Received: 22 July 2019 | Revised: 17 December 2019 | Accepted: 6 June 2020
DOI: 10.1002/evan.21854

REVIEW ARTICLE

Evolutionary Anthropology ISSUES, NEWS, AND REVIEWS WILEY

Issues of theory and method in the analysis of Paleolithic mortuary behavior: A view from Shanidar Cave

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Funding information
British Academy; Calleva Foundation; Human Origins Research Fund; Leverhulme Trust, Grant/Award Numbers: ECF-2017-284, RPG-2013-105; McDonald Institute for Archaeological Research; Natural Environment Research Council, Grant/Award Numbers: NE/L002507/1, NF/2016/2/14; Rust Family Foundation; Society of Antiquaries of London; Wenner-Gren Foundation, Grant/Award Number: CONF-788

Abstract

Mortuary behavior (activities concerning dead conspecifics) is one of many traits that were previously widely considered to have been uniquely human, but on which perspectives have changed markedly in recent years. Theoretical approaches to hominin mortuary activity and its evolution have undergone major revision, and advances in diverse archeological and paleoanthropological methods have brought new ways of identifying behaviors such as intentional burial. Despite these advances, debates concerning the nature of hominin mortuary activity, particularly among the Neanderthals, rely heavily on the rereading of old excavations as new finds are relatively rare, limiting the extent to which such debates can benefit from advances in the field. The recent discovery of in situ articulated Neanderthal remains at Shanidar Cave offers a rare opportunity to take full advantage of these methodological and theoretical developments to understand Neanderthal mortuary activity, making a review of these advances relevant and timely.

KEYWORDS

burial, funerary activity, mortuary activity, Neanderthal, sediment micromorphology, taphonomy

1 | INTRODUCTION

The nature and possible extent of behavioral and cognitive similarities between our own taxon, *Homo sapiens*, and our close evolutionary relatives, the Neanderthals, have fueled a longstanding and still unresolved debate.[1–5] Evidence emerging in the last decade that these taxa interbred,[6–8] and potentially shared greater behavioral similarities (e.g., symbolism) than previously recognized,[9–15] gives renewed relevance to this discussion, particularly concerning the degree of resemblance between these groups, and the dynamics of their interactions that preceded the extinction of the Neanderthals and the spread of modern humans across the globe.

Within such debates, a key question concerns Neanderthal mortuary activity.[16–22] Here, we define *mortuary behavior* or *mortuary activity* in broad terms as any activity involving and directed toward the dead body of a conspecific which may, but does not necessarily, involve any kind of ritualized or symbolic activity; and *funerary activity* or *funerary behavior* as referring more specifically to examples where activities surrounding the body of a dead conspecific involve a ritualized or symbolic component, as discussed further below. The partial remains of 10 Neanderthal men, women, and children, found during Ralph Solecki's 1951–1960 excavations at Shanidar Cave, Iraqi Kurdistan[23–26] (Figure 1), have featured centrally in discussions about whether Neanderthals conducted purposeful burial, how variable their mortuary behavior was in time and space, if deliberate burials signify the beginnings of religious belief, and if sites with multiple burials like Shanidar Cave signify notions of "persistent places" of burial and landscape attachment—all behaviors strongly associated with modern *Homo sapiens*. Solecki argued that although some of the Shanidar Cave Neanderthals died in rock falls, others were intentionally buried, perhaps with accompanying rites, such as the famous "Flower Burial," and for the use of "grave markers."[23,27,28] Evidence from Shanidar Cave therefore feeds into wider debates about spatiotemporal variation in Paleolithic mortuary behavior, including intentional burial and cannibalism/body processing at other sites,[19,29–31] which are relevant to characterizing Neanderthal capacities for cultural variation and innovation.

A major source of controversy has been how to identify funerary behavior in the archeological record and distinguish between scenarios leaving similar archeological signatures, for example, chance preservation of a complete body in a natural depression versus intentional

FIGURE 1 View of Shanidar Cave, seen from the south (photograph: Graeme Barker) [Color figure can be viewed at wileyonlinelibrary.com]

burial.[17–20,32–37] Data obtained at the time of discovery are critical to confirming or disproving intentional human agency in the interment process, but the rarity of new in situ Neanderthal fossil finds has meant that most recent research has inevitably concentrated on "rereading" old excavations, primarily from western Europe, for which contextual and taphonomic information is limited.[32,35–38] The recovery and recognition of "grave goods" during some of the early excavations of Middle Paleolithic hominin remains, for example, those of *H. sapiens* at Skhul[39] and Qafzeh,[40] attest to the quality of some earlier excavations, and implies their absence at other sites may be genuine. Equally, the paucity of recently excavated skeletal material has further limited the impact on the "Neanderthal burial debate" of recent advances in areas including cave geology and stratigraphy, sediment micromorphology and chemistry, biostratinomy and forensic taphonomy that offer the potential to evaluate the archeological and cultural contexts of hominin remains more robustly than was previously possible.

In this context, renewed excavations at Shanidar Cave by some of the present authors[41,42] offer a unique opportunity to reinvestigate the chronological, paleoclimatological, and sedimentological characteristics of the original Neanderthal finds. The recovery of new in situ remains from the original Shanidar 5 skeleton[43] (Figure 2a), and most recently the discovery of articulated skull and upper body parts thought to belong to one of the individuals from Solecki's Shanidar 4, 6, 8, and 9 burial cluster[44] (Figure 2b), are highly significant, presenting a rare opportunity to study articulated Neanderthal remains and their depositional contexts with the full suite of modern archeological techniques.

A reconsideration of current theoretical, methodological, and practical approaches to debates on the evolution of hominin mortuary behavior is therefore extremely timely, and this review aims to achieve this with a focus on shaping future investigations at Shanidar Cave and other similar key sites. We begin by taking a broad perspective, considering the relevance of evidence for mortuary activity within the wider animal kingdom in shaping hypotheses and expectations for such behavior among extinct hominins, and then focusing more specifically on the investigation of mortuary behavior among past hominin taxa. In doing so, we use the emerging Shanidar Cave data to highlight the potential for investigating the evolution of mortuary activities, taking full advantage of recent advances in modern archeological science and broader theoretical perspectives.

2 | MORTUARY BEHAVIOR IN THE ANIMAL KINGDOM: A COMPARATIVE PERSPECTIVE

Identifying an appropriate null hypothesis for Neanderthal (or other hominin) mortuary behavior is an important baseline for attempting to identify and evaluate archeological evidence. Given other behavioral similarities between our taxon and Neanderthals, should the null hypothesis be that Neanderthals did not engage in mortuary activity, or should we work from the assumption that they did? Indeed, should we assume that the earliest representatives of *H. sapiens* behaved exactly as recent modern humans do? There are indications that some of the earliest potential evidence of mortuary behavior in the Middle Paleolithic follow geographic, rather than taxon-specific patterns,[22] so investigating the contexts of other Middle and Upper Paleolithic hominin remains with the same scrutiny and threshold of evidential support for interpretation is essential if we are to understand the origins of the kinds of mortuary behavior we see in recent populations of our own taxon.

