5. The Sites: Nimji, Garnawala 2, Gordolya and Jagoliya

This chapter presents descriptions of the four rockshelter sites discussed in detail in this monograph, focussing on the location, environs, excavation, stratigraphy, dating and cultural materials. These sites are known to Wardaman People as Nimji (Ingaladdi), Garnawala 2, Gordolya and Jagoliya. All appear to date to the terminal Pleistocene/early Holocene period and contain a large number and diversity of stone artefacts, and so are well-suited to answering chronological and technological questions. The sites are located in quite different environmental settings (Table 5.1), and yet similar changes in the nature of stone artefact manufacture and discard can be identified in each.

Table 5.1. Location of excavated rockshelters in relation to land systems, permanent waterholes and stone sources.

Rockshelter	Distance to Permanent Water (km)	Distance to Stone Source (km)	Geomorphic Unit
Nimji	1.74	0.38	Sand Plains
Garnawala 2	10.00	1.50	Sand Plains
Jagoliya	0.08	6.00	Gorge
Gordolya	9.20	4.60	Breakaway

Nimji (Ingaladdi)

Nimji is a large, semi-circular rockshelter (153 m^2) located within a weathered sandstone outcrop (759,360 E 8317,580 N) (Figure 5.1 and 5.2). The floor is comprised of a soft, dark grey ashy sand, and is littered with stone artefacts, ochre and European materials. The rockshelter is located amidst sandy plains, with gently rolling basalt, sandstone and quartzite hills to the north and south and sits within the Delamere Plains and Benches. The Nimji outcrop is one of a number of cavernously weathered residuals of cross-bedded quartz sandstone that occur in the surrounding area. These outcrop in varying size from a few metres to several stories high, and are formed from elongate sandstone lenses within the Antrim Plateau Volcanics (Sweet 1972). More than 48 rock art sites have been documented in these residuals surrounding the Nimji site, although Nimji is the only site to have been excavated (David *et al*. 1990:443). Nimji is also located close to Yingalarri, one of the largest permanent waterholes in the study region (~1.7 km to the southwest). Yingalarri waterhole is the last of a number of permanent waterholes found in the sandstone gorges along Price Creek before the country opens out into more open, drier, black soil country to the east.

1963 and 1966 Excavations

John Mulvaney first excavated at Nimji (he called it 'Ingaladdi' after the nearby Yingalarri waterhole) in 1963 as part of a broad-based archaeological survey of northern Australia, resulting in the excavation of a number of rockshelters between Wardaman Country and Arnhem Land. Mulvaney's interest was principally in obtaining a northern Australian industrial sequence for comparison with those already obtained from elsewhere in Australia (e.g. Kenniff Cave in Central Queensland, Capertee in New South Wales, Clogg's Cave in the Australian Highlands and Devon Downs on the Murray River in South Australia). The 1963 dig opened out a 8 m by 1.5 m trench divided into 8 squares running roughly north to south from the back wall toward the front of the shelter (Figure 5.3 and 5.4). The pit ranged in depth from 1 m in W1-2 to 1.9 m in W8 and was dug in up to 14 spits, averaging 11cm each in depth. Mulvaney returned to the site in 1966 to enlarge the sample of retouched artefacts, clarify the antiquity of the site and the engravings on the back wall, and provide greater resolution for typological changes through finer excavation of a second trench. This trench was 6.1 m long (20') by 1.4 m (4'6") wide, was oriented roughly east west, and abutted the foot of the eastern wall of the shelter (Figure 5.5). The trench was divided in half along its long axis to create an "A" and a "B" trench. This created 13 pairs of adjacent squares each measuring 0.68 m (2'3") by 0.47 m (1'6"). The AB trench ranged in depth from 95 cm in Squares AB1 to 192 cm in Squares AB6-10, and was excavated in up to twenty-five spits each averaging 7.6 cm (3") deep. All spits were sieved through a 6.6 mm mesh sieve.

Figure 5.1. Nimji at the time of Mulvaney's 1966 excavation (courtesy of John Mulvaney).

Figure 5.2. View of the floor from the brow of the shelter (courtesy of Colin Macdonald).

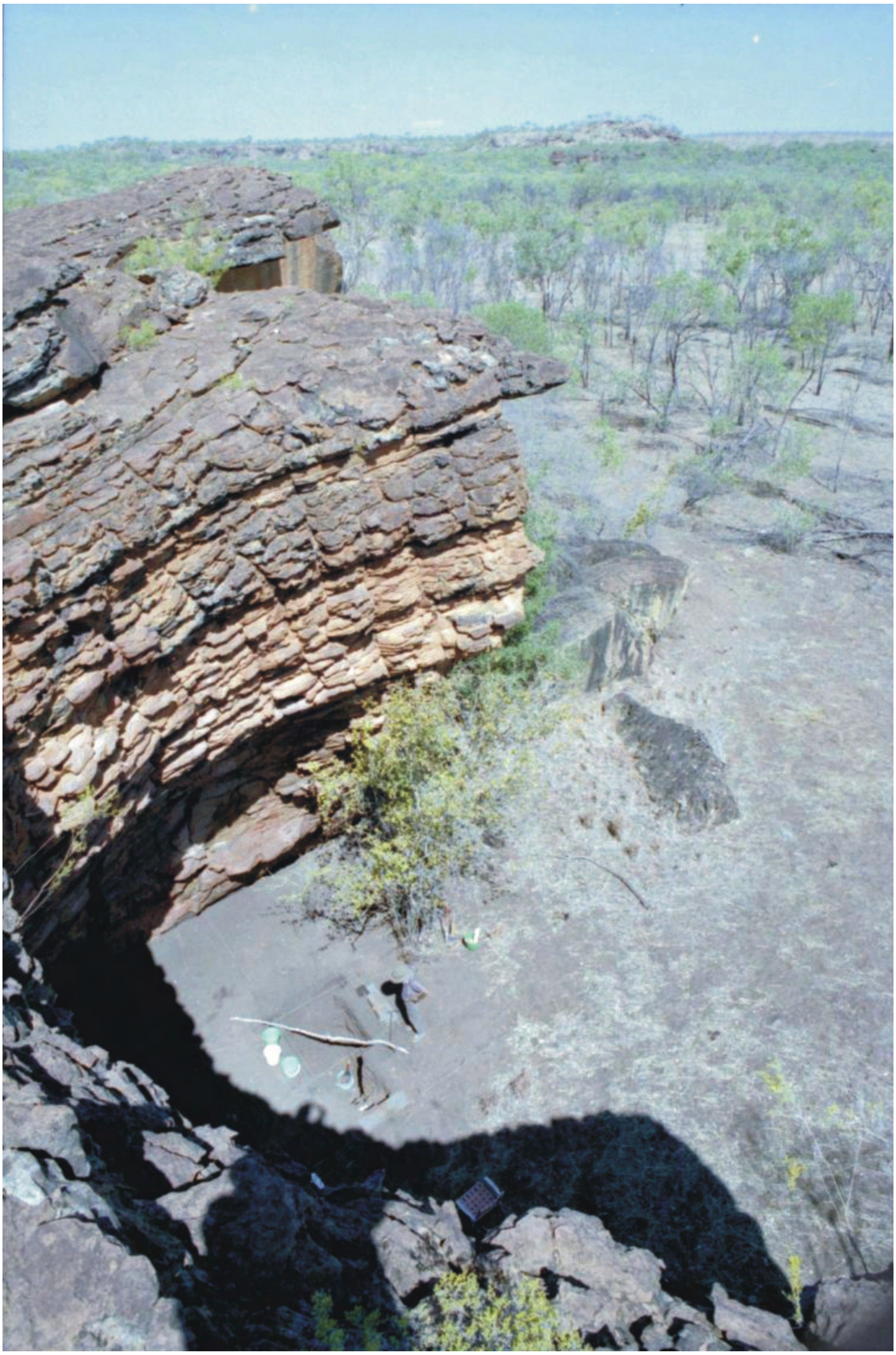


Figure 5.3. Plan of Nimji rockshelter showing the location of the 1963 and 1966 excavation trenches, the location of the squares analysed by Cundy (1990), and the location of major rock art panels.

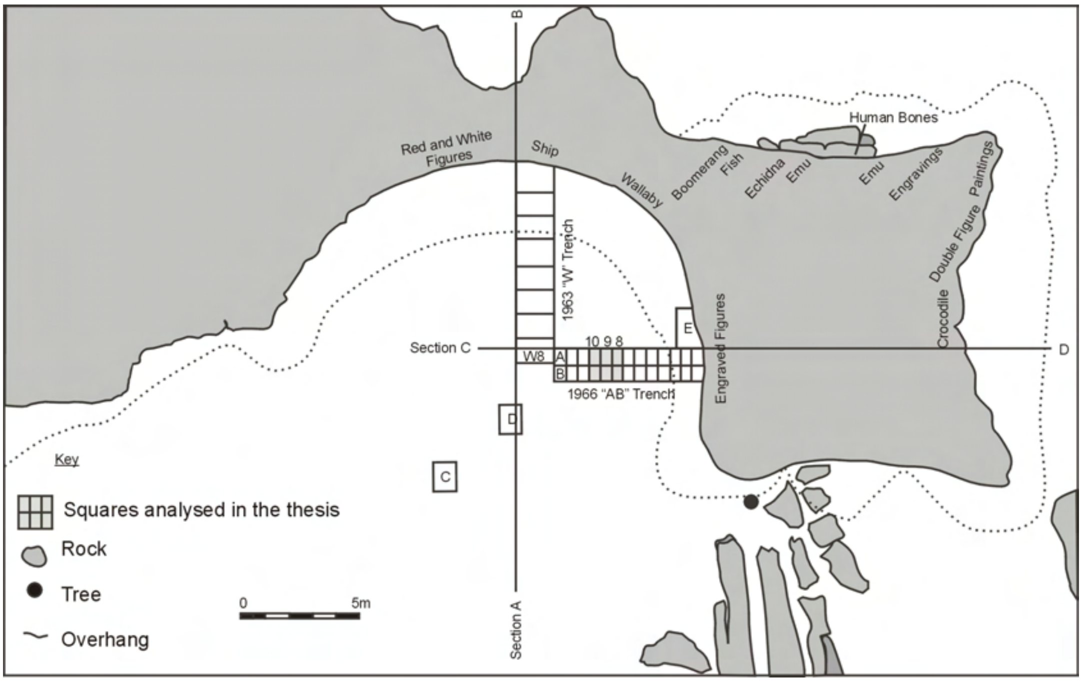


Figure 5.4. North-south and east-west cross-sections of the Nimji sandstone residual, passing through the excavated trenches.

