all members of the 12441/2009 funded project who took part in field research at the site. Other members of the project included Erik Trinkaus who is collaborating in palaeoanthropological analysis, and Alistair Pike, Jean-Luc Schwenninger and Thomas Higham, whose invaluable help in dating the site is gratefully acknowledged,. We thank Ernestina Badal-García, Rafael Arana-Castillo and Francisco Torella-Mateu for laboratory inspection of samples. For a new scale plan of the cave we thank Ignacio Nicolás Vázquez and his collaborators in the Federación de Espeleología de la Región de Murcia, Escuela Murciana de Espeleología and G.E.V.A.. We thank João Zilhão for his suggestions in the field. We thank Ana Asensio-Navarro for help in cleaning remains at our laboratory at Murcia, Klará Parmová for photographic assistance, Francisco Guitián-Rivera for his collaboration with one of us (J.L.P-C.) and Luis Alberto Alcolea-Rubio for his collaboration with another of us (T.R-E.). We acknowledge the collaboration in palaeoanthropological research at Sima de las Palomas of Arthur Vincent Lombardi, Josefina Zapata-Crespo, Alejandro Martínez-Pérez-Pérez and Kornelius Kupczik. We wish to thank Chris Stringer and Chris Collins of the Natural History Museum London for their interest in our skeletal remains and for technical advice about appropriate cleaning and preparation methods.

References

Carrión, J.S., Yll, E.I., Walker, M.J., Legaz, A.J., Chaín, C., López, A., 2003. Glacial refugia of temperate, Mediterranean and Ibero-North African flora in south-eastern Spain: New evidence from cave pollen at two Neanderthal Man sites. Global Ecology and Biogeography 12, 119-129.

Colodrón, I., Martínez, W., Núñez, A., Cabañas, I., Uralde, M. A., Navidad, M., 1994. Fuente-Álamo de Murcia. Hoja y Memoria. Mapa Geológico de España, Instituto Geológico y Minero de España, Ministerio de Industria y Energía, Madrid.

de Gálvez-Cañero, A., 1913. Minas del Cabezo Gordo. In: Bravo-Villasante, F., Fernández, A., de Gálvez-Cañero, A., 1913, Fuente Álamo y Pacheco. In: F. Bravo-Villasante y Gómez (Ed.), Criaderos de Hierro de España, Tomo I, Criaderos de la Provincia de Murcia. Memorias del Instituto Geológico de España, Madrid, pp. 377-384.

Defleur, A., 1993, Les Sépultures Moustériennes. Éditions du Centre National de la Recherche Scientifique, Paris, pp. 321.

Gibert, J., Walker, M.J., Malgosa, A., Sánchez, F., Pomery, P.J., Hunter, D., Arribas, A., Maillo, A., 1994. Hominids in Spain: Ice age Neanderthals from Cabezo Gordo. Research & Exploration 10 (1), 120-123.

Higham, T., 2008. Supporting Information III: Radiocarbon dating of the Sima de las Palomas. In: (electronic edition only) Walker et al., 2008.

Pettit, P., 2002. The Neanderthal dead: exploring mortuary variability in Middle Palaeolithic Eurasia. Before Farming 1 (4), 1-26.

Pike, A., 2008. Supporting Information IV: Uranium-series dating of bones from the Sima de las Palomas. In: (electronic edition only) Walker et al., 2008.

Sánchez-Cabeza, J.A., García-Orellana, J., Gibert, L., 1999. Uranium-thorium dating of natural carbonates: application to the Cabezo-Gordo site (Murcia, Spain). In: Gibert, J., Sánchez, F., Gibert, L., Ribot, F. (Eds.), The hominids and their environment during the Lower and Middle Pleistocene of Eurasia, Proceedings of the International Conference of Human Palaeontology, Orce 1995/Los homínidos y su entorno en el Pleistoceno inferior y medio de Eurasia, Actas del Congreso Internacional de Paleontología Humana, Orce 1995. Museo de Prehistoria y Paleontología "J.Gibert", Ayuntamiento de Orce, Orce, pp. 261-268.

Schwenninger, J-L., 2008. Supporting Information V: Optically stimulated luminescence dating. In: (electronic edition only) Walker et al., 2008.

Tillier, A-M., 1982. Les inhumations d´enfants au Paléolithique ancien et moyen. In : Les Dossiers d'Archéologie 66 (septembre 1982), "La Mort dans le Préhistoire", Éditions Faton, Dijon, pp. 19-22.

Trinkaus, E., 1989. In: Comments, pp. 183-184, in response to Gargett, R.H., Grave shortcomings. The evidence for Neandertal burial. Current Anthropology 30 (2), 157-190.

Trinkaus, E., Ortega, J., Lombardi, A.V., Pérez-Pérez, A., Zapata, J., Walker, M.J., 2008. Supporting Information II: The human remains from the Sima de las Palomas del Cabezo Gordo. In: (electronic edition only) Walker et al., 2008.