The long anthropological tradition of looking to our primate relatives, or even to more distantly related species, offers an important point of departure for understanding the nature and context of mortuary activity among hominins, but one that is not always given adequate recognition. Examples of mortuary behavior (as defined above) have been documented across a wide range of species[20,45–50] (Table 1), from the carrying of dead infants for several weeks by chimpanzee mothers, to the revisiting of elephant carcasses by members of their social group,[47] to "necrophoresis" (removal of corpses from living areas) and "necroclaustralization" (corpse-covering) behavior among termites.[48] What is common to most of these mortuary practices is that they occur among species where there are long-term bonds among group members, and a relatively high level of social cognition. Thus, several of the mortuary activities commonly identified as significant or unique among humans are not necessarily as unusual as we might think, yet have not been considered by archeologists for whom burial is considered to be "symbolic" by default.[20,46]

Spatial and temporal variation in mortuary activity within the hominin lineage, including that potentially apparent among our hominin relatives such as *Homo naledi*,[51] the Sima de los Huesos hominins,[52] Neanderthals[19,22,53,54] and some mid and late Upper Paleolithic (Gravettian and Magdalenian) *H. sapiens*,[20,53,55] represents an important consideration for understanding the evolution of hominin mortuary behavior, particularly since mortuary activity in recent *H. sapiens* populations is notably highly variable across space and time. The identification of geographical or temporal patterns in the archeological record is limited by research bias, preservation bias and the aggregation of evidence spanning tens of thousands of years. Nonetheless, we should recognize the possibility (or probability) that mortuary activity varied through space and time among Neanderthals[53,54] just as it has done and does among *H. sapiens*. Indeed, the Middle and Upper Paleolithic record for mortuary activity shows periods with scant evidence interspersed with periods of relative archeological abundance. It is uncertain why evidence for intentional burial in the Middle Paleolithic seems to appear only from about 120 kya,[22] when both Neanderthals and *H. sapiens* had existed for many tens of thousands of years by that point, or why intentional burial was much more widespread in Europe during the Gravettian compared with the Aurignacian.[55]

Evidence for hominin cannibalism predates both Neanderthals and *H. sapiens*[56,57] and has been suggested at a number of Neanderthal sites in Europe[29–31] alongside evidence for possible interments or at the very least, cave sites containing articulated Neanderthal remains of multiple individuals.[58] In contrast, cannibalism is yet to be documented in the Middle Paleolithic of Southwest Asia,[22] despite a

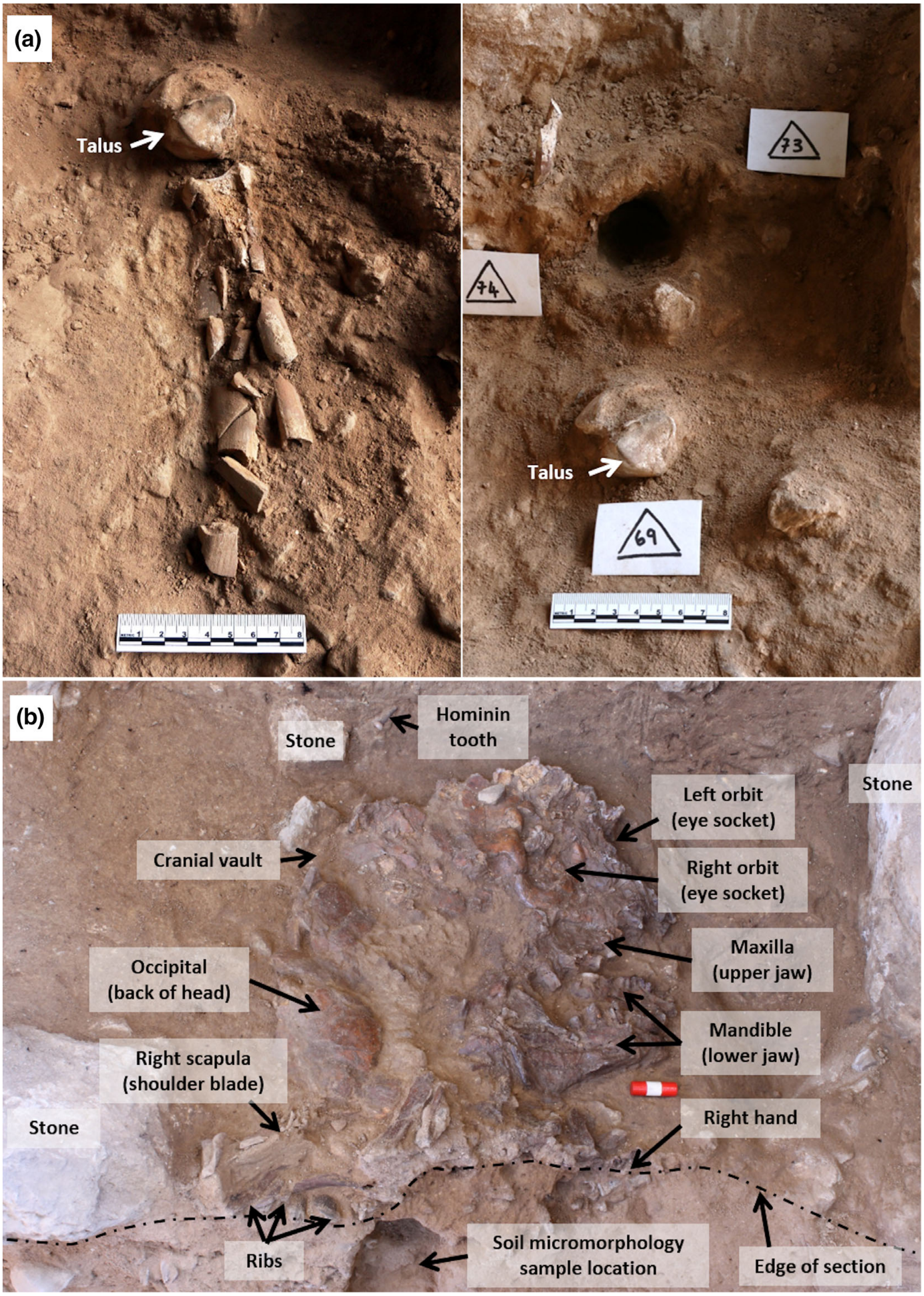

FIGURE 2 (a) Views of the Neanderthal articulated skeletal remains excavated in 2015, identified as part of Solecki's Shanidar 5, looking east; before (left) and after (right) the tibia was lifted. Note the burrow, probably of a mole rat, just above the bones; (b) the crushed skull of an adult Neanderthal excavated in 2018 adjacent to the location of Solecki's Shanidar 4 (the "flower burial"). Scales: (a) 8 cm; (b) 3 cm (photographs: Graeme Barker) [Color figure can be viewed at wileyonlinelibrary.com]

rich record of articulated Neanderthal skeletal remains from both caves (e.g., Amud,[59] Kebara,[60] Tabun,[39] Dederiyeh,[61] Shanidar) and an open air site (site 'Ein Qashish).[62] Cannibalism is also well documented at sites associated with Middle Paleolithic/Middle Stone Age *H. sapiens* in Europe and Africa.[63–65] Evidence suggests the bodies of conspecifics were sometimes processed for consumption and that this may have reflected ecological stress.[66,67] There is less evidence for the use of hominin bone to make tools,[30] or for nondietary related

TABLE 1 Examples of mortuary behavior in different species, compiled from References,[41–46] references therein

Species	Behavior
Chimpanzees	Carrying dead infant for up to ~70 days
	Attention prior to death
	Body processing (tooth cleaning)
	Cannibalism
	Aggression to body
Gorillas	Carrying dead infant
	Touching
	Burying with leaves
	Grooming dead body
	Vigils
Lemurs, macaques, muriqui	Mothers carry dead infants
Dolphins, orca	Carry dead
	Guarding the body
Elephants	Prolonged touching, attempts to lift
	Stay with body
	Revisit carcass
	Carry bones
Horses	Vigil
	Investigating the body
Magpies/jays	Flocking
	Bring leaves, twigs

processing of remains.[22] However, at present, it is only among modern humans that we have evidence for ritual significance attributed to hominin bone tools.[64] While variation in mortuary activity in both taxa may not be entirely due to cultural variation, the important observation is that while a single baseline expectation, or null hypothesis, for Neanderthal mortuary activity cannot be easily formulated, there is no reason not to expect a level of mortuary-related activity among Neanderthals, or conversely that mortuary behavior in the earliest *H. sapiens* was expressed in the same way as in more recent populations of our taxon. Whatever the case, one cannot simply conclude from the evidence we have that "Neanderthals buried their dead." It may be more profitable to ask why some Neanderthals buried some of their dead, some of the time.