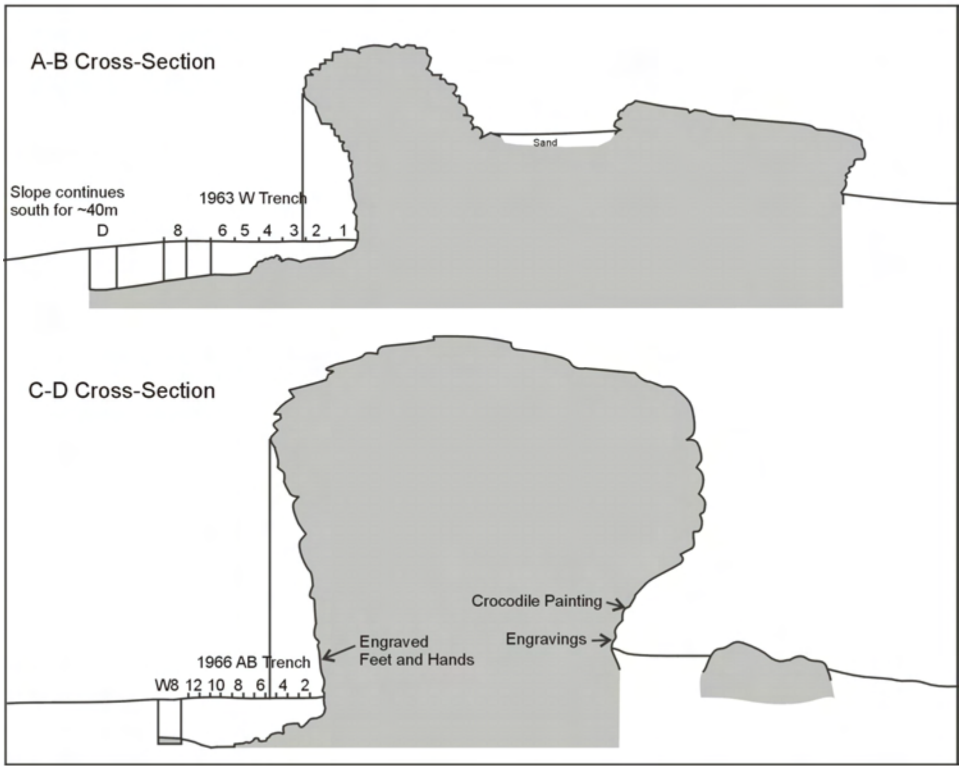
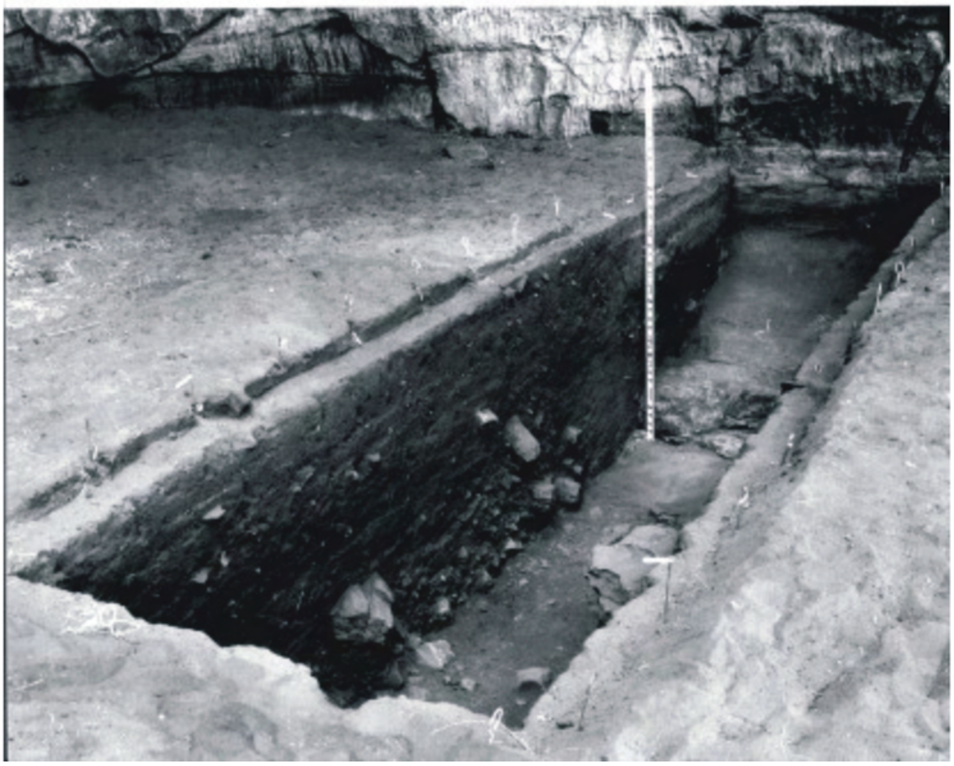


Figure 5.5. The 1966 AB trench at the completion of the excavation (courtesy of John Mulvaney).



Two additional 1.4 x 1.4 m squares were excavated further out from the back wall (Squares C and D) to check the stratigraphy at the front of the shelter. Only 'diagnostic' artefacts conforming to Mulvaney's typology were kept from these squares to enlarge the overall sample of stone implements from the site.

Stratigraphy

The sediments of the Nimji deposit merge continuously into the extensive sand sheet that surrounds the sandstone ridges and outliers in this region (Cundy 1990:92). Stratigraphic profiles redrawn from Mulvaney's and Cundy's (1990) drawings are shown for the 1963 and 1966 trenches in Figures 5.6 and 5.7. A description of the average depth, colour, pH and type of sediments found in each layer for Squares AB8-10 of the 1966 trench, as well as the associated spits, is provided in Appendix B.

From Mulvaney's stratigraphic drawings and notes it appears that finer stratigraphic layering was apparent toward the back of the excavation than at the front in both the 1963 and 1966 trenches. The transition from fine layering to broader and more gradational stratigraphy takes place at around Squares AB5 in the 1966 excavation, and around Squares W3 and W4 in the 1963 trench. As indicated on the section drawings and site profiles, this change appears to correspond with the location of the drip line and the maximum outward extent of the brow of the overhang. It seems that there was also a noticeable darkening of sediments towards the front of the shelter in many cases (i.e. from Squares AB6-13 and W4-8).

Figure 5.6. Section drawings of the 1963 trench, redrawn from Mulvaney's originals.

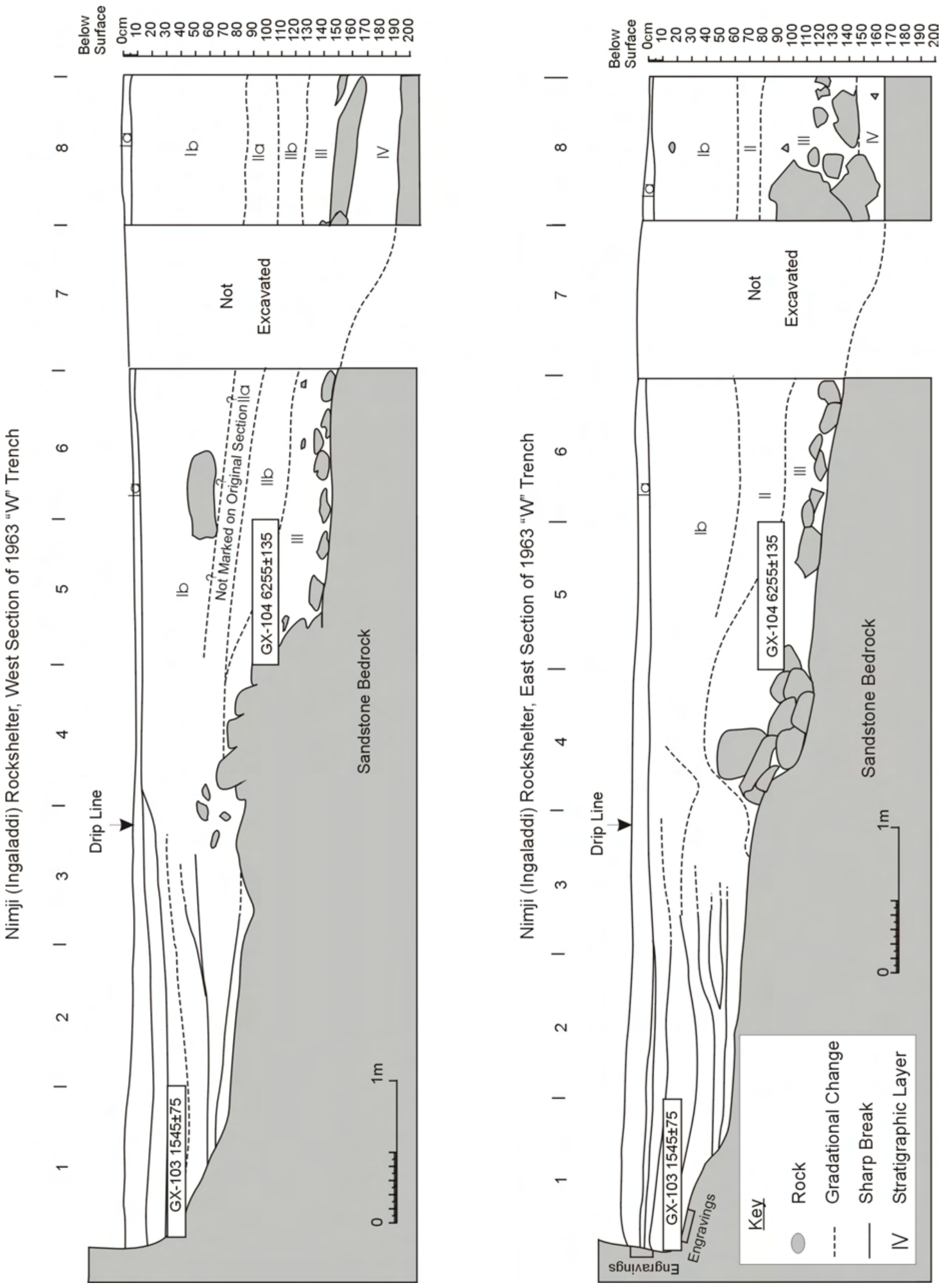
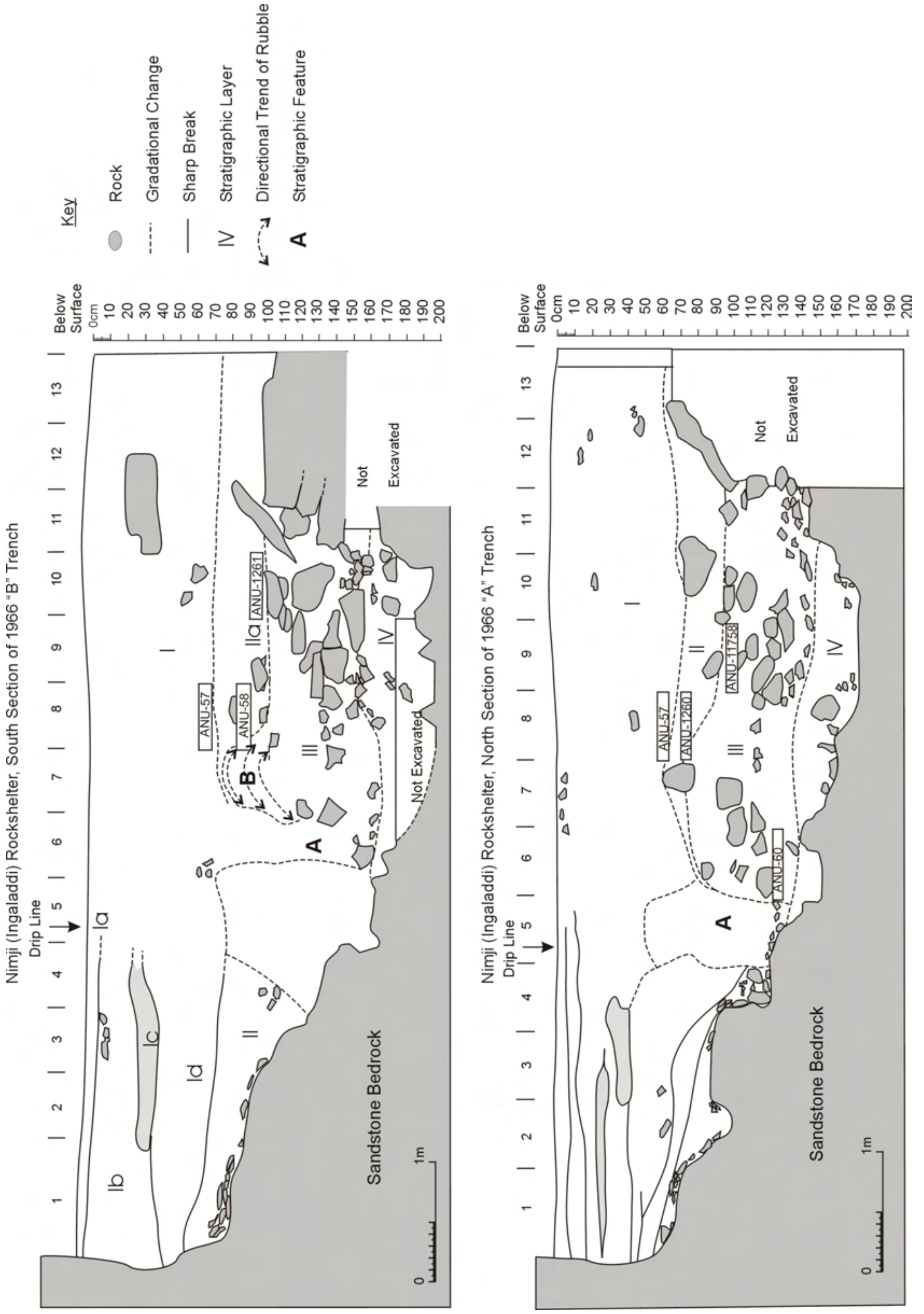


Figure 5.7. Section drawings for the 1966 trench, redrawn from Mulvaney's originals.



