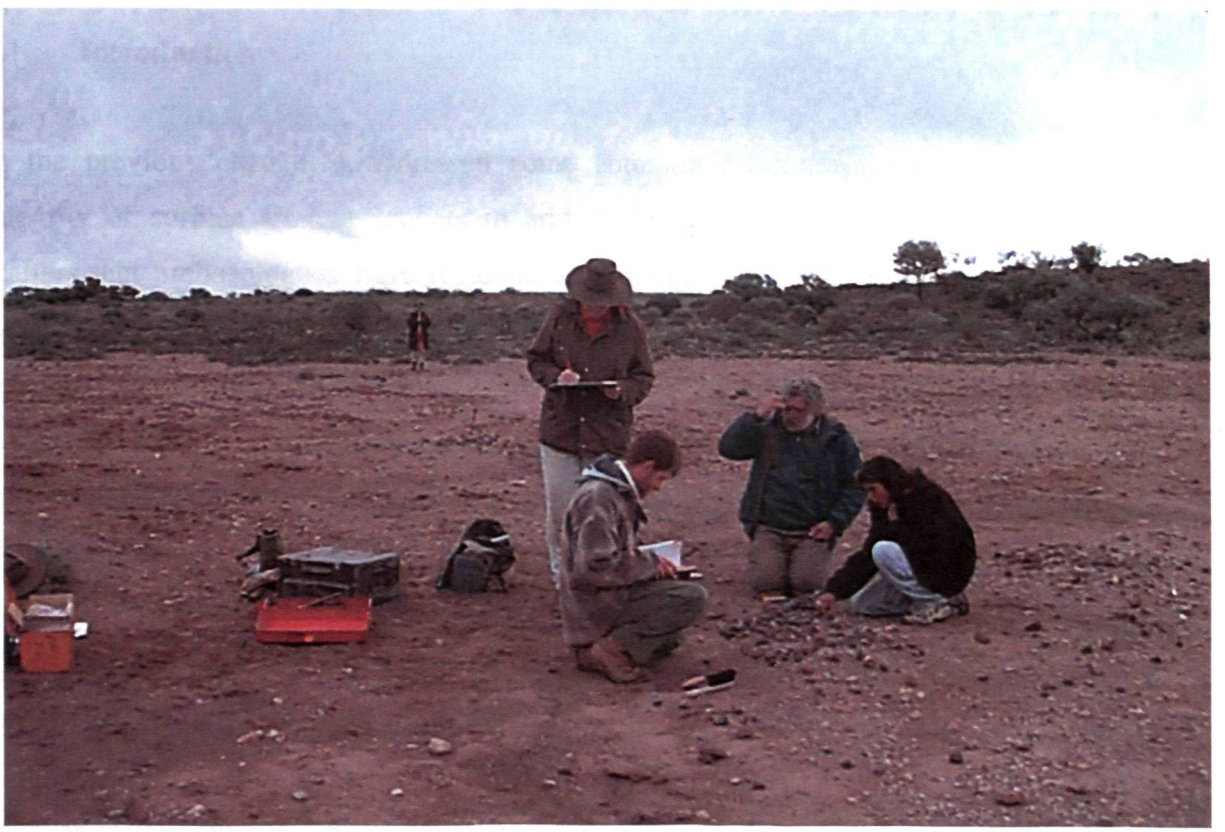
Chapter Four



Field crew (including Ainslie Ebsworth, right, a traditional owner) excavating the remains of a heat-retainer oven to sample charcoal for radiocarbon determination.

A Temporal Framework for Interpreting Surface Artefact Scatters in Western NSW

CHAPTER FOUR

A TEMPORAL FRAMEWORK FOR INTERPRETING SURFACE ARTEFACT SCATTERS IN WESTERN NSW

4.1 Introduction

In the previous chapter, I addressed some common misconceptions about the spatial integrity of surface artefact scatters in arid Australia. Another characteristic of surface scatters that archaeologists have regarded as limiting their contribution to understanding Aboriginal prehistory is the lack of stratigraphy, traditionally considered essential for building an archaeological chronology (HOLDAWAY ET AL. 1998). Because the debris of many individual behavioural events are conflated on to a common surface, such deposits have been considered to be too mixed to provide any useful information on the time frame of Aboriginal activity in the past; Thorley (1998:1) even referred to them as '…static…outside time's flow'. Excavation and dating of stratified deposits has been considered the only legitimate way to understand and interpret occupation and activity patterns over time.

Excavation is, however, limited by time and resources to providing information about the archaeological record of relatively small areas (but see Field et al. 2001). In spite of this, there have been many attempts in Australia to develop regional and even continent-wide chronologies from what are essentially local records. These have largely been unsuccessful because incomplete understanding of the relationship between depositional units, landscape evolution and time has meant that the rationale for correlating one set of deposits with another was not always well founded (Holdaway & Stern, in press).

With the increasing sophistication and more intensive application of absolute dating techniques, some occupation sequences are now very well dated such as Willandra Lakes in southwestern NSW (Bowler & Price 1998), Devils Lair in southwestern Western Australia (Turney et al. 2001), Carpenters Gap in the Kimberley region of Western Australia (O'Connor 1995) and Bone Cave in Tasmania (Allen 1996). However, in a continent as large as Australia sites like these are few and far between (Figure 1.1). Surface artefact

scatters are much more common, more extensive and more accessible, and have the potential to provide much more information about Aboriginal use of place than excavated deposits. Moreover, it will become increasingly difficult for archaeologists to obtain permission from traditional owners for excavation and removal of archaeological material. An approach that unlocks the information about place use history preserved in the surface scatters and associated heat-retainer ovens, without destroying them, is required.

In this chapter, a framework for determining the temporal context of surface artefact scatters is presented. Two separate, but linked, sets of data from the Stud Creek study area in Sturt National Park are used:

1. radiocarbon determinations on the charcoal preserved in heat-retainer ovens associated with the artefact scatters;
2. stratigraphic analysis of the valley fill sediments underlying the artefact scatters, including radiocarbon determinations on contained charcoal fragments and Optically Stimulated Luminescence (OSL) determinations on quartz sediments.

The radiocarbon determinations from the heat-retainer ovens provide a range of dates when the ovens were last used. The stratigraphic analysis provides a maximum age for the artefacts lying on top of the valley fill. Together, they provide an *envelope of time* during which the stone artefacts were discarded. Equally importantly, the valley fill stratigraphy allows a history of geomorphic change within the valley to be developed, with implications for preservation of the archaeological record.

4.2 Dating Artefact Scatters

In the first paper in this chapter (HOLDAWAY ET AL. 2002), we explain how dating charcoal from the remains of heat-retainer ovens at Stud Creek provides remarkably detailed information, not only about the time span that they represent, but more importantly, about the temporal pattern of oven-building activity. While not a complete record due to the likelihood of other ovens either being buried by sediments or completely eroded away, the relatively large number of successful determinations (n = 28) meant that we could statistically look for patterns among multiple oven-building events in ways that are not possible when only one or two dates are available. In other words, we analysed the oven data set in similar ways to the artefact data set, by looking for patterns in multiple behavioural events.