Walker, M.J., Gibert, J., Sánchez, F., Lombardi, A.V., Serrano, I., Gómez, A., Eastham, A., Ribot, F., Arribas, A., Cuenca, A., Gibert, L., Albaladejo, S., Andreu, J.A., 1999. Excavations at new sites of early man in Murcia, Sima de las Palomas del Cabezo Gordo and Cueva Negra del Estrecho del Río Quípar de la Encarnación. Human Evolution 14 (1-2), 99-123.

Walker, M.J., Gibert, J., 1999. Dos yacimientos murcianos con restos neandertalenses: La Sima de las Palomas del Cabezo Gordo y la Cueva Negra del Estrecho del Quípar de La Encarnación. In: Actas del XXIX Congreso Nacional de Arqueología, Cartagena, 28-31 Octubre 1997, Volumen I. Instituto de Patrimonio Histórico, Dirección-General de Cultura, Comunidad Autónoma de la Región de Murcia, Murcia, pp. 299-310.

Walker, M.J., Gibert, J., López, M.V., Lombardi, A.V., Pérez-Pérez, A., Zapata, J., Ortega, J., Higham, T., Pike, A., Schwenninger, J-L., Zilhão, J., Trinkaus, E., 2008. Late Neandertals in Southeastern Spain: Sima de las Palomas del Cabezo Gordo, Murcia, Spain. Proceedings of the National Academy of Sciences USA, 105 (52), 20631-20636. (Note: Supporting Information was published only in the electronic edition.)

Walker, M.J., Lombardi, A.V., Zapata, J., Trinkaus, E., 2010a. Neandertal mandibles from the Sima de las Palomas del Cabezo Gordo, Murcia, southeastern Spain. American Journal of Physical Anthropology 142, 261-272.

Walker, M.J., Ortega-Rodrigáñez, J., López-Martínez, M.V., Parmová, K., Trinkaus, E., 2010b. Neandertal postcranial remains from the Sima de las Palomas del Cabezo Gordo, Murcia, southeastern Spain. American Journal of Physical Anthropology (early electronic edition, December 2010, DOI 10.1002/ajpa.21428).

Legends to Figures

Figure 1 Location of Cabezo Gordo behind the Mar Menor in Murcia, Spain

Figure 2 Cabezo Gordo showing Sima de las Palomas, Cueva del Agua, and local geology.

Figure 3 Main shaft, sketch of vertical elevation, scale plan. A = mouth of main shaft. U = upper cutting. L = lower cutting. T = terminal shaft. The plan includes the artificial terrace on the hill-side, in front of the entrance to the mine tunnel, formed by rubble and soil we have excavated and sieved.

Figure 4 Mouth of the main shaft and upper cutting. Red arrow = rock-faces forming a rectangular corner. Blue arrow = area of possible rock "chute". Black arrow = stalagmitic flowstone covering apex of conglomerate A.

Figure 5 Excavating conglomerate A containing SP-96.

Figure 6 Stratigraphy and chronology of the upper cutting. SP-96, the upper and lower grey layers, and the underlying conglomerate B are indicated. The situation of conglomerate A is indicated by the fan of broken lines. Two Neanderthal mandibular fragments from the upper fine sediment are included also. Black circles indicate horizontal positions and inverted triangles the vertical positions of dated samples, with green and red bands indicating possible groups of "late" and "early" estimates (sample 5 very likely became displaced from the adjacent conglomerate A).

Figure 7 Stratigraphy of the upper cutting. A = upper finer sedimentary deposit. B = upper grey layer. C = cemented scree and rock tumble of conglomerate A; the broken line indicates the slope and although it hardly impinged at all on the northern section at the rear of the figure, its presence was well demonstrated in standing sections in the foreground before they were removed at excavation. D = block of conglomerate A containing part of SP-97 (see Figure 11). E = lower grey layer. F = conglomerate B.

Figure 8 Some Mousterian artifacts. Scrapers and points were made on flint of good quality. No flint outcrops are known on Cabezo Gordo and many artifacts were brought to the site, together with small amounts of the raw material for knapping although cores and knapping débris are infrequent.

Figure 9 Schematic situation of the SP9-6 skeleton. From left to right: head, arms and chest, pelvis and legs.