The zone of transition between the front and back of both trenches (Squares A5, B5 & 6 and W3 & 4) shows a break down in finer stratigraphy, an increase in the quantity of roots, darker staining of the sediments and very little rubble. This zone also tends not to preserve the stratigraphic layering present toward the back of both trenches. At the front of the shelter only four distinct stratigraphic layers were found over a maximum depth of around 190cm in the 1966 trench. Rather than forming sharp breaks, these four stratigraphic layers tended to grade into one another. At the top of the profile, Layer I consists of a dark grey ashy sand that is relatively free of rubble, grading into an increasingly rubbly yellow/red sand in Layer II, to a very rubbly orange sand with massive rubble in Layer III, and finally a bright orange sand with finer gravel in Layer IV that appears to derive from the disintegration of the underlying sandstone bedrock. The 1963 trench changes from dark brown sand in Layer I, merging to lighter brown sand with more rock rubble in Layer IIa, a distinctly lighter brown sand in Layer IIb, and finally a very rubbly darker brown sand with a large amount of massive rubble in Layer III. It should be noted that Mulvaney's descriptions of colour change in the 1963 trench appear to be impressionistic and are not based on Munsell colour charts.

Mulvaney saw the change in colour and rock rubble content from Layers I to II as possibly indicating a break in deposition and an apparent change in weathering conditions from those forming the orange rubble in Layer III to that of the dark grey sand in Layer I. Dates returned for each of these layers were also used to support this interpretation (see below). However, Cundy (1990:96) later performed a particle size analysis on bulk sediment samples from the front of the 1966 trench that revealed "no evidence of weathering, sediment sorting or erosional events consistent with a substantial stratigraphic break." Instead, Cundy argued that the stratigraphic changes were best accounted for by two principal factors: the relative size and density of the rock fall and the degree of charcoal content in the fine sediment. While Cundy could find no evidence for a break in deposition, he believed a change in weathering conditions, or a period of catastrophic instability in the structure of the overhang unrelated to environmental changes, could account for the build up of rubble in the lower layers.

Dating

Eleven dates have been obtained for the 1963 and 1966 excavations and these are listed in Table 5.2. For the 1966 trench, one date comes from the base of Layer I (ANU-57, 2890 ± 73), two from the middle of Layer II (ANU-1260, 3,740 ± 80 and ANU-1261, 3,450 ± 110), one from an ambiguous stratigraphic position, but perhaps best ascribed to the transitional zone between Layers II and III (ANU-58, 4,920 ± 100), one from the top of Layer III (ANU-11758, 6,390 ± 80), and one from the base of Layer III (ANU-60, 6,800 ± 270). These dates provide a consistent series of ages that appear to increase with stratigraphic depth. Although ANU-1261 in the A section is lower than ANU-1260 in the B section, this can be explained by the downward tilt in Layer II seen in the A section in Figure 5.7. Both dates therefore likely derive from roughly the same position in the middle to base of Layer II. They also overlap at two standard deviations, and there is therefore no reason to suggest an inversion.

Table 5.2. Radiocarbon dates for the 1966 excavation.

Lab Code	Square	Spit	Layer	Depth (cm)	Radiocarbon Age	Cal BP (2σ range)
ANU-11820	A11	4	I - Top	34.3	810 ± 80	923 (726,719,711) 571
ANU-11821	B9	6	I - Middle	44.5	1220 ± 60	1286 (1171) 973
GX-103	W1	2	I - Middle	40.2	1545 ± 75	1606 (1413) 1294
ANU-57	AB8	10	I - Base	80.0	2890 ± 73	3316 (2996) 2813
ANU-1260	A8	12	II – Middle/Base	92.7	3740 ± 80	4406 (4090) 3868
ANU-1261	B10	14	II – Middle/Base	96.0	3450 ± 110	4055 (3692) 3465
ANU-58	B8	13	II/III - Transition	112.0	4920 ± 100	5908 (5624) 5469
ANU-11819	B9	15	II/III - Transition	113.0	5470 ± 110	6471 (6284) 5954
GX-104	W5?	11?	III - Top	100.0	6255 ± 135	7429 (7184) 6761
ANU-11758	A9	16	III - Top	129.6	6390 ± 80	7432 (7294) 7100
ANU-60	A6	20	III – Base	160.0	6800 ± 270	8168 (7627) 7164

Mulvaney also obtained two dates for the 1963 excavation. These samples come from different stratigraphic positions to those obtained from the 1966 excavation, and date the middle of Layer I

(GX-103, 1,545 ± 75) and the top of Layer III (GX-104, 6,255 ± 135). The GX-103 sample is also from a spit that immediately overlays engravings found on the bedrock at the back of the 1963 excavation trench.

Site Formation

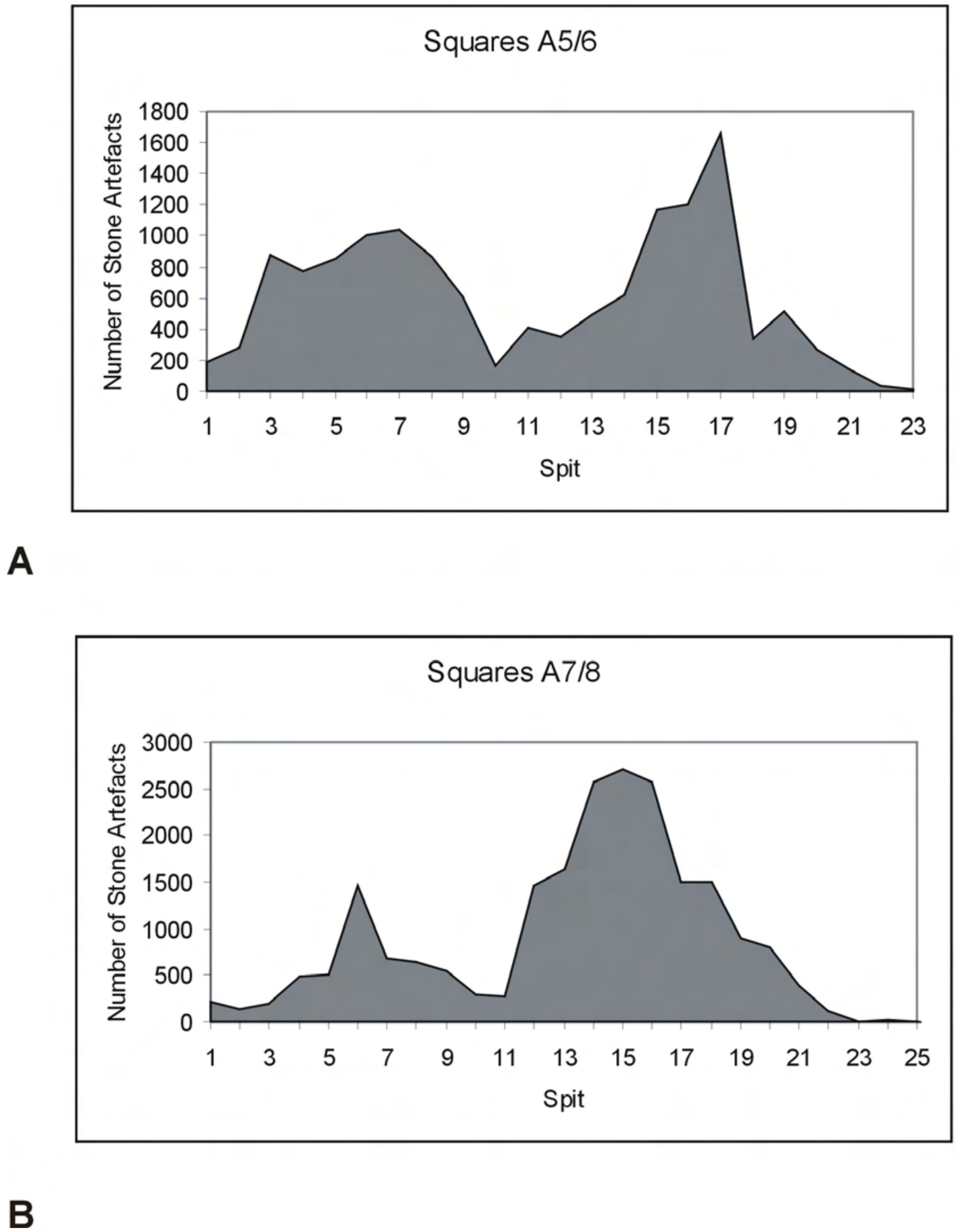
A number of models of site formation have been proposed for Nimji over the years, each involving anthropogenic clearing of rubble from the shelter floor as an agent of disturbance to varying degrees. Mulvaney, for instance, observed at the time of excavation that the feature marked 'B' on the 1966 B section shown in Figure 5.7, resembled a midden-like structure that sloped toward the front and the rear of the excavation, and contained both rock rubble and stone artefacts. Mulvaney suggested that this feature could have been formed through the systematic dumping of rubble and stone artefacts in Square B7 by past occupants of the site. In her M.A. Thesis on the Ingaladdi scrapers, Sanders (1975) took the absence of rubble at the back of the shelter to indicate systematic clearing of rock from the back toward the front of the shelter. Cundy (1990) further developed the idea of anthropogenic disturbance in his PhD Thesis, and argued that the rubbly 'B' feature likely resulted from the digging of an extensive pit into the Level III deposits at the spot marked 'A' in Figure 5.9, and the heaping of the removed material over the existing deposits in Square B7. Cundy argued that the dark brown sand found in feature 'A' in Squares A5 and B6 therefore likely derived from the infilling of the pit with Level I deposits, while the rubble in the "B" feature consisted of heaped up Level III material.

These arguments for digging and/or piling of stone are unconvincing for a number of reasons. A closer examination of the 1963 and 1966 sections (Figure 5.6 and 5.7) reveals that both trenches exhibit almost identical stratigraphic features despite their location in quite different parts of the shelter. For example, as mentioned above, both trenches show the loss of finer stratigraphic layering around half way out from the back wall. This also coincides in both trenches with the beginnings of a darker stained zone that is free from rubble and shows more abundant root activity. Just beyond this point the rubbly III and IV units begin, the Feature B 'rock mound' is found in Square B7, and a darkening of sediments takes place throughout the stratigraphic profile. As noted above, the positioning of these changes in colour, layering and rock content in both excavated trenches closely correspond to the maximum outward extent of the brow of the overhang (Figure 5.5 and 5.6).

These combined features suggest an alternative model of site formation, and one that emphasizes natural processes over anthropogenic ones. It is proposed that the rubbly matrix found in front of Squares W3, A5 and B5 could simply result from the gradual collapse of the overhang, and hence, greater exposure of the outer sediments to the elements, leading to the loss of finer stratigraphic layering through more intense weathering in tropical conditions, darker staining of the sediments through the formation of humic compounds and increased moisture-content from exposure to rain (Bowler 1983). The 'B' feature could then simply represent the last in a series of catastrophic collapses from a disintegrating overhang that resulted in the development of a small mound of exogenous rubble on the surface of Level III deposits directly in front of the present outer limit of the brow of the shelter. The rapid piling up of roof derived material might also explain the 'midden-like' slope in this material toward the front and back of the excavation, as material gradually slid downward on either side of the pile.

An additional line of evidence can be advanced to support this model of natural site formation. If extensive clearing or digging were undertaken toward the back of the shelter in the area of the 1966 trench, and then later infilled with Unit I material, any broad pattern of stone artefact discard evident at the front of the shelter would be unlikely to occur at the back. However, when the combined artefact totals per spit for Squares A5-6 located in the zone of supposed digging (the 'A' feature) are compared with those in the adjoining A7-8 Squares (containing the 'B' feature), a near identical pattern of discard is found, as seen in Figure 5.8. Both samples show bimodal distributions, with peaks located between Spits 5 and 7 and between Spits 14 and 17. It is difficult to believe that this pattern would be replicated in both locations at roughly the same depths had this area been extensively excavated and infilled.