So how can this problem be resolved, and what should we take from this comparative perspective? Ultimately, the combination and weight of multiple lines of evidence for intentionality and deliberate action appear to be essential,[22] incorporating many of the components discussed below. What is also clear from ethnographic studies of humans and behavioral studies of other animals is that we must keep our minds open to alternative scenarios (e.g., covering the body with earth, or stones, or plant materials, or textiles, or a combination of materials), to whether/how these can be tested archeologically, and the impact of alternative scenarios on skeletal presentation and other aspects of the archeological evidence. We also need to take care to avoid conflating the question of a taxon's capacity for a behavior with whether or not they undertook that behavior. While some researchers have debated whether Neanderthals practiced certain mortuary behaviors, for example, interment, very few have argued that they lacked the capacity for such behaviors.

Of the many challenges encountered during discussions about mortuary behavior that of terminology is frequent but lacks an obvious resolution.[68] Terms like "burial," "pit," and "grave" perhaps misleadingly evoke images of a deep, straight-sided shaft, which in terms of Neanderthal burials, are far from being the case; even assuming a degree of sediment deflation, existing examples are relatively shallow and the term "scoop" may describe reality better. Cases like these can be interpreted in multiple ways and contribute to confusion or generate disagreement where none may in fact exist. However, no single set of terminology would appear to satisfy all researchers: proposed terms such as "deposition" as a neutral description for a find of archeological human remains[20,68] for some people still carry implicit assumptions (deposition implies action for which someone or something is responsible), while "burial" may sometimes imply intentionality. Although no simple solution is apparent, qualifying adjectives ("intentional burial," "anthropogenic pit," "natural gully") help to reduce ambiguity and misunderstanding. "Mortuary activity" or "mortuary behavior" offer useful general terms for activities by conspecifics concerning or around the dead body, like cannibalism, contrasting with "funerary activity" or "funerary behavior," which imply formal practices or rituals associated with and symbolizing the relationship of the dead to the living.

3 | SKELETAL EVIDENCE FOR NEANDERTHAL MORTUARY ACTIVITY

The skeletal remains themselves have traditionally played a central role in the assessment of hominin mortuary activity. Characteristics including skeletal completeness and articulation, body positioning, taphonomic alterations, and the relationship between individuals all feed into debates concerning the treatment of the dead.[17,20,22,23,54,68–70] However, sometimes the resulting interpretations of mortuary behavior become too readily accepted in the literature when the strength of evidence is actually lacking. Of course, it is impossible for every individual researcher to fully reassess all available evidence and where attempts have been made, they have stimulated substantial controversy.[17,18,32,36] Nonetheless, the detailed reexamination of the previously published remains from Shanidar Cave as part of the new work at the site raises significant questions about the accepted interpretations of this material, such as whether remains could be confidently attributed to single individuals and the likelihood of natural or anthropogenic placement of the bodies. For example, reexamination of archive photographs of Shanidar 1 (Figure 3) suggests that the placement of the skull and mandible were unlikely to have occurred naturally given the location of the skull upslope from the body and the side-by-side placement of the cranium and mandible in their anatomical orientation relative to the ground but not to one another. Plans are in place to revisit and reexamine all the available evidence in the site archives at the National Anthropological Archives and Smithsonian Institute in Washington, DC,

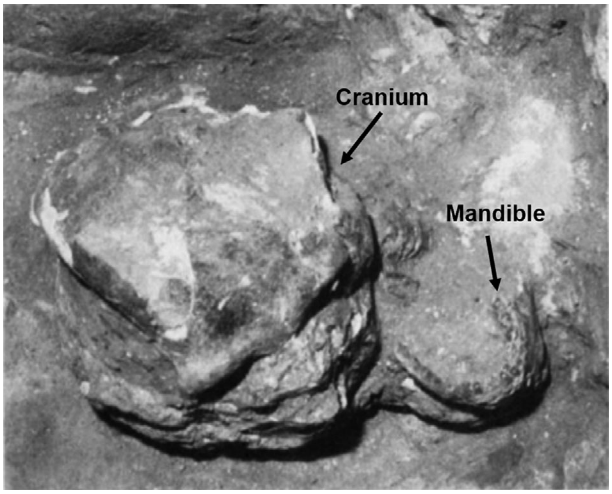

FIGURE 3 Photograph of the Shanidar 1 skull in situ, showing the displacement of the cranium and mandible[71]

which has been significantly enhanced by further materials donated by Ralph Solecki shortly before his death in March 2019, and materials housed in the Baghdad Museum.

Skeletal evidence related to cause of death and the taphonomic history of skeletal remains is central to understanding how hominin remains entered the archeological record and so for identifying potential hominin mortuary activity. Work at other sites to identify evidence for premortem, perimortem, and postmortem bone damage has demonstrated the effectiveness of such approaches, which are only recently being systematically applied to hominin remains[51,72,73] (Figure 4). As bone breaks differently in its fresh, fleshed, state compared with when it is dry and the soft tissue decomposed,[77,78] detailed analyses of bone breakage patterns at, for example, Sima de los Huesos[74–76] (Figure 4) provide a useful model for the re-evaluation of interpretations of the Shanidar Cave Neanderthals, such as Solecki's argument that some individuals were killed on the spot by rock fall.[23,24,27,28] Comparative taphonomic analyses of associated faunal remains, including analyses of bone breakage patterns, could also offer further insight into the depositional contexts of the hominin and animal remains, and the contribution of factors such as rock fall from the cave roof.

The potential impact of environmental factors on skeletal completeness, and how this could be better recognized and assessed, remains an important area for research and clarification. The potential effects of freezing/thawing or desiccation on the preservation and disintegration of intact bodies may be relevant to explaining hominin skeletal completeness in caves such as Shanidar, but it appears that the potential impact of these kinds of processes has not been well explored in the context of hominin mortuary activity. Greater engagement with relevant "archeothanatological"[69,79] and forensic anthropological and taphonomic literature may offer some answers,[80–82] or reveal the need for further experimental work. The evidence for environmental conditions when bodies was deposited (see below) will be important for evaluating the likelihood of any such taphonomic effects on skeletal preservation.

Comparative work on animal skeletal articulation and completeness at sites where Neanderthal remains are recovered, and on the taphonomic processes affecting these, has been mentioned in the literature as a means of better understanding how articulated hominin remains enter the archeological record at the same sites,[17,20] but little systematic work on this topic has been done at Shanidar Cave. Such data might present important new evidence for or against intentional burial at particular sites, although careful consideration of how both hominins and other animals used caves, and their likelihood of dying in these kinds of locations, is required. Detailed taphonomic analyses of the hominin and faunal remains for features including cortical surface weathering, burning, and anthropogenic marks in the form of cut and butchery marks, could provide indications of the differential treatment of human and faunal remains, and comparisons of cortical surface weathering could be especially useful to identify potential differences in the taphonomic and postdepositional history of the animal and hominin remains(e.g., References 36 and 38). Microscopic analyses of bone damage patterns can also be revealing about the speed of deposition and covering of the body,[83–85] offering yet another line of evidence to more accurately reconstruct the taphonomic history of the hominin remains (although see Reference 86).

