

**DEVELOPING A RELATIVE DATING SYSTEM FOR THE MORETON REGION:  
AN ASSESSMENT OF PROSPECTS FOR A TECHNOLOGICAL APPROACH**

**PETER HISCOCK**

*Anthropology & Sociology  
University of Queensland*

**INTRODUCTION**

The imperative of dating sites rests uneasily upon the shoulders of Australian archaeologists. Despite the growing array of sophisticated physical and chemical techniques for estimating the age of objects, the most common archaeological site-type in Australia, the stone artefact surface scatter, remains generally difficult to date with any precision. During the 1960's and 1970's researchers focussed their attention on stratified sites which could be dated by the conventional radiocarbon process, and thereby established a chronological framework for their studies. More recently a shift in interests, particularly towards the testing of demographic and settlement models, has made it inappropriate to restrict investigations to the small proportion of sites which are stratified. In this context there is an urgent need to develop some means to date artefact scatters. This paper assesses the prospects for constructing a system of dating artefacts in the Moreton Region by inferring the way in which they were made.

Before turning to the specific requirements and possibilities of the Moreton Region it is necessary to describe in some detail the type of dating system which is envisaged, and to posit its critical features. In particular, it is necessary to address those issues which are unique, or at least unusual, to the use of stone artefacts in such a dating system.

**PREVIOUS APPROACHES TO DATING OPEN ARTEFACT SCATTERS**

Previous attempts to infer the age of artefacts by reference to their size and morphology are instructive in outlining the difficulties of such an approach. The idea that each temporal period produced distinctive objects was the foundation of much archaeological work prior to the advent of radiometric dating techniques, and formed the basis for many of the culture-historical frameworks employed in the nineteenth and early twentieth centuries (cf. Daniels 1975). These studies ignored archaeological variability which was not directly attributable to time and thereby developed time-sensitive categories, often called "temporal types" or "temporal markers" (Thomas 1979:163). For each assemblage, the relative popularity of these categories was calculated and the assemblages ordered "so that the percentages for each type tend to grade

smoothly into each other, forming the types into battleship-shaped curves" (Thomas 1979:226). This sequence was assumed to be the chronological order. Seriation approaches of this kind continue to be employed in more recent archaeological investigations of open sites. Johansen (1971), for example, seriated eight Norwegian assemblages on the basis of the relative thickness of flakes, and argued that the resulting sequence represented the chronological order of the assemblages. Underlying his approach was the assumption that the ratio of length to thickness of flakes was culturally determined and that the output of knappers in any particular period would have been relatively invariable, irrespective of circumstance. It can easily be demonstrated, however, that individual knappers may strike off a variety of flakes and employ a number of different techniques in doing so (cf. Indrelid 1971). Furthermore, flake dimensions are often highly sensitive to the properties of the stone material being worked (cf. Cullberg 1971). Clearly, any attempt to devise a dating system based on artefact form must control for both the effects of raw material and for the diversity of knapping techniques which a single knapper might possess.

Artefact size has occasionally been employed to indicate the antiquity of Australian assemblages. Lorblanchet and Jones (1979) and Lampert (1981) have proposed that surface sites containing large Kartan "core-tools" should have a high antiquity because large, robust implements are characteristic of early Australian tool-kits. Radiocarbon dates obtained in recent years do not support their argument (eg. Lampert 1985; Draper 1987:4). Other researchers have also devised chronological frameworks in which older assemblages contained larger and coarser artefacts, although they did not attempt to date open sites by reference to that framework (eg. Kohen, Stockton and Williams 1984). One weakness in these investigations is that they fail to control for the effects of raw material properties. In particular, they fail to examine the effect that factors such as raw material availability can have on knapping practices and the resulting artefacts.

Several Australian studies have demonstrated a strong positive relationship between the distance stone was transported from its source and the amount of reduction it underwent (Byrne 1980; Hiscock 1988). When raw material rarely crops out, artefacts far from the source may be smaller and more finely flaked than those near the source, because they have been flaked repeatedly by knappers attempting to conserve available stone. Consequently, the use of size as an indication of antiquity may be misleading. A possible example of such a misinterpretation is found in Ross's (1981) investigations of the Victorian Mallee. Sites on the Raak Plains were inferred to be relatively old because they lack backed blades and the artefacts are large, whereas in the southern Mallee, sites were thought to be more recent because the artefacts are smaller and backed blades are present (Ross 1981:149). The properties of raw material and access to replacement stone is very different for the two areas, however, with the large artefacts at Raak Plains being made of local coarse grained quartzites and the small artefacts of the Southern Mallee being made of imported chert. While this coincidence does not of itself invalidate Ross's conclusions it does deprive them of strength, particularly as the alternative explanation of raw material properties was not adequately assessed. Possible environmental effects on the nature of prehistoric knapping must be investigated if dating systems based on assemblage content are to be reliable.