Figure 5.8. Stone artefact numbers from adjacent squares.



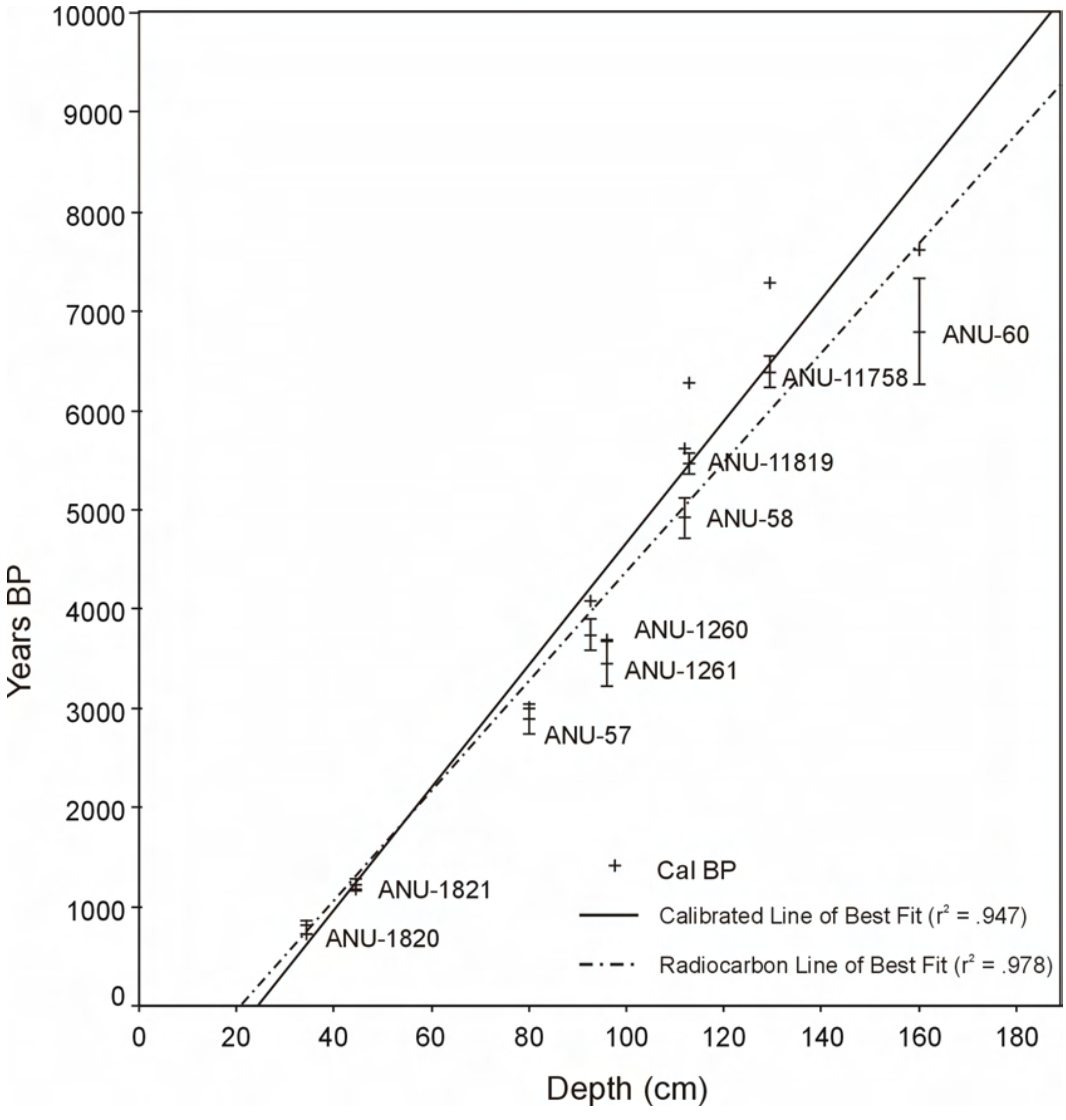
Having said this, it does appear that the stratigraphy in Squares AB5-7 of the 1966 trench is more extensively altered, probably due to their location within the present day drip zone, than those squares on either side. Furthermore, as the squares to the font of this zone (Squares AB8-10) are the deepest, and contain the most extensive section of the Level III and IV deposits, these will form the focus for analysis of the stone artefacts from the site. The 1963 trench remains poorly dated and was excavated in spits that are too thick to allow the detection of finer chronological changes. Only Squares AB8-10 from Nimji are therefore discussed in the following chapters.

Sedimentation Rates

Consistent with the model of site formation presented above, examination of the age-depth curve reveals that the Nimji dates for the AB trench Squares 8 through 11 form a coherent sequence of

increasing age with depth for both radiocarbon and calibrated ages (Figure 5.9). A linear regression reveals a strong and significant relationship between age and depth (radiocarbon years bp: $r^2 = .978$, $p < .0005$; Cal BP: $r^2 = .947$, $p < .0005$), and indicates a deposition rate of around 1cm per 69 years. The tight linear relationship also makes it possible to calculate the first use of the shelter at around 10,000 Cal BP. The only detectable change in sedimentation rate occurs in the top 20cm of the site, which are likely to be of contact age given the presence of European items in the top few spits.

Figure 5.9. Age-depth curve for all dates from the 1966 AB trench.



Cultural Materials

Both the 1963 and 1966 excavations recovered massive stone artefact assemblages, rich in retouched artefacts made from a wide variety of raw materials. Mulvaney (1969) divided the assemblage into two cultural units based on stratigraphic and typological changes. The lower industry was comprised of flakes, cores and retouched flakes (scrapers) and was associated with Layers II to IV. The upper industry was present only in Layer I and was characterized by the introduction of pointed blades (hereafter referred to as lancets following Roth [1904] and Cundy [1990]), unifacial and bifacial points, tulas, burrens, burins, stone axes and axe flakes, with large Leilira blades (parallel or pointed elongate flakes (>2:1 length:width) over 10cm in length) appearing toward the very top of the sequence. Scrapers also continued into the upper unit, but cores dropped out almost entirely. Stone artefact

deposition formed two distinct peaks of roughly equal size, with the lower one centred on Spits 16 to 18 (c. 6,200-7,200 Cal BP) and the upper one centred on Spits 6 to 8 (c. 1,000-2,000 Cal BP).

Organic remains were extremely rare below the top few spits in both excavations, presumably due to the acid environment of the sandy floor and the ravages of the tropical climate – a situation that is typical of most sites in the study region (see Appendix B for tables of recovered cultural materials). The large size of the sieves has no doubt resulted in the loss of many of the smaller botanic and bone fragments as well as stone artefacts. This is readily apparent when the range and quantity of cultural materials retrieved is compared with those from Garnawala 2, Jagoliya and Gordolya where 3mm sieves were used.

Ochre pieces - some with distinct striations - were also found in large quantities in those squares closest to the back wall. Combined ochre weights for all four squares (AB8-10) show a clear lower peak centred on Spits 13-15 as well as a second though much smaller peak centred on Spits 4 and 5. Burnt earth shows a peak in quantities from Spits 18 to 20, slightly below the lower peak in stone artefact and ochre deposition which should be expected if intense burning during periods of of heightened occupation resulted in baking underlying sediments.

Artefact totals currently exist only for the A trench as well as for other scattered squares, but those for the A trench provide an indication of the likely size of the recovered assemblage. The assemblage from the A trench alone exceeds 61,600 stone artefacts retrieved from the 6.6 mm sieves, but given that this total represents a 1.9% sample of the total area of the site, the total number of artefacts larger than 6.6 mm should exceed three million. Needless to say, the excavated assemblage represents a very large sample, and many of the rarer stone artefact types should therefore be expected to occur in a collection of this size (Hiscock 2001b).

Four local sources of stone (local being defined as less than 10 km from the site), including varieties of chert, chalcedony and quartzite are known to occur within 10 km of Nimji. The closest is an extensive ridge of high quality chocolate brown to grey quartzite over 1 km in length and located ~300 m to the east of site. This quartzite was formed by lava contacting sandstone during formation of the Antrim Plateau Volcanics. This stone tends to outcrop as angular blocks on the ridge top and as rounded and sub-angular nodules on the surrounding black soil plain. Although it is very difficult to differentiate between the many sources of quartzite found within the Antrim Plateau Volcanics, this source was extensively quarried and much of the quartzite found at Nimji and other surrounding sites likely derives from it.

A further two sources of local stone are the hydrothermal pinkish-red cherts and yellow-white chalcedonies that sometimes outcrop as thick veins alongside the quartzite and sandstone ridges of the Antrim Plateau Volcanics. Several sources of hydrothermal chert were inspected in the field, and all were found to be of medium to low quality with abundant internal flaws and weathering plains, with blocks available up to fist size in Aroona Creek around 12 km to the south. The chalcedony, on the other hand, was far less abundant and only one source of good quality stone was located in the field further to the north near Garnawala. Cundy identified a source of agate in the black soil alluvium close to the site, but nodules were of consistently small size and are unlikely to have been intensively exploited. A source of poor quality mottled and brecciated chalcedony was also found to the northwest within one kilometre of the site, and this appears to have been extensively utilized, especially in the early occupation levels at Nimji. This stone is referred to here as local brecciated chalcedony.

Six varieties of non-local stone (defined as derived from greater than 10 km from the site) can also be identified in the Nimji assemblage, with most deriving from sources more than 30 km from the site. These include four distinctive varieties of chert (Banyan Chert, Tindall Chert, Oolitic Chert and Montejinni Chert), a distinctive white, yellow and red quartzite that derives from the Jasper Gorge Sandstone to the west of the site, and silcrete from the lateritic plateaus and mesas to the east and west of the site. Materials that could not be identified were classified as chert, quartzite or other.

Figure 5.10. The Garnawala outcrop with open savanna woodland and sand sheet in the foreground.

Figure 5.11. View of Garnawala 2 rockshelter from the south, showing the rock ledge and the magnificent rock art panels on the back wall.

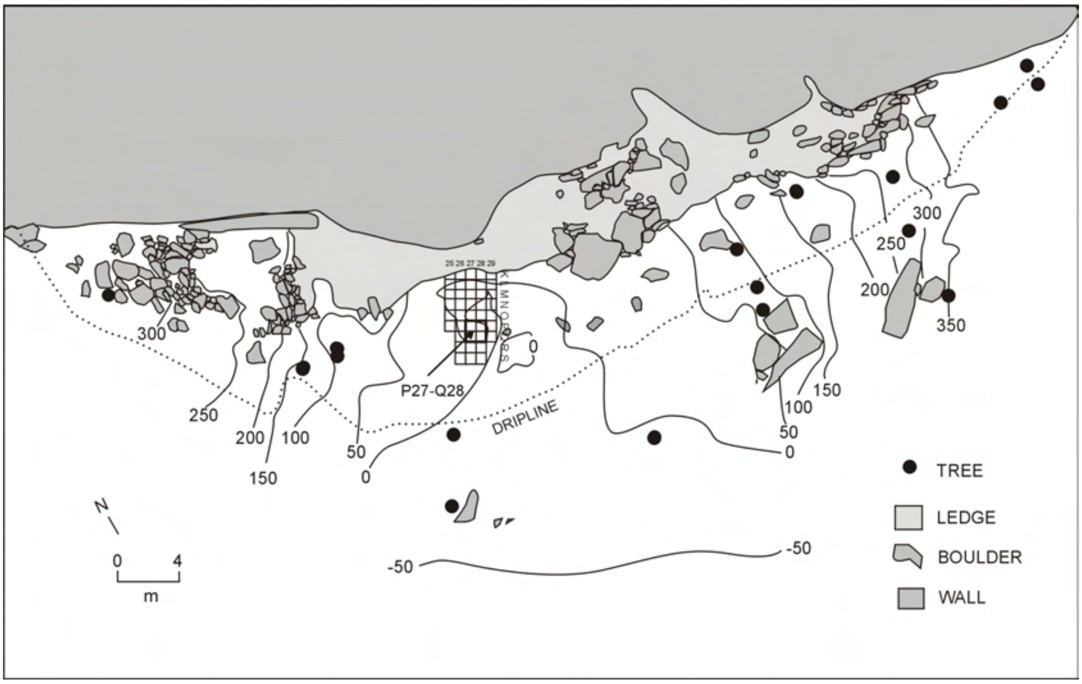
Garnawala 2

Garnawala 2 is another large rockshelter (676 m^2), also situated within a massive fine aeolian sandstone outcrop with numerous overhangs (Figure 5.10), many of which contain rock art and occupational

deposits. The Garnawala ('hawk place') outcrop lies in the central part of the study region (752,000 E 8,325,800 S) at the junction of the Victoria River Plateau and the Delamere Plains and Benches physiographic units. The Garnawala 2 site (Figure 5.11) is located on the northern side of the outcrop and was excavated by Bryce Barker, Bruno David and Josephine Flood in 1990 and 1991 (Clarkson and David 1995; David *et al*. 1994).