Examples from a number of sites, both Paleolithic and more recent, demonstrate the utility of carefully reconstructing the original position of the body in combination with the subsequent impact of taphonomic and anthropogenic factors, to fully evaluate potential mortuary treatment of the body, as has been emphasized in some of the literature.[68,69,79] While this evidence is irretrievable for some of the older Shanidar Cave material because poor preservation and time constraints limited the observation of remains in situ, the reanalysis of unpublished archive material may be informative. The discovery in the current excavations of one (possibly two) partial, articulated skeletons[44] (Figure 5) directly adjacent to where a sediment block containing Shanidar 4 (the "Flower Burial") and three other partial individuals (6, 8, and 9) was removed in 1960,[23,71] offers a valuable new opportunity to reevaluate the nature of the Shanidar 4, 6, 8, 9 cluster, the relationship between the individuals, and interpretations of potential secondary burial of some of them (which based on a reexamination of published evidence[23] would appear unlikely). The new remains clearly show that two individuals in the cluster, the new find ('Shanidar Z') and Shanidar 4, were left in extremely close proximity and in an articulated state.[44] Future work will establish in greater detail the relationship between this new individual and what appears to be a second individual found below it in 2019 that remains largely unexcavated.

4 | STRATIGRAPHIC AND SEDIMENTARY EVIDENCE FOR NEANDERTHAL MORTUARY ACTIVITY

Many of the past debates about mortuary activity and possible deliberate burials—and accidental ones exemplified by the rockfall deaths suggested by Solecki in the case of Shanidar Cave—have occurred because evidence from the sedimentary and stratigraphic context of

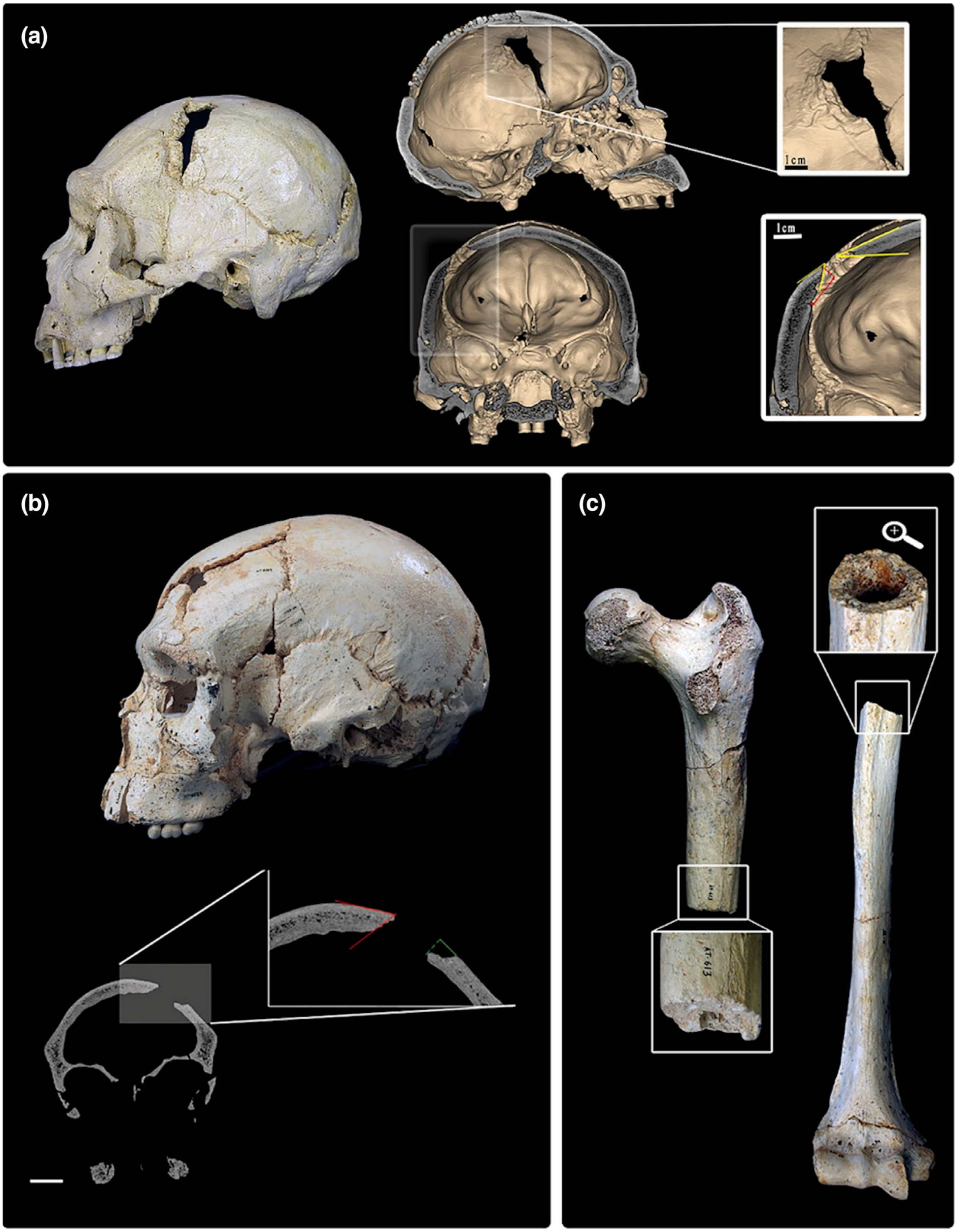

FIGURE 4 Examples of the forensic-taphonomic techniques applied for the breakage analysis of Sima de los Huesos hominin fossils: (a) Cranium 5 (Cr-5) perimortem fracture on left parietal bone (modified from Sala et al.[74]); (b) Cranium 17 (Cr-17) perimortem trauma on the frontal squama (modified from Sala et al.[75]); (c) examples of long bone postmortem fractures (modified from Sala et al.[76]) [Color figure can be viewed at wileyonlinelibrary.com]

hominin remains was either not recorded at all or in sufficient detail, or was not published, either because it was not recognized or not thought to be of critical importance, or because the evidence, although recognized, was equivocal. Revisiting excavators' notebooks and correspondence can at times provide evidence not published at the time, as in the case of La Ferrassie,[87] Roc de Marsal,[37] and Régourdou.[88] This is a very important task for the Shanidar Cave Project as much of the detailed observation by Ralph Solecki and his team remains unpublished but is present in notebooks and other records.

