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Chapter 4

The Klithi Deposits: Sedimentology, Stratigraphy and Chronology

Geoff Bailey & Jamie Woodward

This chapter focuses on the following issues:

- The sedimentology and mode of formation of the deposits in the uppermost two metres of the shelter fill exposed during excavation.
- The stratigraphic and chronological framework for the interpretation of the finds, and its implications for chronological resolution and taphonomy.
- The presence of cultural features such as hearths or other forms of cultural disturbance, representing spatial differentiation of human activities or discard practices, and their relationship to the stratigraphy.

We begin with the sedimentology of the deposits because variations in such features as clast size and the colour and texture of the fine sediments play an important role in the interpretation of stratigraphy in rockshelter deposits (Laville *et al.* 1980), and it is essential to understand the causes of this variation if stratigraphic schemes are to be built on secure foundations. The common assumption is that sedimentological variation is caused by changes in local climate. The analysis of rockshelter sediments thus, in principle, provides not only a basis for stratigraphic correlation but also an independent framework of climatic variation against which to calibrate variations in the cultural data. We show, below, however, that variability in the uppermost two metres of the Klithi deposit, which contains the flint and bone assemblages, cannot be referred with confidence to palaeoclimatic variation. The size of limestone clasts varies over short distances because of local variation in the character of the host bedrock and other factors, while variation in the colour and texture of the fine sediments is strongly affected by cultural activities, notably the location and intensity of hearths and the dispersal of ash from them, features which have a marked spatial component. Detailed physical and chemical analysis of the fine sediment fraction in the full 7-metre sequence revealed by coring is presented in Chapter 18. This shows that the upper two metres of the deposit are essentially uniform in respect of palaeoeclimatic signals and that such variation as does occur, and that can be related to significant changes in the local palaeoenvironment, occurs on a longer time scale. This aspect of the Klithi sedimentological analysis is therefore deferred until Part IV, where it can be properly placed within the wider geomorphological context of the Voïdomatis valley.

General features of the Klithi sediments

Clastic cave and rockshelter sediments in limestone karst environments probably show more variation in size, shape, structure and lithology than any other sedimentary environment (Jennings 1985). They commonly display a crude stratification, are accompanied to a greater or lesser extent by a fine interstitial matrix, display poor textural sorting, and share many similarities with sub-aerial stratified slope deposits, talus cones, scree slope materials and periglacial head deposits (DeWolf 1988; Jennings 1985; Wilson 1990).

The sediments at Klithi are characterized by a thick accumulation of coarse limestone debris forming unconsolidated, generally poorly sorted and roughly stratified screes with a predominantly silt-grade calcareous fine matrix (Fig. 4.1). These deposits are the product of host-rock breakdown and local hillslope transport processes resulting from progressive erosion and retreat of the shelter and valley sides. The angular nature of the limestone clasts indicates that they are locally derived from the rockshelter walls and the limestone rock face above the site. The sheer gorge wall shows that the valley side is retreating more or less uniformly across its entire surface (*cf.* Jennings 1985; Selby 1993).

The sediment fill as a whole takes the form of a cone with its apex towards the western end of the shelter just outside the overhang (see Figs. 3.1 & 3.2). This reflects local structural variation in the limestone bedrock, as the western wall of the shelter and the cliff face above has numerous joints and fissures more liable to spalling and clast detachment, whereas the overhang consists of a more massive limestone. The natural dip of the deposits is thus from west to east. There is also a gentle dip from south to north into the back of the rockshelter, visible in many of the trench sections on the north–south axis, and a much steeper dip towards the river.

The upper part of the fill has been truncated and levelled to form a flat and near-horizontal surface, with a layer of recent goat dung about 10 cm thick resting unconformably on the prehistoric deposit. This levelling was presumably carried out in recent times by the goatherd occupants of the shelter, and has truncated some of the prehistoric deposits, which can be seen in section to dip at a steeper angle than the modern surface.

The coarse sediment fraction ranges from very fine (2–4 mm) gravel up to boulder-sized (>256 mm) clasts. These materials are arranged in a variety of fabrics: clast-supported fabrics in which all the voids between the coarse limestone clasts are filled with a fine-grained matrix, partly open-work fabrics in which some voids are filled with fine materials and matrix-supported fabrics (Fig. 4.1). The fine-grained matrix contains some clay-grade sediment and a significant proportion of ashy material as well as fragments of charcoal, bones and lithic micro-debitage. Some of this variability appears to represent lateral variaton in the relative importance of natural depositional processes and cultural activities. Broadly speaking the outermost part of the site, beyond the dripline, is dominated by natural geomorphological processes with sediments displaying clast-supported fabrics with large clasts and boulders representing partial roof collapse and valley-side rockfalls. The innermost zone towards the back wall is dominated by ashy deposits, and variation in cultural activities has imposed a strong imprint on the character of the deposits. The intermediate zone between the rear hearth area and the dripline is characterized by more uniform matrix-supported fabrics.

The reddish-pink colouration (5 YR 6/4) observed in the fine sediments in the upper part of the fill appears to be related to burning of the uppermost layer of goat dung in recent times (see Woodward, Chapters 18 & 19), since it was widely observed in the uppermost few centimetres immediately beneath the layer of goat dung. Otherwise the colour of the fine sediment ranges from brown (7.5 YR 5/2) to pinkish white (7.5 YR 8/2), a variation which appears to be largely determined by exposure to fire and ash content. The natural sediment colour is a yellowish-brown (10 YR 5/6), reflecting an origin from flysch rocks and soils which overlie the limestone bedrock on either side of the gorge. Some of this material has been washed into the rockshelter entrance from outside or has percolated through joints and fissures in the limestone ceiling (Woodward, Chapters 18 & 19). The various shades of brown and red-brown reflect varying exposure to burning, while the shades of white and grey reflect large admixtures of ash.

The interior of the shelter is unusually dry, and there has been little cementation apart from occasional traces of calcitic crust on some stones and flints and localized compaction of finer sediments. Bags of cement stored in the back of the shelter in 1983 were still usable in 1986. The deposits are easy to loosen and the finds easy to extract, in contrast to Asprochaliko and Kastritsa where hammers and chisels were sometimes needed to break apart heavily cemented deposit, differences that reflect the different environmental setting of each site (Woodward, Chapters 18 & 19).

A small number of well-rounded clasts from the river gravels were identified in the cultural horizons during excavation, mostly of flysch but occasionally of limestone. Some are cobble-sized and were evidently brought in to serve as anvils or hammerstones. Small pockets of fine gravel were also found in some of the ashy layers at the back of the site, and we believe that these were introduced accidentally within the grooves and hollows of driftwood carried up from the river and onto the site as fuel, examples of which can be observed on the present-day floodplain. All of the river-rolled material can be accounted for as human imports. The absence of rounded or sub-rounded limestone sediment particles in the sand and coarser sediment fractions also argues against flooding of the site by the Voïdomatis River during high discharge events.

Palaeoenvironmental interpretation of coarse angular limestone sediments

It is commonly assumed that variation in the coarse angular sediment fraction of rockshelter fills is due to palaeoclimatic change, and can therefore be used as a means of chronological ordering and correlation. Palaeoenvironmental interpretation, however, is not straightforward. As a general rule structure,

Figure 4.1. *The rockshelter sediments exposed in the deep trench (W32–33). Note the wide range of particle sizes and the presence of boulder-sized clasts throughout the sequence. The sediments exposed in this trench are roughly stratified screes with alternations of coarse and finer grade angular limestone debris. There is considerable vertical* and *lateral variation in particle calibre, sorting, sediment fabric and void ratio (the volume of pores/volume of solids: Selby 1993). A closed, clast supported fabric is typical as these sediments contain a significant proportion of fine-grained (sand, silt and clay) matrix.*

mineralogy and texture determine the susceptibility of a rock to fragmentation. Together with the nature and intensity of the weathering processes operating, these parameters determine the *rate* of rock fragment release and the *morphology* and *calibre* of the breakdown products. To date, most studies of rockshelter sedimentology have related the presence of angular limestone clasts to the operation of freeze-thaw processes (e.g. Laville 1976; Laville *et al*. 1980). This mechanism of rock reduction is also often referred to as frost action or gelifraction. Collcutt (1979) and Farrand (1985), however, have stressed the importance of avoiding oversimplified palaeoenvironmental interpretations, and have drawn attention to other rock reduction mechanisms, such as insolation, collapse, solution (hydration), the growth of salt crystals and other processes. Under favourable conditions these mechanisms are capable of producing significant quantities of coarse, angular limestone debris, especially in active tectonic settings which are prone to earth tremors and stress release. Long-term tectonic instability in the Mediterranean region (King *et al.*, Chapter 28) has, in addition, produced intensely folded, fractured and brittle bedrock walls which are especially susceptible to a variety of rock reduction and detachment processes and can liberate large amounts of coarse material to valley-side colluvial formations and rockshelter environments (see Bailey *et al.*, Chapter 16).

In the Klithi sequence, the sediment fraction >8 mm and the coarse sand and very fine gravel component (2–4 mm) are all characterized by highly angular, straight-edged, multifaceted limestone clasts, representing locally-derived products of rock reduction processes (Fig. 4.1). It is also likely that some of the larger clasts and boulders were detached during rock falls from the cliff face above the site or during partial roof/wall collapse triggered by earth tremors.

Many workers have considered an increase in the mean size of rock fragments in rockshelter fills to be a function of increasing severity of frost action (e.g. Bonifay 1956). Laville (1976) has further refined this approach by distinguishing two different types of freeze–thaw process and sedimentary product: 'macrothermoclastism', associated with an annual freeze–thaw cycle where an extended period of freezing liberates large, angular rock fragments; and 'microthermoclastism', associated with less extreme diurnal cycles producing finer grained debris. This distinction suggests that the size of rock particles is directly proportional to the intensity of the freezing regime. This may indeed be true in certain contexts, but this assumption cannot be used as a universal rule for palaeoenvironmental inference. Farrand (1975), for example, has argued that smaller fragments may be an indication of more intensive frost action, and highlights the interpretive problems encountered if a slab of rockshelter ceiling crashes to the site floor, breaking into numerous angular fragments in the same size range as freeze–thaw debris. It is obviously an oversimplification to generalize in this manner when so many variables are imperfectly understood. As Collcutt (1979) has pointed out, the simple equation of a sediment parameter with a geological process would appear to be an affliction to which cave sedimentologists are particularly prone. A sedimentary unit dominated by coarse, angular clasts (whatever their dimensions, shapes or surface morphologies) *cannot* be used as unequivocal evidence for a concurrent episode of rigorous cold climate, in the absence of other information. This material may be a product of other processes (or a combination of processes) such as wetting and drying (infiltrated clay expansion), crystal wedging, root expansion, residual stress release, hydration spalling or roof collapse initiated by seismic activity. At the Abri Pataud in the Dordogne, angular clasts appear to be largely frost debris, whereas at Franchthi Cave in Greece they can be attributed to the presence of tectonically fractured bedrock from which fragments have been detached by solution or by earthquakes (Farrand 1985).

All experimental work and field-based observations demonstrate that water is essential for frost action, that high freezing rates are apparently more damaging to rocks than low freezing rates, and that the number of freeze–thaw cycles is important. Frost wedging and splitting appears more active when temperature excursions cross 0°C than when the excursions remain below 0°C (Konishchev & Rogov 1983). Nevertheless, laboratory studies under carefully controlled conditions have also demonstrated that variability in the size and quantity of breakdown products is not solely a result of different intensities of freeze-thaw activity, but is also affected by strength, permeability, pore size distribution, total porosity and the saturation coefficient of the host bedrock (Lautridou 1988; Lautridou & Ozouf 1982; Letavernier 1984; McGreevy 1982). The detailed mechanisms of rock wall attack by frost action are still poorly understood.

An additional and important variable is host bedrock structure, with respect to such features as fold geometries, bedding thickness and the nature and spacing of joints (Davies 1949; Murray 1989; White 1988). Wilson (1990) has demonstrated that such variables can effect pronounced lateral variations in clast size on upland scree slopes under the same local climate.

Coarse sediments within rockshelters are not, therefore, a simple reflection of palaeoclimatic variation, and great caution must be exercised in their interpretation — especially when the former geometry of the site and adjacent rock faces and talus slopes are not well known, and where, as at Klithi, the local limestone rock face shows a wide range of bedding thicknesses and vertical joint spacings and includes numerous tightly folded and fractured beds. Indeed in such a setting it can be argued that the calibre and form of the particles is conditioned more by tectonic preparation of the host rock than by the influence of exogenic detachment mechanisms.

Elsewhere in the Voïdomatis Valley scree slopes are present and are composed of coarse angular limestone particles of all sizes. These sediments are sorted by natural slope processes (*cf.* Selby 1993), and different facies and degrees of sorting can be identified over distances of a few metres. The present climate of the Voïdomatis basin is characterized by freezing winters and numerous frost cycles (Bailey *et al.*, Chapter 16). That the action of frost is primarily responsible for detachment and fragmentation is indicated by the angular edges and fresh faces of the clasts, but it is not possible to say with any degree of certainty, in the absence of other information, whether a particular rockshelter coarse sediment facies is the product of a climatic regime like the Last Glacial Maximum or one rather similar to today. Evaluating the contribution from other rock breakdown and detachment processes is also problematic.

The limited exposures provided by the deep trench at Klithi (in WX32 and adjacent squares) show that below about 2 m the angular limestone clasts become increasingly large (Fig. 4.2). Early on in the Klithi excavations Bailey *et al.* (1984) suggested that the coarsest sediments at the base of the deep trench are 'cold climate screes'. This may well be the case, but these coarse sediments could be the result of a number of processes including local rock falls, a process which is not confined to a particular past climatic regime. The lateral extent of this bed of coarser material is not known. The sediment cores were drilled several metres away (Y25, CC27 etc.) and penetrated below 2 m but did not appear to encounter such coarse grained material at the base of the cultural horizons. The V25 trench reached to a depth of 1 m but the radiocarbon dates suggest that this sequence is coeval with that of the deep trench, and the continuous section from W32 to W24 shows some lateral reduction in clast size (Fig. 4.6).

The many uncertainties associated with the interpretation of variations in coarse sediment particles lead us to doubt their usefulness as measures of palaeoclimatic variation or as stratigraphic markers, at least in the Klithi context, and we have relied on the fine sediment fraction for off-site correlation and detailed palaeoenvironmental interpretations (see Woodward, Chapter 18).

The absence or relative weakness of a temporal signal in sediment variation might seem surpising in a site spanning the Late Glacial — a period of supposedly rapid or oscillating climatic change (Macklin *et al.*, Chapter 17). The radiocarbon dates discussed in detail below, however, suggest that the bulk of the deposit was accumulated between about 16,500 and 13,500 BP, an interval short enough to miss some of the more dramatic changes of the Late Glacial. In so far as we have prehistoric deposits later than this, they appear to be confined to the rear section of the shelter where any climatic signals in patterns of sedimentation are obscured by the dominant effect of cultural activity.

Stratigraphic implications of sedimentological variability

When we began excavation at Klithi, we expected that we would find a stratigraphic sequence of distinct *layers*, characterized by more or less subtle differences of lithology, sediment texture and sediment colour. These layers were to be treated as *geological* entities, variation between layers being determined by changes in local environmental conditions. Each successive layer would represent a discrete and non-overlapping unit of time, corresponding to successive variations in climatic or palaeoenvironmental regime, and provide a means of site-wide correlation. Radiocarbon dates would give us the time scale and an independent method of testing correlations between stratigraphically unconnected trenches. Within each layer we expected to find spatial variation in *features*, such as hearths, representing *cultural* modifications of the deposit. Distribution of cultural features within each layer would correspond to contemporaneous spatial variation in the human activities carried out in different areas of the site. Indeed this distinction between layers and features formed the basis for the initial recording scheme (Bailey, Chapter 3).

In practice, these apparently neat categories — cultural, geological, temporal, spatial — have turned out to be arbitrary, and to depend on assumptions of geological uniformity that cannot be sustained, at least not in the case of Klithi:

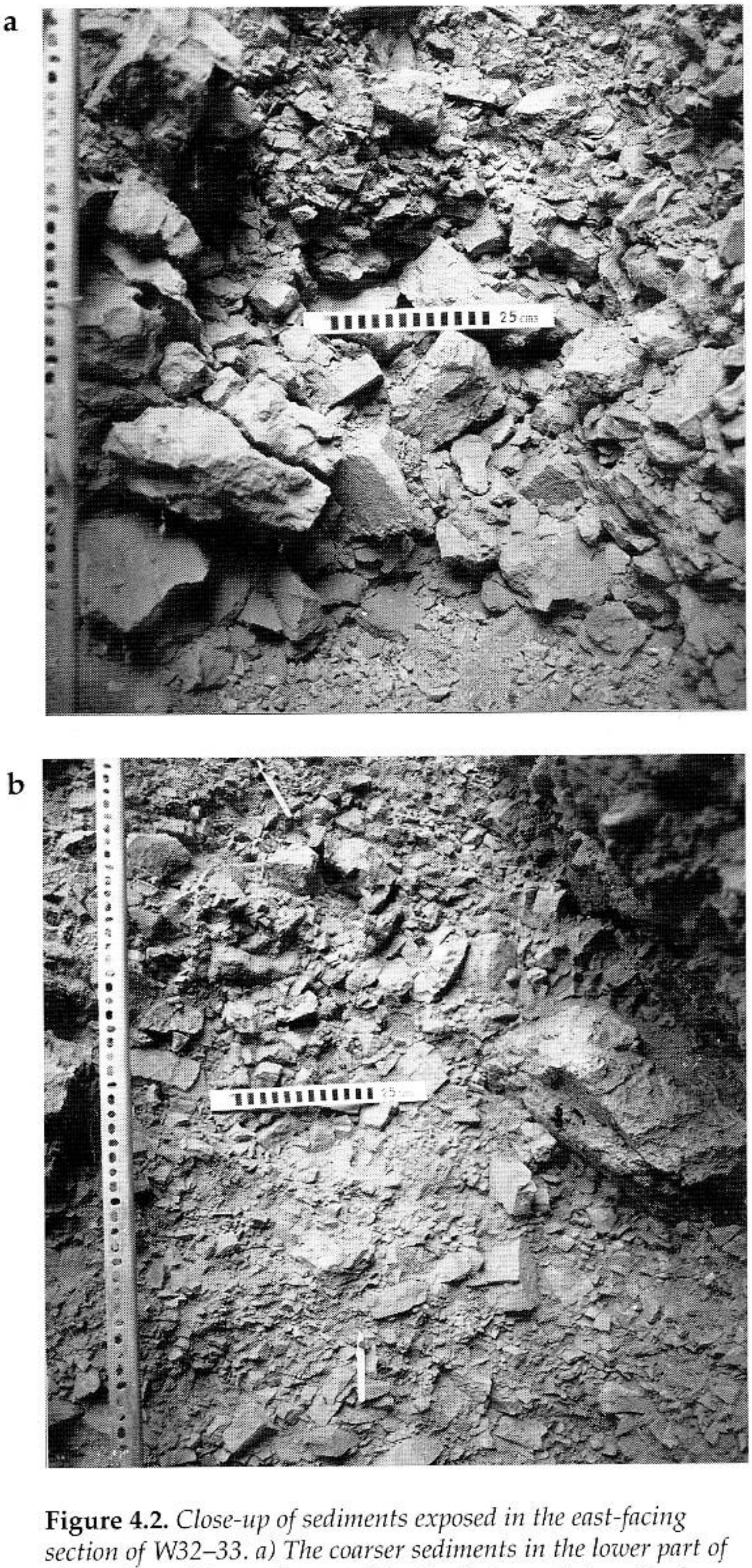


Figure 4.2. *Close-up of sediments exposed in the east-facing section of W32–33. a) The coarser sediments in the lower part of the section with a median particle size (intermediate axis) of* c. *120 mm. b) Finer-grained limestone debris in the central part of the sequence with a median particle size of* c. *30 mm.*

- The environmental controls on sediment accumulation are not uniform but are subject to local spatial variability. As we have shown above, the clast size of scree deposits in particular shows substantial lateral variation over short distances within the Klithi rockshelter and should not be used as a record of climatic change in this context.
- Post-depositional alteration of the deposits by human activities is a major variable that cannot be ignored. In locations of intensive human activity, physical and chemical modification of deposits is to be expected, especially as a result of the use of fire, and both the larger clasts as well as the finer sediment fraction can be affected, producing lateral variations which have no chronological significance. There is the added factor at Klithi of the activities of the most recent occupants of the shelter during the past few centuries, namely goatherds and their goats, which have had a number of disturbing effects on underlying sediments originally deposited some thousands of years earlier. It is clear that the original sloping surface of the prehistoric surface has been scraped flat in more recent times, and that this uppermost surface has been further disturbed by goat hooves, and later covered by a thick layer of goat dung. The compacted dung is highly combustible and has caused fire-induced changes in the colour of the fine sediment fraction near the surface of the prehistoric deposit, and heat fractures on some of the flint artefacts immediately below the surface. Chemical, micromorphological and other techniques, as discussed later (Woodward, Chapters 18 & 19), can sometimes be used to disentangle cultural and natural processes of deposition or post-depositional modification, but in the Klithi case variations in sediment colour and texture should be used with caution as stratigraphic markers.
- With the removal of certain sedimentological parameters as a reliable source of stratigraphic information, we are forced back on other considerations, such as the general slope of the deposits

as seen in section and the use of radiocarbon dates. Radiocarbon dates too, however, are not without problems. Quite apart from the margins of error inherent in the method of measurement and the difficulties of obtaining a date from a given specimen (Gowlett *et al.*, Chapter 2), there is a tendency to assume that the specimens used for radiocarbon dating are fixed in the deposit and have not been subject to vertical or lateral movement across stratigraphic boundaries. Such post-depositional movements, however, can easily occur, as Wenban-Smith (Chapter 5) has demonstrated with some of the flint artefacts, especially where the carbon samples are small fragments of charred bone or charcoal in loose and unconsolidated sediments of the type common at Klithi. Examples of modern or historical dating samples that have penetrated some way down into the prehistoric deposit are given below.