Figure 5.12. View from the rock ledge down into the 1990 excavation pit. The analysed squares are the deepest ones furthest from the camera (courtesy of Bryce Barker and Bruno David).

Figure 5.13. Site plan of Garnawala 2 rockshelter showing the location of the analysed squares P27-Q27.



The 1990 and 1991 Excavations

The site was initially excavated as a large grid of 50 x 50 cm squares situated against the rock ledge at the back of the shelter (Figure 5.12 and 5.13). This grid was assigned an alpha-numeric referencing system. Each square was dug in maximum 10-litre 'bucket spits' within stratigraphic layers. All cultural items >2 cm in length were plotted in three dimensions and bagged separately. Sediment samples were collected from each excavation unit of each square. A 3 mm mesh sieve was used to screen the sediments before sorting.

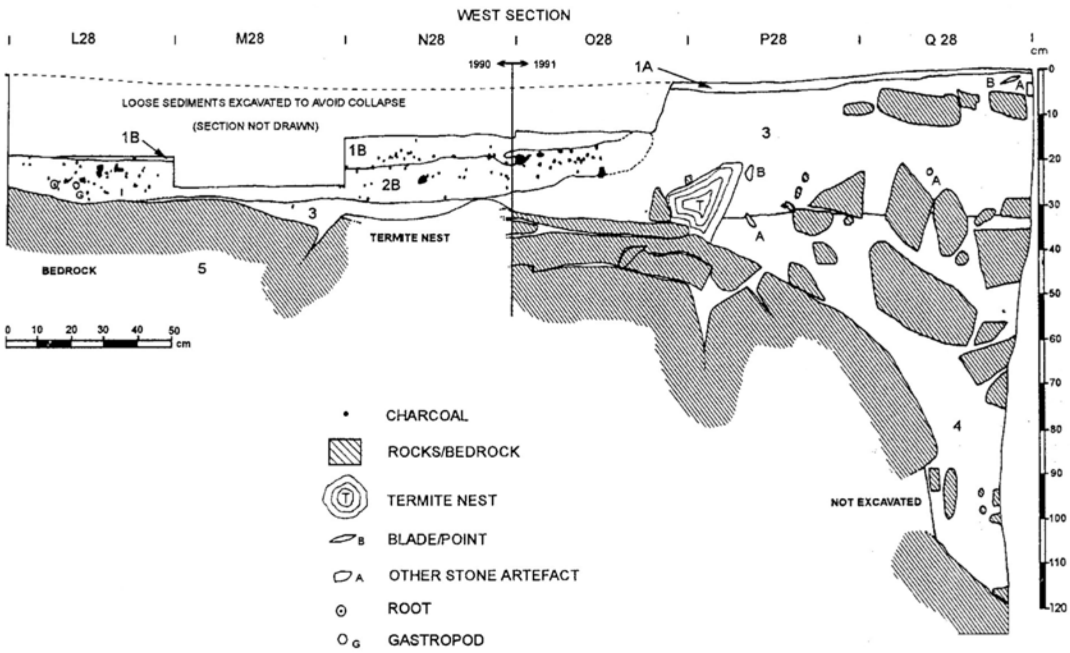
A total of fifteen 50x50 cm squares were fully excavated in 1990 (Squares J26 to N28) and a further 17 peripheral squares were partially excavated to remove loose surface sediments that would otherwise have fallen into the main excavation squares. A small number of abraded grooves were identified on bedrock below the base of Layer II.

In order to follow the bedrock to a greater depth, and thereby obtain a deeper chronological sequence, the original excavations were extended in l991 to include a further six 50 x 50 cm squares, and another seven periphery squares (P26, P29, Q26, R26-R28 and S26-S28). The deepest square was Q28 which reached bedrock at around 1.2 m. No further engravings were uncovered during the 1991 season.

Stratigraphy

The 1990 excavation revealed four well-defined stratigraphic units (Layers I, II, III and V) (Appendix D), with Layers I and II made up of fine ashy sand and containing European and Aboriginal objects, and lower units grading toward a coarse orange sand with pieces of disintegrating sandstone. The excavation proceeded to bedrock, which was only some 30 cm below the surface in the 1990 squares (Figure 5.14). Stratigraphic layers were contiguous between the 1990 and 1991 seasons, however, the 1991 squares closer to the drip line consisted of only three broad stratigraphic units (Layers Ia, III and IV). Layer IV does not occur in the 1990 squares. A maximum of 26 spits were excavated from Square Q28 during the 1991 season and the corresponding stratigraphic layer for each is listed in Appendix D. Squares P27 to Q28 have the deepest deposit and contain a large stone artefact assemblage, and these squares were therefore the focus of the lithic analysis presented later.

Figure 5.14. Section drawing of the 1990 excavation (from Clarkson and David 1995).



Dating

A total of 21 dates have been obtained for the Garnawala 2 rockshelter (Table 5.3); however, a number of anomalies make interpretation difficult. The greatest difficulty arises from the discrepancy between the age estimates obtained from small pieces of charcoal using AMS dating which are poorly ordered in relation to depth (Spearman's rho = .045, p = .89; ANOVA, F = 172, p = .06), and a series of conventional dates that are strongly ordered (Spearman's rho = .683, p = .04; ANOVA, F = 326, p = .04). The fact that the ordering is significant for conventional dates but not for AMS dates suggests that the mobility of small sized particles of charcoal in the sequence may be to blame for the poor results. The site consists of fairly loose sandy sediments, and there is much potential for movement of materials within such a matrix, as demonstrated by Stockton's (1973) trampling experiments in sandy-floored rockshelters. Termites are also highly active in northern Australian rockshelters (and were observed at Garnawala 2) and constitute another mechanism for the transport of small particles of charcoal upward or downward through the deposit. Larger, combined samples of charcoal are therefore likely to provide more reliable dates than small, individual pieces, and hence only conventional ages will be used to build the chronology of this site.

Table 5.3. Radiocarbon dates from Garnawala 2.

Lab Code	Square	Spit	Layer	Max. Depth (cm)	Radiocarbon Age	Calibrated Age (2δ)	Type
OZD429	Q28	6	III	15.0	2,250 ± 50	2758 (2735) 2468	AMS
OZD430	Q28	9	III	22.6	2,450 ± 50	2736 (2485, 2481, 2469) 2348	AMS
Beta 66434	Q28	12	III	34.7	2,920 ± 120	3380 (3075) 2776	Con.
NZA4626	Q28	13	III/IV	39.3	2,755 ± 67	2998 (2849) 2750	AMS
NZA4627	Q28	17	IV	54.2	10,164 ± 92	12348 (11904, 11820, 11752) 11264	AMS
OZD432	Q28	19	IV	62.5	9,450 ± 110	11160 (10688, 10646, 10644) 10292	AMS
OZD433	Q28	23	IV	89.6	2,610 ± 50	2782 (2748) 2547	AMS
OZD434	Q28	25	IV	106.6	2,080 ± 60	2300 (2040, 2023, 2010) 1896	AMS
Wk-3571	Q28	20	IV	68.5	8,984 ± 98	10360 (10186) 9779	Con.
ANU-11367	Q27	13	IV	46.0	5,670 ± 200	6901 (6445, 6418, 6413) 5993	Con.
ANU-11268	Q28	17/18	IV	55.0	3,850 ± 470	5585 (4244) 3004	Con.
OZD431	Q28	15	IV	48.0	2,180 ± 80	2349 (2291, 2273, 2151) 1951	AMS
Wk-9247	Q27	7	IV	11.4	2,360 ± 50	2705 (2350) 2212	Con.
Wk-9248	Q27	9	IV	19.4	1,640 ± 90	1730 (1533) 1332	Con.
Wk-9249	Q27	11	IV	24.8	1,879 ± 131	2145 (1822) 1524	Con.
Wk-9250	Q27	12	IV	40.7	896 ± 66	947 (790) 673	AMS
Wk-9251	Q28	15	IV	48.0	2,517 ± 68	2660 (2426, 2421, 2360) 2355	AMS
Wk-9252	P27	14	IV	35.0	2,751 ± 60	2997 (2848) 2749	AMS
Wk-9253	P28	13	IV	34.2	5,227 ± 62	6174 (5986, 5970, 5945) 5894	AMS
ANU-11597	Q28	7	IV	17.8	2,160 ± 60	2335 (2148, 2135, 2133) 1954	Con.
ANU-11760	Q28	5	IV	12.8	2,400 ± 670	4091 (2357) 958	Con.

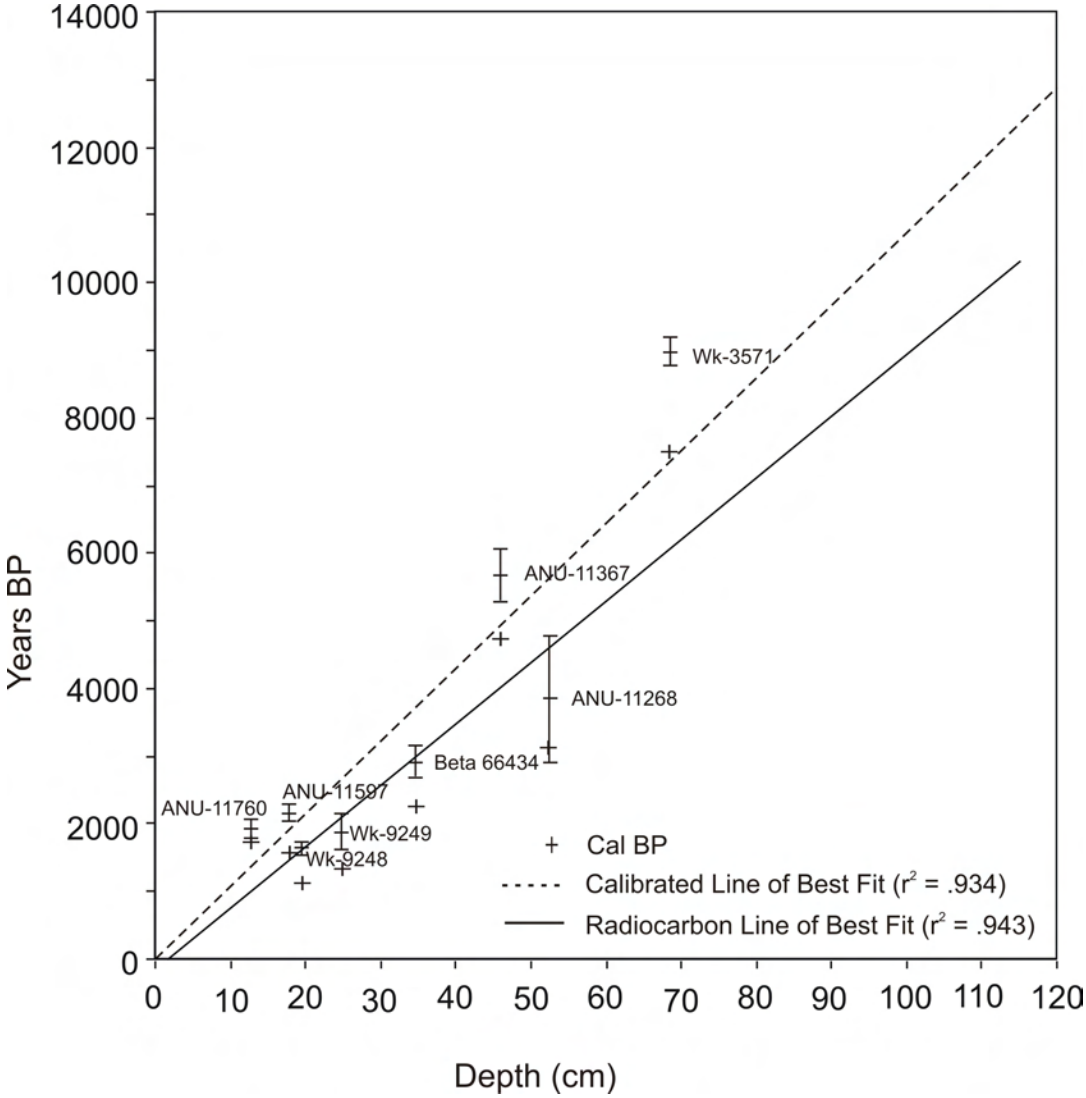
Con. = Conventional

Using only conventional ages as a guide, Layer I and II both appear to have accumulated over the last 200 years, judging by the presence of European artefacts in these layers, while Layer III spans the period >200 BP to c. 2,920 bp (3,075 Cal BP) and is associated with the first appearance of points, tulas and burins. Layer IV spans the period >2,920 to >13,000.