One of the issues to be considered in deciphering the stratigraphic and sedimentary context of human remains is that the starting point

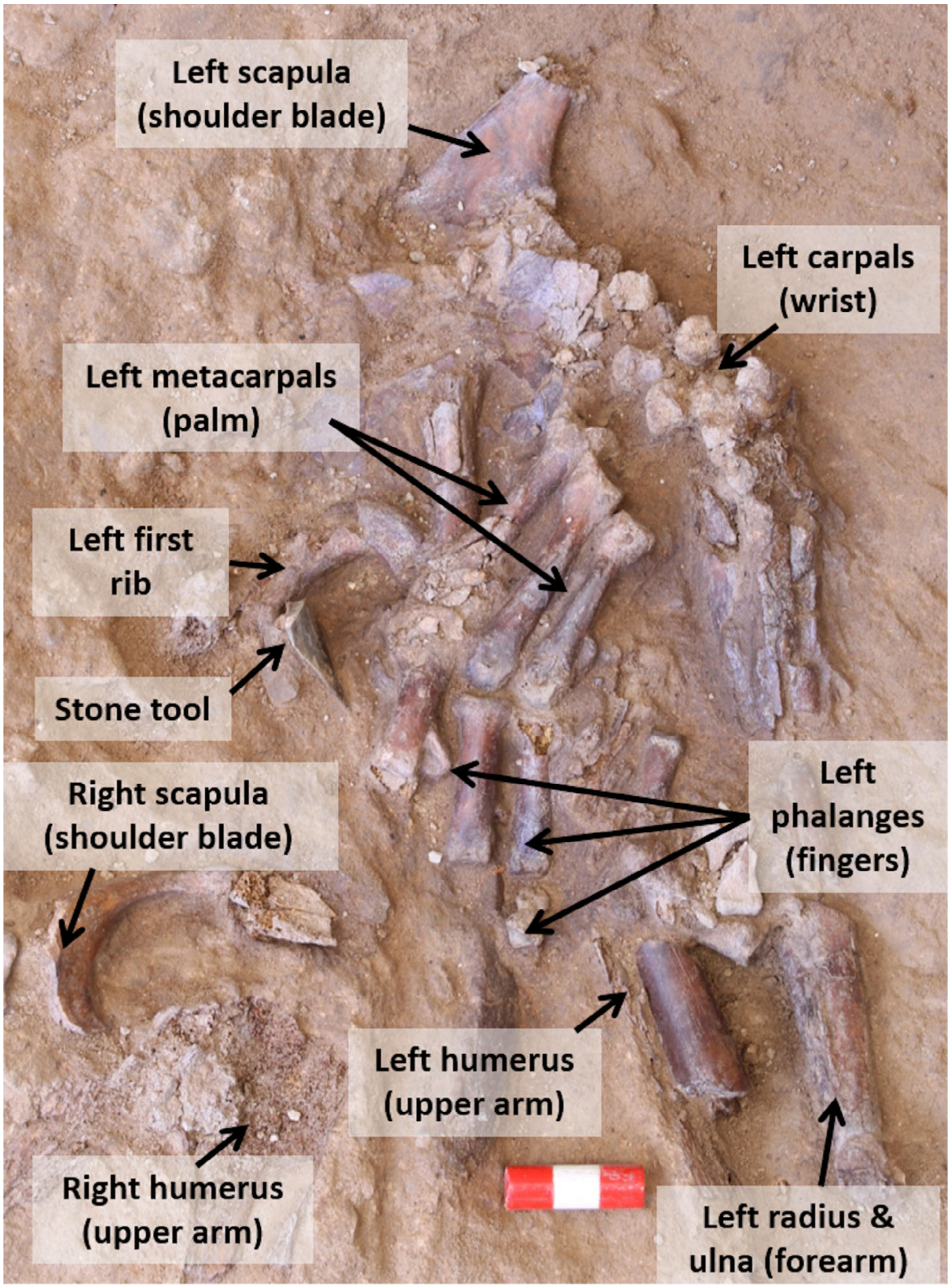

FIGURE 5 The articulated upper limbs of an adult Neanderthal excavated in Shanidar Cave in 2018, found adjacent to Solecki's Shanidar 4 (the "flower burial"), looking east. Scale: 3 cm (photograph: Graeme Barker) [Color figure can be viewed at wileyonlinelibrary.com]

cannot be assumed to be uniform. Recent human populations, both living and ethnographic, as well as some animal species display an extraordinary array of mortuary activity and resting places for the dead, as discussed above. Importantly, the state of the body, and the presence and durability of any wrapping or container, will impact considerably on the nature and action of sedimentary and diagenetic processes during and following disposal of a body, and there is a wealth of forensic evidence to draw from in addition to geoarcheological analyses.

The details of stratification and sediment fabric (patterns of clast and fabric orientation, sorting and grading, and patterns of dissolution and mineral deposition around the individual) are of critical importance (cf. References 35, 89, and90). The particular repose of a body is likely to conform to the surface on which it comes to rest unless in *rigor mortis* or constrained in a bundle and buried rapidly, or otherwise laid out deliberately. The shape of the lower bounding surface and whether it cuts preexisting features may provide evidence for whether it was a natural phenomenon or anthropogenically modified in some way (e.g., Reference 36). In modern forensic cases, tool marks may occasionally survive in a cut grave,[91] but these are rarely identified in older burials, even of comparatively recent date. In the Paleolithic, tools for excavation were probably rudimentary and not particularly effective in anything other than the softest and least consolidated of sediments or soils, so purposeful excavations are unlikely to have been very deep or very regular.

It is likely that available natural locations, for example, karstic cavities and gullies, will have been exploited by Neanderthals as locations for the disposal of their dead.[19,22] In this scenario, bodies may have been intentionally covered, partially or completely, with sediment or with less durable materials such as branches or brush, or skins, for example, to deter scavengers. It is, however, also likely that, during inclement conditions or if unwell, individuals may have taken refuge in sheltered gullies or karstic cavities, where they may have died and become covered by naturally accumulating sediments.[17,18] Only by extremely careful micromorphological, sedimentological, and taphonomical analyses might we distinguish between these scenarios, but it must be borne in mind that sedimentary processes in caves are often dominated by dry (or wet) mass flows very similar to those that might occur through purposeful infilling of a cavity. Characteristic sedimentary structures and fabrics are associated with different natural and anthropogenically mediated processes of cave sediment deposition. Sedimentation in caves can be extremely variable, but sedimentary features typical of running water, mudflow, dry grain flow and fall are all common (e.g.,[92–95]). Most of these are identifiable macroscopically, but far more may be evident through microscopic examination of sediment sample thin sections. Some may overlap with the processes operating in the infilling of graves, but the purposeful infilling of a cavity such as a grave can sometimes lead to characteristic stratification and fabric (e.g., Reference 89; Figure 6).

Postdepositional processes may provide evidence for the state of the body when it came to rest. Sediments that accumulated or were placed over and against the body may be displaced during putrefactive swelling, and then collapse into voids left by decay of soft tissues.[86] The presence of large quantities of decaying organic matter and leaking body fluids can lead to localized calcification[89] and the formation of the secondary phosphatic mineral apatite through the phosphatization of bone[98] (Figure 7). These indicators will not necessarily be present in the case of previously skeletonized or desiccated remains. Layering may be disrupted physically—predators may dig out parts of buried bodies, while plant roots and burrowing animals may favor and thus disrupt the relatively unconsolidated sediments in grave fills.[18] Diagenesis, particularly in the presence of groundwater, which may precipitate or dissolve minerals, may modify sediments and can disrupt or overprint stratification, as was the case for many of the Qafzeh individuals,[99] and even destroy bone, as in the case of lower limbs of Kebara 2.[100] Diagenetic shrinkage/compaction is particularly marked in semi-arid and tropical environments—in some caves in these locations sediments may lose a significant part of their volume during diagenesis, with consequent disruption of stratigraphy.