We are able to demonstrate that, over the period from about 1700 y BP to about 200 y BP, Aboriginal people occupied the Stud Creek valley intermittently across two time spans of considerable duration. Regular use of heat-retainer ovens is demonstrated during both phases, but at a rate of once every few decades (cf. Smith 1989). Moreover, there is a gap of approximately 300 years, between about 800 and 1100 y BP, when no heat-retainer ovens were constructed. I examine the record of palaeoenvironmental change for the region, and the Australian continental interior, for environmental explanations for this gap in the record (HOLDAWAY ET AL. 2002, Table 2). One of the main constraints of this type of analysis, however, is the problem of inherent differences in the temporal sensitivity of palaeoenvironmental analyses compared with changes in the pattern of human behaviour (Dean 1993). The resolution of the Late Holocene palaeoenvironmental record for this part of Australia is too coarse and the records too sparse to be of much use in understanding patterns of occupation spanning time periods of just a few hundred years. Nevertheless we are able to demonstrate that a temporal record of local Aboriginal occupation can be determined by detailed analysis and dating of surface artefact scatters via their associated heat-retainer ovens.

4.3 Dating the Landscape

The second paper (FANNING AND HOLDAWAY 2001b) presents sedimentary evidence from the Stud Creek valley fill that demonstrates that the length of the archaeological record here – and probably elsewhere in the region – is limited by geomorphic landscape change during the Holocene. Aboriginal traditional owners and the NSW NPWS gave permission to excavate a backhoe trench (Figure 4.1) across the valley floor at the Stud 1 location to obtain better access to the full sedimentary sequence than that exposed in the Stud Creek bank sections (Figure 4.2). Sedimentary units were described in accordance with standard field methods, and samples obtained for laboratory particle size analysis, and radiocarbon and OSL determinations.

An OSL date of 2040±100 years on sediments comprising the former flood plain provides an upper limit on the age of the artefacts lying on its now-eroded surface, and ties in with the record of occupation provided by the dates on charcoal from the heat-retainer ovens. An erosional unconformity between this and the underlying unit, dating to around 4,500 y BP,

suggests that any archaeological record of Aboriginal occupation of the Stud Creek valley prior to about 2000 years ago has been eroded away. The episodic erosion and sedimentation displayed by the Stud Creek valley fill sequence is common in fluvial settings throughout Australia (e.g. Williams et al., 1991). Thus, evidence for Aboriginal occupation prior to a few thousand years ago is unlikely to be found in these locations, which leads to the truism that 'absence of evidence can not be construed as evidence of absence'.

In FANNING AND HOLDAWAY (2001b), we demonstrate that, contrary to widely held views, a chronology can be developed for surface artefact scatters if a two-stage approach is taken: first, by analysing and dating the sediments and surfaces on which the artefacts are lying and second, by dating the archaeological materials themselves. This requires a detailed analysis of the mode and tempo of geomorphological changes within the locality and the region of interest, and focus on the *patterns* of geomorphic landscape change, and artefact discard and hearth construction, rather than single events.

These themes will be further developed in the final chapter of the thesis.

Figure 4.1: Trench excavated by backhoe across the valley floor of Stud Creek to expose the valley fill sediments.

Figure 4.2: Bank section on Stud Creek. Red sandy PEM unconformably overlies more gravely GSC. The holes mark the locations where OSL sample tubes were extracted and a gamma spectrometer inserted for background radiation measurements.

4.4 References

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Publication

Due to copyright laws, the following article has been omitted from this thesis. Please refer to the following link for the abstract details.

Holdaway, Simon J., Jones, Martin, Shiner, Justin, Fanning, Patricia C., Witter, Dan C. & Nicholls, Geoff (2002). Variability in the chronology of late Holocene Aboriginal occupation on the arid margin of southeastern Australia. *Journal of archaeological science*, 29(4), 351-363.
http://dx.doi.org/10.1006/jasc.2002.0719

Publication

Due to copyright laws, the following paper has been omitted from this thesis.

Fanning, P. & Holdaway, S. (2001). Temporal limits to the archaeological record in arid western NSW, Australia: lessons from OSL and radiocarbon dating of hearths and sediments. In M. Jones and P. Sheppard (eds) *Australasian Connections and New Directions: Proceedings of the 7th Australasian Archaeometry Conference*. Research in Anthropology and Linguistics 5, 91-111.

Abstract:

The Western NSW Archaeology Program (WNSWAP) has been investigating surface scatters of Aboriginal stone artefacts and associated heat-retainer hearths in arid north-western NSW, Australia, since 1995. The research combines new methods for documenting and analysing stone artefact scatters with an understanding of geomorphic landscape dynamics to seek insights into spatial and temporal patterns of Aboriginal occupation of the arid margin of Australia during the Late Holocene.

The temporal dimension is dealt with in two ways: by radiocarbon determinations on charcoal from the remains of heat-retainer hearths associated with the artefact scatters, and by using Optically Stimulated Luminescence (OSL) and radiocarbon determinations from valley fill sediments to develop a chronology of landscape evolution of the valleys in which the artefacts and hearths are found. The heat-retainer hearths produced a record of just less than 2,000 years of activity within the valley of Stud Creek, a 30 km^2 catchment in Sturt National Park. However, the record is discontinuous, with a gap in heat-retainer hearth construction of 200 - 400 years occurring between about 800 and 1100 y BP. Examination of patterns of erosion and deposition at the places where the hearths were found, and Bayesian statistical analysis of the radiocarbon determinations, demonstrates that this gap is real and not an artefact of the survey protocol.

A discontinuous record is also evident when the sediments that comprise the valley fill upon which the hearths and stone artefact scatters are currently lying are examined. Five major sedimentary units can be identified, providing a record of depositional episodes ranging from modern or post-European hack to the Late Pleistocene (about 70,000 years). But, in contrast to the record from the remains of the heat-retainer hearths, erosion is the major determinant of the temporal pattern of landscape change that can be reconstructed from this record. Gaps of up to 10,000 years, for which there is no sedimentary record, are observed in the Stud Creek alluvial fill. Thus, any evidence for Aboriginal occupation of the valley prior to 2,000 years ago is likely to have been destroyed by erosion. This pattern of episodic disequilibrium in landforming events (after Nanson, 1986) is common in the arid zone, with similar patterns being observed in stratigraphic records elsewhere in the region.

Detailed, local scale investigation of the archaeological and sedimentary records of places in the arid zone where Aboriginal people lived is likely to reveal similar discontinuities. We therefore conclude that any models of Aboriginal occupation of the Australian arid zone, which assume a continuous record on a stable landscape, are open to question.

Chapter Five

Heat-retainer ovens and artefact scatters currently exposed on eroded surfaces will inevitably be destroyed or concealed by ongoing erosion and deposition in these dynamic landscape settings.

Synthesis: Stone Artefact Scatters in a Dynamic Landscape

CHAPTER FIVE

SYNTHESIS: STONE ARTEFACT SCATTERS IN A DYNAMIC LANDSCAPE

5.1 Introduction

In the research presented in this thesis, I have explored the interrelationships between geomorphology and Aboriginal archaeology in western NSW, Australia. In particular, I demonstrated how geomorphic processes on a variety of scales influence the spatial and temporal distribution of the surface stone artefact record that archaeologists study.