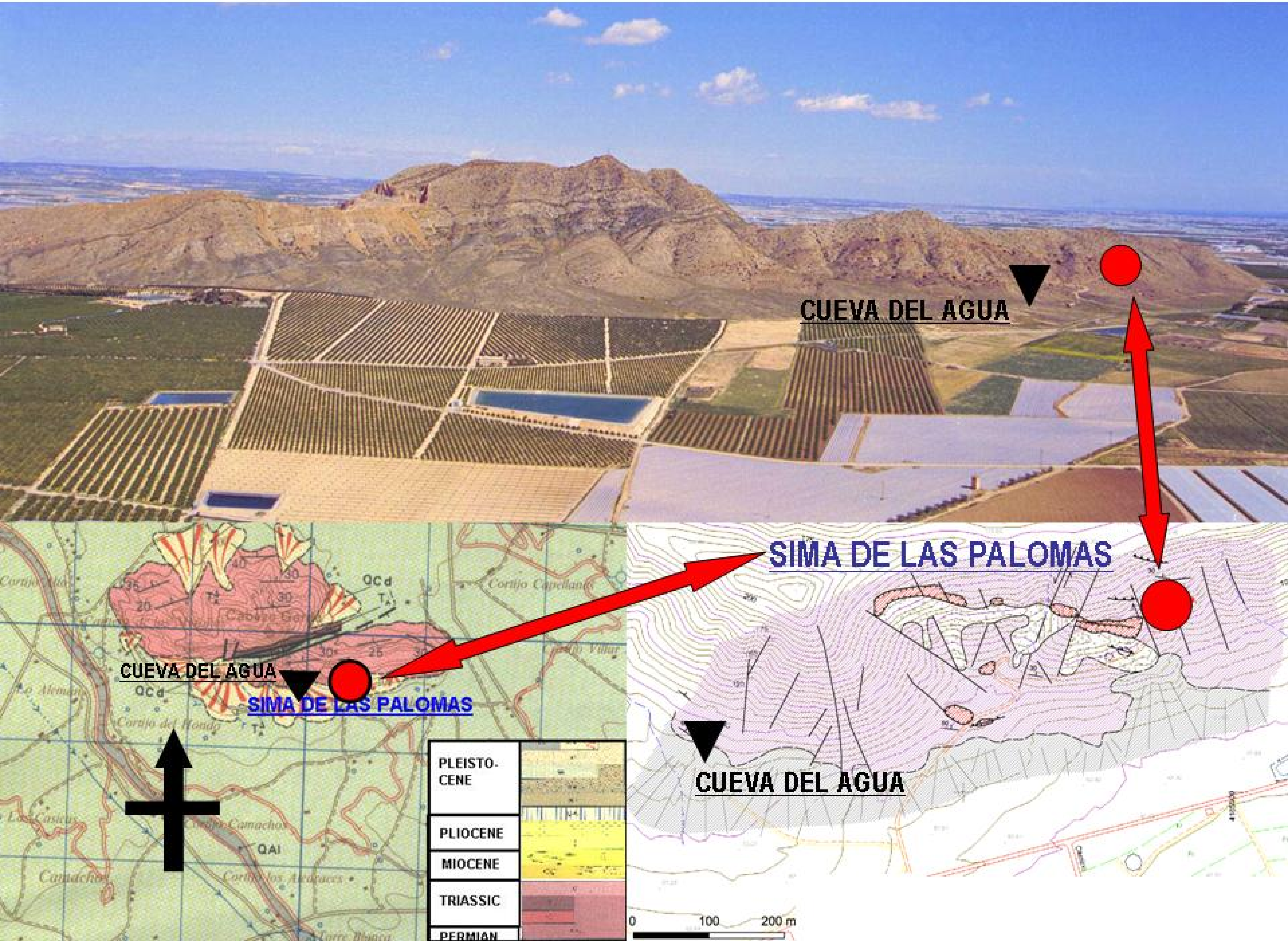
Figure 10 SP-96 skeleton and skull partly cleaned. Bones of the hands and feet have been omitted from the photograph.

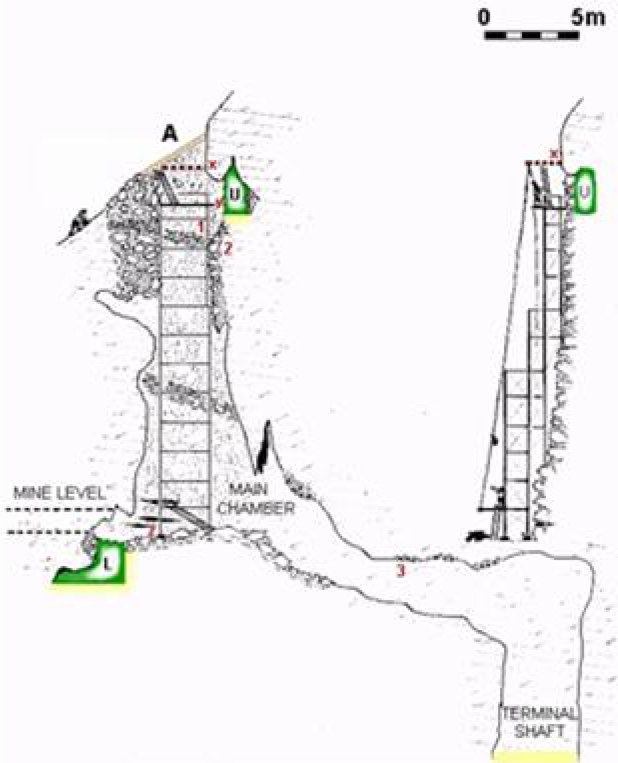
Figure 11 Left: block of conglomerate A containing a part of the SP-97 skeleton which is shown below partly cleaned. Lower right: conglomerate B during excavation.