In his relative dating of Norwegian open sites, Johansen (1971) attempted to verify the inferred sequence by comparing it to observed

chronological changes in assemblages from stratified sites. The application to surface scatters, of sequences derived from stratified sites is a common way of integrating both types of sites into a single chronological framework. This procedure involves the analysis of artefact assemblages from a number of sites to determine characteristics which are restricted in time and so may be used as "temporal markers" for that period. Sometimes, the distinctiveness of the assemblage which permits its chronological identification is the nature of the rock on which the artefacts are made, the source of which was only available during particular periods (eg. Glover 1984). Only rarely are geomorphic conditions of this type present. More commonly, distinctive "implement types" are employed as temporal markers. Thomas (1986) points out that the use of elaborate implement typologies remains the backbone of many investigations of non-stratified sites. A number of researchers have argued that by their very nature, these complex forms of implements may be subject to resharpening and reshaping during their use by prehistoric people and that their distinctive features are not immutable, but dependent on the context in which they were discarded (eg. Flenniken 1985; Flenniken and Raymond 1986; Dibble 1987). Accordingly, implement typologies can only form the basis of a dating system when it has been demonstrated that they are robust, in the sense that their form is unresponsive to change in function, context or raw material.

In Australia, the use of implements as temporal markers is widespread, but is plagued by a number of further difficulties. Major industrial changes as recorded on distinctive retouched flakes are rare, and most syntheses of prehistory opt for only two chronological changes in artefact assemblages. In eastern Australia this broadly equates with the appearance of backed blades in the mid-Holocene and their disappearance in the late Holocene (Attenbrow 1982; Johnson 1979; Lampert 1971:9; McCarthy 1958, 1964; Morwood 1981; Mulvaney and Joyce 1965). Changes in other forms of implements do occur, but specimens of those types are so infrequent that they are generally not employed as temporal markers. Effectively this means that many Australian surface assemblages could be categorized as being from either the backed blade phase or another phase. Applying these categories to surface sites without backed blades has been of little value, and generally age estimates are based on geomorphic context. The absence of finished backed blades does not necessarily mean that the site is earlier or later than the phase of backed blade production, because finished retouched flakes of this type may have been discarded in only a limited range of circumstances, such as large "campsites". Quarries and many small sites, including knapping floors, are therefore excluded from discussion of chronological change. Even when backed blades are recovered from surface sites, inferences about the antiquity of occupation are limited. While the find indicates that the site was visited by the backed blade makers it cannot exclude earlier or later occupation; indeed, there is no necessary chronological association between the backed blade(s) and the rest of the assemblage. Nor does the find provide any indication of when the site was occupied during the several thousand years that backed blades were manufactured. Furthermore, as the timing of the apparent appearance and disappearance of backed blades varies widely between areas, the use of this implement type may often provide an indication of relative rather than absolute antiquity. Compounding these difficulties is the fact that amateur collectors are more likely to take distinctive and attractive retouched flakes, such as backed blades, than other artefacts. The application of a temporal marker method based on the discovery of backed blades is therefore particularly sensitive to the activities of collectors.

## THE REQUIREMENTS OF A DATING FRAMEWORK

A dating system which successfully employs assemblage content as an indication of antiquity must deal with the issues raised above. Consideration of these issues indicates that nine characteristics are required by such a dating system:

1. **Wide applicability.** The dating system must be applicable to a large proportion of surface sites in the region for which it is designed.
2. **Stated limits.** The interpretative limits of the framework should be defined so that antiquity is not inferred for surface assemblages which are measurably different to those found in stratified and dated contexts.
3. **Verification.** The sequence of temporal markers must be independently verified by reference to stratified sites and/or by association with absolute dates.
4. **Uniformity of sequences.** The same chronological sequence must be found at all stratified sites in a region or subregion.
5. **Sensitivity.** The set of variables measured should be sensitive to relatively subtle changes in stoneworking technology, thereby allowing the identification of a large number of chronological changes and providing good temporal resolution.
6. **Robustness.** The temporal markers must be robust in that inferences about the antiquity of surface sites are not invalidated by small changes in factors such as site size and location, raw material form, or the removal of small numbers of artefacts by collectors. This clearly requires that the system should not be based merely on the presence or absence of rare artefact types. Ideally, the chronological sequence should be defined in terms of quantitative and qualitative differences among a large number of variables.
7. **Control over the effects of raw material.** Effects on artefact form of changes to raw material properties must be defined. If variations owing to raw material are marked, controlling for this factor will probably involve either restricting assessments to a single rock type or, preferably, constructing separate indices of chronological change for each raw material type.
8. **Control over the effects of spatial variation.** The effects of environmental context, especially the influence of stone availability, must be identified. If environmental context proves to be an important factor in the production of assemblage variation then the dating system will need to account for environmental change through time and space.
9. **Full description of technology.** Finally, the chronological sequence must measure all phases of technology, not only the final stages represented by discarded retouched implements.