- It is convenient to assume that the spatial and temporal components of variation broadly correspond to the horizontal and vertical dimensions of the stratigraphic matrix, horizontal differences within a layer representing spatial trends and vertical differences between layers representing temporal trends. This is not even true, however, of sedimentological variability, as we have emphasized at length above, and is even less likely to be the case with cultural activities. As discussed in Chapter 3, this distinction between contemporaneity and succession is entirely arbitrary and takes no account of the chronological resolution and precision with which individual layers can be characterized, or of lateral variations in their characteristics. Nor does it allow for the possibility that human activities and patterns of discard may shift laterally over time, thus creating the illusion of a temporal succession in a column of deposit excavated in just one restricted area of the whole site.

Stratigraphy: general considerations

With all these caveats in mind, we turn now to the details of the stratigraphic scheme finally devised to provide a framework for interpretation. One of the difficulties that should be recognized at the outset, quite apart from the problems already discussed above, is that the layers or contexts recognized at the time of excavation often do not correspond to the units subsequently recognized in the sections, or correspond only to a rough approximation. The best fit between excavated layers and layers identified in section is achieved where lithological boundaries are sharply defined, and where it is possible to excavate from a pre-existing vertical section. In the early stages of excavation at Klithi, and in most areas of the deposit, neither of these conditions applied. In the back trench in particular (Q20 to T22) the many subtle changes in sediment type identified during the early seasons of excavation were later judged to have little or no stratigraphic significance, representing no more than varying mixtures and combinations of ash and sediment and localized variations in the intensity and effects of heat from fires. The difficulties of disentangling stratigraphic relationships, particularly in the back trench, were further exacerbated by the method of shallow and extensive excavation adopted from 1984 to 1986. It was only when deeper sections became available during the 1988 season that it was possible to achieve any coherent overview of general stratigraphic trends in this area of the site. Uncertainties in the stratigraphic provenancing of material that might have resulted from this confusion are mitigated by two factors: the application of the three-dimensional grid as a control on the position of finds; and the tendency during excavation to over subdivide the deposit into different layers or contexts. In the final analysis, many of the units distinguished at the time of excavation from 1984 onwards had to be regrouped later to form meaningful contextual and stratigraphic units.

Layers, features, contexts and strata

The original recording system incorporated provision for assigning two layer numbers to any unit of provenance: the layer assigned at the time of excavation, together with a feature and feature number in some cases, e.g. Layer 15, Layer 14 H2; and a second series of layers intended to represent a revised layering in the light of subsequent analysis, which would also attempt to incorporate correlations between the separate trenches (Bailey, Chapter 3). A provisional re-ordering of the layers was carried out in 1987, and the new series of numbers was added to the Master Bagno computer files. In the event it proved necessary to assign yet a third series of numerical labels in the light of the plans and sections of the 1988 excavations, a re-examination of all the existing plans and sections from previous years' excavations, and the available radiocarbon dates. This final scheme provides two new pieces of information about provenance: *context* and *stratum*.

Context is the local layer or feature within any given trench. In order to avoid confusion with the old layer numbers, the new context numbers are 4-digit numbers which always begin with an integer. Blocks of numbers were arbitrarily allocated to each of the major trenches, as follows: 1001–1999 (the 1983 Trench, W33 etc.); 2001–2999 (the Back Trench Q20–T23); 3001–3999 (the Front Trench P24–R27); 4000–4999 (the V/W Trench, W24–W/X29 and V25 of the 1985 and 1988 excavations).

These context numbers refer to the smallest indivisible depositional units of provenance identifiable from the excavation records (i.e. units of provenance identified by colour, sediment-type, etc., as opposed to arbitrary subdivisions of quadrant and spit). The numbers have been allocated to reflect as nearly as possible stratigraphic sequence within each trench. A detailed description of contexts including Munsell colour readings, and a list of other labels and names given during excavation is in Appendix 4.1, and the stratigraphic relationship betwen contexts is indicated in the form of Harris matrices (Appendix 4.2). The numbering is from the top down — i.e. 2001 is the youngest deposit in the back trench. Numbering in each trench usually begins with the material immediately below the goat dung, often treated as a 'contaminated' layer subject to recent disturbance.

In effect, context provides a local layer scheme within each trench. We prefer the label 'context' for three reasons: to avoid confusion with the original Layer 1 and Layer 2 schemes; to emphasize that the numbers refer to both geologically defined units and culturally defined ones (e.g. ashy layers); and to allow for the fact that the sequence of context numbers does not always exactly follow stratigraphic sequence, especially in the back trench.

In many cases a deposit identified as a unique context corresponds to a deposit assigned a layer and/or feature number in the original excavation. In other cases, deposits distinguished during excavation or in section have been grouped into single contexts. Allocation of context numbers has in general been straightforward, except for the back trench. Here the complexities of the deposit, with its many overlapping ashy deposits, is such that, at the time of excavation, different layer numbers or feature numbers were sometimes assigned in different rectangles, or in different years of excavation, to avoid prejudgements about correlations between one area of the trench and another. It is also clear that there were other sorts of inconsistencies at the time of excavation. Some excavators assigned numbers on the basis of what they thought was stratigraphic reality. Others assigned numbers on the basis of what they thought was depositional or contextual uniformity, i.e. Layer 14 H5 would be used to label all hearth units of white ash, regardless of their stratigraphic position. The other most common sort of inconsistency recurred frequently in the back trench, namely the tendency for coding conventions to drift with time, or vary between individuals. Thus H4 and H5 were sometimes used to refer to grey and white ash respectively. At other times the convention was reversed. At yet other times the feature label L9 was used for grey ashy deposits. The Layer/Feature division was, of course, originally devised to avoid precisely this sort of confusion: layer numbers would reflect stratigraphic sequence, feature numbers would reflect type of deposit. In practice, however, the two concepts became confused, partly through inconsistencies of usage, partly because of the difficulties of unambiguously distinguishing different sorts of units in the back trench. In 1988 some of the ambiguities of the earlier system of labelling layers were avoided by giving every unit distinguished in excavation a letter code to describe the character of the deposit (e.g. BA for a brown ashy deposit), and a number indicating the stratigraphic position for that type of deposit (thus BA1 would be the first brown ashy layer identified in the course of excavating a given trench, BA2 the second in descending stratigraphic sequence, and so on). The new scheme of contexts attempts to iron out all the inconsistencies between different years and usages, and to define a single coherent scheme for the whole site.

On the computer database the character of the contexts is summarized using three variables: colour/ashiness, stoniness and compactness. The colour is derived from the Munsell value but also takes into account the amount of ash present in the deposit. The following categories are used: 1 brown, no ash; 2 red-brown, little ash/some burning; 3 grey-brown, some ash; 4 grey, ashy; 5 white, very ashy. The stratigraphic sections use this 5-fold convention for distinguishing Contexts. Contexts are also characterized as stony (=1) or not stony (=0) and as compact (=1) or loose (= 0) (see Appendix 4.1).

Stratum refers to the grouping of contexts or local layers into stratigraphic units. These apply across the whole excavation and are numbered from the base of the excavated deposit upwards. Thus Stratum 1 is treated as the earliest phase in the site — the base of the Carter 1983 trench, and Stratum 10 is the youngest — the uppermost scree deposit at the very back of the back trench. Stratum 20 refers to goat dung and/or contaminated deposits. Strata are always numbered with 4 digits beginning with 0, to minimize the risk of confusion with context numbers.

Allocation of stratum numbers is a two-stage process: grouping of contexts within each trench; and correlation between trenches. The aim has been to produce a sequence which can be applied across the whole area of the excavation, which is sufficiently detailed to allow the detection of time-trends if they are there, but which is not so detailed as to complicate analysis. Grouping of contexts within each trench is a relatively straightforward process, based on radiocarbon dates, changes in the general character of the deposits, and the degree of chronological resolution that can be realistically achieved given the margins of error inherent in the radiocarbon dates and the uncertainties of using sedimentary characteristics to establish stratigraphic correlation and continuity. This leads to two sorts of uncertainties.

- Correlation between trenches. For the back and front trenches (P,Q,R,S,T rectangles), this is fairly straightforward because there are continuous sections. Less certain is the correlation between these rectangles and the V,W,X trenches. The nearest adjacent sections are in R24 and V25. In order to make the correlation we have had to rely on 'eyeballing' sections across the stratigraphic gap, taking account of the general slope of the deposits, comparisons of deposit descriptions and radiocarbon dates. There is a similar uncertainty about the correlation between the lower levels of the 1983 trench (WX32–33) and the lower levels of the W25–V25 deep hole, which are assumed to be contemporaneous on the basis of the radiocarbon dates rather than on evidence of stratigraphic continuity.
- Equivalence of strata. The decision about where to draw the line between one stratum and the next is somewhat arbitrary. Moreover, the definition of a stratum implies some equivalence between strata, notably that each stratum represents an equivalent unit of time. The strata were originally defined at an early stage in the post-excavation analysis before all the radiocarbon dates became available. Subsequent dates produced a further test of the scheme and show some overlap of dates between contexts and strata, examined in more detail below. An overview of the relationship between strata in the various areas of the excavation is shown in Figure 4.3.

Description of stratigraphic contexts

1000 and 4000 series

These two series are treated together since they are stratigraphically connected and cover a similar time span. The 1000 series refers to the deposits excavated in 1983 in WX32–33 and W28–31 (Figs. 4.1 & 4.3). As discussed in Chapter 3, this area was excavated relatively rapidly to provide an initial window into the prehistoric deposit, and stratigraphic control was further impeded by substantial boulders. The excavation did not reach to bedrock. The east-facing section of the west trench wall of WX32–33 is shown in Figure 4.4. (For the relationships between the various sections see Fig. 4.5.) The sequence shows considerable textural variation, ranging from a basal deposit with large angular limestone clasts, some with voids between them, to matrix-supported sediments with smaller clasts in the upper part of the sequence. Compared to the other excavated areas, the lower series of deposits (Strata 1–3) show little colour modification, relatively large clasts, and very low densities of stone artefacts and animal bones. The upper series of deposits (Strata 4–6) are more matrix-rich and show some reddening of the fine matrix, but remain poor in finds of stone artefacts and bones. The uppermost ashy layer (Stratum 20) is modern and represents burnt goat dung thrown out from inside the rockshelter after a fire in the 1970s. Burnt bone and charcoal are rare throughout this sequence, and it proved very difficult to extract samples suitable for radiocarbon dating. The two dates from the base are derived from the collagen fraction of two large bone fragments, but bones from higher in the sequence and elsewhere in the deposits failed to provide sufficient collagen for dating (Gowlett *et al.*, Chapter 2). The general slope of the deposits is quite gentle, and if anything dips towards the north, towards the back of the rockshelter, in contrast to the modern surface at this point which dips southwards towards the outside of the shelter.

The stratigraphic subdivision of the deposit is based on textural variations visible in the section. In 1984 it was suggested by Bailey *et al.* that the large scree at the base of the sequence might represent a climatically distinctive episode associated with more severe freeze–thaw activity at the end of the Last Glacial Maximum. However, it might equally well represent roof collapse or the accumulation of coarser material outside the rock overhang. As discussed above, scree deposits are subject to considerable lateral variation in clast size and sorting, and there is some uncertainty as to whether the variations visible in the WX32–33 sequence represent climatic trends.

The 4000 series of deposits refer to excavations carried out in 1985 in X29 and W29–24 and the deepening of the excavation of W25 and its extension to V25 carried out in 1988. If one follows the uppermost deposits along a lateral transect from W29 to W24 there is some variation in clast size and fine sediment colour (Fig. 4.6). The size of the limestone clasts in particular tends to decrease as one moves towards the back of the shelter, and the more obvious reddening of the fine matrix and the greater admixture of ash in the area of W29 to W24 appears to reflect greater intensity of human activity compared to the area of WX32 and 33, which is now well outside the brow of the rock overhang, a supposition borne out by the much greater density of bone and artefact remains in the 4000 series of deposits. In W24 the corner of a much ashier deposit was found (Fig. 4.6), and this may represent the edge of a hearth area against the back wall of the rockshelter, comparable to that described below in the area of the 2000 contexts, as is also suggested by an independent quantitative analysis of latent structures in the distribution of the lithic and faunal assemblages (Galanidou, Chapter 15).

Finally the W29–24 section also shows that the prehistoric deposit is dome-shaped, sloping upwards from the back of the shelter, flattening out in the vicinity of W25 an W26 and then sloping downwards again from W27 to W31.

The VW25 sections shows less textural variation through the sequence than that visible in WX32–33 (Figs. 4.7–4.10). Apart from some isolated small boulders, the deposits show the typical combination of small limestone clasts and reddish, ashy fines, and these features continue to the base of the excavated sequence.

It was not possible to excavate to as great a depth here as in WX32–33 because of the slow pace of excavation and the lack of time and resources (Chapter 3), but it is notable that the radiocarbon dates form a consistent stratigraphic sequence. The lowest date (16,250 ± 170 BP), from Stratum 4, is also statistically indistinguishable from the dates at the base of Stratum 1 in X32 (16,300 ± 400 BP and 17,000 ± 400 BP). This discrepancy between the lithology of deposits with apparently similar dates might be accounted for in three ways:

- Stratum 1 is earlier than Stratum 4 but the chronological difference is not detectable within the margins of error of the radiocarbon dates. The main arguments in favour of this hypothesis are the greater depth of Stratum 1 with respect to Stratum 4 in the VW25 trench, and the distinctive lithologies, notably the larger size of clasts in Stratum 1 and the absence of reddening of the fine sediments. Roubet (Chapter 8) also favours this hypothesis on the basis of her analysis of the lithic artefacts, suggesting that the atypical character of the lithic industry and the small number of artefacts in the basal strata of WX32–33 represent an early and fleeting visit to Klithi before the establishment of a more stable occupation.
- The deposits of Stratum 1 (and by implication of Strata 2 and 3) are genuinely contemporaneous with those of Stratum 4, and their different lithologies reflect local variations in the pattern of sediment accumulation. This hypothesis is certainly to be expected in view of the earlier comments about local variations in particle size: the larger clasts might represent rockfalls and roof collapse near the brow of the rockshelter, while the absence of reddening of the fines, which is essentially a cultural feature related to burning, might simply reflect the much lower levels of human activity on the edge of the talus compared with the intensive focus of activities around the main hearth areas at the back of the shelter. Similarly the distinctive character of the lithic industry might represent spatial variation in patterns of activity and discard rather than temporal patterning.
- The bones which yielded the X32 dates have worked their way down to a level considerably deeper than the surface on which they were first discarded. This hypothesis is plausible to the extent that even quite large fragments of bone are more liable to penetrate downwards through deposits where there are large stones and voids, although Gowlett (Chapter 2) believes that this is unlikely. This hypothesis also resolves the otherwise curious anomaly that the surface of the deposit in WX32 at about 16 ka was some 2 m lower than the surface in V25, just 7 m away. If we accept the position of the radiocarbon dates at face value, this suggests quite a steep downward slope southwards from inside the rockshelter. In the W32–33 section itself, however, the general trend of the deposits is nearly horizontal, or sloping downwards in the opposite direction, from south to north. On the other hand the full section from W30 through to W24 suggests a doming of the deposit with its apex near the dripline and a slight slope from north to south from about W27 onwards, so that a steeper slope at deeper levels is not inconceivable. The depth of the two dates in X32 is also comparable to the depth of similar dates recovered from the drill cores in Y25.

In summary, it seems reasonable to infer that Strata 1–4 in WX32–33 represent a local temporal sequence, but whether this sequence extends significantly earlier than Stratum 4 in the VW25 trench is uncertain. Whatever the truth of the matter, the small samples of cultural material in the lower part of the 1000 series coupled with the relatively crude recovery methods are such as to cast doubt on the validity of stratigraphic subdivisions aimed at the detection of more finely resolved chronological trends. The subdivisions may be worth retaining for detailed contextual analysis, but for the purposes of detecting overall trends in the lithic and faunal assemblages for the site as a whole, Strata 1–4 are best treated as a single unit.