Apart from human behaviour determining what artefacts were discarded and where, the material record of Aboriginal hunter-gatherer activity that is available for study by archaeologists is limited by

- *preservation* of artefacts in geomorphically dynamic landscapes evolving over time scales of hundreds to thousands of years,
- *exposure* of artefacts by geomorphic processes on time scales of tens to hundreds of years, and
- *visibility* of artefacts at the time of survey, which is related to geomorphic and other environmental processes, such as vegetation growth, operating on time scales of as little as a few hours to several years.

The specific aims of the research presented in this thesis were to:

1. investigate recent landscape change in western NSW and the contemporary geomorphic setting of surface artefact scatters;
2. determine the degree of disturbance of those scatters by geomorphic processes and whether it affects their potential for informing on prehistoric Aboriginal ‘use of place’;
3. develop a chronology for landscape history and Aboriginal occupation in the study area using absolute and relative dating of both the sedimentary and the archaeological record;

4. present a geoarchaeological framework for surface artefact survey and analysis that takes account of their contemporary geomorphic landscape setting and the history of landscape change.

In this chapter, I summarise the outcomes of the research in relation to those aims, and integrate these outcomes to develop a new geoarchaeological approach to surface artefact survey and interpretation anchored by an understanding of geomorphic landscape dynamics. Finally, I discuss the implications of this research for theory and practice in Aboriginal archaeology, particularly current models of Holocene Aboriginal settlement patterns, and management of surface stone artefact scatters as the most common material record of Aboriginal hunter-gatherer activity in Australia.

5.2 Recent Landscape Change and the Contemporary Geomorphic Setting of Surface Artefact Scatters in Western NSW

The first objective of my research was to investigate recent landscape change in western NSW, and why surface scatters of stone artefacts and the associated remains of heat-retainer hearths were so visible in the landscape. As shown in Chapter Two, the generally high level of stone artefact exposure as surface scatters is a result of the acceleration of geomorphic processes, and consequent landform evolution, which has taken place since the introduction of sheep grazing by European pastoralists in the mid 1800s (FANNING 1999, HOLDAWAY ET AL. 2000).

Evidence for topsoil stripping, ground surface lowering, valley floor incision, and channel enlargement and knickpoint retreat is widespread across the region. Historical accounts, stratigraphic evidence, and radiocarbon determinations on charcoal from some of the Aboriginal heat-retainer ovens that have either been exposed by erosion or buried by valley floor sedimentation, indicate that these processes of landscape evolution were accelerated in the region in the last 150 years or so since the introduction of sheep grazing. This has, in effect, ‘excavated’ many thousands of square metres of ground surface in any one place, removing the fine sediments (the sands, silts and clays) and leaving the coarse clasts, including artefacts, as a lag (or ‘blanket’) on the surface (HOLDAWAY ET AL. 2000). In other places, erosion has removed the artefacts completely, or they have been buried by sediments transported from upslope and/or upstream.

Geomorphic landscape change of this type and magnitude, however, is not just confined to the last two hundred years. Stratigraphic evidence from the valley fill in the Stud Creek study area (FANNING & HOLDAWAY 2001b) and from elsewhere in western NSW (FANNING 1999, Wasson 1976, 1979, Wasson & Galloway 1986, Williams et al. 1991) indicates that episodic erosion and sedimentation is characteristic of the landscape history of this arid margin region throughout the late Quaternary, including the Holocene. While the evidence points to land use change by European pastoralists as being a primary trigger for this latest episode, it is not the causes of landscape change which are of concern here, but the effects they have had on exposure and preservation of the archaeological record.

Exposure and/or burial of Aboriginal artefact scatters in western NSW is controlled by landscape morphodynamics operating on time scales of decades to hundreds of years and spatial scales of tens to thousands of square metres. These same processes, operating on similar scales, also determine whether or not artefact scatters are preserved in the contemporary landscape and/or in the sedimentary record of past landscapes, and how long they survive. In other words, they determine which parts of the Aboriginal material record become part of the archaeological record, and where and for how long it is preserved for the future. The chronology of geomorphic landscape change that we have established for the Stud Creek study area (FANNING & HOLDAWAY 2001b) is therefore equally as important as artefact analysis (HOLDAWAY ET AL. 2000) and radiocarbon dating of heat-retainer ovens (HOLDAWAY ET AL. 2002) in interpreting the archaeological record of prehistoric hunter-gatherer activity. A geoarchaeological framework incorporating all three aspects of the study of surface artefact scatters is therefore an important outcome of this study.

5.3 Artefact Exposure and Visibility, and Lateral Integrity of Surface Artefact Scatters at Stud Creek

Given the key role played by geomorphic processes and landscape evolution in determining the preservation and exposure of the archaeological record, I developed a landform-based framework for stratified sampling to accommodate spatial variability in artefact exposure across many thousands of square metres of the Stud Creek study area (FANNING & HOLDAWAY submitted). Those parts of the landscape where exposure is maximised (i.e. residual, eroding and fully lagged surfaces) are targeted to maximise the potential for finding artefacts and having them included in the survey. Whilst those areas where exposure

is limited (e.g. depositional surfaces) are ignored, and the artefacts they contain are thus excluded from the survey, this approach to survey design has several significant advantages. First, it precludes the need for archaeological excavation, which is spatially limited, expensive, and forces artificial boundaries on the artefact assemblages recorded. Second, and more importantly, it acknowledges and conforms to the desire of Aboriginal custodians for their material cultural heritage to be left in place.

Geomorphic and other environmental processes such as vegetation growth, bioturbation and animal trampling, operating both seasonally and on time scales from as little as hours to days, determine which artefacts and how many are visible at the time of the survey. The differential visibility of artefacts is accommodated by recording, at the same time as the artefact survey, percent cover of various surface types that either enhance the visibility of artefacts, such as bedrock, gravel, or subsoil, or obscure them, such as vegetation, sand, or mud. I expected that numerical estimates of true artefact density and distribution could be readily determined from these measurements. However, I found that no simple relationship exists between artefact density and measures of visibility at the local level, most likely because of the dynamic interplay between original discard patterns and the contemporary surface processes controlling artefact visibility (FANNING AND HOLDAWAY submitted).

While episodic geomorphic events have removed parts of the archaeological record, and buried other parts, there are still extensive areas of landsurface containing artefact scatters that appear to be largely intact. As a test of the lateral integrity of surface scatters at Stud Creek, I analysed the relationship between artefact dimensions and various landform parameters. I determined that lateral disturbance to artefact scatters by post-discard geo-hydrologic processes has had a minimal effect on spatial patterns of artefact distribution (FANNING & HOLDAWAY 2001a), except on surfaces subject to concentrated flow, such as rills, gullies and channels (HOLDAWAY ET AL. 1998). Everything with a maximum dimension smaller than 20 mm was ignored at the time of the survey, and a seven percent sample of the artefacts remaining on low-angled, unchannelled surfaces was analysed (FANNING & HOLDAWAY, submitted). While it may be argued that this limits the usefulness of the documented archaeological record by excluding from the artefact analysis certain artefact types, such as geometric microliths and microdebitage, the increased likelihood of lateral transport of these smaller pieces from their original discard location precludes their usefulness in determining patterns of Aboriginal activity in prehistory from that record.