Many of these conditions were fulfilled by the relative dating sequence designed by Hiscock (1986; in press) for the Central Lowlands region of the Hunter River Valley in New South Wales. A study of unretouched mudstone flakes at Sandy Hollow 1 formed the basis of a quantified description of chronological change in stoneworking

technology. Three phases were recognised, each with its own system of knapping and a distinctive set of artefactual debris. Assemblages from open sites were assigned a relative date by comparison with the technological sequence identified at Sandy Hollow 1. Similarities between assemblages from open sites and one of the three phases at Sandy Hollow 1 was assumed to have occurred because the artefacts were made using a reduction system which was employed only during a particular period. Because the definition of phases at Sandy Hollow 1 was couched in terms of the minimum and maximum frequency of each time-sensitive attribute, the interpretative limits of the analysis was stated and it was possible to identify assemblages which could not be dated using this framework.

Flakes result from all stages of the stoneworking process and thereby reflect a greater range of technological practices than either cores or retouched flakes. By measuring unretouched flakes, Hiscock (1986:42) was able to argue that all phases of stoneworking were being examined. Furthermore, the measurement of numerous attributes on unretouched flakes produced a description of technology which was sensitive to chronological change and yet not biased by amateur collecting, and which could be applied to a large proportion of artefact scatters, including small knapping floors (Hiscock 1986:45). Thus, in the Hunter Valley a robust but sensitive measure of all aspects of technology was constructed. The chronological sequence was verified at a stratified and radiometrically dated site and the interpretative limits of the system were established.

Hiscock's (1986) attempt to set up a relative dating system in the Hunter Valley was less successful in dealing with the issues of contextual and raw material variation. Both Hiscock (in press) and Moore (1971:37, 41; 1981:415) argued that the stone material used to make artefacts was readily available throughout the region, and hence assemblage composition would not have altered as a response to changes in raw material availability. This assertion was not directly tested, however, and Hiscock's (in press) observation that the same prehistoric technology was applied at open sites throughout the region need not imply that this technology was temporally restricted. These difficulties in quantifying spatial variations in stoneworking were exacerbated by the analysis of only one stratified and dated site. Without comparable analyses of other caves it is not possible to demonstrate that the direction and timing of technological change at Sandy Hollow 1 was a regional rather than a local phenomenon. In particular, it is difficult to gauge which attributes are least sensitive to variations in context and raw material and would therefore be most useful in analyses at a regional level.

Even more problematic in the Hunter Valley study was the lack of control over the effects of changes in raw material on chronological trends in stoneworking. Hiscock (1986:45) applied a technological sequence identified on mudstone artefacts to open site assemblages made from silcrete, fossilized wood and porcellinite as well as mudstone. It has been shown that in the Hunter Valley, silcrete flakes break more frequently than do mudstone flakes, probably because each material produced flakes of different sizes and shapes (Hiscock 1985:85). To reduce the effects of these raw material differences, Hiscock (1986) employed primarily non-metrical attributes associated with core preparation and the location of blows in the relative dating assessment. Nevertheless, there was no demonstration that all technologies in the Hunter Valley were temporally restricted, irrespective of the type of

stone materials.

These inadequacies with the Hunter Valley relative dating system spring from the limited scope of that study, and could be overcome by the analysis of further dated and stratified sites containing chipped artefacts made on stone materials other than mudstone. Despite its shortcomings, the Hunter Valley study indicates how an archaeological project might proceed in constructing a relative dating system based on stone artefacts. The nine characteristics required of technological dating systems, together with their implementation in the Hunter Valley project, were used as a basis in assessing the potential of such research in the Moreton Region.

## THE MORETON REGION

The Moreton Region is located mid-way along the east coast of Australia (Figure 1). It is centred on Moreton Bay, and includes both the off-shore islands to the east and the coastally-draining river valleys to the west. The region is environmentally diverse, and it may be possible to address any particular archaeological question in only limited portions of the region.