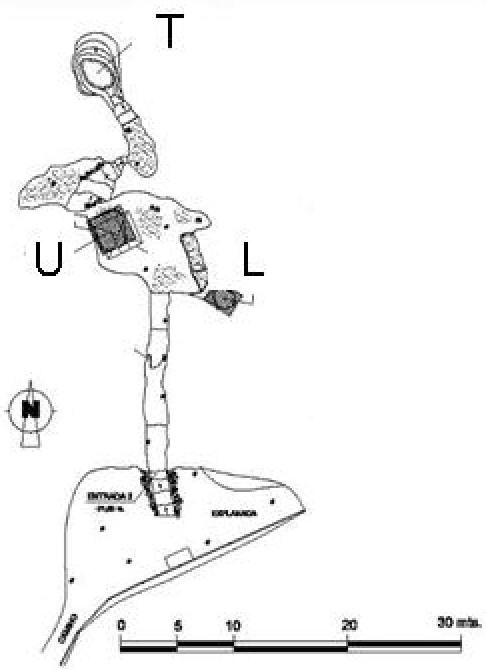
Figure 12 SP-97 skeleton and skull partly cleaned.

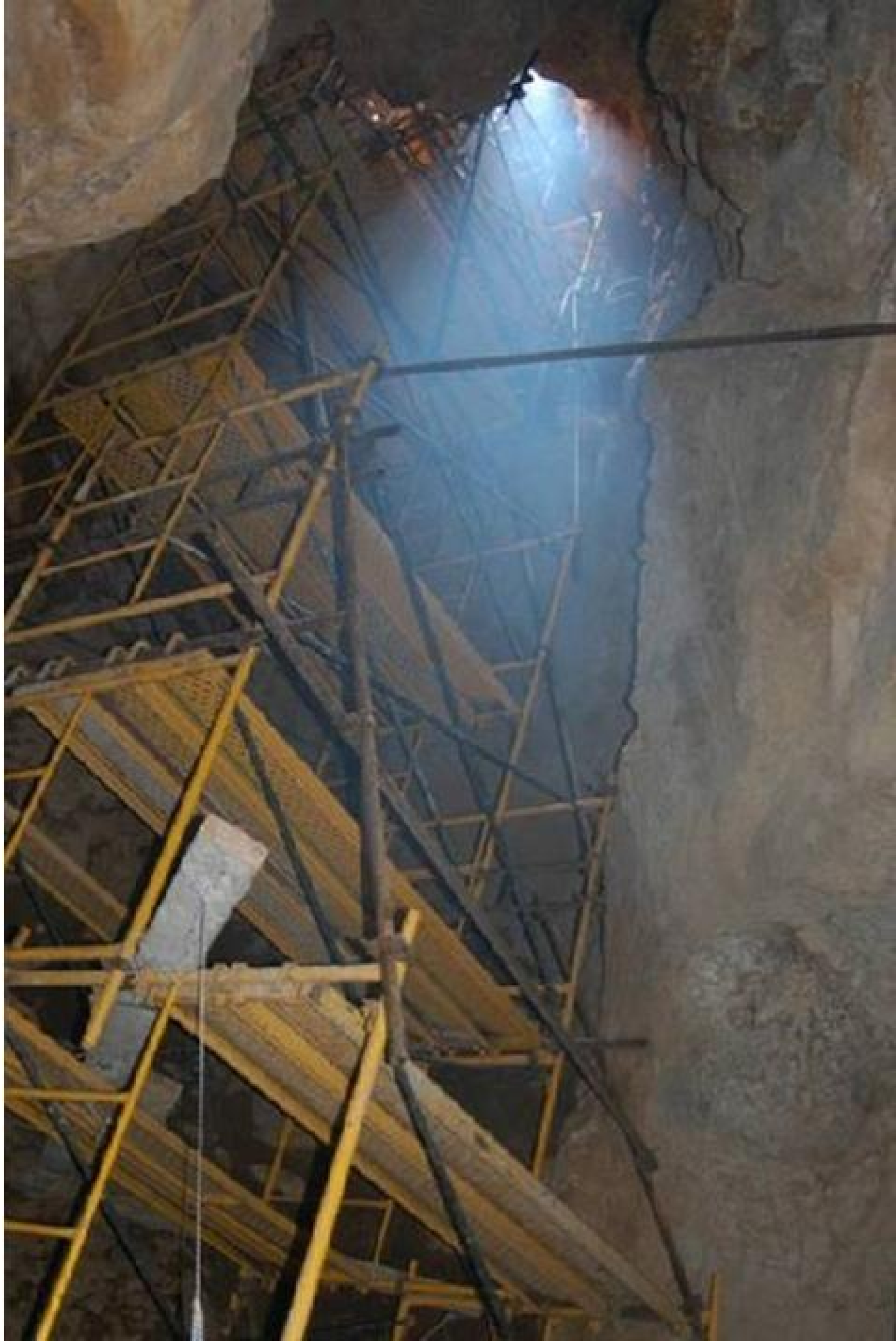
Figure 13 Some articulated parts of the SP-92 facial and post-cranial skeleton.