5.4 Developing a Local Chronology for Surface Artefact Scatters

Preliminary analyses of the artefact scatters from TIB-13 and Stud Creek in Sturt National Park indicated that, while not preserving evidence of individual behavioural events, the nature of the artefacts accumulated over time in different places in the landscape can be used to analyse Aboriginal 'use of place' (*sensu* Wandsnider 1989) (HOLDAWAY ET AL. 1998, HOLDAWAY ET AL. 2000). While surface scatters of artefacts exposed by erosion do not represent 'living floors', and indeed are a palimpsest of many individual behavioural activities conflated onto a common surface, the research presented in this thesis demonstrates that it is possible to establish a chronology for artefact discard (the 'time-averaged' record *sensu* Stern 1994 or 'trans-episodic' record *sensu* Wandsnider 1989) using absolute and relative dating of both landscape and archaeology.

Radiocarbon dating of charcoal from the remains of many heat-retainer ovens provides an indication of the time span over which the ovens were used, and a sample of dates that can be analysed statistically (HOLDAWAY ET AL. 2002). Further, the law of superposition says that the ovens must be younger than the sediments into which they have been excavated, and older than any sediment that buries them. Thus, determining the time of deposition of the sediments in the valley fills (FANNING & HOLDAWAY, 2001b) gives a maximum age of the ovens, and absolute dating of the charcoal in the ovens gives a maximum age of the sediments that, in places, buries them. The time span defined by the youngest of the dated ovens at one end and the age of the landsurface into which they were excavated at the other is then the *envelope of time* during which oven-building activity took place in the study area. It is then assumed to be the time period during which the associated stone artefacts were discarded, since the artefacts cannot be older than the surface upon which they are lying. The only exception occurs when artefacts are transported and deposited on to younger depositional surfaces by geomorphic processes like overland or channel flow; however, they would not be included in the artefact survey since depositional surfaces, and any artefacts they contain, are ignored in the survey protocols outlined here (FANNING & HOLDAWAY submitted).

Applying these principles to the results of the charcoal dating program for Stud Creek, I conclude that the stone artefact scatters visible on the surface today are no more than 2000 years old, based on an OSL date of 2040±100 y on quartz sediment contained within the former floodplain surface into which the hearths were excavated (FANNING &

HOLDAWAY 2001b). The youngest oven date of 220±55 y BP from Stud Creek places Aboriginal activity within this catchment prior to European contact, about 150 years ago. Similar dates from ovens elsewhere in the region that are buried by the red sandy sediments that comprise the topmost unit of the valley fill sequence confirm that these sediments post-date European occupation and hence justify the label of 'post-European material' or PEM (FANNING 1999). In this way, archaeological evidence informs on the timing of recent geomorphic landscape change in the region.

Thus, evidence for Aboriginal occupation of the Stud Creek valley spans a period of about 1400 years. This is very short compared with 13,000 years at Currawinya Lakes (Robins 1993, 1996), a few hundred kilometers to the north (Figure 1.1), or 35,000 years at Carpenters Gap in the Kimberley region of Western Australia (O'Connor 1995) or 50,000 years at Malakunanja in Arnhem Land (Roberts et al. 1990) and Devils Lair in southwestern Australia (Turney et al. 2001). However, these are mostly basal dates from sedimentary sequences containing stratigraphic unconformities, and do not necessarily reflect continuous occupation at these places over the full extent of these time spans. Our results from Stud Creek in northwestern NSW also suggest a discontinuous occupation pattern for the late Holocene.

The radiocarbon determinations from the heat-retainer ovens contain details that are unique in the study of Holocene Aboriginal occupation of the arid zone. By dating a relatively large sample of ovens and statistically analyzing the results, it is possible to detect patterns of activity over time. Far from the valley being continuously occupied, statistical analysis of the determinations highlights a discontinuous record of hearth construction and abandonment across two time spans of considerable duration, the earlier period dating from 1630±50 y BP to 1170±130 y BP and the later period dating from 820±50 y BP to 220±55 y BP (HOLDAWAY ET AL. 2002: Table 1). While both palaeoenvironmental and archaeological explanations for the intervening gap in oven construction of 200 - 400 years are inconclusive, these results are nevertheless extremely important in highlighting local variability in the temporal pattern of Aboriginal occupation of the arid interior during the late Holocene.

Analysis and absolute dating of the record of landscape change that is preserved in valley fills underlying the artefact scatters also highlights spatial and temporal discontinuities in the preservation of the sedimentary record and with it, the archaeological record. The loose

red sandy sediments that blanketed the valley floor of Stud Creek following the introduction of sheep grazing (the PEM – Figure 2.2) have been largely eroded away since valley floor incision increased local gradients. Remnants comprise the Valley Floor Depositional landform unit as shown in Figure 3 of FANNING AND HOLDAWAY (submitted). Towards the distal margins of the valley floor, the PEM overlies the pre-European valley floor surface sediments (the PRE unit – FANNING & HOLDAWAY 2001b Figure 7.3), dated by OSL to around 2000 y BP. Closer to the contemporary channel, this unit has also been eroded away, and the PEM unconformably overlies grey sandy clays (the GSC unit) tightly dated via conventional radiocarbon and AMS to between 4000 and 4500 y BP (FANNING AND HOLDAWAY 2001b, Table 7.2). The unconformity between the GSC unit and the overlying PRE or PEM units represents a loss of sedimentary record of between 2000 and 4000 years. With it has been lost any evidence of Aboriginal occupation of the valley during that time period. The alternate explanation is that there was no net accumulation of sediment during this period, and the valley was unoccupied until about 1700 years ago. However, evidence of valley floor instability prior to, and following, this period undermines this argument.

An erosional unconformity also separates the GSC unit from the underlying RSG unit (FANNING & HOLDAWAY 2001b Figure 7.3), which is frequently encountered throughout the Stud Creek valley, either in outcrop in the gully walls and floor at the downstream end of the valley, or exposed by erosion on the distal margins of the valley floor where it has been mapped as the Eroding Valley Margin landform unit (Figure 3.1; FANNING AND HOLDAWAY submitted, Figure 3). The radiocarbon and OSL dates obtained for this unit (FANNING AND HOLDAWAY 2001b, Table 7.2), and its three-dimensional sedimentary architecture, suggest that the unit is time-transgressive, being deposited episodically in multiple, onlapping upwardly fining sequences over a time period of at least 27,000 years and perhaps more than 40,000 years. I concluded from this chronology that unstable or 'episodic disequilibrium' geomorphic conditions (*sensu* Nanson 1986[2]) prevailed in the Stud Creek valley in the late Pleistocene and through to the mid- to

[2] The term 'nonequilibrium' is a more precise descriptor of the record of landscape change described by Nanson (1986) and observed here for Stud Creek. Nonequilibrium landforms undergo substantial and sometimes abrupt adjustment via thresholds activated by high magnitude/low frequency events, strong positive feedbacks, deterministic chaos, or a combination of these. They do not tend towards equilibrium even with relatively long periods of environmental stability (Renwick 1992: 268-270).

late Holocene (FANNING AND HOLDAWAY 2001b: 105-106). Under these conditions, it is highly unlikely that evidence of Aboriginal activity in the valley prior to that represented by the ovens and artefact scatters currently exposed on the valley floor surface would be preserved. The absence of any archaeological material exposed in outcrops of the valley fill supports this conclusion.