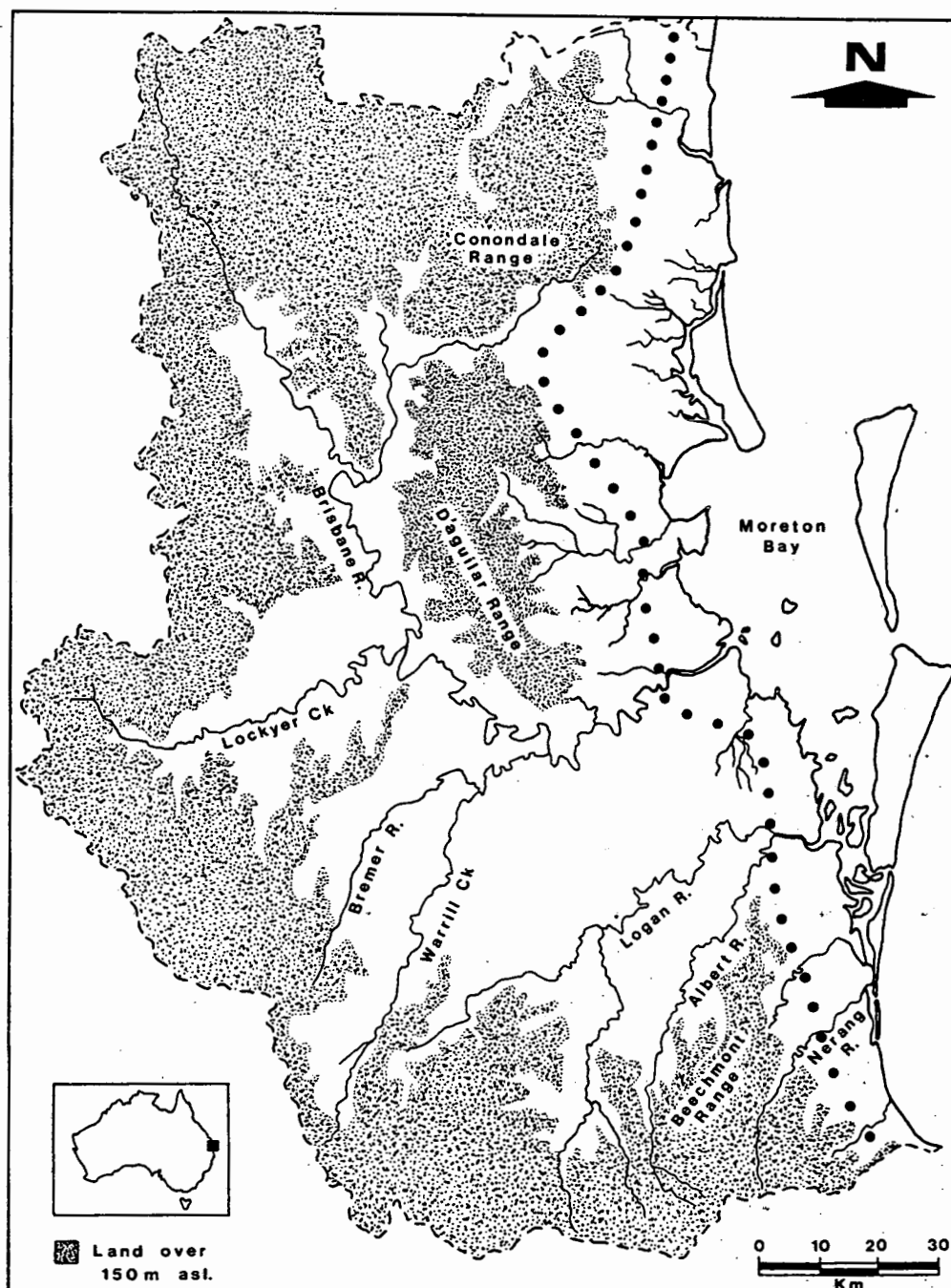
As the purpose of this paper is to assess the viability of dating open sites in the Moreton Region by reference to assemblage content it is necessary to construct a framework with which to make an assessment. The success of such investigations in any particular region will depend on the presence of appropriate environmental and cultural conditions in prehistoric times. Three conditions are considered here: environmental conditions, archaeological resources and cultural conditions.

## ENVIRONMENTAL CONDITIONS

The Moreton Region can be divided into two subregions for the purposes of environmental description (Lilley 1984). One subregion is the coastal zone, which encompasses Moreton Bay and the surrounding lowlands, including the offshore islands (Figure 1). This is largely synonymous with what is often termed the "Wallum" landscape, a low-lying coastal area containing beaches, dunes, streams, fringing forests, heaths and dune forests (Coaldrake 1961). Much of this coastal zone consists of Pleistocene and Holocene sands and silts deposited by fluvial or aeolian processes. Stone crops out only rarely, often in the form of gravels in mainland creeks or as rocky headlands which anchor the northern ends of sand islands. Away from these features there are few potential sources of stone for artefact manufacture.

The other subregion is the subcoastal zone, which stretches westward from the Conondale, D'Aguilar and Beechmont Ranges to encompass most of the Brisbane River catchment (Figure 1). This consists of a converging series of broad valleys, bounded by escarpments and steep ranges to the north, south and west. Along major water courses, and in limited upland areas, forests have formed on deep soils; but most of the subregion contains open eucalypt forest formed on shallow leached soils (Lilley 1984). The geological history of this zone is complex, but a noteworthy feature is the widespread occurrence of the Neranleigh-Fernvale Beds and geological formations which contain rocks derived from those beds. The Neranleigh-Fernvale Beds are conglomerate lenses of chert, quartzite, basalt and quartz pebbles and cobbles (Bryan and Jones

1962; Cranfield, Schwarzbock and Day 1976:17; O'Flynn, Holmes and Trezise 1983; Tucker 1961). Extensive erosion of the Neranleigh-Fernvale Beds, and subsequent deposition of the rock in low-lying areas, created many of the other sedimentary deposits found in the subcoastal zone.