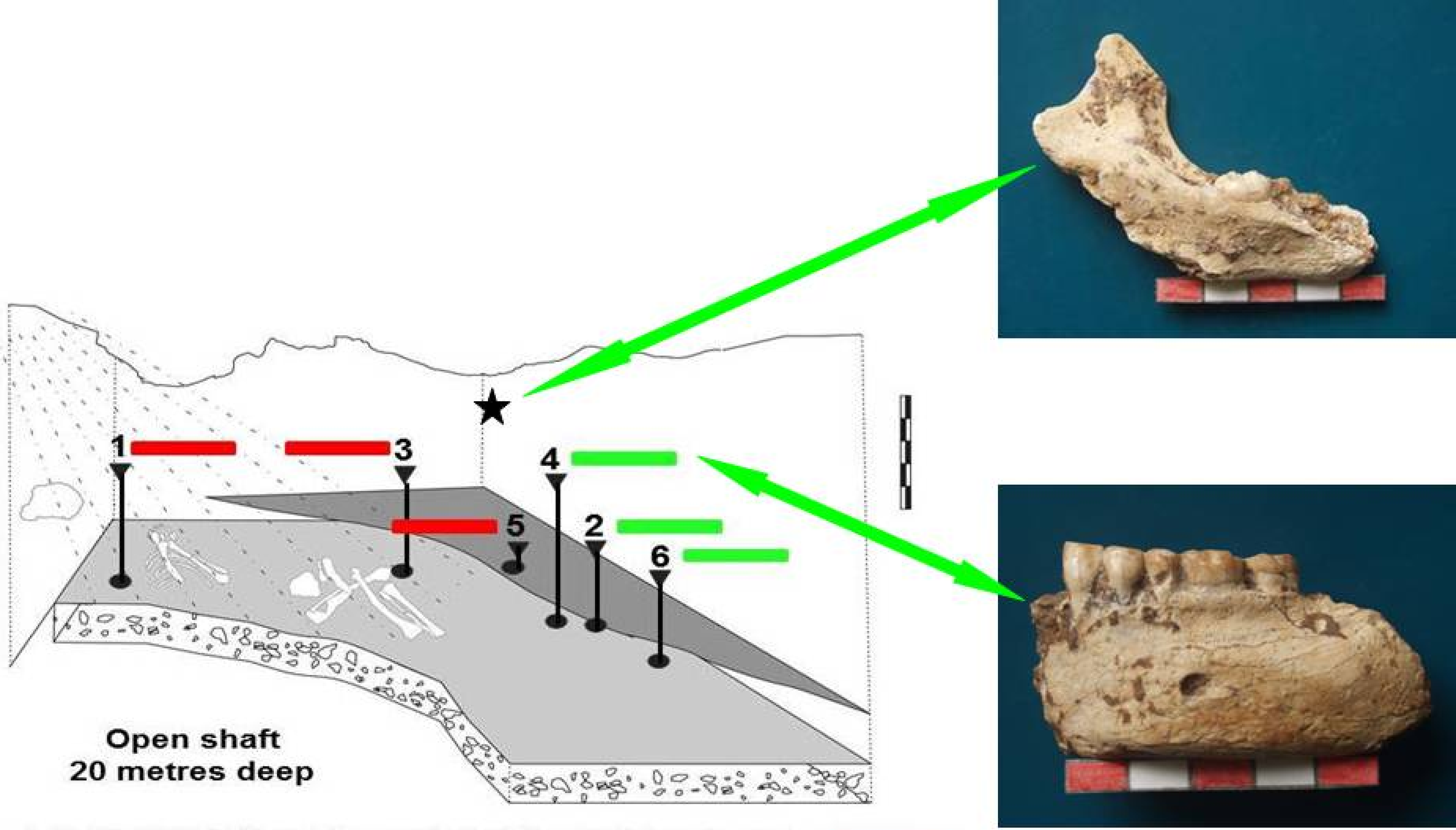
Sima de las Palomas
del Cabezo Gordo,
Torre Pacheco, Murcia


CUEVA DEL AGUA
SIMA DE LAS PALOMAS
CUEVA DEL AGUA
SIMA DE LAS PALOMAS
QCd
Cortijo Capellania
Cabezo Gordo
QAl
PLEISTO-
CENE
PLIOCENE
MIOCENE
TRIASSIC
PERMIAN
SIMA DE LAS PALOMAS
CUEVA DEL AGUA
0
100
200 m


0
5m
A
U
U
1
2
3
MINE LEVEL
MAIN CHAMBER
L
TERMINAL SHAFT


T
U
L
N
0
5
10
20
30 m/s.