5.5 Testing the Model: Geomorphic Landscape Variability and Preservation of the Archaeological Record at Fowlers Gap

An informal test of the role of geomorphic landscape dynamics in controlling the shape of the archaeological record is provided by some early results of a pilot study from another location within the western NSW region. I present this material here simply to illustrate the interrelationships between landscape dynamics and the preservation of the archaeological record; speculation on the causes of the patterns in the record awaits further archaeological analysis that is beyond the scope of this thesis.

In June 1999, WNSWAP researchers surveyed surface artefact scatters and associated clusters of heat-retainer ovens at several locations on Fowlers Gap Arid Zone Research Station, a pastoral property approximately 250 km south of Stud Creek (Figure 1.1). This research, funded by an Australian Research Council Large Grant, aims to investigate the Late Holocene archaeological record in one location with a variety of landscapes as a way of assessing variation in Aboriginal occupation intensity, mobility and resource use. The locations on Fowlers Gap were chosen because they were representative of different geomorphic landscapes (Figure 5.1). We wanted to see if there was any detectable variation in the nature of the archaeological record preserved there.

Having accounted for differential preservation, exposure and visibility of artefacts using the survey protocols outlined in Chapter Three, preliminary analysis of the results of the artefact surveys (Holdaway et al., submitted) has confirmed our first impressions that the stone artefacts are neither randomly nor uniformly distributed across the landscape. On the contrary, they are clustered in different ways in each location investigated, reflecting the different ways in which Aboriginal people interacted with the varied landscape in the past. For example, artefacts at the FC study site are manufactured predominantly from locally available quartz nodules (Figure 5.2). Those from ND are made from a variety of materials, including some from sources several kilometers distant. These differences may represent

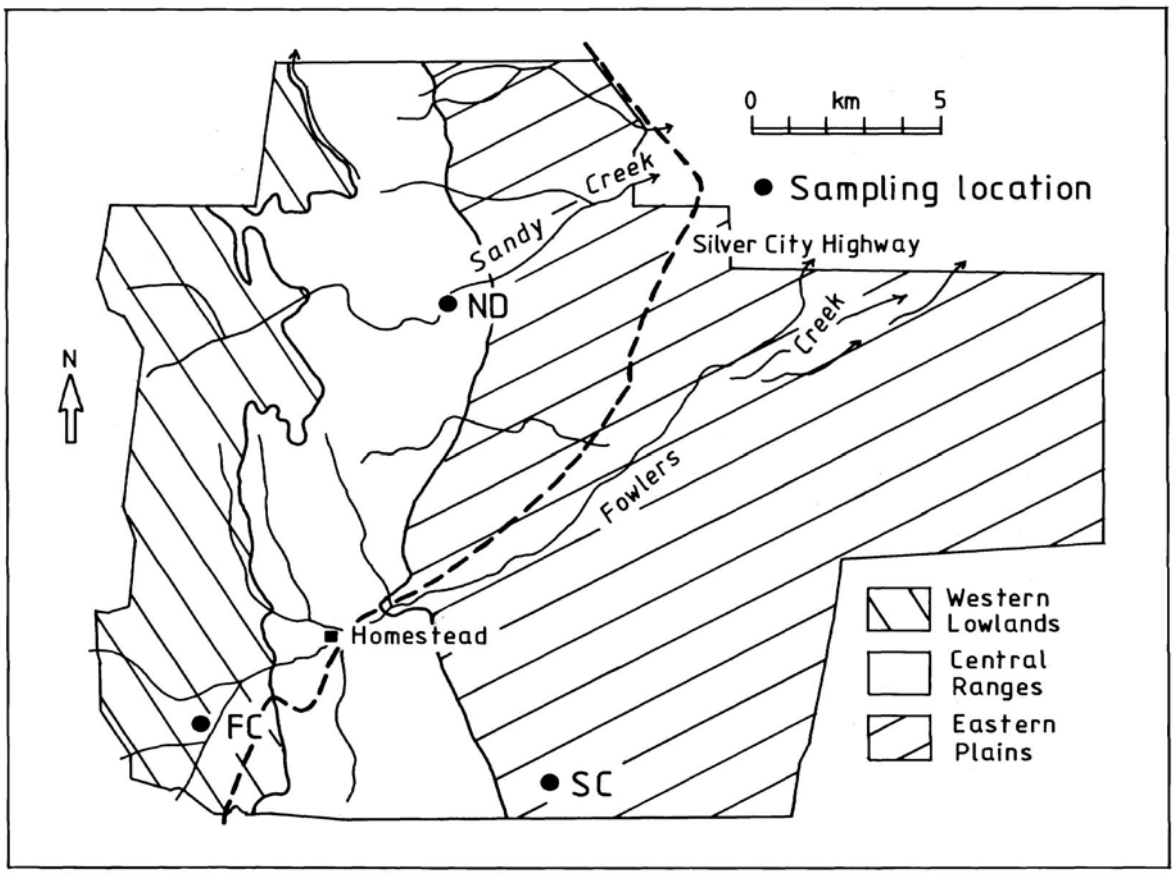

Figure 5.1: Fowlers Gap Arid Zone Research Station showing sampling locations in each of the three physiographic sections defined by Mabbutt (1973). The location of Fowlers Gap in western NSW is shown in Figure 1.1.

Figure 5.2: The FC study location, with Badger Bates and Simon Holdaway searching for artefacts on quartz gibber.

differences in the activities performed at different places in the landscape but they also reflect differences in the length of occupation at these places. More complex sets of artefacts represent places that were returned to more often and were used for longer periods when compared to locations that have less varied artefact assemblages (HOLDAWAY ET AL. 2000).

Table 5.1: Radiocarbon determinations on charcoal sampled from the remains of heat-retainer ovens on 'Fowlers Gap' Station near Broken Hill in western NSW.