Sedimentation Rates

The depth-age relationship for Square P27-Q28 is shown in Figure 5.15. The age-depth relationship appears to be linear, and shows a strong linear correlation for both the calibrated dates (r^2 = .934, p = <.0005) and uncalibrated dates (r^2 = .943, p = <.0005) with depth. Based on the calibrated line of best fit, 1 cm of deposit accumulated in roughly 138 years. The depth-age curve indicates a likely maximum age for occupation at the site of c. 13,000 Cal BP.

Figure 5.15. Depth-age graph for conventional dates from Garnawala 2, Squares P27-Q28.



Cultural Materials

Cultural materials were present to bedrock (SU5) in all main squares. Cultural materials were recovered from all spits and appeared in reasonable numbers down to the lowermost levels (Appendix C). Charcoal peaks in Spit 6 and then rapidly decreases in quantity with depth. To some extent this trend is likely to reflect the poor preservation of organic remains at greater depths, and hence it is problematic to interpret this pattern as a reliable signal of the intensity of human burning within the shelter (though the peak in Spit 6 may be significant). Organic matter and bone follow a similar pattern of declining abundance with depth and this is also likely to represent differential preservation.

The same range of stone artefact classes is found at Garnawala 2 as at Nimji, with an apparent transition in typological elements around Spit 12, with the first appearance of the points, burins, tulas, burrens, etc. in large numbers at this time (Appendix C). Two peaks in stone artefact deposition occur

over the depth of the site – one in Spit 19 and one in spit 9. The stone artefact assemblage is also very large, with 11,225 artefacts recovered from a single 50 x 50 cm square (Q28), which makes up around 0.05% of the floor area of the site. The total number of artefacts >3 mm within the drip line of the site is therefore likely to be in excess of fifteen million.

Three clearly identifiable local raw materials are present within the assemblage. These are a low-grade white chert, a high grade yellowish chalcedony, and a low-quality pinkish red chert. All three materials are likely of hydrothermal origin and are found in a series of bands around 1.5 km to the south of the site. Another local material is the brown to grey quartzite of the Antrim Plateau Volcanics which outcrops in a wide variety of forms as part of a long NW-SW trending scarp line around 1.5 km to the south. Although local in occurrence, this type of quartzite is common throughout Wardaman country and it is impossible to distinguish it from other sources. The location of all four raw materials follows a characteristic pattern within the Antrim Plateau Volcanics of an elongate ridge of quartzite adjacent to a NW trending sandstone ridge, with various kinds of hydrothermal chert running parallel to the quartzite and sandstone outcrops.

Jagoliya

Jagoliya ('at the black headed python') is a small (~100 m^2) sandstone rockshelter and rock art site formed beneath the overhang of a large boulder that has detached and fallen from a cliff immediately to the north of the site (Figure 5.16 and 5.17). The shelter is located at the mouth of a shallow gorge, which forms the junction between a high sandstone escarpment to the west and undulating limestone plains to the east. The site is located close to the northern end of Hayward Creek on Innesvale Station (743,100 E 8,355,100 S) at the junction of the Victoria River Plateau and the Daly River Basin physiographic units. The shelter sits around 80m from a permanent spring-fed waterhole and would have been an attractive location for various activities including fishing, swimming, hunting and gathering bush foods from the plains and the gorge.

The vegetation on the escarpment surrounding the gorge is a low, open, snappy gum woodland with curly spinifex, while a taller woodland and grassland dominates the plains to the east. Spinifex, bloodwood and pandanus occur on the rocky slopes immediately outside the site, but vine thicket, weeping paperbarks and pandanus groves occur deeper within the gorge fringing the narrow permanent waterholes.

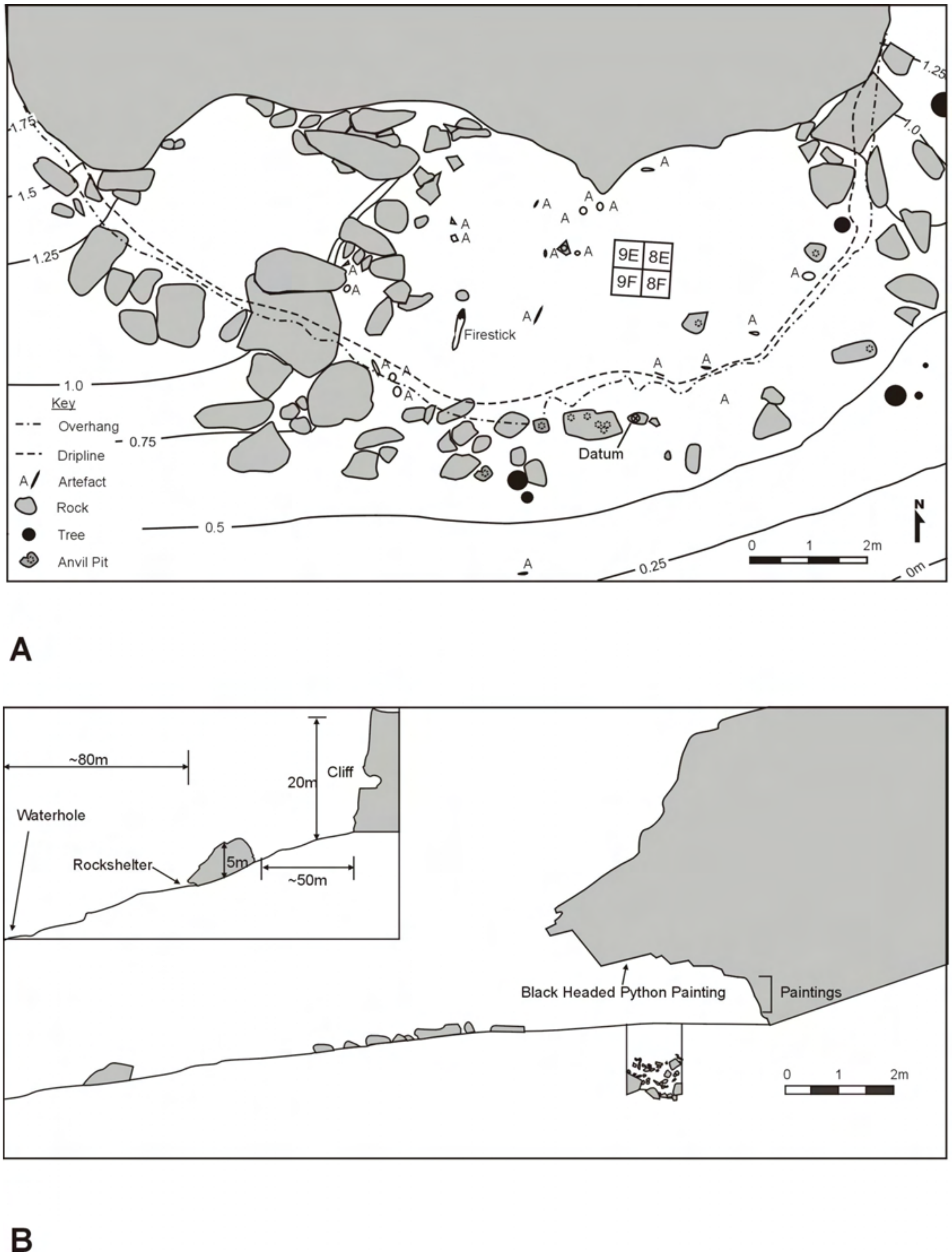
The 1998 Excavation

Four 50 x 50 cm squares were excavated in the centre of the sandy shelter floor directly in front of a rock art panel depicting dingoes and anthropomorphs. The site was excavated in up to 37 spits to a total depth of 1.3m, terminating when rock rubble made further progress impossible (Figure 5.18). Two stone artefacts appeared in the last spit at a depth of 1.24 m, and it is therefore possible that cultural material does continue to greater depth, though at extremely low density.

Figure 5.16. View of Jagoliya rockshelter. The opening to the shelter is beneath the two pandanus trees at the base of the rock.

Figure 5.17. View of the shelter floor before excavation. Rock art is visible on the back wall and the excavation squares have been strung out.

Figure 5.18. Jagoliya rockshelter. A: site plan showing excavated squares, and B: cross-section through the site and through the excavated squares.



Stratigraphy

Excavation revealed a total of seven well-defined stratigraphic units (Figure 5.19). Sediments changed from dark grayish-brown loamy sandy at the top to a reddish-grey clayey sand at the bottom, with the quantity of sandstone rubble and large sandstone blocks increasing with depth (Figure 5.20). A description of each stratigraphic unit and associated spits is provided in Appendix D.

Figure 5.19. Stratigraphic section of Jagoliya rockshelter, Squares 8F-9E.

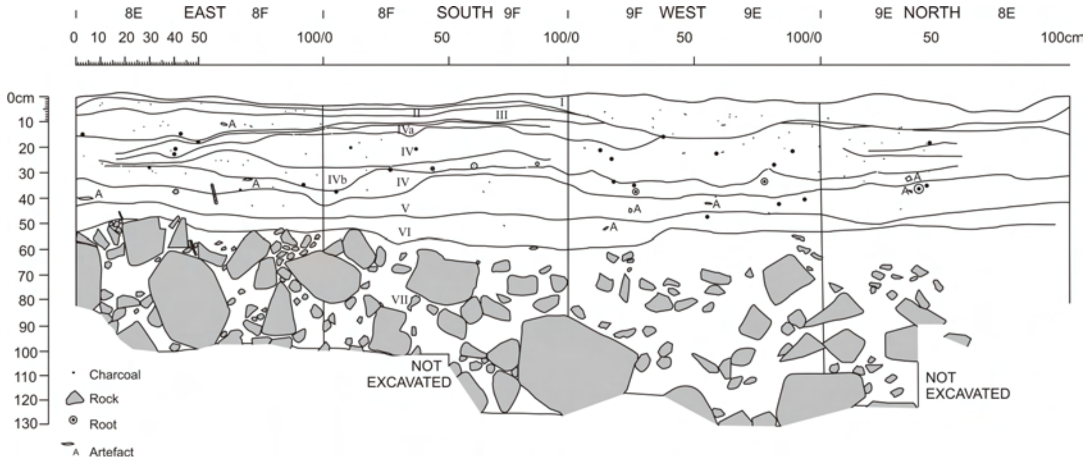


Figure 5.20. View into the completed excavation at Jagoliya. Note the dark band formed by Layer V and the massive rubble at the base of the excavation.