2000 and 3000 series

These two series refer to the two large shallow trenches originally positioned to detect activities associated with hearths. Taken

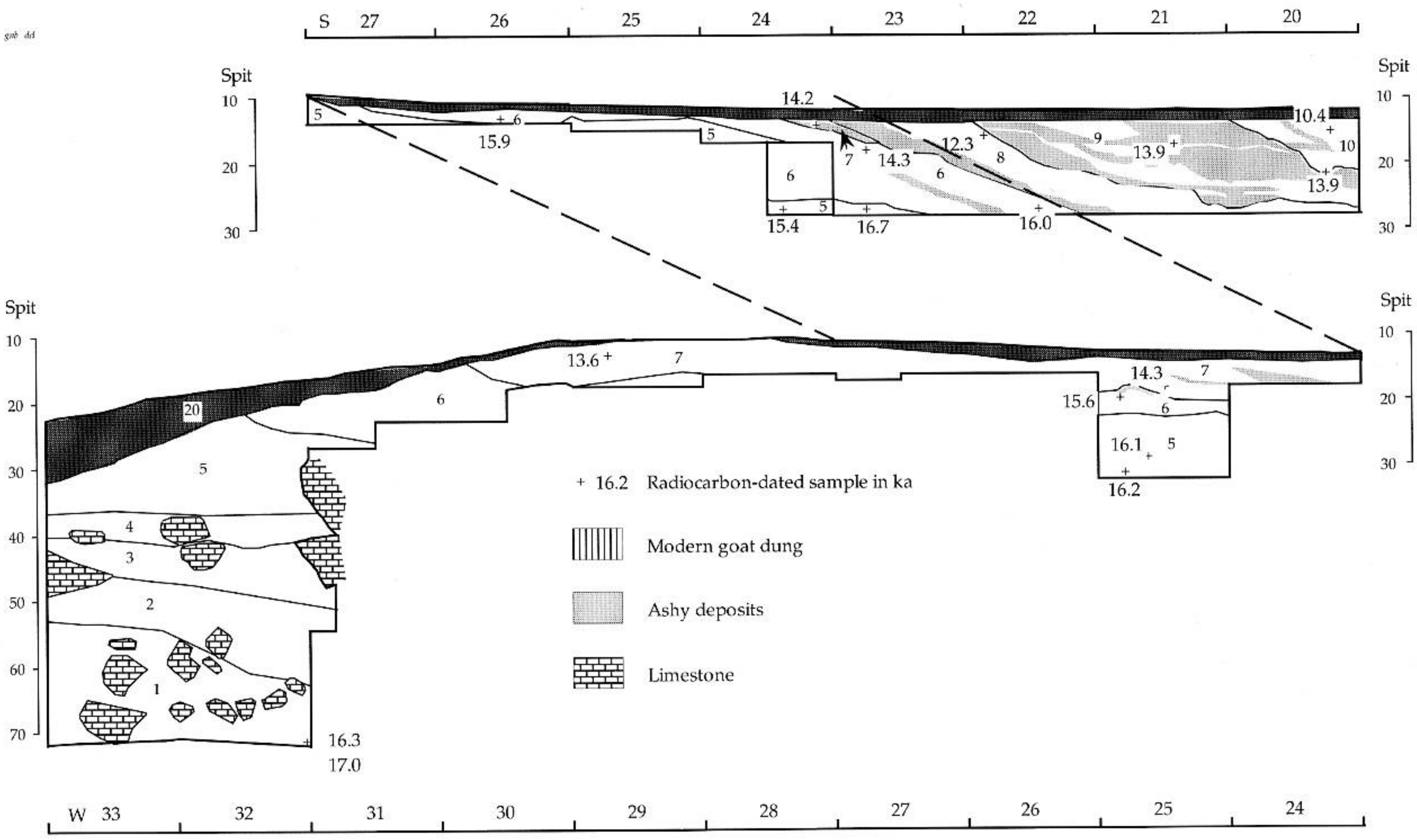
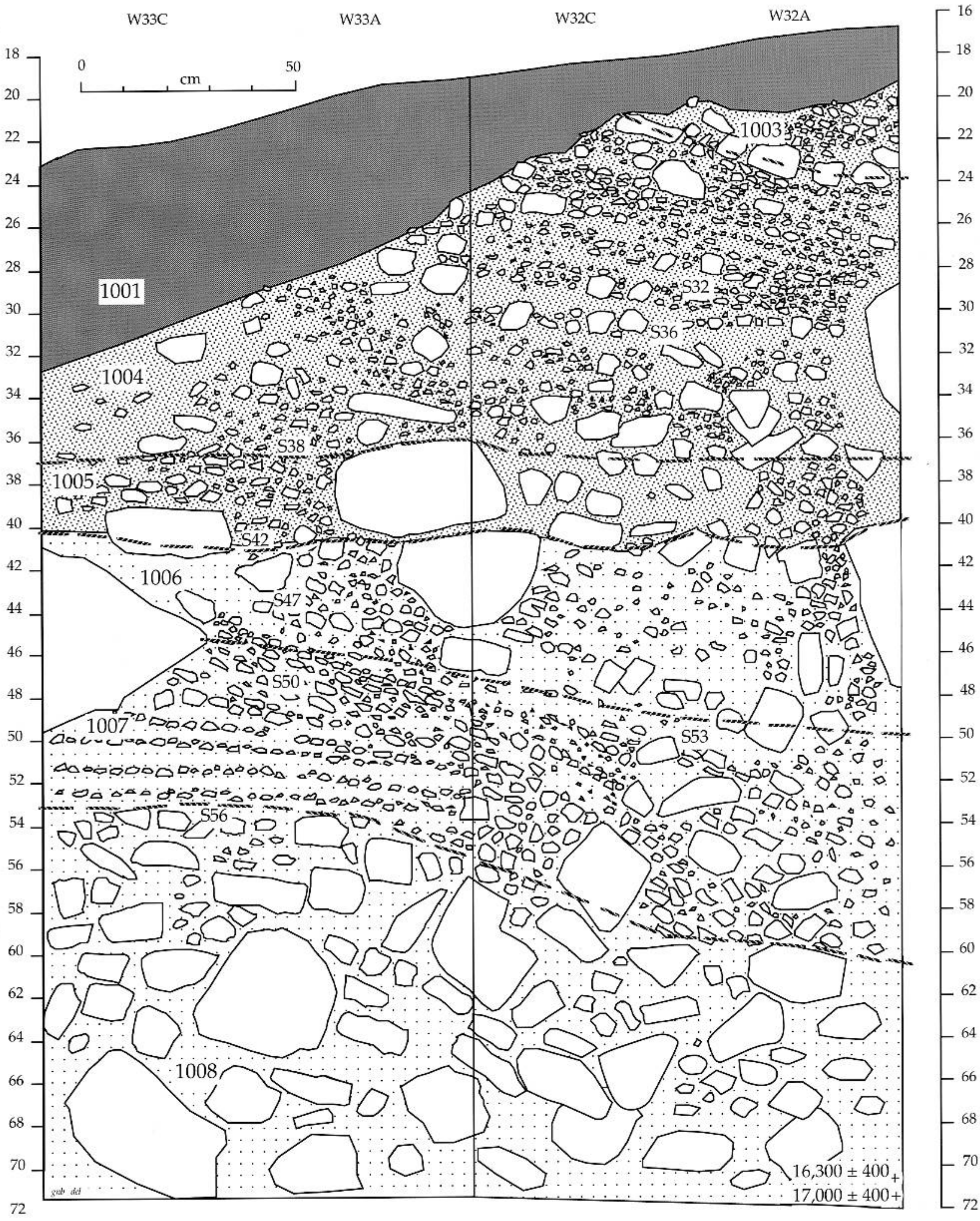


Figure 4.3. *Overview of stratigraphy, showing in simplified form the distribution of strata and the principal radiocarbon dates.*


W33C
W33A
W32C
W32A
0
cm
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1001
1003
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1005
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S32
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S42
S47
S50
S53
S56
16,300 ± 400+
17,000 ± 400+
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Figure 4.4. *(On left) East-facing section of W32 and W33, based on a drawing by Janusz Kozlowski and Colette Roubet in 1986, and incorporating information recorded in 1983, showing context numbers. Stippling follows the colour-coding conventions as described in the text and shown in the legend of Figure 4.6. The spit numbers shown on the section indicate the position of labels inserted to mark the base of the spit as recorded at the time of excavation, and do not necessarily correspond to the spit numbers specified by the three-dimensional coordinate system as shown in the margin. The relationship of the layers recognized during excavation in 1983, the layers recognized in section by Kozlowski and Roubet in 1986, and the final allocation to context and stratum are shown in Appendix 4.1. It should be noted that the position of the radiocarbon dates has been transposed from the original provenance (in X32) to the corresponding stratigraphic position on the W32 section.*

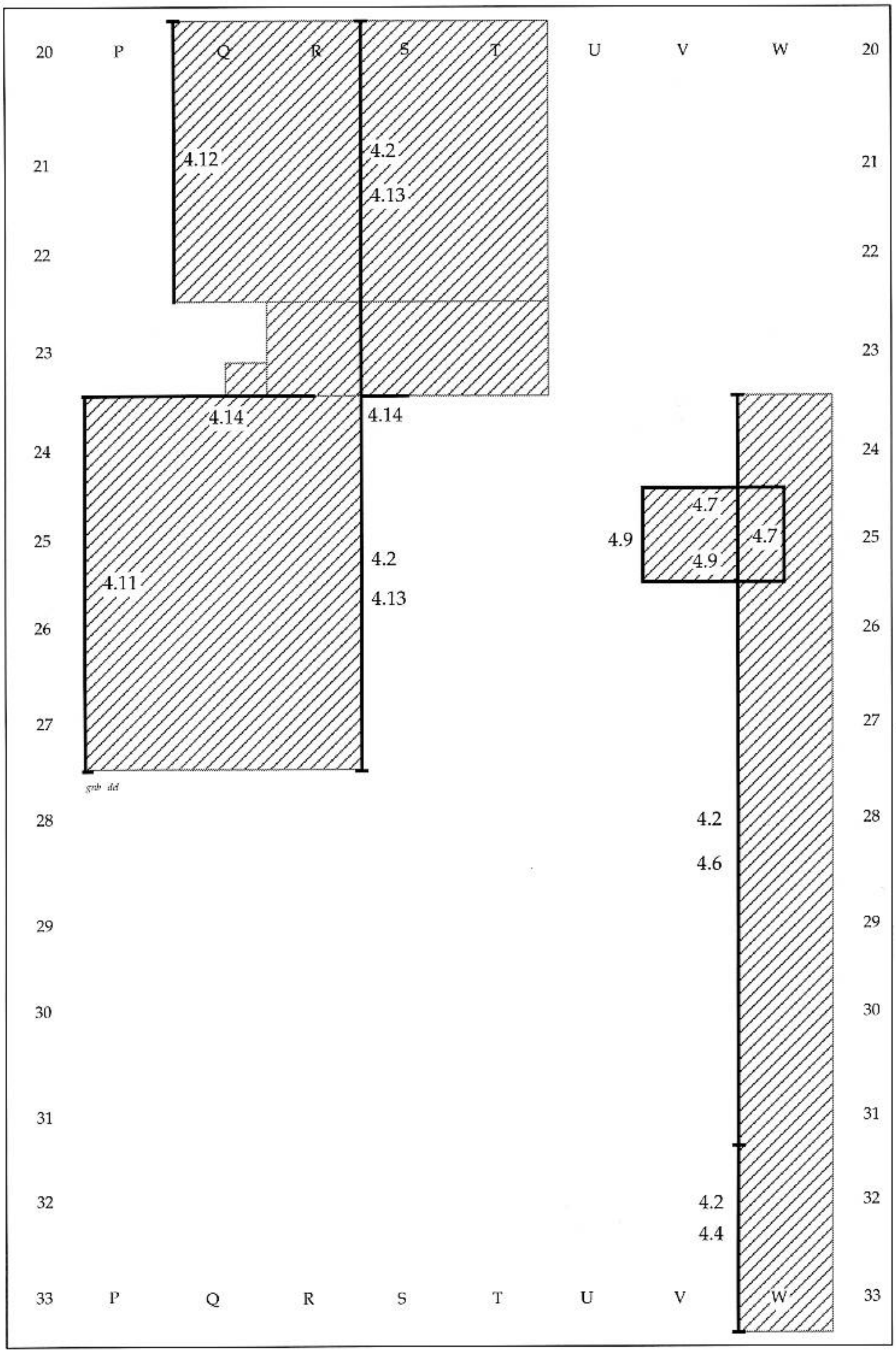


Figure 4.5. *Diagrammatic relationship between sections. The bold line indicates the position of the section, the adjacent number the Figure in which it is illustrated.*

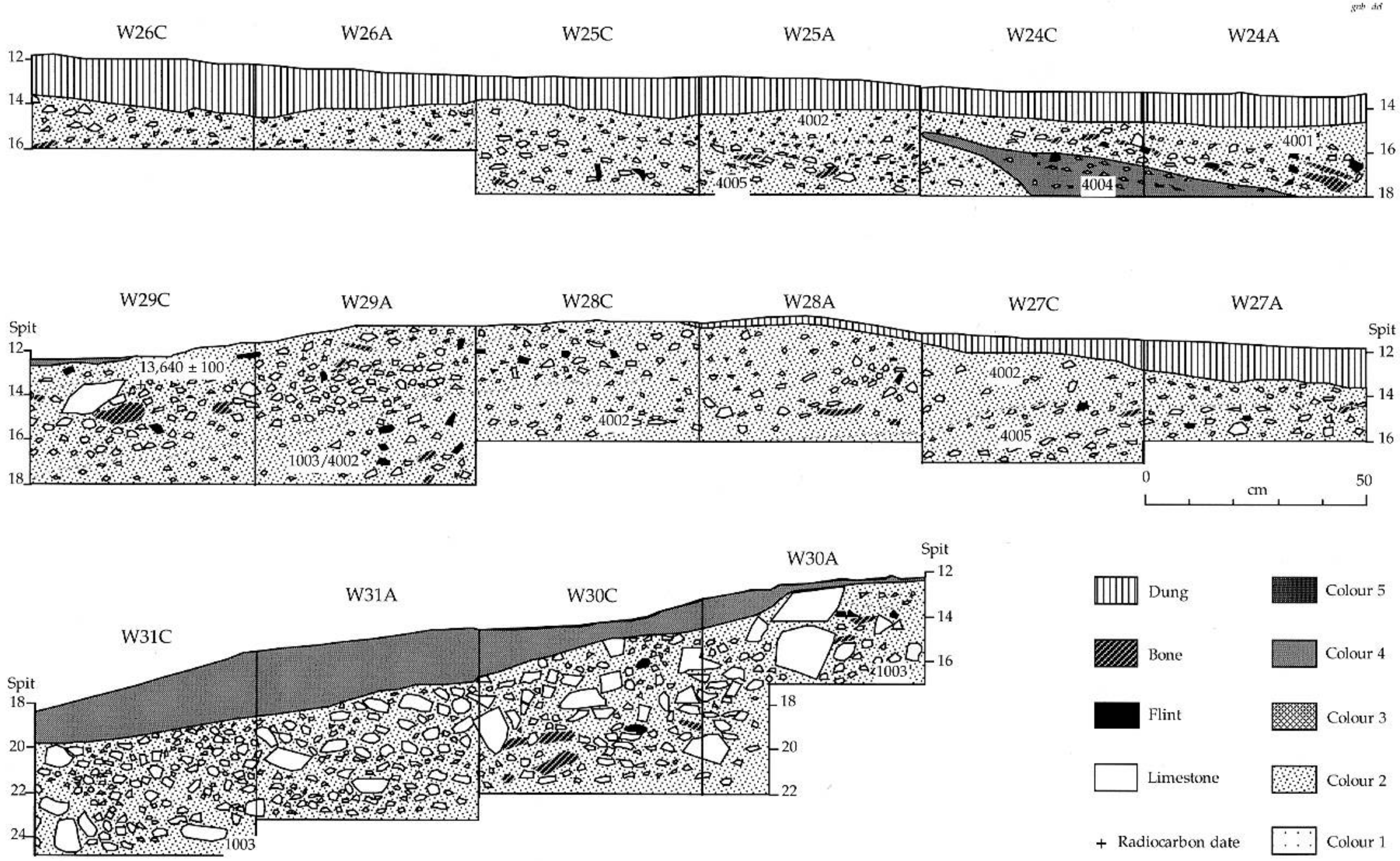


Figure 4.6. *East-facing section of W31–24, showing context numbers.*

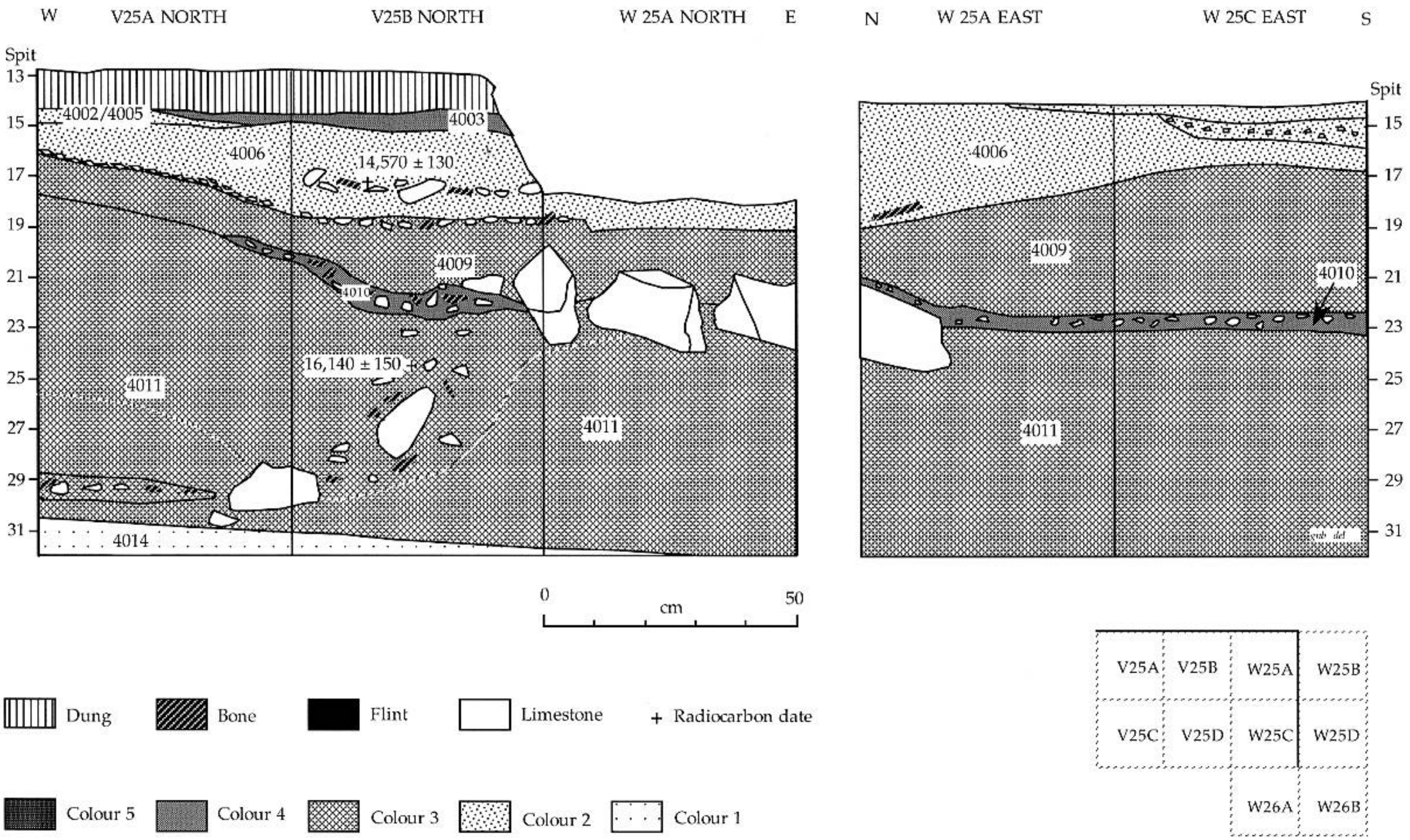


Figure 4.7. *South-facing and west-facing sections of V25 and W25, showing context numbers. Only the largest clasts are shown, in contrast to the sections in Figures 4.2 and 4.6.*

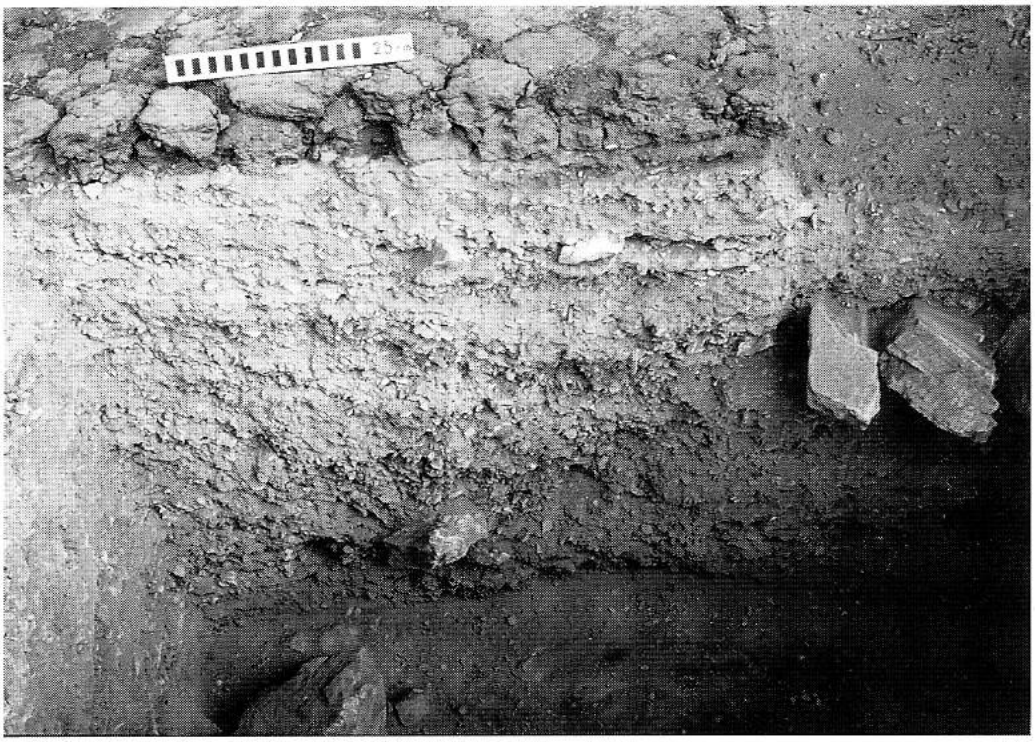


Figure 4.8. *View of south-facing section of V25 and W24.*

together they offer an insight into the stratigraphic and spatial relationships between the large hearth area at the back of the shelter and the deposits situated further forward towards the shelter mouth. Here we concentrate on the stratigraphic and chronological relationships, and give more detail on spatial patterns in a later section below. Stratigraphic connections between the two areas are given by longitudinal sections in P27–P24 (Fig. 4.11), Q22–Q20 (Fig. 4.12) and S27–S20 (Fig. 4.13).