WNSWAP ID	Lab ID	δC^{13}	% Modern	Result (y BP)
SC: active channel margin environment				
SC45	Wk9357	-25.4±0.2	97.9±0.6	Modern
SC81	Wk9360	-23.3±0.2	96.9±0.5	252±39
SC52	Wk9358	-23.6±0.2	96.9±0.6	255±49
SC44	Wk9356	-23.7±0.2	95.6±0.4	362±38
ND: low terrace environment				
ND2	Wk9334	-23.3±0.2	97.7±0.5	Modern
ND10	Wk9339	-22.9±0.2	96.2±0.5	314±39
ND9	Wk9338	-21.8±0.2	95.7±0.5	354±39
ND8	Wk9337	-23.9±0.2	95.6±0.6	357±53
ND15	Wk9342	-24.8±0.2	95.4±0.5	379±46
ND17	Wk9343	-23.2±0.2	95.2±1.3	398±111
ND6	Wk9336	-23.0±0.2	94.3±0.5	468±38
ND11	Wk9340	-24.8±0.2	91.9±0.4	678±37
ND13	Wk9341	-24.3±0.2	91.6±1.5	709±128
FC: high terrace environment				
FC455	Wk9363	-23.4±0.2	97.4±0.5	213±40
FC445	NZA13576	-23.8±0.2	89.4±0.6	898±56
FC20	Wk9346	-23.0±0.2	79.4±0.6	1857±62
FC21	Wk9347	-22.7±0.2	67.7±0.5	3130±54
FC33	Wk9351	-23.1±0.2	66.1±0.7	3327±91
FC2	Wk9345	-23.5±0.2	65.6±0.5	3383±56
FC6	Wk9354	-22.5±0.2	65.6±0.7	3385±81
FC5	Wk9353	-21.7±0.2	65.6±0.4	3392±49
FC7	Wk9355	-24.0±0.2	64.9±0.8	3467±100
FC16	Wk9344	-23.4±0.0	64.3±1.2	3549±153
FC24	Wk9349	-22.4±0.2	63.4±0.8	3661±102
FC22	Wk9348	-23.9±0.2	52.1±1.1	5243±164

The results most relevant to this thesis, however, come from the radiocarbon determinations on 26 heat-retainer oven charcoal samples (Table 5.1). They demonstrate that Aboriginal people repeatedly occupied certain areas on what is now Fowlers Gap Station throughout the mid to late Holocene. The oldest date obtained so far is 5243 ± 164 y BP from the FC study site, and the youngest are less than 200 years old (i.e. modern) from the SC and ND

study sites. However, it is not the time span of these dates that is of most interest here, but the *pattern* of dates in relation to the geomorphic dynamics of the landsurfaces on which the hearths and associated artefacts are found.

On landsurfaces where geomorphic processes of erosion and deposition are relatively active, such as the margins of the modern stream channels (SC, Figure 5.3), the dates are relatively recent and the record relatively short, reflecting the dynamic geomorphic environments at these locations. Sediments accumulate over short periods of time, perhaps a few hundred years, and are then removed by erosion during large flood events. In contrast, the fine-grained alluvial drapes on low terrace surfaces in the Sandy Creek gorge (ND, Figure 5.4) are only geomorphically reworked during less frequent, high magnitude floods, and thus preserve a longer archaeological record. Jansen (2001) has established a chronology spanning the last 1700 years for such floods in Sandy Creek gorge. The longest archaeological record found so far is on alluvial terrace surfaces parallel to Fowlers Creek (FC), reflecting the relative longevity of this particular landform feature. Friedel et al. (1993) describe analogous patterning in Central Australian vegetation communities, where long-lived trees are established on older landsurfaces, for example those formed by deposition in 700-year-old 'superfloods', while less stable surfaces support shorter-lived trees and shrubs, and the most frequently disturbed surfaces are entirely treeless.

But even on the older FC terrace surfaces, the record is not continuous. Apart from the 5243±164 y BP date, there is a cluster of eight dates between 3661 and 3130 y BP, one at 1857±62 y BP, one at 898± y BP and one at 213±40 y BP. This is similar to the intermittent pattern obtained from radiocarbon determinations on charcoal from heat-retainer ovens at Stud Creek (HOLDAWAY ET AL. 2002). One interpretation is that, like Stud Creek, Aboriginal people moved into and out of the Fowlers Gap area throughout the mid to late Holocene, re-occupying locations that perhaps had not been occupied for several centuries. It contrasts with the commonly held view that Aboriginal occupation of some regions of Australia, particularly the humid southeast, was more or less continuous from the late Holocene onwards, reflecting increasing population and a more sedentary lifestyle (e.g. Lourandos & Ross 1984). Our research at both Stud Creek and Fowlers Gap suggests instead that, at least in this part of the Australian arid zone, Aboriginal hunter-gatherer groups remained relatively mobile, moving away from, then back into, previously occupied areas on a fairly regular basis throughout the mid to late Holocene and right up to the time of European contact around 150 years ago. However, as stated at the start of this section, I am not speculating on the causes of these temporal patterns of occupation and abandonment,

Figure 5.3: SC sampling location at Fowlers Gap, with Simon Holdaway and field crew preparing to survey artefacts. The position of the contemporary watercourse is marked by the River Red Gum (*Eucalyptus camaldulensis*). The creek abuts a higher alluvial fan surface in the background.

Figure 5.4: ND sampling location in Sandy Creek gorge at Fowlers Gap. Artefacts and oven remains are found on fine-grained alluvial deposits that drape the low terrace surface in the middle ground. River Red Gums line the contemporary channel.

but simply pointing out that such patterns are discernible in the record of heat retainer oven use at Fowlers Gap as well as Stud Creek.

5.6 Application to Australian Archaeological Theory and Practice

Theory: current models of Holocene Aboriginal settlement patterns

The results of the geomorphological and archaeological investigations reported here for Stud Creek highlight the uncertainties of framing continent-wide models by extrapolation from limited local site data. Bettis & Mandel (2002) reached similar conclusions from their examination of the alluvial stratigraphies and archaeological records of river basins across the Great Plains of the U.S.A. They found that '…the accuracy of paleo-demographic and subsistence models based on archaeological data depends in large part on the amount and quality of data available for assessing differential temporal and spatial preservation [and visibility]…" (p.152).

Geomorphic processes that affect the archaeological record – by eroding it or covering it up – are temporally episodic. In Chapter Two, I demonstrated that recent geomorphic landscape instability had profound effects on preservation and exposure of the archaeological record in western NSW on time scales as short as 200 years (FANNING 1999). But the record of instability extends much further back in time: available Holocene valley fill chronologies, including that for Stud Creek (FANNING & HOLDAWAY 2001b), show that episodic landscape change is typical of the geomorphological record of the late Pleistocene and Holocene.

Furthermore, dating of landforms and sedimentary sequences from different locations shows that the geomorphic landscape is spatially disjointed as well as temporally disjointed, even with locations in relatively close proximity as demonstrated by our results from Fowlers Gap. There is plenty of evidence in the literature that shows that episodes of valley erosion and aggradation can be diachronous across single catchments (e.g. Bettis & Mandel 2002; Patton & Schumm 1981; Schumm & Hadley 1957). Even the accumulation of sediment within any one stratigraphic unit can be discontinuous across space (e.g. FANNING & HOLDAWAY 2001b) so multiple sites within any one sedimentary layer cannot be assumed to represent a synchronous settlement pattern (Stern 1994). It follows, therefore, that the archaeological record is spatially as well as temporally disjointed.