**Figure 1. Map of the Moreton Region (dotted line indicates approximate boundary between coastal and subcoastal zones).**

These lithologically similar sediments crop out widely throughout the zone, and, as a consequence, flakeable stone is available in the frequent exposures of bedrock and as gravel lags in most creeks. Thus, for the purposes of this paper, it is reasonable to consider stone material suitable for the manufacture of chipped stone artefacts to have been both plentiful and ubiquitous in the subcoastal portions of the Moreton Region.

These environmental patterns have three implications. First, sourcing of stone materials to particular points in the landscape may be arduous or impossible. Most of the chipped artefacts, in both coastal and subcoastal zones, are made on material that ultimately derives from the Neranleigh-Fernvale Beds. Consequently, it will often be the case that all of the artefacts in an assemblage are made on rocks available throughout the region, and although the nearest outcrop was probably the source, this will be difficult to demonstrate (cf. Richardson 1979:27). Exceptions may occasionally occur where distinctive materials which crop out only in restricted portions of the region have been employed for artefact manufacture (eg. Bird *et al.* 1987).

The coastal/subcoastal dichotomy has a second implication for the archaeological study of stone artefacts. Although it may be difficult to source stone material, the rarity of flakeable rock in the coastal zone and its abundance in the subcoastal zone suggests that different systems of stone procurement and use might have existed in each zone. In coastal areas, where stone is scarce, it is likely that the nature of stoneworking may have depended on the proximity to stone sources, thereby creating extensive inter-site variation in technology and artefact assemblages. In the subcoastal zone, where stone was readily available, such inter-site variability may have been minimal. For this reason, the prospect of defining technological sequences, and employing them to date open sites, is far greater in the subcoastal zone than in the coastal zone.

The third implication of geological patterning in the Moreton Region is the effect of raw material properties on artefact manufacture. Assemblages are likely to contain a number of different lithological types, each with distinct fracture characteristics. The technological procedures applied during stoneworking, and the artefacts which were produced, often vary with the nature of the stone being worked. If this is the case in the Moreton Region, the size and form of artefacts may be strongly related to the type of rock on which they are made. Within the subcoastal zone, it could be expected that there might be greater variation within sites than between sites, due to different properties of rocks.

#### ARCHAEOLOGICAL RESOURCES

A technological sequence is most readily established by examining assemblages from well-dated, stone-rich, stratified sites containing evidence for occupation since at least the mid-Holocene. A review of the literature on archaeological sites in the Moreton Region suggests that the subcoastal zone is the most productive research area in these terms. Most excavations of stratified sites in the coastal zone have yielded little artefactual material. Table 1 shows that coastal sites have relatively low artefact densities, and consequently, excavations at those sites have usually produced less than 250 artefacts. In contrast, rockshelter sites in the subcoastal zone contain much higher artefact densities, and excavations in those sites have yielded large assemblages of artefacts.

Moreover, the subcoastal rockshelters regularly have deposits dating back more than 2,500 years. These sites provide not only large samples of artefacts, but also reveal sequential changes in assemblages over a substantial period of time. Five such rockshelters, spread throughout the subcoastal zone, have already been dated and described



(see Table-1). One further site has been excavated but not yet fully reported (cf. Morwood 1987:345), and numerous other caves are reported in the literature, but have not been excavated (eg. Gillieson 1981; Jensen 1909). By identifying the technological changes at a large number of rockshelters it should be possible to build a substantial database for the subcoastal zone. The viability of a relative dating system can then be assessed, and its development pursued.

**Table 1. Artefact densities in excavated sites in the Moreton Region**

Site	Number of artefacts	Estimated density (#/m <sup>3</sup> )	Maximum C14 date (years bp)	Reference
<b>COASTAL ZONE</b>				
Sandstone Point	227	378	2,100	Nolan (1987)
Brisbane Airport	232	211	4,000	Hall & Lilley (1987)
Wallen Wallen Ck.	311	124	20,500	Neal & Stock (1986)
St Helena Is.	3	24	2,700	Alfredson (1984)
Toulkerrie (Tr 4,6)	100	19	370	Hall (1984)
Hope Island	4	3	4,350	Walters <i>et al</i> (1987)
Miner Dint	4	1	520	Hall (1980)
<b>SUBCOASTAL ZONE</b>				
Bishop's Peak (L45 W1/4)	266	3432	2,620	Edmonds (1986)
Gatton	5826	2388	3,800	Morwood (1986)
Bushrangers Cave (H91)	179	955	5,540	Hiscock & Hall 1988
Maidenwell	623	767	4,300	Morwood (1986)
Platypus R'shelter	3602	368	4,540	Hall & Hiscock (1988)