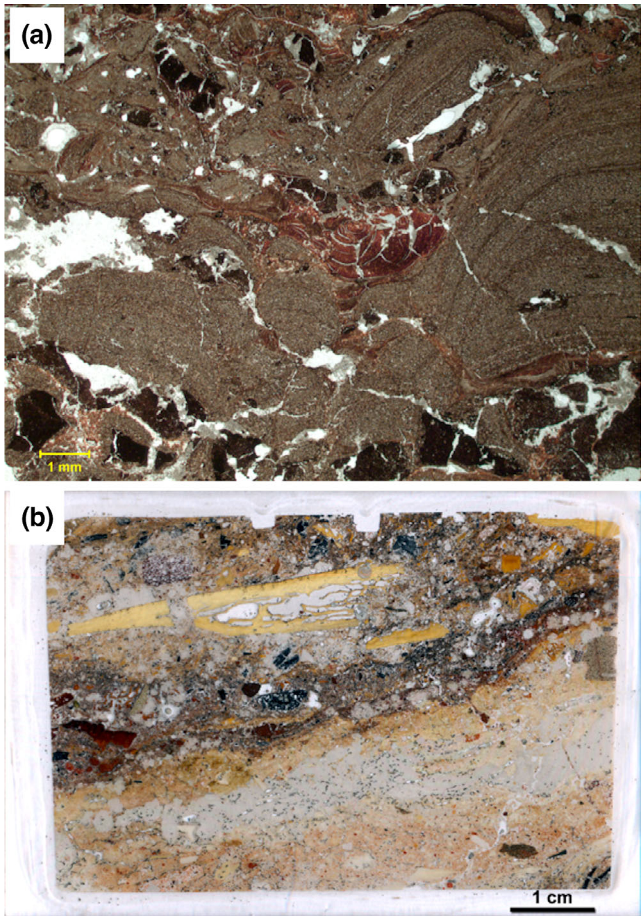

FIGURE 6 Photomicrographs of natural and anthropogenic sediments. (a) Contorted finely laminated silts and clay from Archeological Stratum 12 at Wonderwerk Cave, South Africa.[96] These waterlain deposits predate the occupation of the cave and are linked to phreatic processes of the cave system. Plane-polarized light (PPL); scale is 1 mm. (b) Thin section scan of bedded cultural material from Sibudu Cave[97] consisting, at the base, of pinkish brown angular crushed bone in a matrix of phosphatized ashes that were likely redistributed by sweeping or raking out of ashes; these are overlain by a whiter banded lens of gypsum. The upper half of the slide is a charcoal-rich layer with some burnt fibrous organic material and appears to represent a trampled in situ hearth, which is shown by a large (cm sized) bone that has been snapped in place. PPL; scale is 1 cm. (images: Paul Goldberg) [Color figure can be viewed at wileyonlinelibrary.com]

5 | ECOLOGY AND AFFORDANCES

Although long regarded as a cold-adapted taxon, there is increasing evidence that Neanderthals occupied a broad ecological range characterized by a temperate climate with warm to cool temperatures and open or woodland vegetation, and that they preferred regions with high topographic diversity and moderate slopes.[4,101–104] This ecological range was part of their niche, that is, it contained the environmental affordances of water, food, materials, and shelter required to sustain Neanderthal groups. Within their ecological range, Neanderthals' foraging lifeways likely relied on mobility not only to access food and materials but also for information gathering and social networking as a means of countering risk. These activities must have depended on both their spatial cognition and the "legibility" of the landscapes that they traversed.[1] Legibility is a concept drawn from geography[105] that captures spatial coherence of the landscape and the availability of navigational aids, both physical and sociocultural (places imbued with special and persistent significance from past shared experiences). Many caves in Italy may have held such special significance for Late Upper Paleolithic and Mesolithic hunter-gatherer populations.[106] Arene Candide, for example, was used both for occupation and for burial, the latter on repeated occasions with skeletal parts being

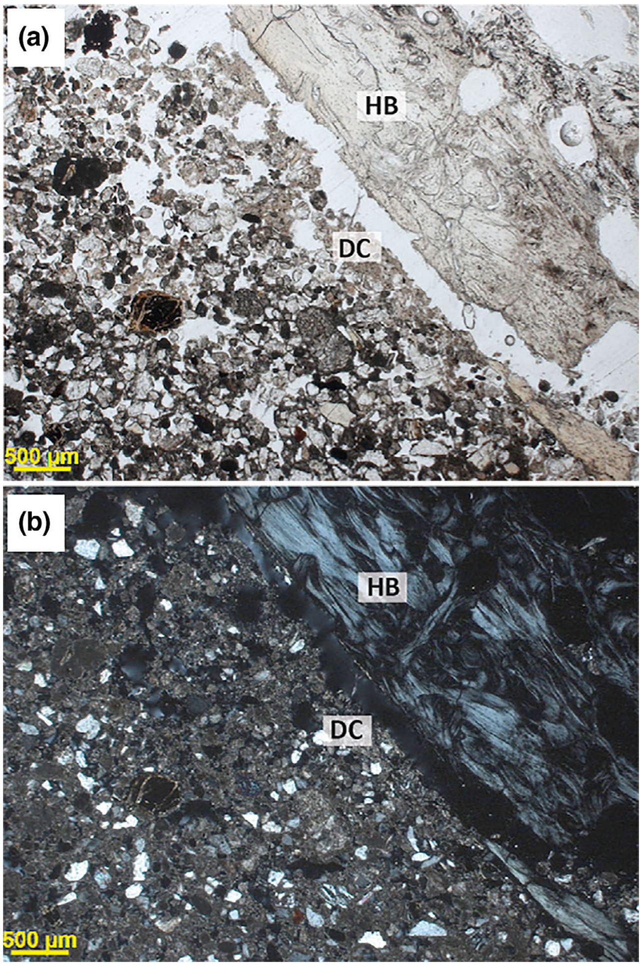

FIGURE 7 Photomicrograph of a micromorphological thin section of a human cranium and surrounding sediments from a late pre-Islamic burial in the United Arab Emirates, in plane polarized light (a) and cross polarized light (b). The grave pit was dug into bedded deposits in a Wadi; the grave-pit fill consists of sedimentary components identical to those of the Wadi deposits but lacks clear bedding structures. The fill exhibits a more porous microstructure and contains fragments of reworked bedded sediments (i.e., slaking crusts). Kutterer et al.[90] argue that decalcification (DC) of the grave pit fill directly adjacent to the human cranium (HB) was caused by decomposition of the body following burial (image: Christopher E. Miller) [Color figure can be viewed at wileyonlinelibrary.com]

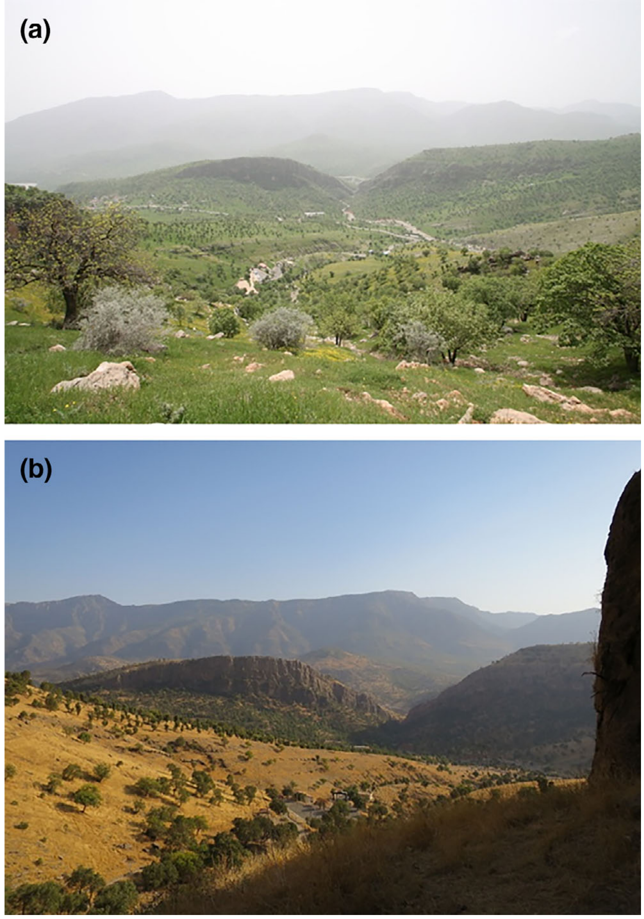

FIGURE 8 Views south from Shanidar cave: (a) in early spring; (b) in late summer (photographs: Graeme Barker) [Color figure can be viewed at wileyonlinelibrary.com]

displaced by subsequent interments.[107,108] Did prominent places in the landscape have similar roles for Neanderthals, and was Shanidar Cave one of them? The cave is located on the edge of a steep gorge, surrounded by prominent rocky escarpments, under a distinct ridge that could have acted as a navigation beacon. A history of occupation would have added cultural significance to the visual salience of the site, creating a sense of place that could have been transmitted intergenerationally.