Current models of Aboriginal hunter-gatherer settlement patterns (e.g. Smith 1996; Veth 1993; Thorley 1998) that assume more or less synchronous occupation of multiple locations across a landscape at particular points in time must therefore be challenged. Our results from Fowlers Gap show that such models are bound to fail because each location has a unique geomorphic history that controls the spatial and temporal dimensions of the archaeological record that is preserved at that location. Moreover, our results from Stud Creek show that continuous settlement of a particular place even over relatively short time periods cannot necessarily be assumed. The record of heat retainer oven construction demonstrates intermittent occupation and long periods of abandonment of Stud Creek and of Fowlers Gap throughout the late Holocene.

The record of landscape change preserved in the Stud Creek valley fill sediments is a function of processes of erosion and deposition operating at a local (i.e. catchment-wide) level. Like the record from the heat-retainer ovens, it is a relatively high-resolution record because of the fortuitous preservation of a variable sedimentary sequence, and because we had the money to excavate and date it. For both these reasons, it is fairly unusual in Australian arid zone geomorphology and should be treated as such. On the other hand, geomorphologists have a tendency, as do archaeologists, to look for similarities with records beyond the catchment or 'site' boundary, often across the whole Australian continent. In other words, they seek spatial *patterns* in records of discrete *events* (HOLDAWAY ET AL. 2002). There is legitimacy here, as the climatic 'drivers' of local erosion and deposition processes operate on regional and continental scales, and therefore changes over time in patterns of erosion and sedimentation can reflect changes in climate at these scales. However, a continental pattern should not be inferred from records of events at just a few locations: the efficacy of continent-wide models of landscape evolution is only as good as the quantity and quality of the records on which they are based. The same is true for the archaeological record.

Spatial and temporal discontinuity in the preservation, exposure and visibility of the archaeological record is accommodated in the artefact survey protocols developed from my research (FANNING & HOLDAWAY submitted). The high resolution local record they produce presents challenges for archaeologists in the ways in which the evidence for Aboriginal occupation in the Australian arid zone is examined. Whereas it was once considered too difficult to examine regional variation in the distribution and nature of human activities in time and space across the landscape, mostly because of the lack of a

suitable chronological framework for analysing surface artefact scatters, our methods prove that not only is it possible to develop such chronologies, but that both presence and absence of human activity can be identified at open sites (cf. Bird & Frankel 1991). Thus, intensive study of a few well dated places, rather than the general study of large regions, can lead to a better understanding of Aboriginal 'use of place'.

Similarly, the results support the conclusions reached by Bird & Frankel (1991) regarding the assumptions underlying the so-called "intensification" hypothesis, first articulated for Australia by Lourandos (1983) and further developed by Williams (1985) and Ross (1985). As Kirkby & Kirkby (1976) demonstrated over twenty years ago, ratios of sites from different periods cannot simply be interpreted in terms of changes in populations and their distributions through time, as the common empirical impression of an exponential increase in the numbers of sites in successively younger phases may be the result of progressive loss of information about older sites. In Australia, the apparent abundance of late Holocene archaeological 'sites', relative to older ones, is likely to be a function of the preservation of landscape surfaces upon which they lie. The results from Fowlers Gap demonstrate that the length of the archaeological record preserved in any one location is a function of geomorphic landscape dynamics, with locations subject to more frequent erosional events retaining much shorter records of occupation than less geomorphic dynamic locations. The lack of evidence for Aboriginal occupation prior to 2,000 years ago in the Stud Creek valley is a direct result of geomorphic activity episodically truncating the sedimentary record and, with it, any evidence of earlier occupation. By the same token, long archaeological records survive at places like Mungo because environmental conditions favoured preservation of the landforms into which the artefacts, ovens and human remains were incorporated. That, of course, has now changed with the destabilization and accelerated erosion resulting from post-European land use change. While the archaeological record there is now able to be seen and studied because erosion has increased its exposure, that same erosion is threatening its preservation.

Thus, the key to understanding the archaeological record in the Australian arid zone is the survival of landsurfaces, because it is on these landsurfaces that the artefacts rest. Archaeologists have to take account of spatial and temporal patterns of landscape or landsurface preservation if models like intensification and arid zone settlement patterns are to be successfully tested.

Practice: significance assessment and other management issues

The nature of the archaeological record at Stud Creek, and the methods used to extract it, also have important implications for the kinds of 'significance' assigned to surface artefact scatters, and particularly for the way these decisions affect cultural heritage management strategies (FANNING & HOLDAWAY 2001b: 100).

Current archaeological survey practices that involve limited samples constrained by artificial boundaries, such as transects, are unlikely to detect patterns of past Aboriginal activity. As mentioned in the previous section, the high-resolution spatial and temporal record extracted from Stud Creek is largely a function of the high level of resources and technology used. The availability of digital technology has allowed a revolution in approach to surface stone artefact scatters that provides the necessary data on which new theories can be firmly based (Wandsnider 1992).

Similarly, management decisions are often based on predictive models that seek to relate 'site' location to environmental variables, such as water or stone resources (e.g. Hughes & Sullivan 1981 in Hiscock & Hughes 1983). However, such models are based on a static view of human/environment relationships. My research has shown that, on the contrary, environments characterised by episodic nonequilibrium are anything but stable, and simple correlations between environmental variables as they exist today and the location of archaeological materials are unlikely to be of much value in predicting the nature of occupation in the past.

As noted above, material evidence of the most recent activity is the best preserved, therefore conservation needs to target those geoarchaeological landscapes that still contain relicts of the deep past, such as Pleistocene landscapes like Mungo, as they will be scarce relative to the remains of more recent geoarchaeological landscapes such as Stud Creek. Even so, the nature of the on-going landscape evolution is such that even the late Holocene record that we have documented is under threat from continued erosion that was initiated over 100 years ago. Cultural heritage management plans need to incorporate strategies that use geoarchaeological techniques to identify places where longer and/or more variable records might be preserved.

The archaeological record in any one place is a palimpsest of both archaeological and geomorphic events, not a snapshot of activity, so significance assessment will have to take

this into account. Using the survey protocols outlined in this thesis, we are able to distinguish, on the bases of geomorphic interpretation, absolute dating and tool typology, places that were visited more intensively (i.e., more frequently and/or for greater duration and/or over a longer period of time) from those that were less intensively used. Thus, a conservation hierarchy for archaeological landscapes and the material cultural remains they contain can be developed, based on a geoarchaeological assessment of 'significance'. Cultural significance assessment, however, is the business of others, particularly Aboriginal traditional owners, and beyond the brief of WNSWAP research.

5.7 Summary: A New Geoarchaeological Framework for Interpreting Surface Artefact Scatters in Western NSW

A major outcome of the research presented in this thesis is a new geoarchaeological approach to surface artefact survey and interpretation anchored by an understanding of geomorphic landscape dynamics.

The record of Aboriginal hunter-gatherer activity, i.e. the stone tools they manufactured, used and then discarded needs to be studied in spatially extensive sets. However, surface scatters of stone artefacts had previously been largely dismissed by archaeologists because they were unbounded, appeared to be seriously disturbed by post-depositional formation processes, and lacked the stratigraphy considered essential for establishing a chronology of occupation. Moreover, until the advent of Global Positioning Systems (GPS), electronic surveying equipment, digital data capture and Geographic Information Systems (GIS), the technology necessary to record, store and analyse large, spatially extensive data sets was not available (Wandsnider 1992).