The attractiveness of the subcoastal zone for implementing the research project outlined above, is enhanced by two further factors. First, previously completed field surveys have identified numerous surface scatters of stone artefacts which could be compared to the sequences established in shelters (eg. Gillieson 1981; Hall and Love 1985; Lilley 1982, 1985). Second, the geological patterns of the subcoastal zone would probably have minimized inter-site variation in prehistoric technology which might have resulted from the rationing of stone material. If this were the case, then comparisons could be made between most subcoastal sites without concern that assemblages were varying in response to non-temporal factors. In contrast, existing inferences about prehistoric stoneworking in the coastal zone suggest that the comparability of sites is minimal because technology varied spatially in response to the availability of replacement materials (Godwin 1983; McNiven 1985, in press; McNiven and Hiscock 1988; Richardson 1979).

One archaeological resource not reported from the subcoastal zone is open artefact scatters which have been dated by radiometric means. Dated open sites are relatively common in the coastal zone (Gillieson and Hall 1982; Hall and Lilley 1987; Morwood 1986, 1987; Walters *et al.* 1987), but none is known from subcoastal areas. This may simply reflect the greater amount of work done on the coast. Nevertheless, dated open sites play an important role in testing the general applicability of sequences defined in rockshelters, and future archaeological surveys in the subcoastal zone should be directed towards their identification.

## CULTURAL CONDITIONS

Even though the environmental and archaeological conditions appear favourable to such a study, the success of the project largely depends upon the nature of prehistoric human activities carried out in the region. For example, at the most basic level, a successful relative dating framework is only possible if there have been chronological changes in technology. Such changes are now well-documented. Temporal change in stone procurement, working and use is implied by observations of vertical shifts in the proportions of raw material types and implement forms within subcoastal rockshelters (Hall 1986; Morwood 1986, 1987). The conclusion that all bevelled pounders are late Holocene in age also implies technological change within the Moreton Region (Gillieson and Hall 1982; Kamminga 1981:35). Recent studies of artefacts from Bushranger's Cave and Platypus Rockshelter have conclusively demonstrated the existence of technological change within the subcoastal zone (Hall and Hiscock 1988; Hiscock and Hall 1988 - see this volume).

Even if stoneworking procedures did change over time however, the development of a precise dating framework depends upon the characteristics of prehistoric technology. In particular, the resolution and analytical power of such a framework is related to three factors.

1. **The spatial uniformity of technological change.** To use assemblage characteristics as indicators of antiquity, the sequences reconstructed from a number of archaeological sites must be the same, and this will only be the case if all prehistoric stoneworkers living in a region at one time employed the same manufacturing procedures. If the same technology was used throughout the subcoastal zone, then a single dating framework may be established for the region. If technologies were locally restricted, however, multiple dating sequences may be necessary. Within the Moreton Region people were divided into discrete socio-political entities at the time of European contact (Hall 1987; Morwood 1987). The antiquity of these groups, and their effect on stoneworking, have not been defined.

2. **The degree to which technological change is synchronous.** Even if artefactual sequences are the same throughout the region, it is only when the changes in each site occur simultaneously that a surface site may be precisely dated. In such circumstances an absolute date can be provided. When the same sequences are found, but the timing of the changes varies between sites, it will only be feasible to assign surface sites to phases, thereby providing a relative dating system.

3. **The frequency of technological change.** If stoneworking altered frequently through time, for whatever reason, the number of years identified by reference to a particular technology will be relatively small. Consequently, the dating framework would have relatively high

resolution. In many of the subcoastal rockshelters, backed blades are found throughout the deposit but other aspects of the technology changed (Hiscock and Hall, this volume). It may therefore be possible to identify brief changes in technology and provide a precise system of dating. This expectation will need to be verified by excavations specifically designed to recover rapid vertical changes in assemblage composition.

The degree to which these three aspects of prehistoric stoneworking produced archaeological patterns which can be interpreted in the manner proposed here must be determined empirically by reference to archaeological materials and cannot be predicted on the basis of environmental and ethnohistorical information. Some preliminary results suggest that technological change within the subcoastal zone may have been extremely synchronous, spatially uniform and frequent. These data are presented below. What is relevant here is the conclusion that prehistoric activities in the subcoastal zone may well have been structured in a way which facilitates the development of a dating system based on stoneworking technology.