Dating

Four conventional radiocarbon dates have been obtained for the top 55 cm of the site (Table 5.4). The scarcity of charcoal below this depth led to the submission of a further two samples for AMS dating of the lower layers. These samples, however, suffer the same problem as the AMS dates from Garnawala 2 (i.e. temporal inversion) and are therefore rejected. The conventional radiocarbon chronology on the other hand provides a well-ordered series spanning the last 4,000 years.

Table 5.4. Radiocarbon dates obtained for Jagoliya, Squares 8E-9F.

Lab Number	Layer	Square	Spit	Max. Depth (cm)	Radiocarbon Age	Calibrated Age (2δ)	Type
ANU-11266	IVa	8F	9	18.8	270 ± 60	476 (305) 3	Con.
ANU-11267	V	8E	20	44.9	1510 ± 90	1591 (1401)1272	Con.
ANU-11364	VI	9E	22	53.5	2780 ± 200	3385 (2866) 2354	Con.
ANU-11309	VII	9E	23	56.5	3860 ± 230	4861 (4254) 3639	Con.
WK-9246	VII	9E	30	99.8	286 ± 60	497 (309) 4	AMS
WK-9254	VII	9E	33	130.7	982 ± 75	1055 (926) 732	AMS

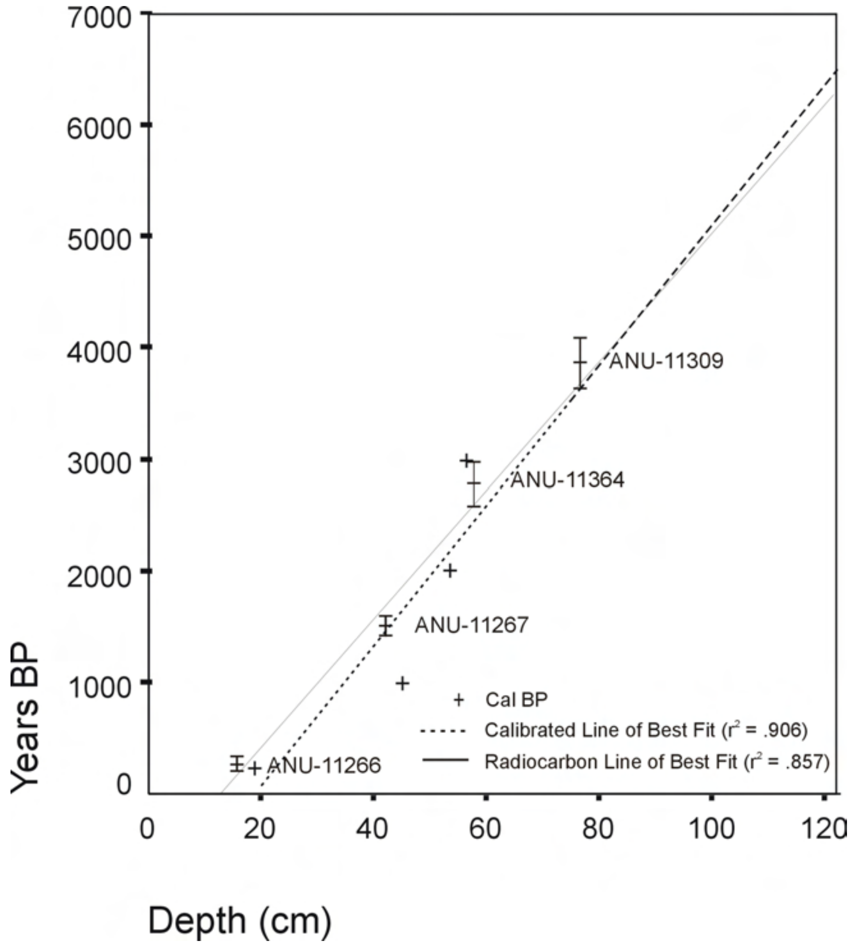
Con = Conventional

Layers I to III all appear to be of post-contact age (i.e. less than 200 BP) based on the presence of European artefacts such as glass beads and glass flakes. Layer IV appears to be pre-contact, and has an associated date of 270 ± 60. The base of layer V has an associated date of 1,510 ± 90. Points, tulas, burins etc all make their first appearance with the beginning of Layer VI dated to 2,780 ± 200 (2,866 Cal BP). Layer VII begins around 3,860 ± 230 and continues to an unknown depth.

Sedimentation Rates

The age-depth relationship for the site is plotted in Figure 5.21. Much like Nimji and Garnawala 2, sedimentation rates also appear linear over the dated range. The relationship between age and depth is also strong and significant for both uncalibrated (radiocarbon $r^2 = .857$, $p = .02$) and calibrated dates ($r^2 = .906$, $p = .01$). From the calibrated line of best fit, 1 cm of deposit would appear to have accumulated roughly every 87 years. Extrapolating from this line of best fit, the first occupation of the shelter can be estimated to have taken place around 6,500 years ago Cal BP.

Figure 5.21. Depth-age curve for Jagoliya. Only conventional radiocarbon dates are plotted.



Cultural Materials

Cultural materials occur from the top spit to the base of the excavation. Like the other two shelters, preservation of organic material is poor, and charcoal and other organics (seeds, faecal pellets and bone) reduce in quantity over the depth of the deposit after a peak in Spit 10 (Appendix D). Stone artefacts ochre and burnt earth, on the other hand, all increase between around 55 and 30 cm depth (between c. 3,400-1,200 Cal BP) with a distinct peak at around 40 cm depth (c. 1,500 Cal BP).

The range of stone artefacts is much like that for other sites in the region described above, with Banyan jasper dominating the assemblage. This material is available at its closest around 6km away to the northeast. Other materials including silcrete and Jasper Gorge and Antrim Plateau Volcanics quartzite also appear in the site, but in much lower quantities. These last raw materials are not found locally, and are probably available no closer than around 15km away.

The stone artefact assemblage is small in comparison to Nimji and Garnawala 2, but sizeable enough (n = 8,622) to detect major assemblage changes and conduct detailed technological analysis on complete artefacts. The excavated area amounts to around 1% of the shelter floor area, and the overall site assemblage is therefore estimated to be around 862,200 artefacts larger than 3 mm.

Gordolya

Gordolya ('at the owl') is a medium sized rockshelter (~510 m^2), and is the largest shelter in a medium-sized sandstone outcrop known as Jigaigarn (Figure 5.22), situated in the Sturt Plateau physiographic unit. Like the other three sites described so far, Gordolya contains spectacular rock art, with over 147 rock art paintings and 4,556 engravings found on the walls and boulders.

Figure 5.22. View of Gordolya with the excavation in progress in the background (courtesy of Jacqui Collins).

The 1991 Excavation

Gordolya was excavated in 1991 by Jacqui Collins as part of the Lightning Brothers Project (David 1991). As at the other sites, an alphanumeric system was used to divide the shelter floor into 50 x 50 cm squares (Figure 5.23). A 2 x 2 m (16 squares) pit oriented north was excavated immediately adjacent to a large boulder, and directly beneath overhanging painted motifs, with questions concerning the antiquity of rock art and technological change determining the choice of location. The excavation was undertaken in 2 cm bucket spits within stratigraphic layers, and reached bedrock at a maximum depth of around 62.7 cm in Square M24.

Figure 5.23. Site plan of Gordolya rockshelter. A: site plan showing excavated squares, and B: cross-section through the excavated squares.

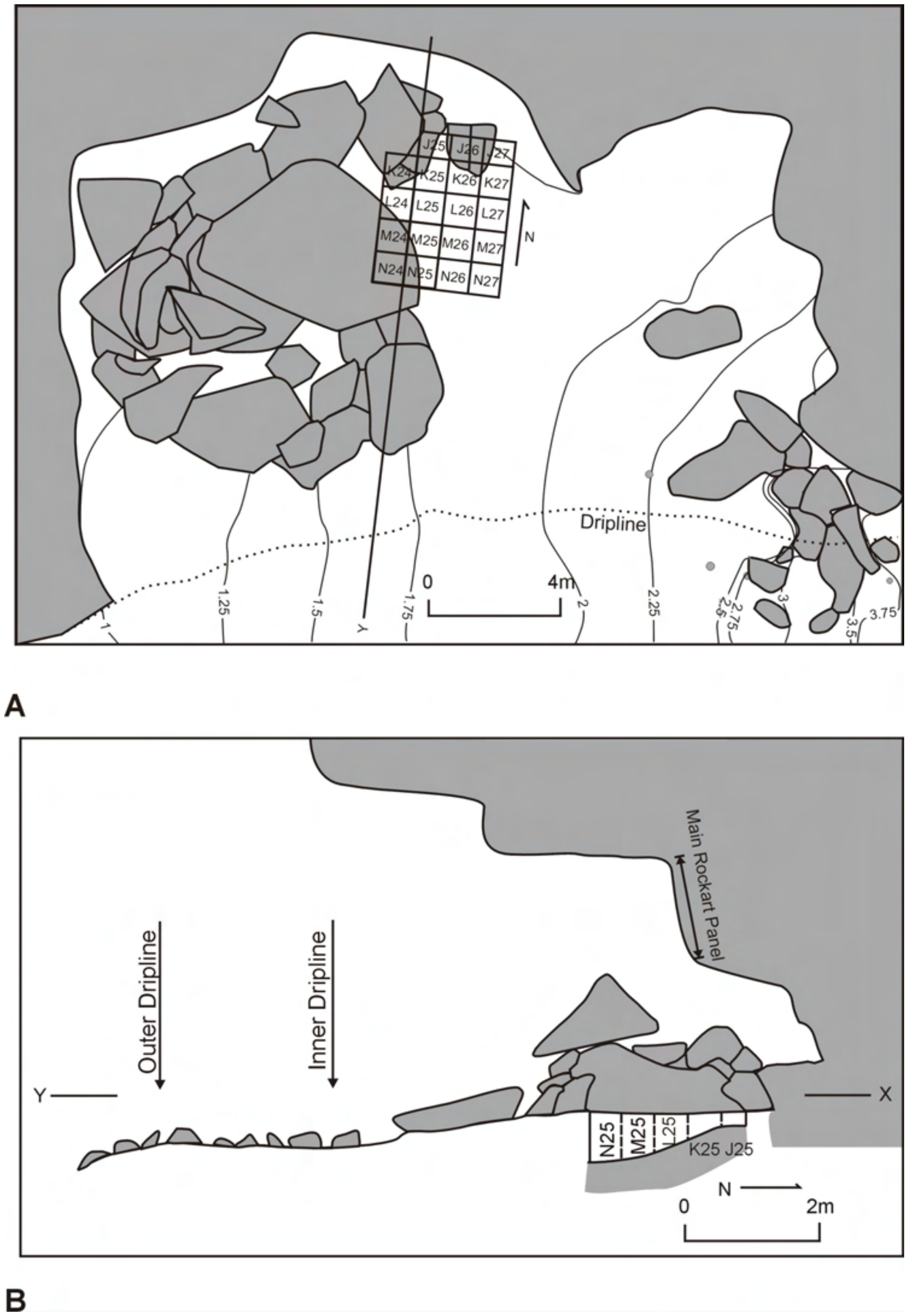
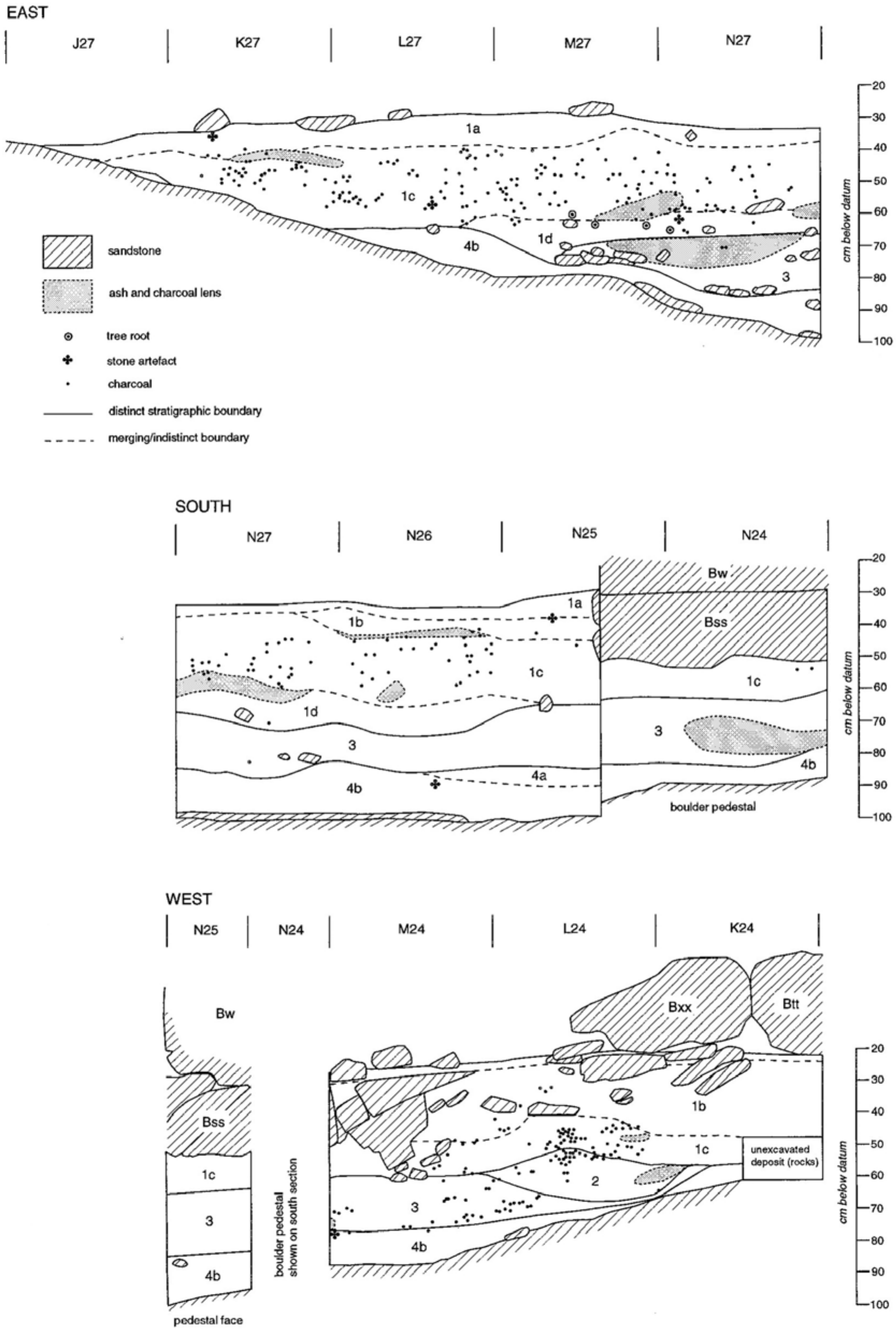