In western NSW, artefact exposure and burial has been enhanced by geomorphic dynamics, particularly accelerated erosion and sedimentation that was a consequence of the introduction of sheep grazing in the mid- to late eighteenth century. These geomorphic processes operating differentially across the physical landscape are the principal determinants of artefact exposure and preservation and, as a consequence, the principal determinants of the nature of the archaeological record at the time of artefact survey

The artefact survey protocols outlined in this thesis target landsurfaces with the greatest potential for exposure of the archaeological record. The protocols accommodate differential

artefact visibility at the time of the survey by including assessment of surface cover and quantifying its effects on artefact density. To draw behavioural inferences from the spatial distribution of the surface artefacts in a study area, archaeologists must determine the lateral integrity of the visible scatters being sampled. We use the powerful spatial analysis and data interrogation tools provided by a GIS to eliminate from the assemblage analyses any artefacts likely to have been moved laterally from their original discard position. This includes all artefacts smaller than 20 mm maximum dimension, and all artefacts now lying on rilled or gullied surfaces subject to concentrated water flow. By ensuring that a suitably large number of artefacts are included in assemblage analyses (the Stud Creek database contains nearly 60,000 artefacts), any other disturbance effects, e.g. movement of artefacts by overland flow, or kicking, trampling and burial by animals, are likely to be statistically insignificant.

Erosion of the fine sediments surrounding and supporting the stone artefacts has meant that the discard products of Aboriginal activity have been conflated. In effect, the artefact scatters have become 'time-averaged' (*sensu* Stern 1994) or 'trans-episodic' (*sensu* Wandsnider 1989) deposits in which the products of many individual behaviours are now lumped together. By looking at the nature of the artefacts accumulated over time in different places in the landscape, archaeologists are able to distinguish those places that were used frequently from those that were used less often and those used for common activities from those used more sparingly. But, rather than seeking to date individual events, the goal is to seek *pattern* in the both the spatial and temporal record of events that will allow a detailed prehistory of Aboriginal 'use of place' (*sensu* Wandsnider 1989) to be developed.

This prehistory can be fitted into a chronology using a two-stage approach: first, analysing and dating the sediments and surfaces on which the artefacts are lying and second, dating the archaeological materials themselves. Such chronology requires a detailed analysis of the mode and tempo of geomorphological changes within the locality and the region of interest, and focus on the *patterns* of geomorphic landscape change, as well as artefact discard and hearth construction, rather than single events.

The radiocarbon determinations from the heat-retainer ovens associated with the artefacts provide a range of dates when the ovens were last used and, by association, an *envelope of time* during which the stone artefacts were discarded. This may be an incomplete record due to the likelihood of other ovens either being buried by sediments or completely eroded

away. High resolution records using radiocarbon dating are an expensive but necessary part of the research because clues to the age of ovens cannot be gained from simply looking at them. As indicated in HOLDAWAY ET AL. (2002), preservation is a function of contemporary processes, not the time since the ovens were last used. Moreover, dating as many ovens as possible (e.g. 28 determinations were obtained from Stud Creek, and 26 so far from Fowlers Gap) means that we can statistically look for patterns among multiple oven-building events in ways that are simply not possible when only one or two dates are available. In other words, we analyse the oven data set in similar ways to the artefact data set, by looking for pattern in multiple behavioural events.

The stratigraphic analysis provides a maximum age for the artefacts lying on top of the valley fill, and equally importantly, a history of geomorphic change within the valley that informs on the likelihood of preservation of the archaeological record. The episodic erosion and sedimentation reflected in the Stud Creek valley fill sequence, which removes or preserves the archaeological record, is common in fluvial settings throughout Australia. Thus, evidence for Aboriginal occupation prior to a few thousand years ago is unlikely to be found in such locations. The length and continuity of the archaeological record is thus limited by the geomorphic history of the 'site' chosen for survey. In Stud Creek, prior erosion has limited the record to the past 1700 years, whereas at Fowlers Gap the record extends back at least 5000 years because of the lack of geomorphic activity in those locations, that is,. on the summits of terraces removed from the active stream channel. This is summarized by the notion of 'episodic disequilibrium' (*sensu* Nanson 1986) or nonequilibrium landscapes (Renwick 1992), whereby long periods of little or no geomorphic activity are punctuated by discrete catastrophic events which erode or deposit sediments, and hence remove or cover up the archaeological record located there.

Some may argue that archaeological investigations in fluvial settings like Stud Creek are a waste of time and resources because of the reduced likelihood of preserving long records in places that are subject to frequent, episodic erosional activity. The likelihood of post-depositional disturbance of the record that remains is also quite high compared with, for example, the record preserved in rockshelters. However, Aboriginal campsites with associated artefact scatters are likely to be abundant in places where essential resources like water and food were more likely to be found, such as along former watercourses and around the margins of former lakes, swamps and topographic depressions. Thus, to ignore surface artefact scatters in fluvial settings would mean to disregard a significant proportion of the

available archaeological record. I have demonstrated in this thesis that it is possible to obtain a high resolution record of Aboriginal occupation of these locations by identifying and accommodating the dynamics of the geomorphic setting. All that is needed is for archaeologists to shift their attention from establishing a continent-wide history, where fluvial settings are clearly limiting, to investigating the *nature* of hunter-gatherer society and its variability (Frankel 1993).

5.8 Conclusion

Geoarchaeological landscapes are a complex mosaic of landsurfaces of variable ages containing records of human activity of variable lengths. The key to understanding the archaeological record, and to managing it as the material cultural heritage of Aboriginal people, lies with understanding the dynamics of the geomorphic landscape in which it is found. The high resolution dating of both landscape and archaeology used here is fundamental to further illumination of the on-going debate in Australian archaeology on resource use, settlement patterns and late Holocene 'intensification'.

> *"…Ultimately, the writing of Aboriginal history is structured by the resolution of the archaeological record…"*
>
> *(*Williamson 1998: 147*).*

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THE LAST WORD…!

There once was a sheila called Trish
who really was quite a dish!
The ABC failed to see
the importance of geomorphology
which only fired the mission for Trish!

The landscape was shifting and vast
OSL dates and sections a blast!
The lines in the sand
gave the archies a hand.
Your data outdates all the past!

From NZ there came 'Dr Evil',
the slave driver for all of these people!
The earliest riser,
somewhat of a miser!
(we had to come and make him more civil!!)

The 'gangsta' wagon carried the thugs
who drank whiskey and beer by the jugs!
Their musical taste
laid all to waste!
(but they still knew their tools from their tula slugs!)

Key-ers and tidiers do the mundane
for Bridget and Justin and Shane.
Justin exhorts them: "Go hard!"
but never drops his guard.
They came from world over to drink the champagne!

So now we go, knowing much more
about hearths and compsplits and cores.
Not a 'dig' nor a 'site'
(or Trish'll give us a fright!)
So…let's burn the tags, and may there be many more!!

(written and performed by Ngaire Kerse, Emma and Marycarol Holdaway, and friends at the end of the 2001 field season at Fowlers Gap)