The south–north section running from P27 to P24 (Fig. 4.11) shows a concentration of large clasts in the vicinity of P27, which is most simply interpreted as the result of rockfalls near to or above the brow of the overhang. In the Q22–Q20 section (Fig. 4.12), there is another concentration of larger clasts near the back wall. There is no obvious natural mechanism that would account for such a concentration in this part of the shelter, and the alternative is to suppose that these are larger stones, perhaps used to line fireplaces, that were then pushed to one side by hearth cleaning activities. Apart from these two concentrations of larger clasts, it is difficult to detect any other patterning in clast size variation along the transect.

Also notable in the P27 to P24 section is the slope of the deposits, which dip at a steeper angle than the modern surface. A similar though less marked tendency is visible in the Q22–Q20 section (Fig. 4.12), although the deposits appear to level off in the vicinity of Q21 and to show a slight rise towards the back of the shelter. Thus a horizontal transect from south to north traverses a fairly smooth temporal gradient from 15,960 ± 200 in P27 through to 12,300 ± 200 in Q22. None of the dating samples collected from the Q21 and Q20 areas yielded sufficient carbon for dating purposes. Two samples of charcoal from near the top of the prehistoric deposit (Contexts 3004 and 3005 in P27 and P26) have given essentially modern dates and must reflect the recent activities of goatherds even though they are associated with prehistoric flint artefacts and animal bones. The goatherds used to keep their shed and cooking fire nearby, and the fire has left a sooty deposit on the adjacent shelter wall close by. Both charcoal samples were carefully chosen and one was found underneath a limestone clast which was thought to provide a reasonably secure and sealed context. They are witness to the ease with which modern or historical contaminants can penetrate at least a short way down into the unconsolidated sediments of the underlying prehistoric deposit.

The other main longitudinal section on a north–south axis, from S27 to S20, is shown in Figure 4.13, and the transverse section from Q24 to S24 in Figure 4.14. This confirms the marked slope of the deposits into the back of the shelter. The deeper section from S23 to S20 cuts through the middle of the large 'hearth' area in the back trench and shows that thick ashy lenses persist to the base of the excavated sequence. It is, however, notable that the very ashy deposits (colours 4 and 5) are interleaved with less ashy deposits (colour 2), which may hint at pulses of occupation of the rockshelter rather than a continuous level of use throughout the 3000-year span represented by the deposits.

The six radiocarbon dates between 13,940 ± 110 BP and 16,650 ± 190 BP are consistent with their stratigraphic position, but two radiocarbon dates are suspect. The date of 3560 ± 100 BP clearly cannot be used to provide a terminal bracket for prehistoric occupation, and may represent nothing more than a fleeting visit. As in the front trench, the prehistoric deposits directly underlie the modern surface and are not sealed or protected in any way. It seems quite plausible then to suppose that later visitors to the rockshelter would have lit a fire in the sheltered back part of the rockshelter in the same area favoured by the prehistoric occupants and that the traces of these later fires would have been mixed into the prehistoric surface.

The date of 10,420 ± 150 BP is more problematic. On the face of it, this date seems quite consistent with its stratigraphic position. It is also based on a piece of burnt caprid bone and is thus evidence of some hunting activity at this time. It is, however, only a few centimetres below the modern surface in an ashy deposit of quite limited extent. Moreover it is separated by just

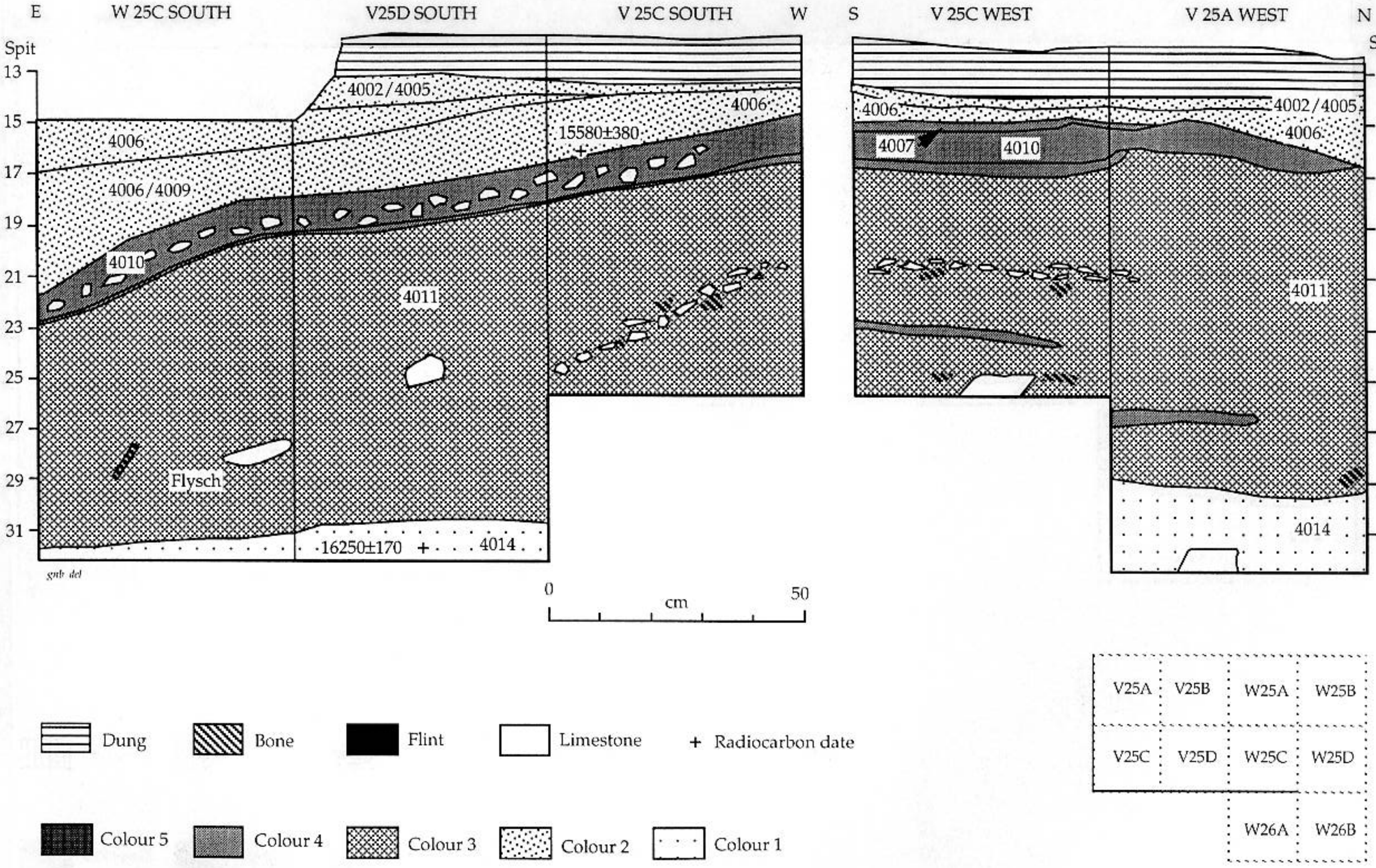


Figure 4.9. *East-facing and north-facing sections of V25 and W24. Representational conventions are the same as in Figure 4.7.*

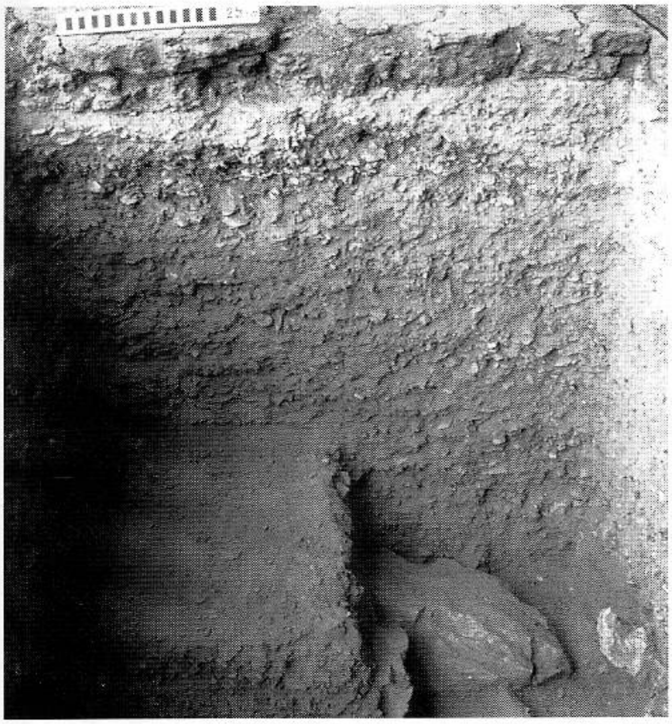


Figure 4.10. *View of east-facing section of V25.*

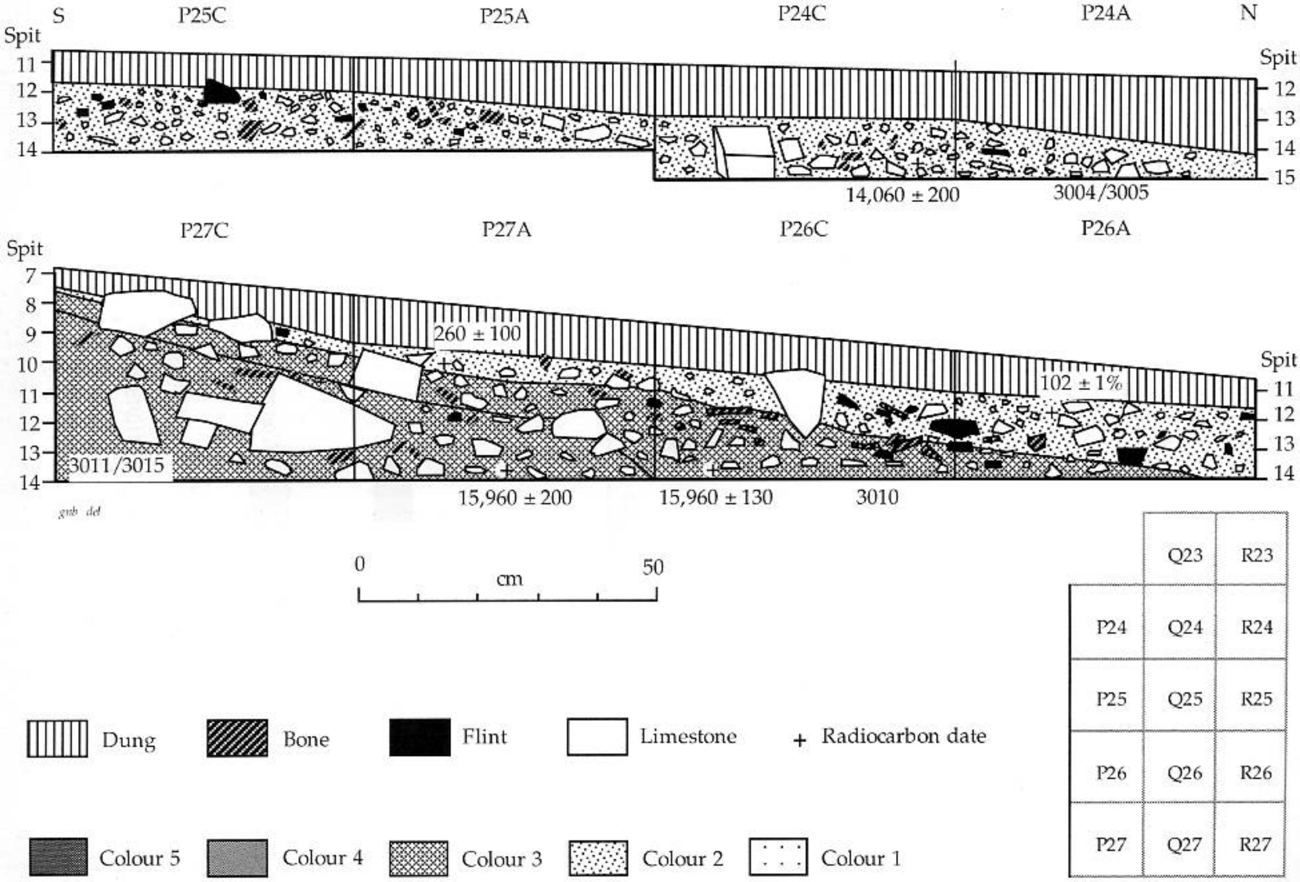


Figure 4.11. *East-facing section of P27–P24, showing clasts and larger bones and flint artefacts.*

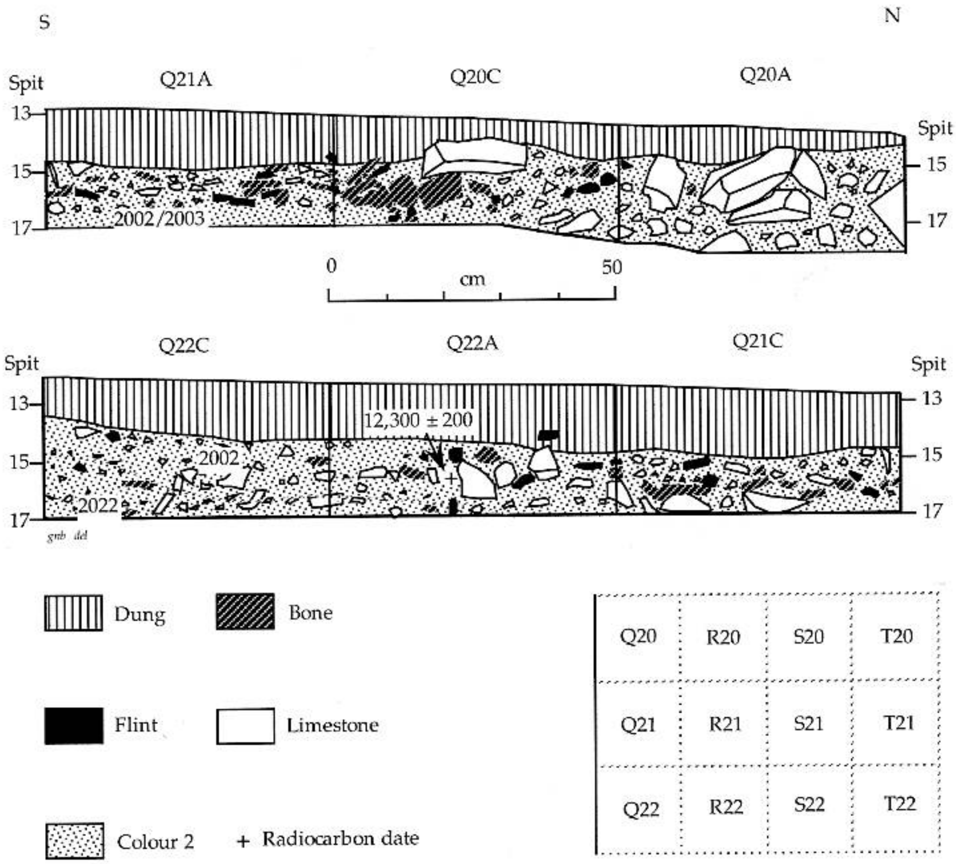


Figure 4.12. *East-facing section of Q22–Q20. Representational conventions are the same as in Figure 4.11.*

30 cm from an underlying date of 13,940 ± 130 BP and by a little over 1 m horizontally from another date of 13,940 ± 110 BP (Fig. 4.13). Both of these earlier dates are in stratigraphic agreement. It is thus arguable that the later date might, like the date of 3560, represent an isolated visit quite unrelated to the main bulk of the prehistoric deposits, and separated from them by as much as 3000 years. It would be unwise to attach too much significance to a single date, and there is certainly no justification for supposing that occupation continued without interruption from 13,940 to 10,420. The next youngest date is 12,300 ± 200 BP from Q22. This too is from an ashy deposit just below the goat dung, although it is sealed by coarse-grained prehistoric deposits (Fig. 4.12). It is the youngest date in the site that can be reliably associated with other archaeological material.

One other notable pattern in the fine sediments is the consistent tendency outside the main hearth area for the deeper and earlier deposits to show a higher ash content than the overlying deposits in the same area. This is clearly apparent in the P24–P27 section (Contexts 3010, 3011 and 3015 are colour 3 in contrast to the overlying Contexts 3004 and 3005, which are colour 2), similarly in the S23–S27 section (Contexts 3011, 3015, 3021 and 3022 are colour 3 in contrast to the overlying Context 3004). A similar pattern is present in the VW25 sections (Figs. 4.7 & 4.9), in the contrast between Contexts 4010 and 4011 (colours 3 and 4) and the overlying Contexts 4005 and 4006 (colour 2). The earlier group of contexts are associated with Strata 5 and 6, and a time span from about 16 ka to 14 ka, while the later group of contexts are associated with Strata 6 and 7 and a time span from about 14 ka to 12 ka. At face value the pattern would appear to indicate either more more intensive occupation in the earlier period, or more intensive use of fires and consequent wider dispersal of ash without necessarily implying any difference in the frequency of visits and the size of the visiting group.

The CC/DD trench

Only a small volume of deposit was excavated from this area of the site, primarily to sample cultural materials well outside and to the east of the main hearth area, and also to test for the presence of a similar hearth area against the eastern end of the backwall of the shelter. Taking account of the general depth of the deposit with respect to the nearby V/W trench, the sediments have been assigned to Stratum 7. There was no evidence of thick and extensive ashy deposits comparable to those recorded in the Q20–T22 trench.