#### FOCUS OF A TECHNOLOGICAL STUDY

Now that it is established that the subcoastal zone provides the best opportunity in the Moreton Region for inferring a prehistoric sequence of technological change, it is appropriate to discuss precisely how that can be accomplished. It was argued earlier that to develop a dating system, the technological study must describe all phases of reduction, control the effects of raw material properties, and produce quantified data about several aspects of stoneworking. While reconstruction of individual reduction sequences through conjoin analysis would provide detailed information about knapping, it is unlikely to be feasible at the known rockshelter sites within the subcoastal zone. The study of reduction sequences may be worthwhile in the future, to refine our understanding of the stoneworking procedures, but it is more profitable to begin the project by quantifying chronological changes in technology by looking at variations in the frequency of attributes. This attribute analysis measures the reduction system that was employed; it describes the activities which took place at various times but does not relate these activities to each other in a way which provides a picture of the dynamics of the manufacturing process (Hiscock 1988, in press).

The first step in describing prehistoric reduction systems is to select attributes. As the objective is to identify sensitive, reliable temporal markers, selection is biased towards attributes that change. As Frankel (1988) has recently implied, this orientation will emphasize chronological difference rather than provide a balanced picture of technological activities. But after all, the purpose of the study is to distinguish temporal change in technology, not to explain it.

Hiscock's (1986, in press) study of the Hunter Valley focussed upon the preparation of cores and retouched flakes and the way stoneworker's blows were applied to them. These aspects of stoneworking can also be examined in the Moreton Region. Core preparation is archaeologically observable in the pattern of decortication, the number and location of platforms, the treatment of platform surfaces, the maintenance of platform angles, the removal of platform overhang, and so on. Variation in the application of blows is observable in the relationship of

ringcracks to features on the core face and the platform, the size of flakes, the termination of flakes, and so on. These components of knapping also have an effect on the size and shape of the resulting artefacts, and can therefore be examined indirectly by measuring flake length, elongation, relative thickness, etc.

The requirement that the technological analysis should describe all phases of the reduction system can be fulfilled by examining cores, flakes, and retouched flakes (Hiscock 1988:34). The frequency with which a knapper used a technique is reflected by the frequency of various types of flakes, because the successful application of a blow results in the removal of a single flake. Flakes result from all phases of knapping, and thereby record the complete range of technological practices. Cores and retouched flakes generally reveal the frequency with which a technique is employed in the final stages of reduction. An analysis of unretouched flakes, supported by reference to cores and retouched flakes when necessary, should therefore yield information about the total reduction system represented in an assemblage.

Control over the effects of raw material properties can be achieved in two ways. First, by calculating the frequency of attributes on artefacts of only one type of stone, chronological change in assemblages caused by differences in the properties of raw material types can be excluded. Secondly, within any one geological type, fracture properties can be more fully described by reference to the visible structure of the rock. Artefacts made from structurally different stone can then be analysed separately, and change in artefact form due to the raw material excluded. For example, if the termination of chert flakes changes markedly through time, it is possible to determine if this was caused by an alteration in the homogeneity of the rock, such as increased cracks or voids. Assemblages from stratified sites are usually recovered by excavation, whereas records of surface scatters are often compiled from the artefacts which can be seen and surface collected. As a result, excavated assemblages often contain the same size classes as surface collections, but additionally contain smaller artefacts. As the purpose of the technological approach discussed here is to compare assemblages from both types of sites it is necessary to standardize the size of artefacts which are analysed. In many of the excavation reports concerning the Moreton Region, only artefacts larger than 5 mm have been analysed in detail (eg. Hall 1986; Hall and Lilley 1987). This size appears to be the minimum that will be recovered during surface collection (Hiscock 1982), so dealing only with larger artefacts should produce comparable samples, irrespective of whether or not the site was excavated. In the technological analyses already undertaken on subcoastal assemblages only artefacts >5 mm in size were measured (see Hall and Hiscock 1988; Hiscock and Hall 1988).

#### **PRELIMINARY INDICATIONS OF A RELATIVE DATING FRAMEWORK**

The prospects for developing a dating system have been assessed. What remains to be discussed is the progress which has been made thus far. A comprehensive technological analysis, along the lines suggested above, has been completed at only two sites: Platypus Rockshelter and Bushranger's Cave (Hall and Hiscock 1988; Hiscock and Hall 1988). Platypus Rockshelter (KB:A70) has yielded a large stone artefact assemblage, but the geomorphic history of the site is such that it may not represent an unbroken cultural sequence. The deposit and dating of Bushranger's Cave (LA:A11) is more straightforward but only a small

sample of artefacts has been excavated. Despite these qualifications, both sites indicate similar temporal changes in the reduction systems. Figure 2 plots the percentage of flakes with faceted platforms against the percentage of flakes with overhang removal for a number of levels at each of these two sites. Flakes with shattered platforms were excluded from the calculations. Assemblages deposited during the last 1500 years have low frequencies of both traits. Between 1500 and 2700 years BP, assemblages have somewhat higher amounts of overhang removal and much higher frequencies of faceting. Prior to 2700 years BP flakes had little faceting but high frequencies of overhang removal. This pattern occurs at both sites and on both chert and quartzite flakes. The boundaries of these three temporal units are marked by broken lines on Figure 2, and it is noteworthy that there is no overlap between the units. This is a remarkably clear separation, considering that only two attributes are employed, and suggests that a multivariate approach to the task may meet with success.