1. **54,100±7700** BP (from 3 U-ser estimates) Neanderthal metacarpal.

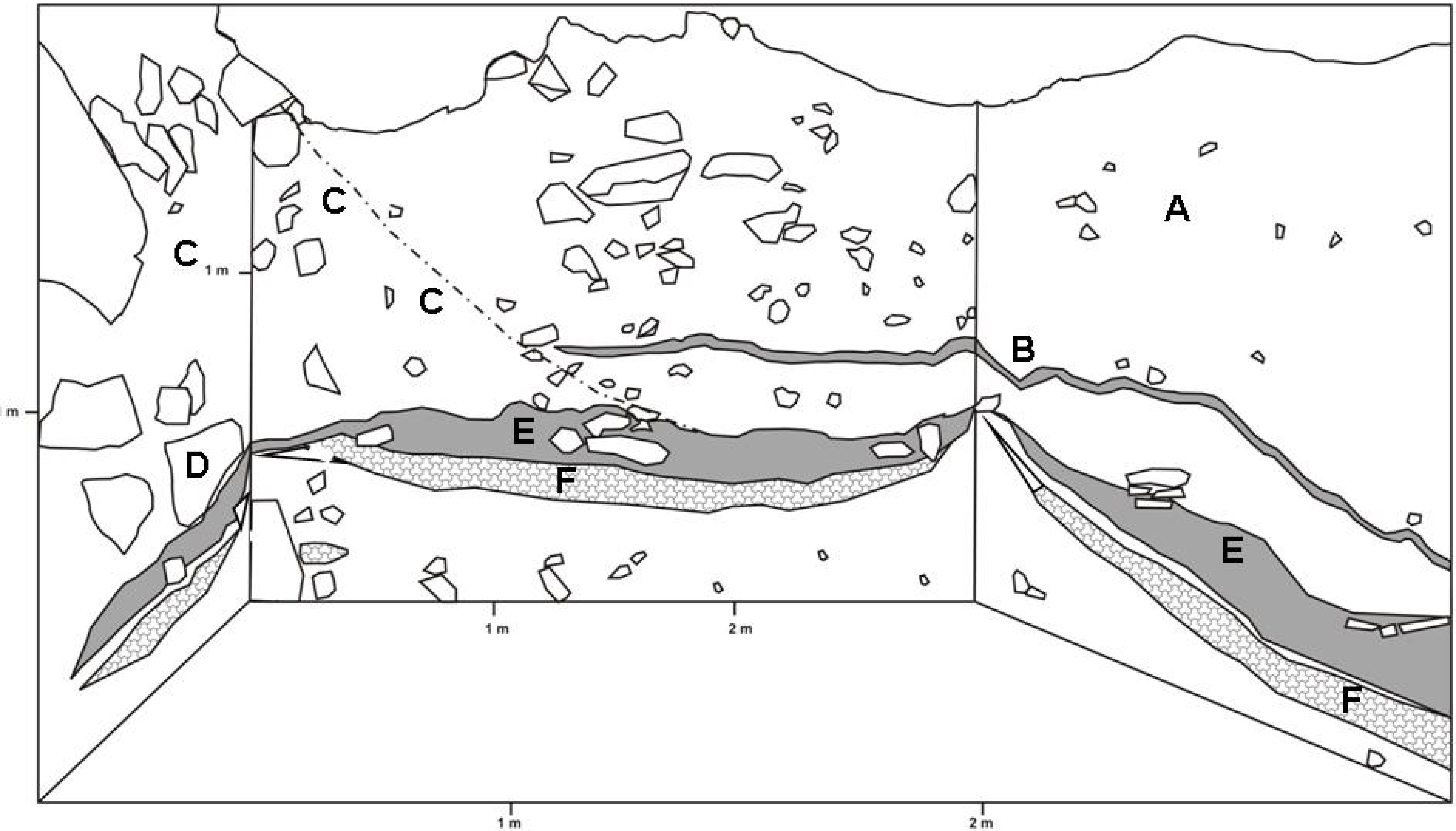
2. **43,800±750** BP (U-ser) Unburnt bone.

3. **51,000±2500** (U-ser) Unburnt bone.