The drill cores

The stratigraphic relationships of the individual core sections in the two longest core sequences (Y25 and CC27) are shown in Figure 4.15. In terms of lithological characteristics the most notable downcore variation is the contrast between the sediments in the uppermost 2.6 metres, which show a reddening of the fine sediment matrix attributable to the effect of burning (Woodward, Chapter 18) and are rich in fragments of animal bone and small flint artefacts, and the underlying sediments, which are completely devoid of bone and artefacts and have a yellow-brown to pale grey sediment matrix. In the deepest core (Y25), the culturally sterile deposits reach a thickness of some 4 metres, and a similar sequence is recorded in the other deep core (CC27), suggesting that the rockshelter witnessed a considerable build up of sediments before it was first entered by human occupants.

The three available radiocarbon dates are confined to the cultural deposits in the uppermost part of the cores and are consistent with dates from elsewhere in the deposit in suggesting that the earliest human occupation took place from about 17–16 ka onwards. The timespan represented by the underlying deposits cannot be accurately measured because they are completely lacking in dateable material, but indirect dating based on a palaeoenvironmental and climatic interpretation of the sediments suggests that they accumulated during a period of maximum glacial conditions, which must represent at least 4–5 ka and probably considerably longer (Woodward, Chapter 18).

Within the upper culturally rich sediments, occasional lenses of concentrated ashy material 2–3 cm thick were observed, notably in the Y25 core. These exposures are too limited to indicate the extent of the ashy layers but give another hint, along with the ashy deposits observed in W24, of a hearth area in this part of the site.

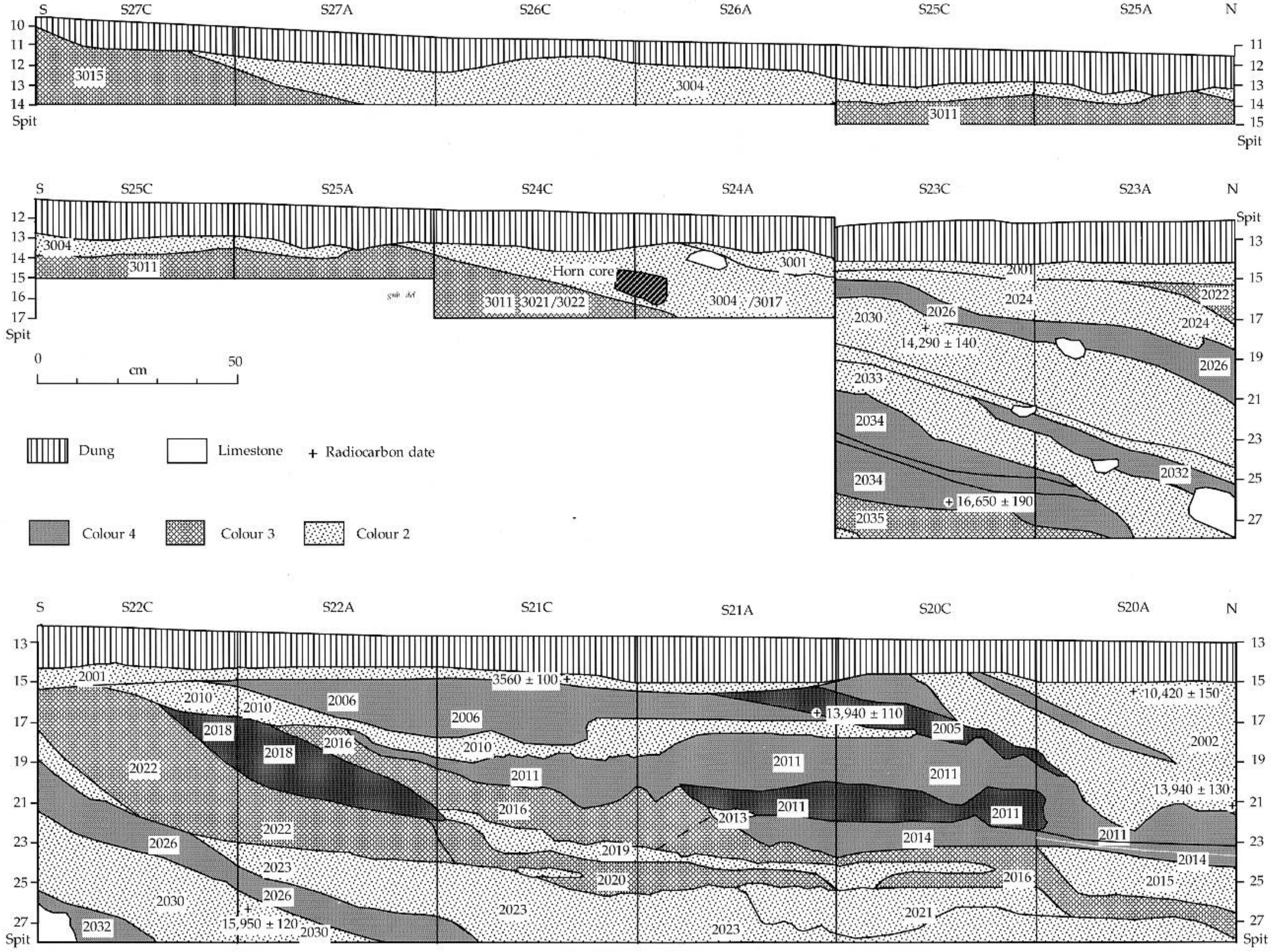


Figure 4.13. *East-facing section of S27–S20. Representational conventions are the same as in Figure 4.6.*

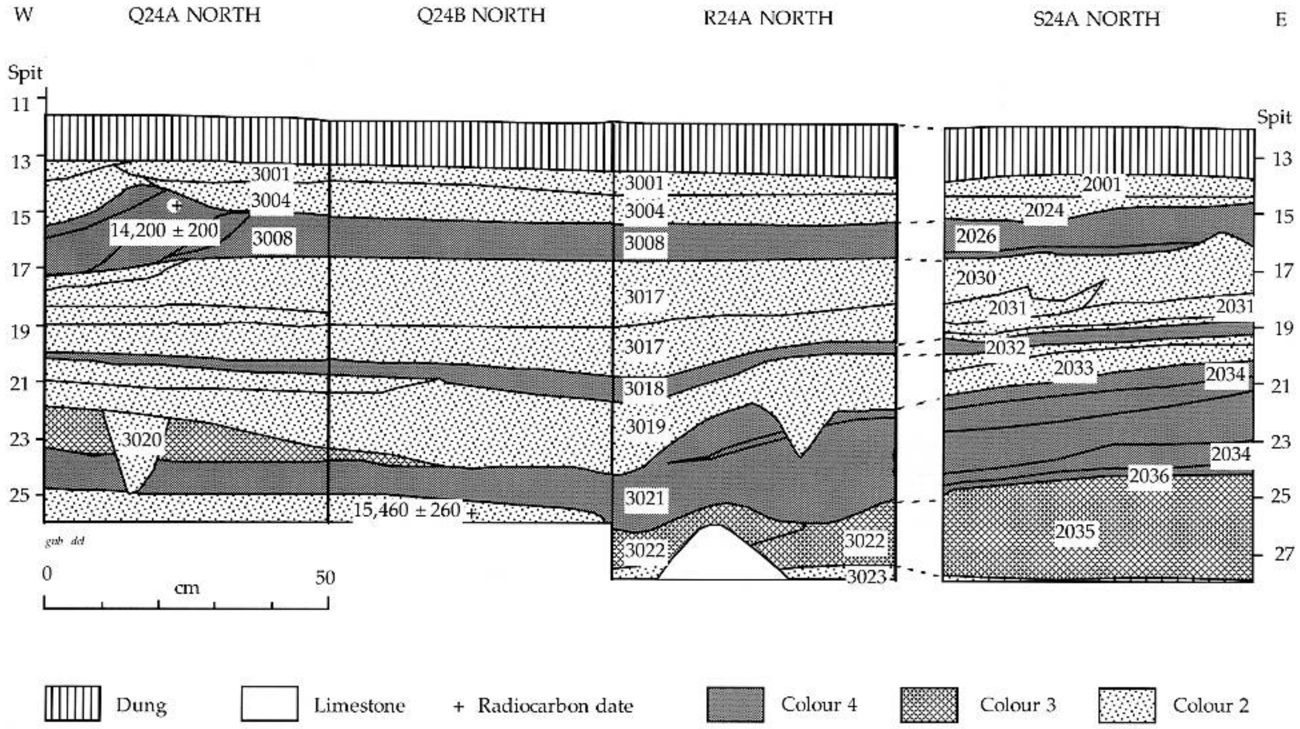


Figure 4.14. *South-facing section of Q24–S24, showing context numbers.*

Two further questions need to be considered. The first is the degree to which deposits recovered from a small-diameter core can be considered as representative of other areas of the site. The change from culturally sterile to culturally rich sediments visible stratigraphically in core Y25 and core CC27 is replicated along a spatial transect in the V/W trench. As observed earlier, the deposits in W32–33 lack the reddening of fines visible in contemporaneous deposits closer to the back wall and have low densities of bones and artefacts. A small diameter core through this part of the deposit might well have recorded a seemingly sterile column of deposits. In other words, does the apparent lack of evidence for human occupation before about 16 ka in core Y25 mean that the whole site was unused in this earlier period? There can be no unequivocal answer to this question except to observe that if there was earlier occupation, it was either at a very low density or it was confined to a more restricted area of the rockshelter. The latter is a tempting argument on the grounds that during maximum glacial conditions occupation might well have been restricted to the deepest and most sheltered recess of the shelter in the area of the Q20–T22 trench, and that Y25 and indeed CC27 are peripheral to this main hearth area. On the other hand it seems improbable that no cultural material — artefacts, bones, ashes from fires and so on — was thrown out to the peripheries from such a putative hearth area. Until excavation has probed more deeply into the backmost part of the shelter, the question should be left open, although it seems likely on present evidence that any occupation that may have occurred substantially before about 17 ka was extremely sporadic and on a quite different scale from what came later.

The second question is the reliability of the provenance of the radiocarbon dates. This question arises because the deepest radiocarbon date, 16,490 ± 220 BP occurs at a depth of 3.5 m below datum (Fig. 2.2), even though it is only some 3 metres away from V25 where a statistically indistinguishable reading occurs at a depth of only 1.6 m below site datum. Four hypotheses can be proposed to account for this:

- There is a radiocarbon anomaly at about this period such that calendrical dates spanning a wide range of possibilities give similar radiocarbon dates because of fluctuations in the production of radioactive carbon in the upper atmosphere.
- The burnt specimens from the cores which yielded radiocarbon dates have been pushed down through the deposits by the coring technique, or inadequacies of the coring technique have obscured the true provenances of the dating samples in some other way.
- The deposits slope very steeply from west to east in this area of the site.
- The accumulation of sediments was sufficiently rapid to build up a metre-thick deposit within a span of time that is too short to be measured accurately by radiocarbon dates.

The first hypothesis is the easiest to eliminate, since radiocarbon dates over this time range have been calibrated against the independent Uranium series dating record (Gowlett *et al.*, Chapter 2). This calibration indicates that radiocarbon dates may underestimate true age by as much as 2000 years, but gives no support to irregularities of the scale that would be required to explain away stratigraphic inconsistencies between identical radiocarbon dates.

Displacement of samples by coring is considered unlikely because great care was taken to clean out deposits that had fallen into the bottom of the hole from the core sides before inserting the next tube (Bailey, Chapter 3). Also, when removing intact sediment from a coring tube, care was taken to select for dating only specimens that had been recovered from within the body of the sediment column and not from the outer layers or the base of the tube, where extraneous material could have been incorporated as the coring tube was pushed down through the deposit.

Even if we grant that younger material might have been pushed to greater depth, we might nevertheless expect that some of our radiocarbon samples also represented older material. Yet,

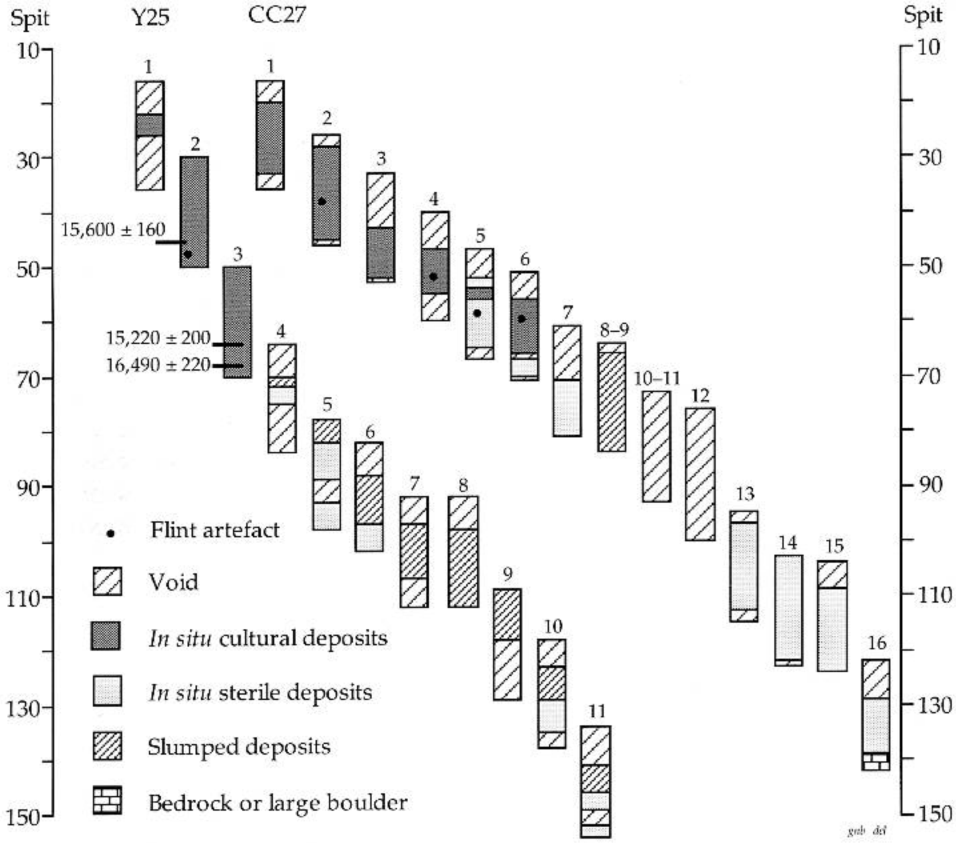


Figure 4.15. *Stratigraphy of the two longest core sequences, Y25 (Cores 1–11), recovered in 1986, and CC27 (Cores 1–16), recovered in 1988. The depth of each core is based on measurements taken at the time of drilling. Overlap between cores reflects the difficulties encountered with deposits slipping out of the tube during extraction or with slumping of deposits from the sides of the drill hole. The use of a liner for the drill hole in CC27 reduced the problems of slumping but did not wholly eradicate them. The presence of voids and layers of slumped deposit, especially in Y25, together with the possibility of compression of* in situ *deposit by the drilling, means that the precise depth of particular specimens or* in situ *layers is subject to some uncertainty, although each sequence preserves a correct record of relative stratigraphic relationships and an accurate estimate of the total depth of deposit.*

all three dates, admittedly a small sample, fall within the time range of human occupation recorded elsewhere in the site.

It is, however, possible that the deposits containing the carbon samples have been displaced by the coring process with respect to their true provenance. Core 2 and Core 3 from Y25, which yielded the three radiocarbon dates, were the most complete core sequences recovered in the whole drilling exercise and lacked voids or layers of slumped deposit (Fig. 4.15). But they were preceded by Core 1 which contains two voids, and it is possible therefore that their recorded depth is deeper than their original position.

Minor inconsistencies between radiocarbon dates and stratigraphic provenance occur elsewhere in the other excavation trenches. For example the ashy layer of Context 3021 in Q24B is stratified above Context 3023 with a date of 15,460 ± 260 (Fig. 4.14), yet Context 3021, which can be traced with some confidence into the adjacent area of S23 (where it is labelled as Context 2034 of the 2000 series) gives a date of 16,650 ± 190 (Fig. 4.13). Presumably this discrepancy reflects some post-depositional disturbance in the position of the samples used for dating. At any rate there is no reason to think that the coring technique itself has added to this problem.

There is rather weak independent evidence for the third hypothesis. If the cone of deposition of sediments in the shelter had its highest point at the western end beyond the rock overhang, then a general slope from west to east is to be expected (Fig. 2.2). Most of the dates suggest rather little evidence of a general slope. Only the dates from W32 seem consistent with the dates from the drill cores, but the bones used for dating could have slipped downwards within the deposit, as discussed earlier.

As for the fourth hypothesis, there is evidence from elsewhere in the deposit that statistically identical dates may be separated by some thickness of deposit. In V25, for example, OxA-2972 (16,140 ± 150) and OxAa-2327 (16,250 ± 170) are separated vertically by nearly half a metre of deposit (Figs. 4.7 & 4.9).

In conclusion, there is no evidence to suggest that the coring technique has obscured stratigraphic relationships, although it is conceivable that it has caused some vertical displacement of dating samples. To the extent that the depth of the dates in the Y25 core seems anomalous with respect to identical dates in the nearest excavation trenches, this can be explained most simply by a combination of sloping deposits and inherent limits on the resolution of radiocarbon dates.

Chronological trends

A total of 52 samples were submitted for radiocarbon dating, but only 25 of these produced dates. Of these, one is modern and two are historical. The assessment of chronological trends is thus based on 22 radiocarbon dates. The fact that so many samples had insufficient carbon to give a date even with the aid of Accelerator Mass Spectrometry is itself an interesting comment on the difficulties of obtaining a large sample of radiocarbon dates from a deposit like Klithi (see Gowlett *et al.*, Chapter 2). It also means that for certain critical areas of the deposit we lack sufficient data to allow a satisfactory evaluation of dating issues. This is particularly the case in the area of the main hearth at the back of the shelter.

Total span of occupation

The majority of dates cluster between 16,500 BP and 13,500 BP (Fig. 4.16), and this is the time span with which the lithic and bone assemblages recovered in excavation are to be associated. Whether this time span represents the full duration of occupation at Klithi is another matter. Because of the relatively small number of dates obtained in relation to the number of samples submitted, it is necessary to examine carefully this aspect of the interpretation.

The earliest dates seem reasonably secure as a guide to the first onset of human occupation, because no earlier dates have been recovered in spite of stratigraphic opportunities to do so. Where deeper sediments have been recovered below the earliest radiocarbon dates, the deposits are culturally sterile. Our best evidence for this comes from the drill cores, but it should be noted that none of the other excavation trenches have certainly reached to bedrock, and indeed none, with the possible exception of the WX32–33 trench, has reached deposits that are unequivocally sterile. Since the drill cores sampled such a small amount of deposit, it is conceivable that they have missed traces of earlier occupation. On the other hand the sedimentological studies carried out at Klithi and Megalakkos (Woodward, Chapters 18 & 19) show that the colour of the fine sediment is typically modified by fire activity where human occupation is present, and we would expect to have observed this feature in the deeper and earlier levels of the deepest cores (Y25 and CC27) if there had been human occupation at these earlier periods even if artefacts and animal bones had been missed by the coring tube. We therefore conclude that the first human occupation of Klithi began at about 16,500 BP (in conventional radiocarbon years) and was preceded by a period of unknown duration, but almost certainly extending over many thousands of years, when the shelter was unoccupied even though it was available for use.

The question of when Palaeolithic occupation ceased at Klithi is less easy to answer, and requires an evaluation of the dates in the back part of the shelter, and an assessment of how much deposit has been removed in historical times by the most recent occupants.