Figure 5.24. Section drawings for Gordolya, Squares J27 to N25.



Stratigraphy

David *et al*. (1991:5) describe the stratigraphy of the site in the following way:

> The upper 8-10 cm of the deposits consisted of relatively loose sediments containing leaf matter, small pieces of exfoliated sandstone, stone artefacts, freshwater mussel sells, and red ochre fragments. Underlying sediments rapidly became more compact with depth, and the density of cultural materials dropped significantly until c. 15 cm in depth …a sterile sandy layer was reached immediately above bedrock.

The stratigraphic profile is provided in Figure 5.24, while the details of each stratigraphic layer (depth, colour, texture, pH) are provided in Appendix E.

Dating

A total of nine dates have been obtained from Gordolya, from Squares M24, M25 and N25, revealing a terminal Pleistocene age for the site. Unlike the other sites described so far, Gordolya has excellent preservation of organic remains, and large amounts of charcoal was present right to the bottom of the cultural layers. Consequently, there was no need for AMS dating, and the set of dates reported in Table 5.5 appears reliable.

Table 5.5. Dates obtained from the Gordolya excavation.

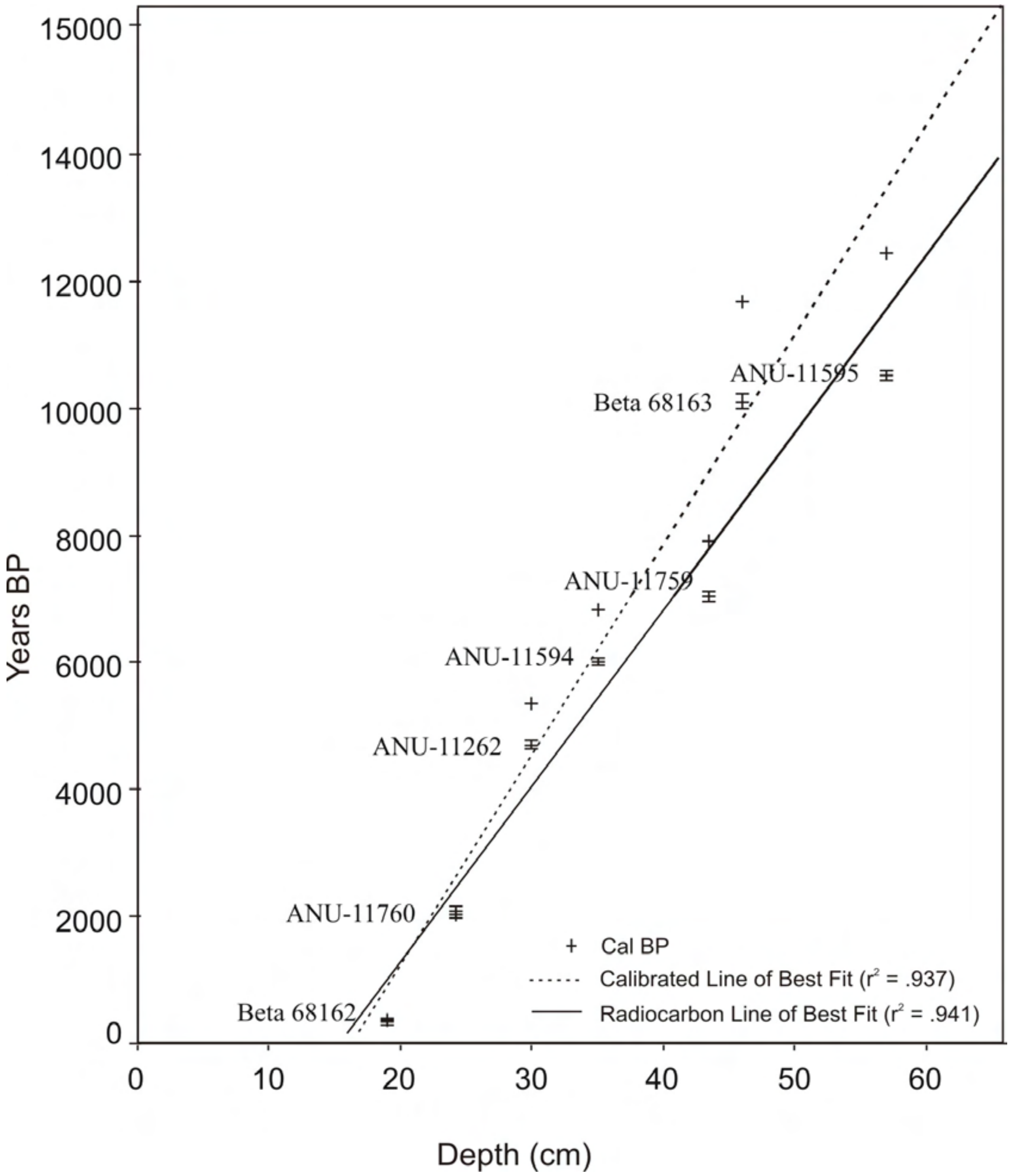
Lab Number	Layer	Square	Spit	Depth (cm)	Radiocarbon Age	Calibrated Age (2δ)
Beta 68162	Ib	M25	7	19.00	340 ± 50	508 (431, 356, 328) 294
ANU-11760	Ic	M25	9	24.20	2070 ± 80	2307 (2036, 2030, 2003) 1833
ANU-11761	III	N25	16	47.6	3840 ± 70	4422 (4240) 3992
ANU-11262	Ic	M25	11	30.00	4700 ± 60	5590 (5462, 5361, 5332) 5307
ANU-11594	III	M24	11	35.10	6010 ± 60	7002 (6853, 6836, 6830, 6822, 6802) 6676
ANU-11763	III	M24	13	43.50	7040 ± 70	7974 (7919, 7901, 7857) 7684
ANU-11759	III - Bottom	N25	18	52.70	7410 ± 100	8394 (8184) 7980
Beta 68163	IV	M25	15	46.00	10110 ± 110	12334 (11689, 11670, 11653) 11232
ANU-11595	IV	M24	17	57.00	10530 ± 90	12929 (12631, 12455, 12429) 11967

Layer I appears to have begun accumulating around 5,300 calendar years ago, and ended in the present period. Layer II is absent from Squares M24-N25. Layer III began accumulating around 8,000 calendar years ago and Layer IV sometime before 12,500 calendar years ago.

Sedimentation Rates

The dates for the M squares form a consistent relationship with depth that is strong and significant for both the calibrated (r^2 = .941, p = <.0005) and uncalibrated (r2 = .937, p = <.0005) dates. This age-depth relationship is plotted in Figure 5.25. The N25 dates apparently have a different slope to the M Squares, reflecting the slight E-W tilt in the stratigraphy of these squares. The nature of this slope is difficult to define, however, since only two dates have been obtained for the N squares. Figure 5.25 indicates that sediments likely began accumulating in the shelter around 15,000 Cal BP, although human use of the shelter appears not to have begun until 500 or so years after this time. As the oldest date so far obtained for occupation in Wardaman Country, it is probably no coincidence that first occupation appears to coincide with a period of rapid climatic shift from cool/dry conditions to warm/wet conditions. This may have made the region vastly more inhabitable at this time than it had been previously.

Figure 5.25. Depth-age curve for M squares at Gordolya rockshelter.



Cultural Materials

A range of cultural materials were found at Gordolya, including ochre, stone artefacts, European contact items and the largest bone assemblage yet recovered from the study region (Appendix E). While bone is abundant throughout the sequence with one clear peak in all squares (Spit 11 in M24, Spit 10 N25), other organic materials are less common and show complex patterns over the depth of the deposit.

Quantities of charcoal, for instance, vary for each square, with two peaks in M24 (Spit 5 and Spit 13), two peak in M25 (Spit 3 and Spit 6), one peak in N24 (Spit 10), and a gradual decline with depth in N25. Other organics (leaves, twigs, animal faeces, etc.) all peak within the top three spits, and greatly reduce in quantity below that depth. Ochre also has a complex distribution, with a single peak in M24 (Spit 2), two peaks in M25 (Spits 11 and 16), two peaks in N25 (Spits 1 and 17) and a single peak in N25 (Spit 2). The small quantities of ochre overall may have caused the noisiness in depositional frequencies. Stone artefacts show a single distinct peak in deposition in three squares (Spit 13 in M24, Spit 15 in M25, and Spit 15 in N25), but two peaks in Square N24 (Spit 14 and Spit 10).

Sample size is small, and fewer technological classes of stone artefacts are found at this site than the others, but a transition from earlier retouched flakes and cores to points, tulas and lancet flakes takes place in most squares, though with limited definition (Appendix E). Three raw materials are likely to be available close to the site: silcrete, hydrothermal chert and brown and grey quartzite of the nearby Antrim Plateau volcanics (Appendix E).

Conclusion

This chapter has presented information on the location, chronology and range of cultural materials found in the four excavated rockshelters. The rockshelters chosen for investigation all contain deposits spanning long periods and do not appear problematic in terms of the their age-depth relationships or the quantity of cultural materials recovered. This information provides the background context to the data that will be presented in the following two chapters. These chapters construct reduction sequences that help measure change and understand assemblage variation, and examine the changing systems of technological provisioning and land use that are expected to reflect changes in mobility, climate change, prey-structure and risk.