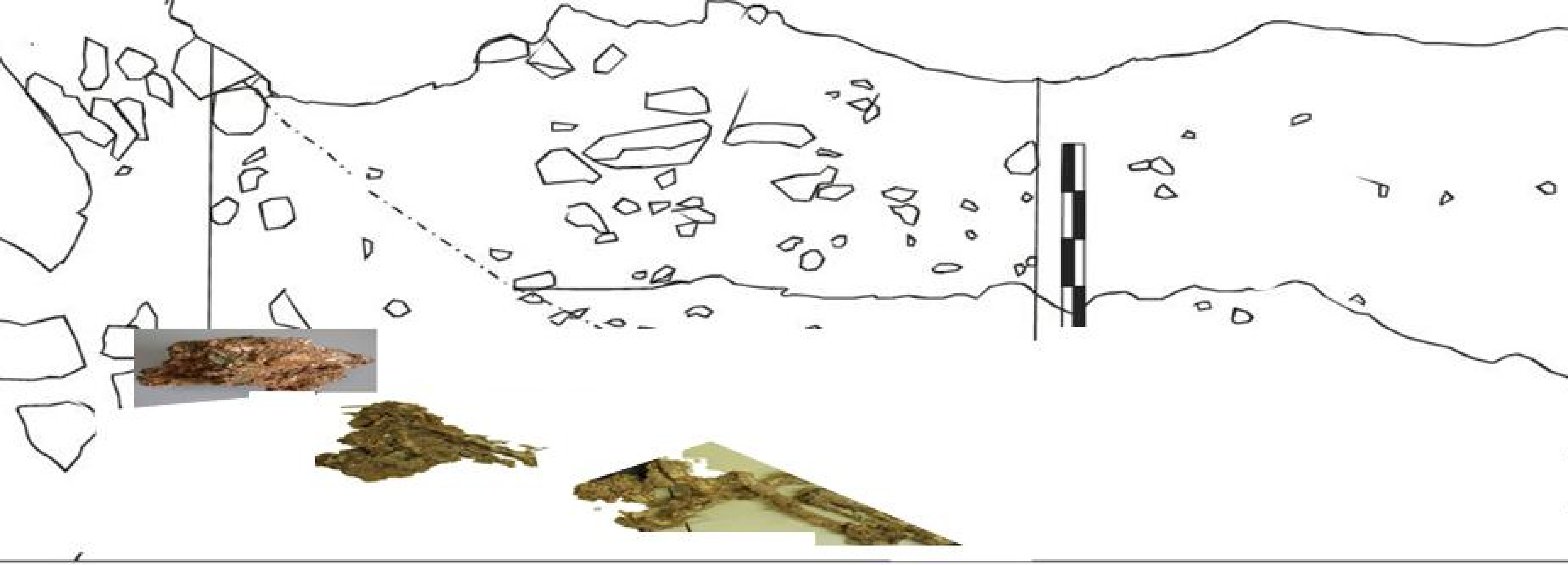
4. **34,450±600** BP (calib 40,950-37,622; C14) Burnt bone cemented to Neanderthal mandible.

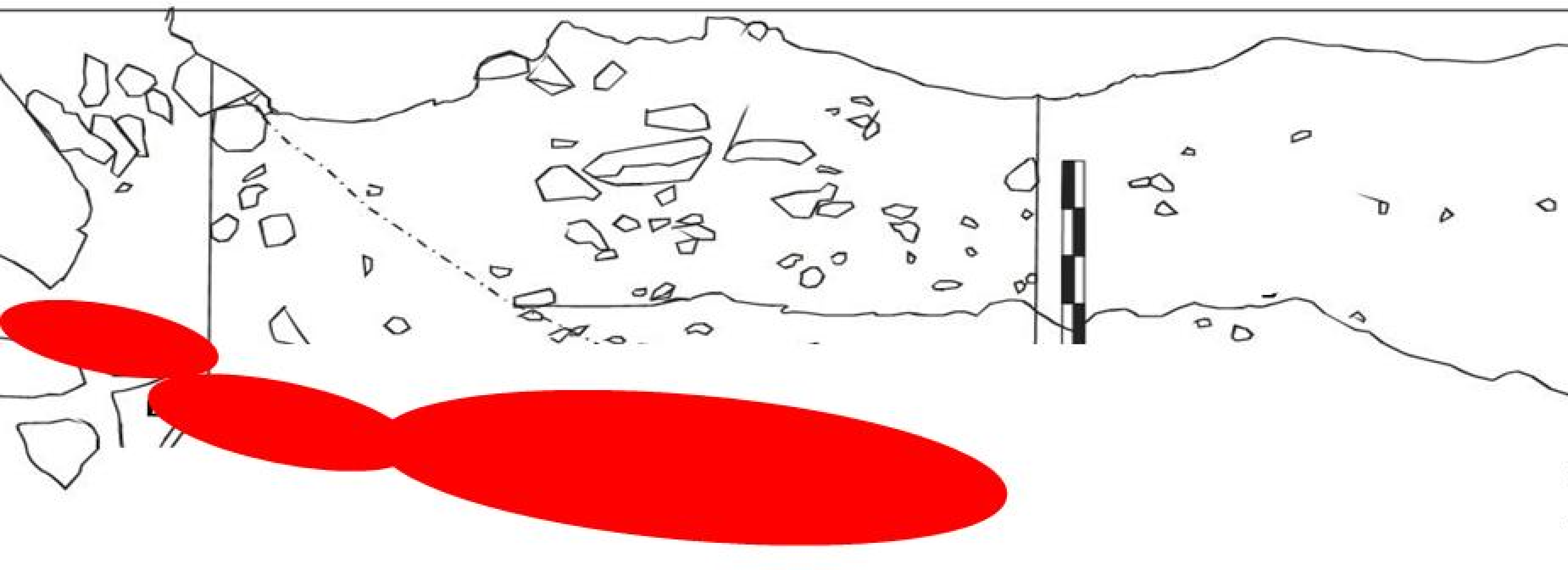
5. **54,700±4700** BP (OSL) Burnt sediment.