Sixteen radiocarbon samples were submitted for dating from deposits in the main hearth area, but only eight gave a positive result. Of these, five give a spread of values between 13,940 BP and 16,650 BP. The other three dates are outliers at, respectively, 12,300 BP, 10,420 BP and 3560 BP. As noted earlier in the detailed discussion of the stratigraphy, all three dates are based on samples that were recovered from just below the modern surface, and they could all represent intermittent episodes of site-use that took place some many centuries and indeed millennia after the main period of Palaeolithic occupation, but whose traces have become mixed in with the underlying prehistoric deposits. This is certainly the case with the 3560 outlier and probably the case with the 10,420 outlier, though this date is based on a burnt caprid bone and therefore presumably indicates the resumption of hunting activity at this time. The case of the 12,300 outlier is more equivocal, since it is sealed by a thin capping of overlying prehistoric deposits, and is reasonably to be associated with the adjacent flint artefacts and animal bones. But it too could represent a short-lived reoccupation of the shelter after a period of abandonment. The distribution of radiocarbon dates from the site as a whole (Fig. 4.16) shows a gap between about 13,500 and 12,300. This gap could of course be a function of the small number of radiocarbon dates from the uppermost deposits and does not necessarily indicate a hiatus of occupation. Nevertheless the general distribution of radiocarbon dates suggests either that occupation of Klithi was more sporadic after about 13,500 BP, or that younger deposits have been removed.

As is evident in many of the sections on a north–south axis, there is some unconformity between the prehistoric deposits and the modern goat dung, along with indications that the prehistoric deposits have been truncated in places, presumably by the clearance activities of the goatherds who have occupied the shelter in recent centuries. This raises the possibility that the top layers of the prehistoric deposit have been removed on such a scale as to erase most of the evidence for human occupation after about 13,500 years ago, and that what survives is an incomplete sequence. By its very nature this possibility is difficult to evaluate, and any assessment must be somewhat speculative, but there are a few clues. First of all, it seems likely that the main objective of recent clearance would have been to produce a more level surface than that presented by the original surface of the prehistoric deposit, which, judging by the general trend of the deposits visible in the sections, would have had a cone-shaped or dome-shaped structure with its apex roughly following the dripline.

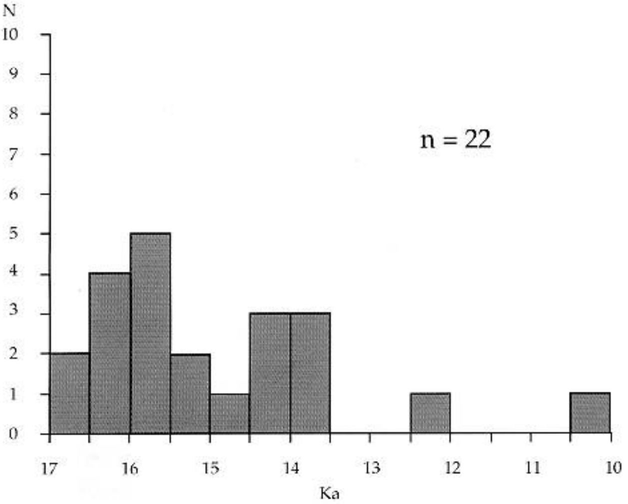


Figure 4.16. *Histogram showing distribution of radiocarbon dates at Klithi.*

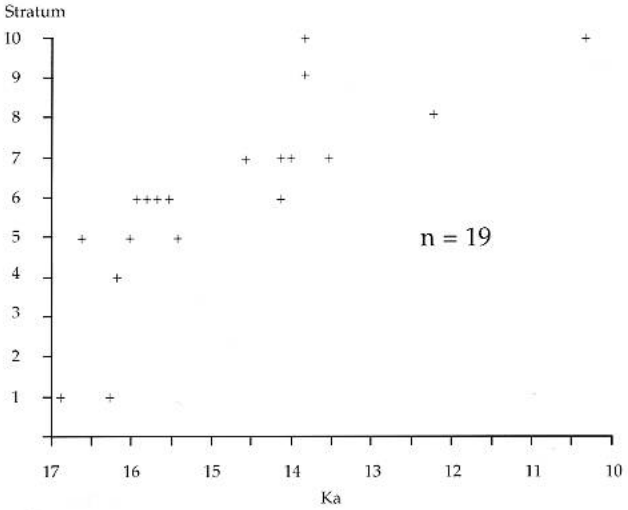


Figure 4.17. *Distribution of radiocarbon dates by stratum. Dates from core Y25 not shown.*

Secondly, the prehistoric scree deposit is in fact quite difficult to scrape off. Although the deposit is not cemented, the dense, stony nature of the sediment makes it very difficult to clear with a spade in the conventional manner. The modern goatherds, though they may have been inspired in part by a wish to deter us from excavation, described the surface underneath the goat dung as a virtually impenetrable stony surface. It seems unlikely that more of the deposit would have been cleared than was necessary to bring the shelter floor level with the main hearth area, and the large stones and boulders outside the dripline would have been a further disincentive to extensive clearance. Finally, it is clear that traces of younger occupation have survived in the back of the shelter, and it seems surprising that no trace of younger prehistoric deposits has survived elsewhere in the site, not even a piece of charcoal from an abandoned fireplace. Although we cannot prove the case with complete confidence, we conclude that very little human occupation and discard of materials took place on the site after about 13,500 years ago, that such occupation as did occur was of limited extent and duration in comparison with earlier periods, and that the surviving evidence is reasonably representative of the pattern of prehistoric occupation.

Chronological and stratigraphic resolution

It is clear from the above discussion and analysis of the stratigraphy that the radiocarbon dates provide a generally consistent temporal series but with some irregularities. The weakest link in the production of a unified stratigraphic scheme for the whole site is the sequence of strata, since this depends on correlations between different trenches and assumptions about the contemporaneity or otherwise of various deposits. Spearman's rank correlation coefficient between stratum and radiocarbon date produces a high rank correlation (–0.88, and –0.92 after adjustment for ties). The plot of stratum against radiocarbon date confirms this but shows that the distribution of dates is not uniform (Fig. 4.17). Strata 1–4, originally defined on the basis of their depth and lithological distinctiveness, are not chronologically distinctive, a point reinforced by the stratigraphic analysis above, and there is a substantial degree of overlap amongst the other strata. Stratum 10 shows a particularly wide range of dates, which suggests either that this stratum represents a very considerable time period, or that there is some intrusive material. The key uncertainty in Stratum 10 is the date of 10,240, and as discussed earlier this date probably refers to a discrete episode of occupation later than the other deposits assigned to Stratum 10. There is also very little basis on dating or stratigraphic grounds for separating Stratum 10 from Strata 8 and 9, and the material from these three strata should be treated as a single unit from a chronological point of view.

This analysis reinforces the view that there is a general temporal ordering of the deposits, but that the resolution is too poor to support a detailed subdivision as originally expressed in the full list of 10 strata. This scheme was originally drawn up when fewer radiocarbon dates had been processed, and when it seemed reasonable to assume that occupation was continuous between 17,000 and 10,240, the oldest and youngest radiocarbon dates then available. With the reinterpretation of the 10,240 date, the time span of Palaeolithic occupation has been halved, and the scope for detailed temporal subdivision reduced accordingly. In the light of the discrepancies that occur between individual radiocarbon dates and their detailed stratigraphic associations, the likelihood of sample mobility within the deposits, the inherent uncertainties in the radiocarbon method, and the unreliability of stratigraphic correlations attempted on purely geological criteria, it is straining beyond the limits of resolution attainable at Klithi to expect to establish a temporal succession with a resolution of much less than 1000 years.

The conjoining studies discussed in the following chapter (Wenban-Smith, Chapter 5) reinforce these conclusions. A significant number of conjoins cross context and stratum boundaries and demonstrate that there has been some disturbance and mixing of material and a consequent loss of resolution in both the temporal and the spatial dimension.

Rates of accumulation

In earlier analyses of the Kastritsa and Asprochaliko sequences an attempt was made to compare the two sites in terms of the rate of accumulation of artefacts and bones, using two statistics: *geometric density* (the quantity of material per unit volume of deposit) and *time density* (the quantity of material per unit area per unit time), the latter statistic being used to bypass inconsistencies introduced by differential rates of sediment accumulation (Bailey *et al.* 1983a,b). The original purpose of such a comparison was to throw light on the differential intensity of use of the two sites.We reproduce the earlier data in Table 4.1 together with similar measures from Klithi. For Klithi we have used the sequence of radiocarbon dates from V25 to give a maximum rate of sediment accumulation, and the dates from W32 and X29 to give a minimum. At Asprochaliko estimates of rates are severely constrained by the presence of only one radiocarbon date from the Upper Palaeolithic deposits, although it is likely that the rate of sediment accumulation was quite low. For estimates of bone quantities we have used the number of identifiable specimens only, since accurate data on the number of unidentifiable bones is not available from Asprochaliko and Kastritsa. For the lithics we present data both on the total number of artefacts and the number of retouched tools. In the earlier analyses the figures were further adjusted to take account of the floor area of each shelter, on the assumption that the larger the floor area, the greater the oportunity for the dispersal of finds and hence the lower the density (Bailey *et al.* 1983a). The validity of this adjustment is uncertain, since it assumes that the dispersal of discarded items expands to fill the area available, and adds a measure of unnecessary refinement to what are really quite crude comparative measures. The figures in Table 4.1 have not been subject to this adjustment, but it is worth noting that if such an adjustment were applied, it would tend to increase the density figures for Klithi as the site with the largest floor area of the three rockshelters.

Several interesting contrasts emerge. The average rate of sediment accumulation at Kastritsa is slightly higher than at Klithi. Geometric densities of flint artefacts and retouched tools are more than ten times higher at Klithi than at Kastritsa, and of identifiable bones over forty times higher, differences which decrease only slighty when the figures are expressed as time densities. Klithi emerges as the more intensively used site on both the lithic and the bone data, and this difference is further accentuated if adjustments are made to allow for the larger shelter area available at Klithi. Geometric densities in the Upper Palaeolithic deposits at Asprochaliko are substantially lower, and time densities lower still.

The interpretation of these contrasts is of course subject to a number of uncertainties. The measures are fairly crude, to the extent that they do not take account of intra-site variability. The bone and lithic data are also expressed in terms of fairly crude quantitative measures that may vary in response to factors that are quite independent of rates of human activity, for example differential patterns of bone fragmentation or differential recovery methods. The confounding problem expounded by Winder (Chapter 6) applies with as much force to inter-site comparisons as to intra-site ones.

Perhaps the most interesting aspect of these

Table 4.1. *Rates of sediment accumulation and densities of material at Klithi in comparison with Kastritsa and Asprochaliko. Figures for Kastritsa and Asprochaliko are taken from Bailey* et al. *1983a. Figures for Klithi are based on data from V25.*

	Klithi	Kastritsa	Asprochaliko
Sediment rate (cm per yr)			
Max	0.067	0.083	–
Geometric density (per m^3)			
Flints	26,424	2354	1994
Retouched tools	1571	154	50
Bones (Ident.)	4472	108	11
Time density (per m^2 per ka)			
Flints	9787	1153	260
Retouched tools	582	83	3.2
Bones (Ident.)	1656	47	1.3

data is their taphonomic implications. Rate of sediment accumulation is an important variable in determining the differential preservation or visibility of archaeological data and in the interpretation of inter-site and intra-site patterning. On *a priori* grounds, one might predict that the greater the rate of sediment accumulation the better the chances of material being preserved by sediment burial. Bone data in particular are vulnerable to deterioration or destruction by being left exposed on the surface, and one might expect the condition of bone data to be worse and the rate of destruction to be higher at sites with lower rates of sedimentation. Similarly, patterning in the spatial distribution of lithics and bones and in cultural features is likely to be better protected from disturbance and mixing where there are higher rates of sediment accumulation. In the light of Gamble's (Chapter 12) comments on the poor condition of the bone at Klithi, and Galanidou's (Chapter 26) comments on the apparently greater integrity of spatial patterning at Kastritsa, it is of particular interest that the rate of sediment accumulation is slightly lower at Klithi than at Kastritsa. If the rate of sediment accumulation at Asprochaliko is as low as the currently available dates suggest, this might account for the very low time density of animal bone, which is not only very low in relation to the other sites, but disproportionately low in relation to the lithic densities from Asprochaliko itself.

Spatial features

Physical features which might have constituted a visible structuring of the living space, such as stone-lined hearths, post-holes indicating artificial structures, or other arrangements of large stones, are notably absent at Klithi, in contrast to Kastritsa (Galanidou, Chapter 26). The four large boulders that form an outer ring around the back area of the shelter (Fig. 3.1) appear to have been artifically positioned, but excavation has not proceeded to the point of establishing their provenance, so that it is not yet clear whether they were already in place in prehistoric times or were put there in historical times. For evidence of spatial organization we are largely dependent on latent structure detectable in the distributions of the bones and lithics themselves (Galanidou, Chapter 15). Independent evidence of contextual variation consists mainly of ashy concentrations indicating fireplaces or material thrown out from them, and the physical constraints of the rockshelter itself in providing differential zones of shelter and light.

Given the large quantities and high densities of artefacts and animal bones, the relatively restricted living area, the taphonomic implications of low sedimentation rates discussed above, and the conjoin work reported by Wenban-Smith in Chapter 5, it is also to be expected that spatial patterning has been blurred or erased by disturbance and mixing of the deposit and site maintenance and clearance activities. Indeed one of the issues that needs to be addressed is whether spatial stuctures, both visible and latent, originally existed but have been modified or erased by subsequent disturbance, for example by the removal and dispersal of large stones used to line hearths, or whether such structures never existed in the first place (Galanidou, Chapter 15). Spatial patterning in these circumstances is only likely to be detectable where there was a high degree of redundancy or uniformity in the use of different areas of the site.

The two most notable features at Klithi are the high densities of material throughout the main areas of excavation, and the hearth feature at the back of the shelter. A general impression of the overall distribution of material is given in Figures 4.18 and 4.19, and a close-up view in Figure 4.20. The main hearth feature in the back of the shelter is characterized by thick lenses of very ashy deposits, by much lower densities of bones and artefacts (clearly visible as an 'empty' area in the distribution of Fig. 4.18), and by concentrations of material including larger items such as flysch pebbles and larger bones and flints which mark the perimeter of the main hearth area, particularly on its southern boundary in QR22 (Figs. 4.21 & 4.22). At first sight this concentration of material looks like the reflection of activites that one might expect to have been carried out around a hearth area, but it might equally well represent a fortuitous amalgamation of materials that have been swept together at the edge of the hearth area as a result of clearance to make way for a new fireplace.

Only two radiocarbon dates were obtained from the upper levels, the 12,300 date from Q22 and the 10,420 date from S20. Because these two dates span nearly 2000 years, we originally thought that the apparent spatial patterning visible in this area, with its contrast between an empty ashy centre and a dense periphery of cultural materials, might be illusory, and that what we were observing was an arbitrary horizontal slice through a sequence of successive deposits representing different patterns of use at different periods of time. This latter hypothesis received some support from the fact that many of the larger artefacts and limestone clasts show a slight but consistent dip on a south–north axis, as if they had been deposited on a slightly sloping surface. With deeper excavation and sectioning of the hearth area along the west boundary of S23–S20 (Fig. 4.13), and the re-interpretation of the 10,420 date as an isolated episode of later occupation, we now believe that the juxtaposition of different deposits is more reasonably interpreted as a penecontemporaneous feature. It is also clear that the thick ashy deposits and evidence of intense burning visible in the uppermost deposits occur at deeper levels and at earlier dates, indicating a consistent, though perhaps intermittent, pattern of usage of this area throughout the full span of occupation. No evidence for comparable hearth features has been identified elsewhere in the areas excavated, although the edge of an ashy deposit was recorded in W24 (Fig. 4.6) and may represent a secondary hearth area located further to the east against the back wall of the shelter.

Finally, a small isolated hearth was originally identified as such in QR24 (Fig. 4.23). This looked like a small and short-lived fireplace, the burnt bones representing the remains of the food cooked over the fire. Further excavation in 1988 established that this apparently isolated feature was simply the top of a more extensive ashy deposit which can be traced stratigraphically back to the main hearth area as Context 3008/2026 (Figs. 4.13 & 4.14). It should thus be interpreted as part of the wider scatter of material extending out from the periphery of the main hearth, rather than an isolated feature in its own right representing a distinctive high-resolution event. Callow *et al.* (1986, 194) have drawn attention to a similar problem at La Cotte St Brelade, where horizontal exposure of an irregular surface may initially create the illusion of apparently discrete hearths.

Conclusions and further implications for assemblage analysis

We can summarize the main conclusions of the stratigraphic analysis as follows:

- The total time span of occupation is *c.* 16,500 to 13,500 BP. There is no evidence of human activity before this even though the site would have been available for human occupation. The evidence of human activity after 13,500 as attested by the later radiocarbon dates repesents sporadic visits which cannot be associated with the bulk of the lithic and bone assemblages.
- The sedimentological characteristics of the deposit show a high degree of lateral variability and cannot be used with confidence to identify palaeoenvironmental trends (at least not within the period from 16,500 to 13,500 BP) or to effect correlations between stratigraphically unconnected areas of excavation.
- It is now clear that there is considerable chronological overlap of strata, that, for analyses of material by stratum, deposits originally assigned to Strata 1–3 should be amalgamated with Stratum 4, and that deposits assigned to Strata 8–10 should also be amalgamated into a single unit.
- Post-depositional mixing and disturbance of materials and sediments has probably resulted in a loss of resolution in both the temporal and the spatial dimension. The chronological resolution that can be applied to the analysis of the lithic and bone assemblages is probably not much better than about 1000 years.
- The dominant cultural feature of the deposits is the large hearth area in the rear of the shelter. A second comparable hearth area, though probably less extensive, may have existed further to the east against the back wall (see also Chapter 15). The rear of the shelter was used for the main hearth area throughout the span of human occupation. In this respect, and at a gross scale of observation, spatial patterning of activities shows a high degree of redundancy.
- There is very little evidence of spatial patterning or organization at finer scales of observation. Arrangements of stones that might represent fireplaces are notably absent, either because they never existed or because they have been displaced or removed by subsequent re-arrangement and surface clearance. The concentration of larger items along the southern and western edge of the main hearth area may reflect a concentration of activities on the edge of the hearth or a fortuitous amalgamation of materials brought together by surface clearance and secondary deposition.