From the analysis of the faunal material excavated by Solecki[109] and the initial results of the new project's studies of environmental proxies including macrofauna, microfauna, mollusks, pollen and plant macrofossils, it would appear that Shanidar Cave had, when the Neanderthals were there in MIS 5–3, a climatic range not dissimilar to that of today. It is also located in a topographically diverse region in addition to providing animal and plant resources. There is a perennial spring today in the valley above the cave, and a water seep at the back of the cave where footprints observed during the new excavations indicate that animals such as wolves, hyenas, foxes, and ibex still come to drink, suggesting that water could have been locally available in the past. As well as providing spectacular views southwards down to the valley of the Greater Zab River and the mountain range beyond (Figure 8), the cave provides shelter from the hot summer sun, from rain and strong winds, and could also have provided a locality defensible against large predators, as it did for transhumant pastoralists in Solecki's time (see below).

Of course, there can be no presumption of continuity in the cave's function during successive occupations. Neanderthals may have used Shanidar Cave as a base for shelter and foraging, as a temporary stopping place and possibly as a place to shelter the dead and dying; and indeed there are indicators of differences in the pattern of occupation of the cave at different times that do not seem to be explicable simply as adaptations to different climatic regimes (though the paleoclimate data are still very coarse). The Shanidar 5 remains were located above a thin archeological layer suggesting sporadic occupation and/or use of the cave as represented by sparse deposits of lithics, butchered bone and burnt plant remains. Hearths excavated in 2018 and 2019 within this layer and layers underneath it appear to have been short-lived fire features, based on their size and thickness, similar to those characterizing the overlying Baradostian (anatomically modern human) layers dating to MIS 3. In contrast, the new skeletal remains, found adjacent to the location of Solecki's "Flower Burial" and c. 3 m below Shanidar 5, were within a thick series of charcoal-rich occupation layers with far denser quantities of archeological material but without visible hearths. Solecki noted similar differences within the Neanderthal layers that he excavated.[110]

6 | LANDSCAPES AND "DEATHSCAPES": NEANDERTHAL "PERSISTENT PLACES"?

Neanderthal use of space in the case of Shanidar Cave can be conceptualized at three distinct scales: the space within the cave used in daily lives and mortuary activity; the landscape around the cave within several hours' walk that we presume would have been the main setting for their daily subsistence activities; and the wider landscape in which they moved (Figure 9).

At the local scale, the very constrained siting and extent of the excavation currently precludes the sort of spatial analysis that has been undertaken at sites like Molodova I, Ukraine,[111] and Grotte du Renne in France,[112] where simple "enclosures" of loosely cleared stones may denote the development of behavior controlling and marking space immediately around and within reach of an individual's body. The earliest example of this is the extraordinary structure of broken stalagmite deep in Bruniquel Cave in southwest France dated to c. 175 ka.[113] Such structures perhaps denote personal behavioral rituals implied by the parallel development of evidence for the symbolic decoration of the body, for example, bivalve shells to contain ochre pigment at Cueva Aviones, Spain, dating to 115–120 kya,[15] eagle talons at Krapina, Rio Secco, Les Fieux and Grotte Mandrin,[114] black raptor and corvid feathers in Gibraltar (based on cut marks on wing bones),[9] marine shells with ochre at Grotta di Fumane, Italy, dating to before 45 kya and the manganese pigment crayons at many Middle Paleolithic sites in France.[11,115] In the case of Shanidar Cave, it remains striking that most of the bodies or body parts seem to have been cached or placed in close proximity to each other in the center of the cave, in natural cavities and shelters afforded by massive boulders derived from the major fault that dissects the cave's ceiling above the Solecki trench. Whilst it could be argued that this clustering is a product of excavation bias, it is also the case that the "rockfall landscape" at the center of the cave provided natural niches that were utilized repeatedly for the disposal/treatment of dead individuals.

There are ethnographic examples of "deathscapes" or "necroscapes" in which certain locations are seen as appropriate for funerary use either by association with another burial or because the landform has special meaning.[42,116] It is clearly risky to transfer concepts like these to the Paleolithic, and indeed to a different hominin taxa, but the unique assemblage of the 10 known individuals in Shanidar Cave, and especially the Shanidar 4 "cluster" or "stack," does invite such transference, particularly given that the systematic

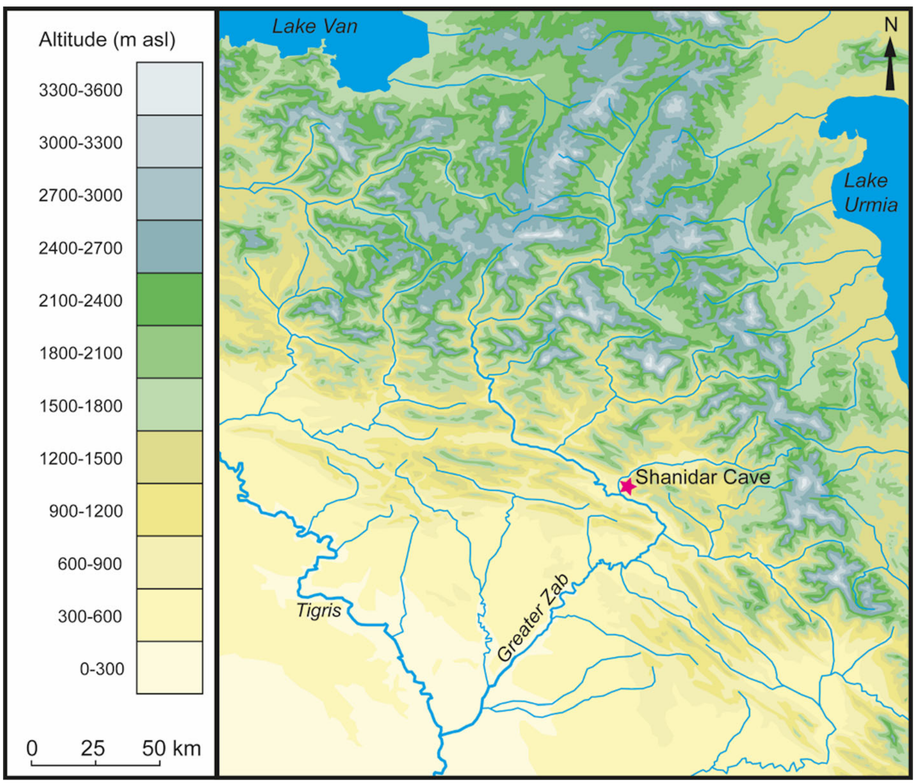

FIGURE 9 The wider landscape connectivities of Shanidar Cave (illustration: Chris Hunt) [Color figure can be viewed at wileyonlinelibrary.com]