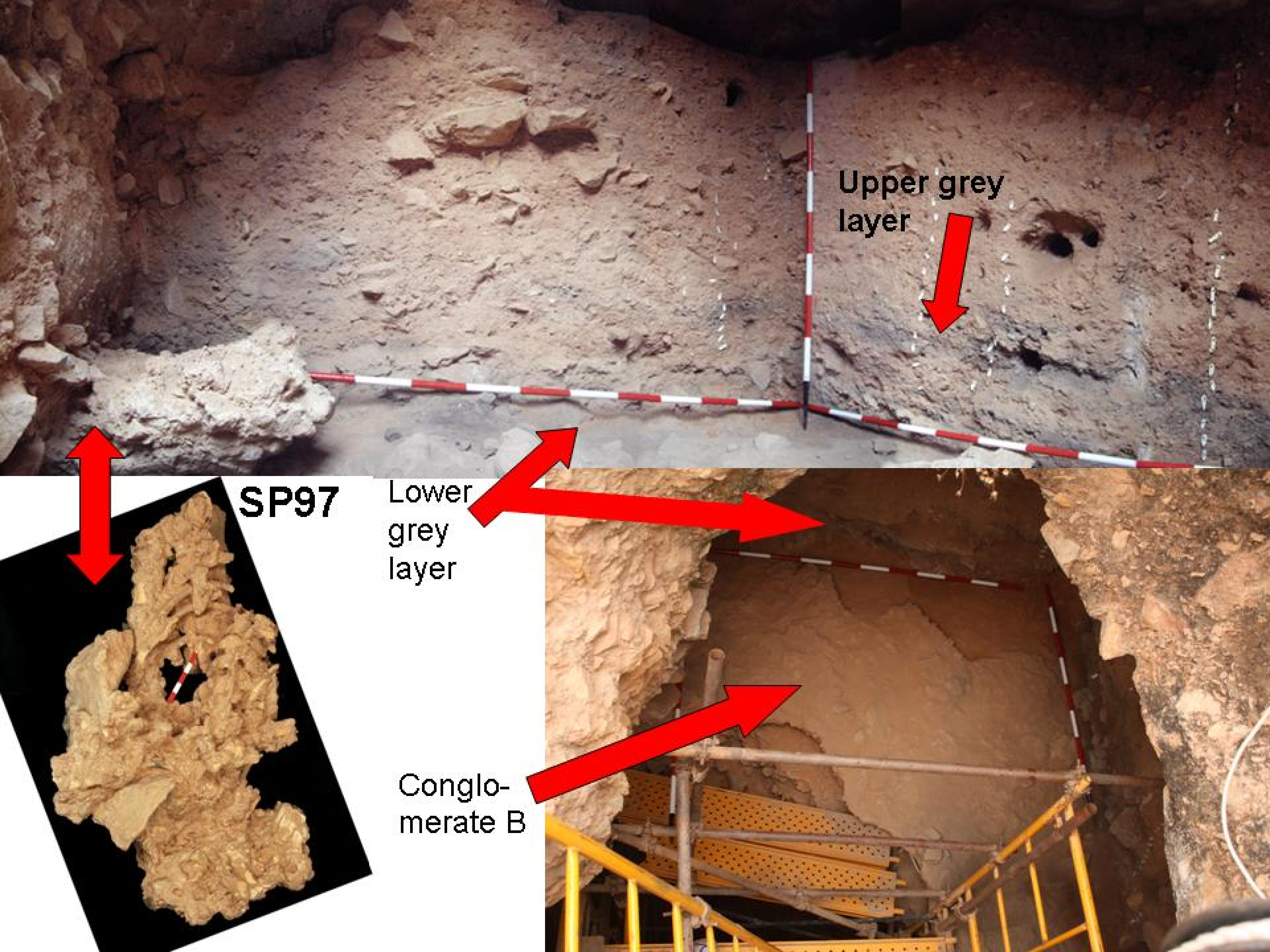
6. **35,030±270** BP (calib 40,986-38,850; C14) Burnt rabbit bones.


A
B
C
C
C
D
E
E
F
F
1 m
1 m
1 m
2 m
1 m
2 m


5 cm
5 cm
5 cm
5 cm
5 cm
5 cm
5 cm
5 cm






Upper grey layer
SP97
Lower grey layer
Conglo-
merate B