Certain difficulties emerge from the above analysis. One is that the excavation strategy has resulted in a spatial transect of the deposits which appears at first sight to be simultaneously a temporal transect, with the younger deposits at the back of the shelter and the older deposits at the front. This outcome could not have been anticipated at the time of excavation, but considerably complicates the study of contemporaneous spatial variation, and can only be corrected by future excavation (Winder, Chapter 6). However, close analysis of the radiocarbon dates and stratigraphic phasing suggests that this problem is less serious than we originally thought. The original

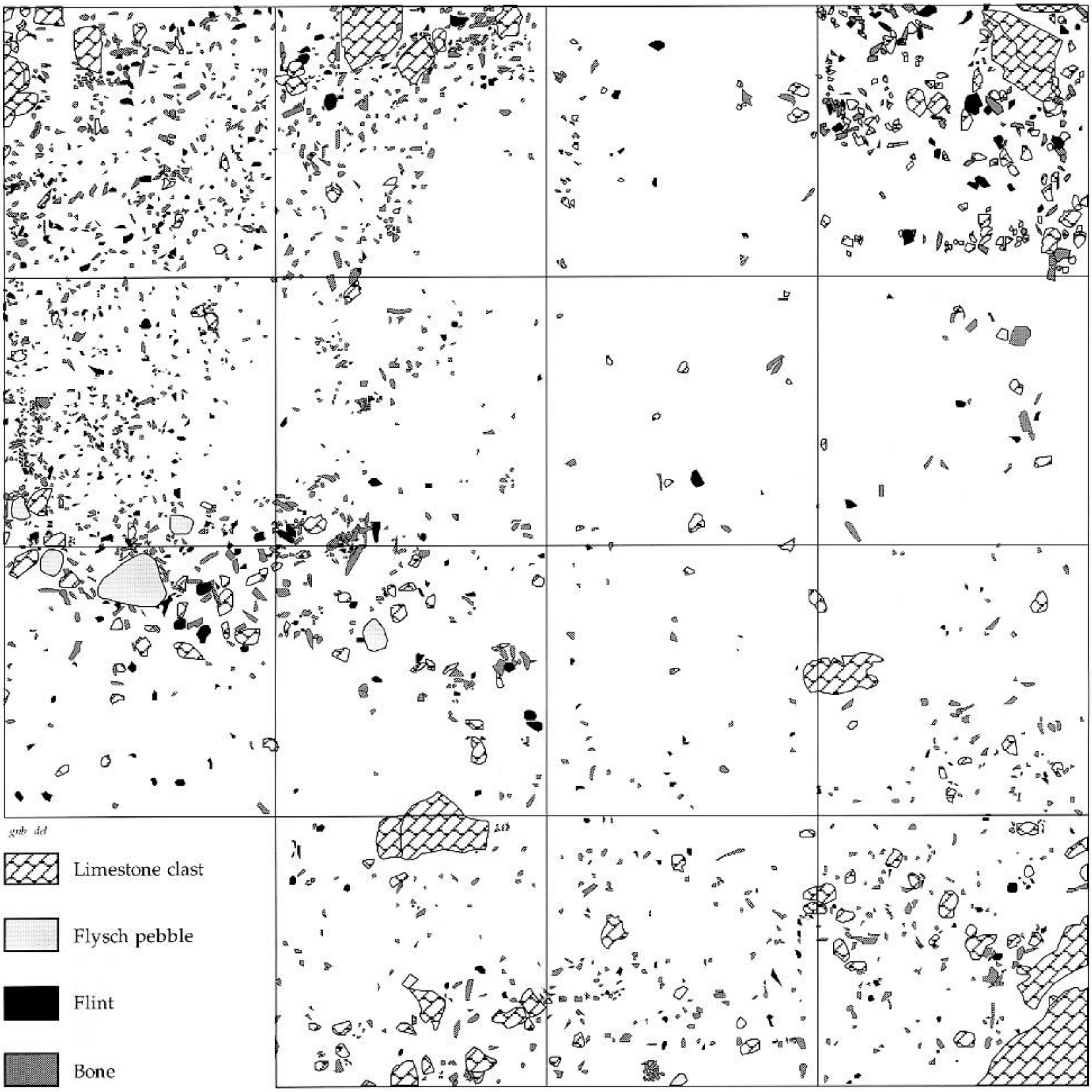


Figure 4.18. *Spatial distribution of animal bones and lithics ≥2 cm and stones ≥5 cm visible on the surface exposed by excavation in the main back trench (Q20–T23).*

subdivision of the deposits into 10 strata was based on lithological subdivisions and extrapolation from a limited number of radiocarbon dates, and subsequent analysis has reduced the number of strata effectively to five — 1–4 (of very limited extent), 5, 6, 7, and 8–10. Most of these are well represented over quite extensive areas and therefore offer rather better opportunities to undertake spatial analysis of latent patterning at finer levels of chronological resolution than was originally anticipated (see Chapters 14 & 15).

Perhaps if we had confined excavation to a single trench, interpretation might have been simpler. Our choice of extensive excavation, however, while it has undoubtedly complicated the task of making correlations between different parts of the deposit

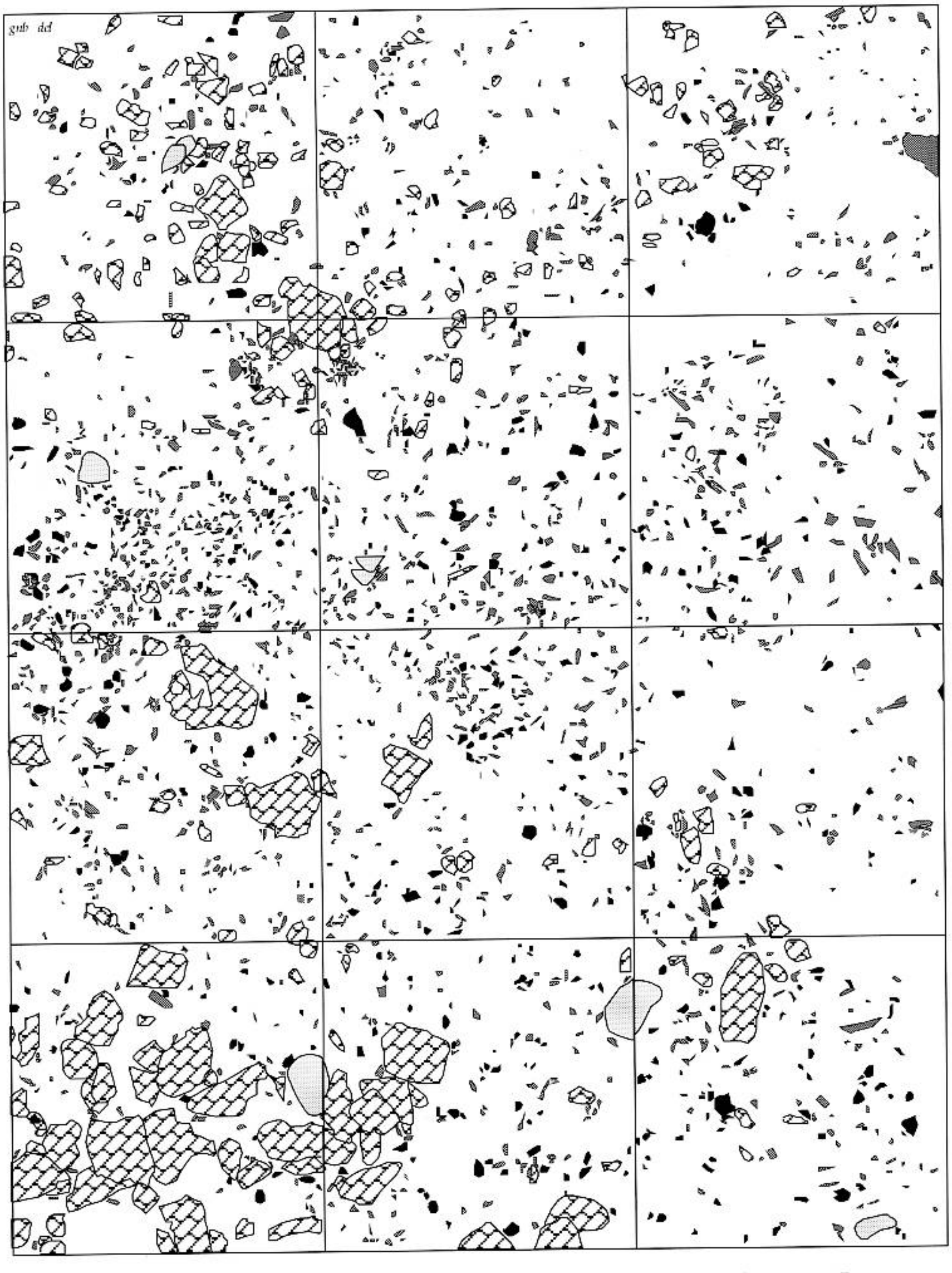


Figure 4.19. *Spatial distribution of animal bones and lithics ≥2 cm and stones ≥5 cm visible on the surface exposed by excavation in the main front trench (P24–R27). Representational conventions as in Figure 4.18.*

and establishing a unified stratigraphic scheme, has also of course revealed why the task is more complicated, because there is an inherently greater complexity to the formation of the deposit, more variability in temporal and spatial characteristics, and poorer resolution than might have been apparent from a single excavation trench. What applies to intra-site comparison applies even more so, of course, to larger scales of analysis and interpretation which depend on inter-site comparison.

These complications have given rise to differences of opinion about the most appropriate approach to the analysis and interpretation of the cultural material. One view articulated by Winder (Chapter 6) is that both temporal and spatial components of variation are present in our excavated sample, but that they are so inextricably confused as to defy separation and interpretation, and that disentangling these two components of variation cannot be achieved at Klithi without further excavation. This confounding problem is probably less serious than it first seemed, given the final interpretation of the stratigraphy and chronology, which now demonstrates that younger and older deposits are present in all the main areas of excavation. Other confounding elements, however, remain, such as differential recovery methods, and the problem of confounding remains a serious issue which is all too easily neglected both at the intra-site level and at larger scales of analysis. It also brings into sharp focus the question of what degree of chronological resolution is possible in archaeological data sets and just what constitutes contemporaneity. If we were unwilling to regard sediments or finds as

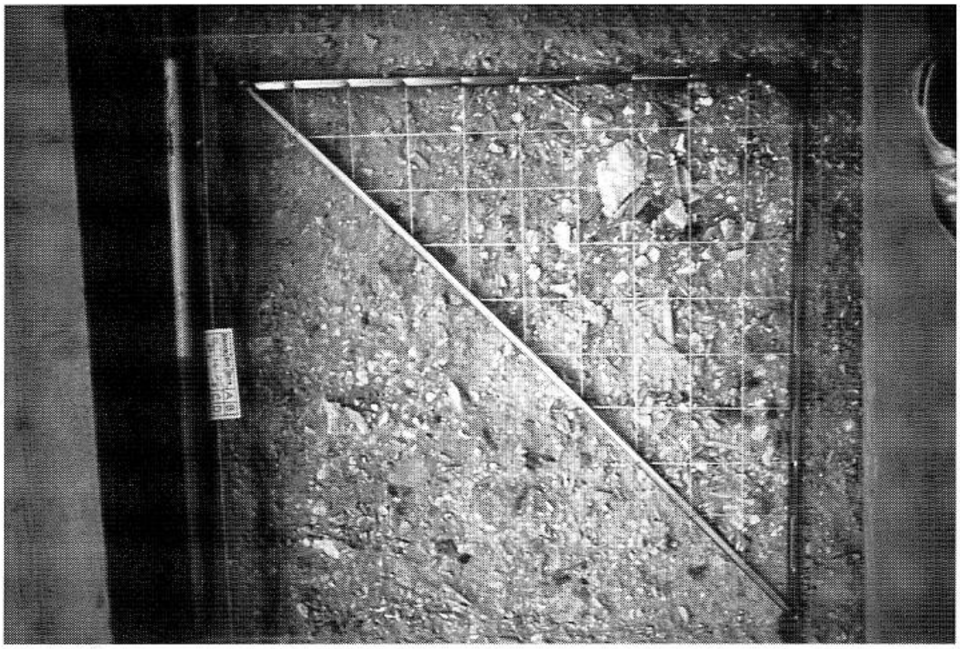


Figure 4.20. *Close-up of bones and flints* in situ *prior to removal.*

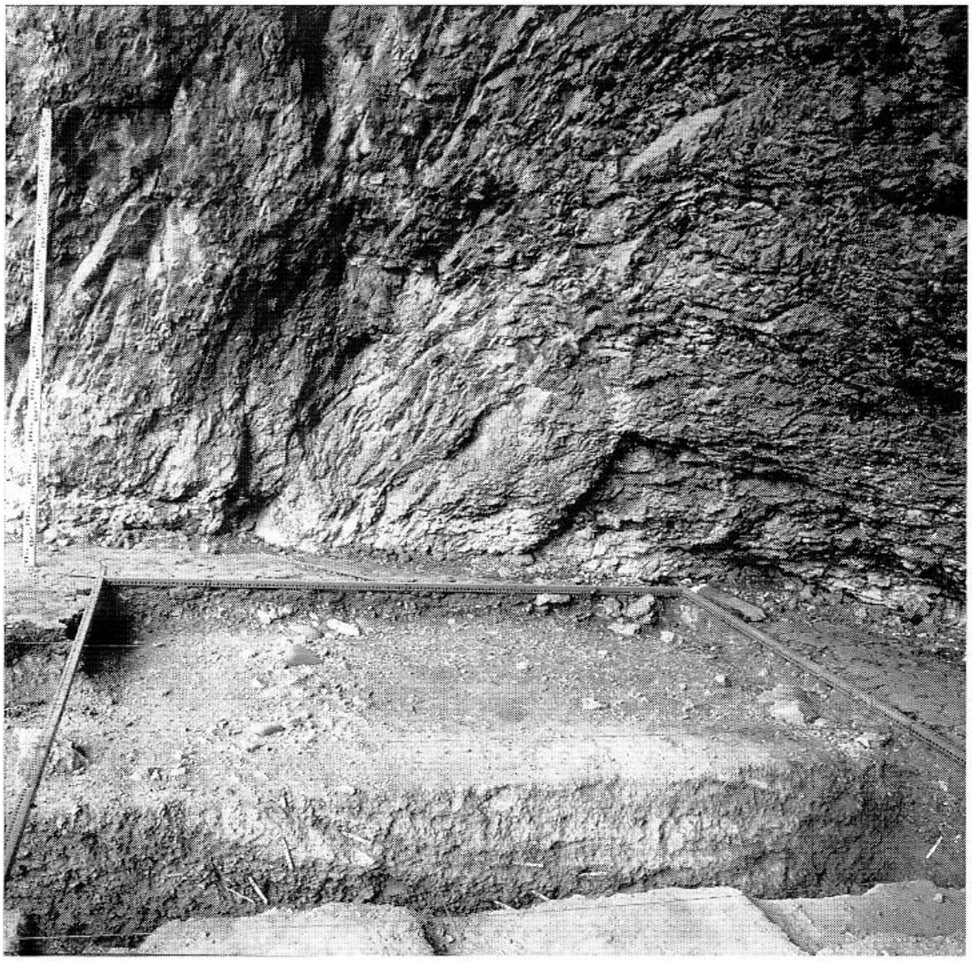


Figure 4.21. *General view of the main hearth area.*

Figure 4.22. *Close-up of the artefacts concentrated on the southern perimeter of the main hearth area.*

Figure 4.23. *View of 'hearth' feature in QR24 during the course of excavation in 1984.*

contemporaneous unless they could be demonstrated to have been deposited in the same year, then untangling the confounding problem on a site like Klithi would be an impossibility. Mixing and disturbance of deposits and discarded materials, and the margins of error inherent in radiocarbon dates, do not permit a resolution much better than 1000 years. If, at the other extreme, we were to regard the excavated deposit as a single layer, in effect to treat as contemporaneous everything within a time envelope of 3000 years, then the confounding problem (or at least the confounding of spatial and temporal variability) would cease to exist.

It is of particular interest that in the two major analyses of cultural material, by Gamble on the fauna (Chapter 12) and by Roubet on the lithic industries (Chapters 8 & 9), both comment on the striking lack of temporal variability. Gamble opted initially for a global analysis of the faunal data by stratum, but this failed to reveal any time trends, and suggests a high degree of uniformity in the bone data, at least on those variables which have been analyzed, clearing the way for a global analysis of the material as a single assemblage. Roubet opted initially for an analysis of material by context, an approach which in principle should be more sensitive to temporal variability. The VW25 area of the excavation offers perhaps the best opportunity for such an approach, where superpositioning of layers ought to offer a better guarantee of chronological progression, but it is notable that even here there is very little evidence of temporal variability in the provisional analyses carried out so far, although Roubet does not rule out the possibility of detecting temporal change in future analyses. This uniformity in the bone and lithic material was a striking and puzzling feature at an earlier stage of the Klithi work, when we believed that the deposits extended through to about 10,000 BP, since evidence from elsewhere suggests that we should expect significant changes in faunal spectra and lithic industries between about 13 ka and 10 ka. The reinterpretation of the site chronology removes this puzzling feature and suggests that uniformity of cultural materials is what we should perhaps expect for such a relatively short-lived span of occupation.

One difficulty of analyses by context is that the resulting subdivision of the cultural material, especially in a single confined trench, results in small sample sizes, and there is the further difficulty that variations recorded vertically through a sequence of contexts cannot be confidently assigned to temporal, as opposed to spatial, variation in activities, without comparable comparative analyses of material from other areas of the deposit. Conversely a site-wide analysis of spatial variation as advocated by Winder (Chapter 14) may lead to over-compression and over-simplification of the data in the attempt to remove sources of confounding, Galanidou (Chapter 15) has taken an intermediate position, and while adopting the working assumption that major intra-site differences represent spatial variations, and that the use of different areas of the site is characterized by a high degree of redundancy, she has also analyzed spatial variation within individual strata which are represented over extensive areas of the excavated deposit. One interesting result that emerges is that different patterns of spatial variation are apparent at different levels of stratigraphic resolution.

Each of these approaches has its problems and advantages, and emphasizes that definitions of contemporaneity, and of chronological and spatial resolution, are not absolute objectives that can be identified and accomplished simply by adopting the correct set of technical procedures, but depend on the scale of observation, the inherent uncertainties of the material under study, and the questions to be addressed.

Acknowledgements

We are grateful to Thomas Cadbury for assistance in assembling the data on stratigraphic records and spatial distribution, and to Nick Winder for the statistical analysis of radiocarbon dates.

Appendix 4.1. *Klithi stratigraphy: description of provenances.*

1000 series: W28–W33

Context 1001 Stratum 20
Contaminated layers, throwout etc. Colour 4 or 2, variable stoniness, loose. Ashy. Carter layers 1, 2, 3, 4. Roubet-Kozlowski (R-K) layer 8.

Context 1002 Stratum 7
Colour 2, stony, loose. Carter layer 8, R-K layer 7. Spits 12–16 in W28, 29 and 30.

Context 1003 Stratum 6
Colour 2, coarse stony, loose. Carter layer 8, R-K layer 6. Spits 17–26 in W30–W32.

Context 1004 Stratum 5
Colour 2, coarse stony, loose. Carter layer 8, R-K layer 5. Spits 27–38 in W32–W33.

Context 1005 Stratum 4
Colour 2, fine stony, loose. Carter layer 8, R-K layer 4, Spits 39–42 in W32–W33.

Context 1006 Stratum 3
Colour 1, stony, loose. Carter layer 10, R-K layer 3. Spits 43–53 in W32. Spits 43–50 in W33.

Context 1007 Stratum 2
Colour 1, stony, loose. Carter layer 10, R-K layer 2. Spit 51 in W32. Spits 47–56 in W33.

Context 1008 Stratum 1
Colour 1, stony, loose. Clast supported scree, very large clasts. Carter layer 12, R-K layer 1. Spits 57–60.

2000 series: QRST rectangles in back trench

Context 2001 Stratum 20
Contaminated deposit, typically pink-brown but mixed colours. Munsell not recorded. Colour 2, stony, loose. On plan sheets called layer 14 and 100C1, corresponds to P1, P3 in front trench.

Context 2002 Stratum 10
Red-brown stony deposit. Munsell 5YR 4/2, 4/3, 5/3, 5/4; 7.5YR 4/2, 4/4, 5/4; 10YR 5/3, 5/4. Colour 2, stony, loose. On plan sheets called layer 15, RB4.

Context 2003 Stratum 10
Dark brown-grey deposit. It seems to be a lens which runs through layer 15 (2002), since in Q22 and Q21 this deposit seems to run above layer 15, while in R rectangles it appears below layer 15. It could also be a mixed deposit of layer 15 and ashy layers (2011). The boundaries of this deposit were never very clear. Munsell 5YR 3/2; 7.5YR 3/2, 4/2; 10YR 3/2. Colour 3, stony, loose. On plan sheets called 14L1 and 15/H3,4.

Context 2004 Stratum 10
Dark lens in layer 15 (2002), Q20, R20 A+B. Not very different to layer 15 (2002). Munsell 7.5YR 4/2; 10YR 4/3. Colour 2, stony, loose. On plan sheets called layer 15L7.

Context 2005 Stratum 9
White-grey ashy deposit. It seems to run out in the west of the R rectangles. Munsell 5YR 6/1, 8/1; 7.5YR 6/2 7/2 8/2. Colour 5, not stony, compact. On plan sheets called H4, W8.

Context 2006 Stratum 9
Grey ashy deposit which seems to run out in the west of the R rectangles. Munsell 5YR 3/1, 4/1, 5/1, 5/2, 7/1; 7.5YR 5/2, 6/2; 10YR 4/2. Colour 4, not stony, compact. On plan sheets called H4, G2.