disposal of the dead occurred in the much older Sima de los Huesos,[78] and the cluster of Neanderthal individuals at Amud, Israel, or the Middle Paleolithic *H. sapiens* burials at Qafzeh[117] may also reflect the status of the sites as a place for burial or disposal of the dead.[59] For Neanderthals and modern humans alike, some caves seem to have been places where the dead was cached. Although the "specialness" of caves in this respect may be mostly a taphonomic artifact of the nonsurvival of remains placed elsewhere in the landscape, it is important to note that the *meanings* associated with placing the dead in caves may have differed enormously over time, including within the Neanderthal realm. In the case of Shanidar Cave, preliminary results from the optically-stimulated luminescence (OSL) and ^{14}C dating program of the new project indicate that Neanderthals placed bodies, or parts of bodies, in the cave in fits and starts over a period of at least 20,000 years, from c. 70 kya to c. 50 kya, a period probably representing at least 1,000 Neanderthal generations, making it highly unlikely that, as with the "domestic" use of the cave, there was any consistent "burial tradition" or way(s) of treating the dead.

At the intermediate scale, most hunting and lithic provisioning for Neanderthals using the cave might be expected to have occurred within a catchment with a radius of 15 km or so. Lithic resources appear to be extremely sparse locally, with occasional chert and metamorphic cobbles within the gravels of the Greater Zab some 2 km from the cave. At the landscape scale (Figure 9), the Greater Zab River flows southwestward to the Tigris and the great plains of Iraq and to the northeast drains a structural depression that runs over 150 km along the front of the Anatolian Mountains to Zakho, with tributary river valleys draining the Zagros and eastern Anatolia. Immediately west of the small valley in which Shanidar Cave is situated, a tributary gorge runs northeastward through the Baradost Mountains into a parallel structural depression, with tributaries running northward and eastward to passes through the High Zagros on the Turkish and Iranian borders. The cave is visible from the Greater Zab valley and in Solecki's time was a prominent waymark and stopover location for transhumant shepherd communities who wintered in the cave and spent the summer months in the High Zagros. Though they have no access today to the grazing within the Shanidar Cave Reserve, transhumant pastoralists still winter in the Greater Zab valley near the cave and move their flocks on foot through the gorge on their way to the High Zagros in the spring.

Presumably there was similar seasonal variability in grazing when Neanderthals visited the cave during climatic regimes similar to today's, but it is an open question whether, in response to similar seasonal fluctuations, the major prey species (e.g., ibex and other ungulates) moved short distances between the Greater Zab and the Baradost Mountains, making them accessible within a day's walk for Neanderthals using the cave, or whether they moved more extensively into the High Zagros in summer requiring Neanderthals to undertake more extensive trips to new hunting ranges if they wanted to hunt these animals in summer. Analysis of seasonal occupation indicators and associated activity evidence at Shanidar Cave such as seasonality of faunal exploitation and lithic sourcing may help to clarify the scale of the landscape connectivities in which the Shanidar Neanderthals were enmeshed.

7 | CONCLUSIONS

Four key conclusions emerge from the above discussion. First, the Neanderthals should not be thought of as a monolithic entity: they had a geographical range that extended from Spain to Siberia and from Wales to the southern parts of western Asia and were around as a lineage for over 300,000 years, during which time they adapted to glacial and interglacial conditions and are known to have evolved physically and interbred with other taxa.[6–8] They also evolved culturally, and indeed there are significant differences between stone tool assemblages made early and those made toward the end of their chronological range, as well as evidence for rapid changes in lithic technology in response to climate fluctuations, for instance in some French cave sequences.[102,118] There are also spatial variations in lithic assemblages. Across this immense span of time and space it is inconceivable that adaptations and behaviors were identical. It is extremely unlikely that mortuary behaviors, as a subset of cultural activity, were uniform in time and space.

Second, it is clear that mortuary behavior has a deep history in hominins and other organisms. It should therefore not be surprising that at times there are indications that Neanderthals are associated with activities relating to the dead that might be termed funerary. The archeological record indicates that this behavior was highly variable and includes cannibalism, the use of human bone for toolmaking, and inhumations.

Third, it is misguided to look for "modern human behavior" in Neanderthals, or indeed in earlier representatives of our own taxon. The use of rigid criteria based on more recent modern human analogies to identify burial or other mortuary activity is likely unhelpful,[22,70] as it fails to allow for potential differences in the ways in which hominins expressed mortuary behavior. We should definitely not be forcing any expectations of a "progressive" typology ranging from mortuary to funerary behavior on to what they did. It is better to examine what Neanderthals and other hominins did, where and when, with the utmost rigor and with as few preconceptions as possible, and to try to identify what factors stimulated particular behaviors.

Finally, it is possible, and indeed likely, that many apparent differences between the archeology of Neanderthals and that of more recent *H. sapiens* may be taphonomic in nature rather than reflecting contrasting behaviors. We are removed from them by the immense geomorphic disruption of the Last Glacial Maximum and by the loss through decay of all but the most durable physical components of their equipment and culture. The surprise is that anything should survive of their intimate lives and deaths and the challenge is to recover as much from the archeological record as we can.

ACKNOWLEDGMENTS

This study derives from a workshop funded by the Wenner-Gren Foundation for Anthropological Research (Grant number CONF-788) on the theme "Neanderthal Notions of Death and its Aftermath: The Contribution of New Data from Shanidar Cave" held at the McDonald Institute for Archaeological Research at the University of Cambridge, UK, in January 2019. G. B. and E. P. would like to thank in particular the Wenner-Gren Foundation for Anthropological Research for funding the Cambridge workshop; the McDonald Institute for Archaeological Research, University of Cambridge, for hosting it; and St John's College Cambridge and Magdalene College Cambridge for accommodating most of the speakers. The new excavations at Shanidar Cave, directed by G. B., C. O. H., and T. R., are with the permission of the Kurdistan General Directorate of Antiquities, are undertaken in collaboration with the Directorate of Antiquities (Soran Province), and have been funded by the Leverhulme Trust (Research Grant RPG-2013-105), the Rust Family Foundation, the British Academy, the Society of Antiquaries, the McDonald Institute of Archaeological Research and the Natural Environment Research Council's Oxford Radiocarbon Dating Facility (grant NF/2016/2/14), all of whose support is gratefully acknowledged. A Leverhulme Trust Early Career Fellowship awarded to Ceren Kabukcu (ECF-2017-284) has enabled the archeobotanical analysis of the Shanidar Cave materials. Nohemi Sala's research is supported by the Ministerio de Ciencia e Innovación (PGC2018-093925-B-C33 MCI/AEI/FEDER, UE project and contract IJCI-2017-32804), Chris Stringer's research is supported by the Calleva Foundation and the Human Origins Research Fund, and Emily Tilby's research is supported by the Natural Environment Research Council (grant number NE/L002507/1). We would like to thank four reviewers for their detailed and helpful comments on the manuscript. This study is dedicated to the memory of Ralph Solecki, who sadly died in March 2019 aged 101 and who was an enthusiastic and generous supporter of the new work.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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How to cite this article: E Pomeroy, CO Hunt, T Reynolds, et al. Issues of theory and method in the analysis of Paleolithic mortuary behavior: A view from Shanidar Cave. *Evolutionary Anthropology*. 2020;29:263–279. https://doi.org/10.1002/evan.21854