Context 2007 Stratum 8
Loose grey-brown layer found on top of 15L1 (2008). Found only in T21 B and is not extensive. It is darker brown, stonier with coarser sediment than 15L1 (2008), and is probably an intermediate layer between 15L1 (2008) and 15 (2002). Munsell 7.5YR 5/4. Colour 3, stony, loose. On plan sheets called 15L2.

Context 2008 Stratum 8
A loose grey-brown layer which seems to lie between layer 15 (2002) and RB2, W2 (2022, 2011). The layer is restricted to rectangle T21 A,B,D (B having the greatest amount). Munsell 7.5YR 5/2, 6/2; 10YR 4/2, 5/3, 6/2, 6/3. Colour 3, stony, loose. On plan sheets described as part of RB4 or G2, or separately as 15L1.

Context 2009 Stratum 8
A layer which seems to be confined to the Q rectangles. It lenses out in Q22 and dips quite sharply down to the north, it also seems to run out to the west in Q21. The layer is characterized by small pebbles and some ash. Munsell 5YR 4/2; 10YR 4/2. Colour 3, stony, loose. On plan sheets called 15H1.

Context 2010 Stratum 9
Orange-brown stony layer. Munsell 5YR 5/3; 7.5YR 5/4, 6/4. Colour 2, stony, loose. On plan sheets called OS2.

Context 2011 Stratum 9
Extensive ashy layer, grey and pink-brown in colour. Munsell 7.5YR 5/2, 6/2, 6/4, 7/2. Colour 4, not stony, compact. On plan sheets called 14H3, 14L9, W2.

Context 2012 Stratum 8
Brown 'earthy' patch found on the west side of S21 at spits 19 and 20 in quads A and C. It has no ash and only occasional clasts. It seems to run out in S21 in spit 20. Munsell 10YR 4/3. Colour 1, not stony, loose.

Context 2013 Stratum 9
Orange stony deposit. Munsell not recorded. Colour 2, stony loose. On section shown as OS4.

Context 2014 Stratum 9
Grey ashy deposit. Munsell not recorded. Colour 4, not stony, loose. On section shown as W4.

Context 2015 Stratum 9
Red-brown deposit. Munsell 2.5YR 4/6. Colour 2, stony, loose. On section shown as RB6.

Context 2016 Stratum 9
Grey ashy deposit, on record sheets often described as white. Munsell 2.5YR 8/2. Colour 3, stony, loose. On section shown as GB2.

Context 2017 Stratum 9
A small brown patch, possibly related to the OS layer (2010) but not stony. Munsell 10YR 4/3. Colour 1, not stony, loose.

Context 2018 Stratum 9
White-grey ashy deposit. Munsell 5YR 7/1, 8/1; 7.5YR 6/2, 8/2; 10YR 6/2. Colour 5, not stony, compact. On plan sheets called 14H5 and W6.

Context 2019 Stratum 9
Brown stony deposit. Munsell 7.5YR 5/2. Colour 2, stony, loose. On section shown as OS6.

Context 2020 Stratum 8
Grey-brown deposit. Munsell 7.5YR 5/2. Colour 3, stony, loose. On section shown as GB4.

Context 2021 Stratum 9
Munsell 2.5YR 6/6. Colour 2, stony, loose. On section shown as OS8.

Context 2022 Stratum 8
Red-brown deposit with some grey in it. Munsell 7.5YR 4/6, 5/4; 10YR 4/3, 5/2, 5/3, 5/4. Colour 3, not stony, compact. On plan sheets called layer 17, RB2, 100G1, and layer 15 in Q rectangles.

Context 2023 Stratum 8
Brown loose stony layer which seems to continue from RB2 (2022) and may even be part of it. It continues the transition in character of RB2 from a grey-brown compact layer near the top of the deposit to a darker brown, loose, stony one lower down. 2023 is a brown, very stony deposit with a large number of bones found in it. Munsell 10YR 7/2. Colour 2, stony, loose. On section shown as B2.

Context 2024 Stratum 8
Brown deposit, this seems to be an intermediate layer between 17 RB2 (2022) and 101N1,B4 (2030). Munsell 10YR 5/3, 5/4. Colour 2, stony, loose. On plan sheets called 100GN, 100N.

Context 2025 Stratum 6
A small, dark, (possibly ashy) patch in T23 C+D. Munsell not recorded. Colour 3, stony, loose.

Context 2026 Stratum 8
Grey loose deposit which is similar to and seems to follow on from 100GN, 100N (2024). Munsell 10YR 6/2. Colour 4, not stony, loose. On section shown as G4.

Context 2027 Stratum 7
Slightly ashy lens which forms a band running across R23. Munsell 7.5YR 6/2; 10YR 5/2. Colour 3, not stony, loose.

Context 2028 Stratum 7
A thin compact grey band which seems to be restricted to R23. Munsell 7.5YR 6/2. Colour 3, not stony, compact.

Context 2029 Stratum 7
Grey brown loose deposit. Munsell 7.5YR 6/2; 10YR 5/3. Colour 3, stony, loose.

Context 2030 Stratum 6
An extensive brown layer. Munsell 10YR 4/3, 5/3. Colour 2, stony, loose. On plan sheets called 101N1 and on section B4. It seems to be the equivalent of PA5, BA1, PA7 (3017) in the front trench.

Context 2031 Stratum 6
Red-brown stony deposit. Very similar to 101N1/B4 (2030) but is more compact. Munsell 5YR 5/2, 6/3. Colour 2, stony, compact. Shown on section as RB8. It seems to be the equivalent of PA5, BA1, PA7 (3017) in the front trench.

Context 2032 Stratum 6
Grey ashy loose layer. Munsell 5YR 6/1, 7/1. Colour 4, not stony, loose. Shown as G10 on the section. It seems to be the equivalent of GA1 (3018) in the front trench.

Context 2033 Stratum 6
Brown, loose, ashy deposit. Munsell 7.5YR 5/2, 10YR 6/2. Colour 3, stony, loose. Shown on section as B6. It seems to be the equivalent of PA9, BA3 (3019) in the front trench.

Context 2034 Stratum 6
Grey, loose, ashy deposit. Munsell 5YR 6/2. Colour 4, not stony, loose. Shown on section as G12. It seems to be the equivalent of GA3 (with BA9), GA5, GA4, (3020) and GA7, GA9 (3022) in the front trench.

Context 2035 Stratum 5
A dark grey-brown ashy deposit. Munsell 7.5YR 5/2. Colour 3, stony, loose. Shown on section as GB4. It seems to be the equivalent of BA5 (3023) in the front trench.

Context 2036 Stratum 5
A thin grey layer within GB4 (2035) containing small stones. Munsell not recorded. Colour 4, stony, loose. Shown on section as G14.

Context 2037 Stratum 6
Localized greenish sandy intrusion found in S23B spit 16. Munsell 2YR 6/4. Colour 1, not stony, loose.

3000 series: PQR rectangles in front trench

Context 3001 Stratum 20
Contaminated deposit, typically pink-brown but mixed colours. Munsell 5YR 6/4. Colour 2, stony, loose. Called P1, P3 in 1988, the equivalent of 100C1, layer 14 in back trench.

Context 3002 Stratum 7
Grey-brown lens or patch found in the R rectangles. Munsell 7.5YR 6/2. Colour 2, stony, loose.

Context 3003 Stratum 7
A dark layer found below 3001 in P26. It had pieces of goat dung. Munsell 7.5YR 4/4. Colour 2, not stony, loose. On plan sheets called 16L8.

Context 3004 Stratum 7
Red-brown deposit running over a large area of the front trench. It seems to be a different red-brown layer from the one found in the back trench. Munsell 5YR 4/4, 4/6, 5/3, 5/4, 5/6; 7.5YR 5/4, 6/4. Colour 2, stony, loose. Called P5, P7, PA1 in 1988. On plan sheets called layer 16.

Context 3005 Stratum 7
A red-brown lens found with 3004 in P25. It varies from being hard, compact to loose but is little different from 3004. Munsell 5YR 4/4; 7.5YR 3/4, 4/4, 5/4. Colour 2, stony, loose. On plan sheets called 16L3.

Context 3006 Stratum 7
Small grey-brown lens, loose, less stony and with fewer finds than 3004. Munsell not recorded. Colour 2, not stony, loose. Called 16L7 on plan sheets.

Context 3007 Stratum 7
Small dark pink-grey intrusion into 3011 found in P27. It was suggested by excavator that it might be part of layer 16 (3004). Munsell 7.5YR 3/2. Colour 2, stony, compact.

Context 3008 Stratum 7
Grey ashy deposit found mainly in Q24A. It has a boundary with layer 18 (3011) which underlies this layer but the distinction between the two is not always clear. Munsell 5YR 4/1, 5/2; 7.5YR 4/2. Colour 4, not stony, loose. Described on plan sheets from 1988 as layer 51.

Context 3009 Stratum 6
Grey-brown slightly ashy deposit found in R25 spit 15. It is probably the top of layer 18 (3011). Munsell 5YR 5/3; 7.5YR 6/2. Colour 3, stony, loose. On plan sheets called 16GN.

Context 3010 Stratum 6
Dark grey deposit found in P26. Probably one of the intermediate layers between layer 16 (3004) and layer 18 (3011). Munsell 5YR 3/3. Colour 3, stony, loose. On plan sheets called 18L12.

Context 3011 Stratum 6
Grey-brown deposit found extensively over the front trench. As noted above this layer has some similarities to layer 51 (3008) and in places the two may have been mixed. Towards the front of the front trench the layer becomes very stony, and has been

given a different context number (3015). Munsell 5YR 5/3; 7.5YR 4/4, 5/4, 6/2, 6/3; 10YR 4/4, 5/3. Colour 3, stony, loose. On plan sheets described as layer 18. It is probably represented by B1, PA3, PA5 from 1988 excavation. It is possibly the equivalent of layers 100G, 100GL (2028, 2029) in the back trench.

Context 3012 Stratum 6
An area in which layer 18 (3011) is mixed with a lot of yellow ochre. Found in Q25. Munsell 7.5YR 5/6. Colour 3, stony, loose.

Context 3013 Stratum 6
A small lens in layer 18 (3011), found in Q26. It is more pink and compact than the rest of the layer. Munsell 5YR 6/4. Colour 3, stony, compact. On plan sheets called 18 L10.

Context 3014 Stratum 6
Grey lens in layer 18 (3011), found in Q26. Munsell not recorded. Colour 4, stony, loose. On plan sheets called 18 L18.

Context 3015 Stratum 6
At the front of the front trench layer 18 (3011) becomes very stony (there is little matrix in some areas). This area seems to continue from layer 18 (3011) but has been given another context number due to the different nature of the deposit. Munsell 5YR 5/3; 7.5YR 5/4; 10YR 4/3. Colour 3, stony, loose.

Context 3016 Stratum 6
A thin pink-brown layer with some ash. Munsell 5YR 5/4, 6/2. Colour 2, stony, loose. Seems to correspond to B1 and PA3 from 1988 excavation.

Context 3017 Stratum 6
Pink, brown, and orange quite ashy deposit. Munsell 5YR 5/2, 6/3. Colour 2, stony, loose. The equivalent of PA5, BA1, PA7, from 1988 excavation. This layer seems to correspond with 101N1/B4 (2030) in the back trench.

Context 3018 Stratum 6
Grey ashy layer. In the R rectangles it was included along with PA5, BA1, PA7 (3017) but in Q24A it can be separately distinguished. Munsell 5YR 7/1. Colour 4, stony, loose. The equivalent of GA1 from 1988 excavation. It is probably the same as G10 in the back trench.

Context 3019 Stratum 6
Brown ashy deposit. Munsell 5YR 5/3, 6/3. Colour 2, stony, loose. The equivalent of PA9, BA3 from 1988 excavation. It probably corresponds to B6 (2033) in the back trench.

Context 3020 Stratum 6
Grey ashy layer with a brown intrusion into it. These were not separated during excavation. Munsell 5YR 6/2. Colour 3, stony, loose. The grey ashy layer was called GA3 and the brown intrusion BA9 in 1988 excavation. They are some of the layers which probably correspond to G12 in the back trench.

Context 3021 Stratum 6
Grey ashy deposit. Munsell 5YR 6/2. Colour 4, stony, loose. Equivalent to GA5 from 1988 excavation. Probably corresponds to G12 in the back trench.

Context 3022 Stratum 6
Brown-grey ashy deposit. Munsell 5YR 5/2; 7.5YR 6/2. Colour 3, stony, loose. Equivalent to GA7 and GA9 from 1988 excavation. Again these probably correspond to G12 in the back trench.

Context 3023 Stratum 5
Brown deposit, not very ashy and in places with no ash. Munsell 5YR 3/3, 6/2. Colour 2, stony, loose. Equivalent to BA5 from 1988 excavation. Probably corresponds to GB4 in the back trench.

4000 series: W24–W29

Context 4001 Stratum 7
Red-brown with some grey, not very stony. Munsell 10YR 5/3; 7YR 5/4, 6/2, 5/6. Colour 2, stony, loose. Described in excavation as layer 54.

Context 4002 Stratum 7
Very light orange-pink, silty or gritty, some small river pebbles. Munsell 7.5YR 5/4, 5/6; 7.5YR 6/4; 5YR 6/6, 7/4. Colour 2, stony, compacted. Described as layer 50 on plans.

Context 4003 Stratum 7
Occasional limestone clasts 1 cm or less. Munsell 10YR 4/1. Colour 4, not stony, loose. Layer 51 on plan sheets.

Context 4004 Stratum 7
Similar deposit to 4003. Munsell 10YR 6/2; 7.5YR 5/2, 6/2. Colour 4, not stony, loose. Layer 56 on plans.

Context 4005 Stratum 7
Munsell 7.5YR 5/4, 6/6; 5YR 5/4, 7/4. Colour 2, stony, loose. Stones 1–2 cm, includes pebbles, described as silty or earthy. Declinations jumbled. Layer 52 on plans.

Context 4006 Stratum 6
Munsell 10YR 6/6. Colour 2, stony, compact. Stones 2–3 cm, chalky. Dark pink, gritty, burnt. Vertical bones and flints. Layer 58 on plans.

Context 4007 Stratum 6
Munsell 5YR 5/1. Colour 4, non-stony, loose. Stones less than 1 cm, ashy. Layer 60 on plans.

Context 4008 Stratum 6
Munsell 10YR 4/6. Colour 2, stony, compact. Stones 1–3 cm. Very similar deposit to Layer 58. Described as Layer 62 on plans.

Context 4009 Stratum 6
Munsell 5YR 7/2. Colour 3, stony, loose. Stones mostly 1–2 cm, occasionally up to 5–10 cm. Silty/sandy, very loose and jumbled. Long bone fragments sometimes vertical. Layer 64 on plans.

Context 4010 Stratum 6
Munsell 7.5YR 4/2. Colour 4, stony, loose. Stones less than 2 cm, chalky. Earthy and ashy. Layer 65 on plans.

Context 4011 Stratum 5
Munsell 5YR 6/2. Colour 3, stony, loose. Stones 1–3 cm, occasionally up to 20 cm. Colour described as pinkish-grey. Layer 66 on plans.

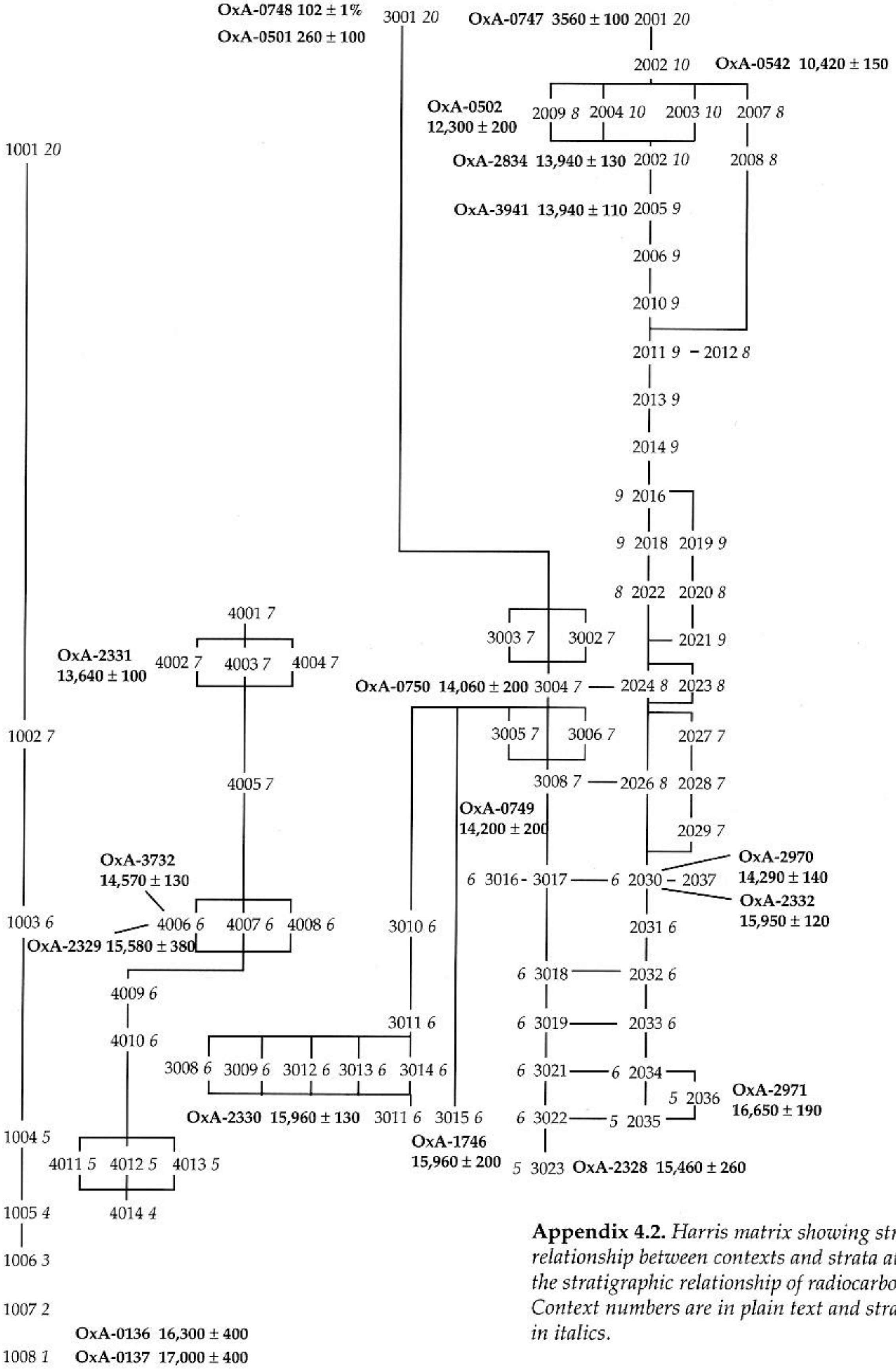
Context 4012 Stratum 5
Munsell not recorded. Colour 2, stony, compact. Very limited in extent, not seen in section. Layer 67 on plans.

Context 4013 Stratum 5
Munsell 5YR 6/2. Colour 4, stony, compact. Very limited in extent. A lens within layer 66. Stones up to 1 cm. Layer 69 on plans.

Context 4014 Stratum 4
Munsell 5YR 3/2. Colour 1, stony, loose. Stones 1–2 cm. Colour described as dark reddish-brown. Layer 70 on plans.

CC and DD rectangles

Finds from these trenches have been assigned to Stratum 7.



Appendix 4.2. *Harris matrix showing stratigraphic relationship between contexts and strata at Klithi and the stratigraphic relationship of radiocarbon dates. Context numbers are in plain text and stratum numbers in italics.*