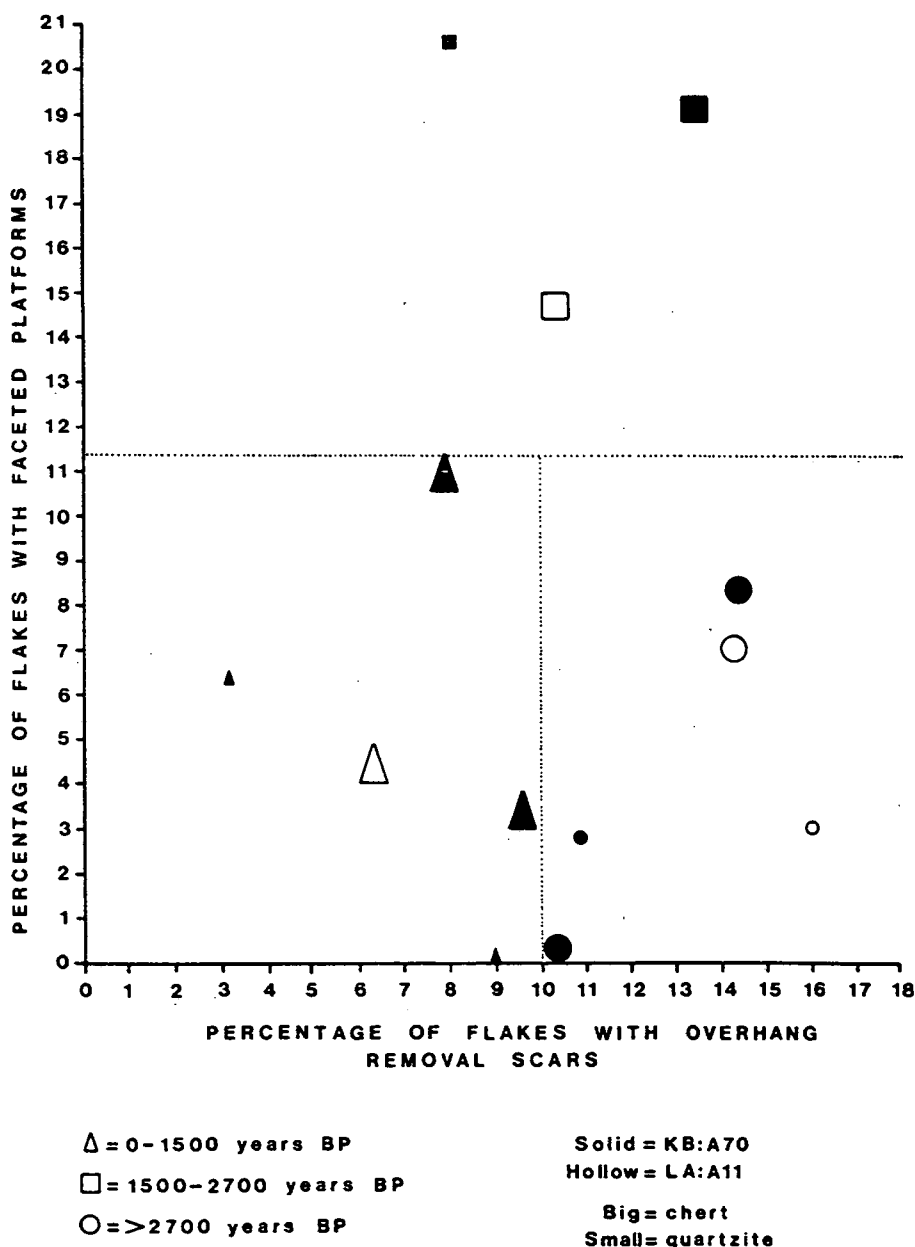


Figure 2. Plot of overhang removal against platform faceting for various levels within two rockshelters.

It does not necessarily follow, however, that only a single reduction system operated in each temporal unit. At both of these sites the knapping procedures used to create flakes on igneous materials (basalt and quartz) differed from those employed to reduce sedimentary rocks (chert, mudstone, quartzite and silcrete). Thus, several dating frameworks are probably needed to accommodate the variety of raw materials. Furthermore, at Platypus Rockshelter, several knapping techniques were identified on chert artefacts. For example, both bipolar and non-bipolar cores were found, possibly suggesting that at any point in time prehistoric knappers employed a number of reduction systems as circumstances warranted. This diversity of stoneworking may make the development of a dating framework difficult. Alternatively, it may be that while in each time period several reduction systems were used, at any one time the systems operated on a single theme, such as haphazard reduction of material to small pieces or careful reduction in a regular manner. In this case, an elaborately constructed technological sequence can act as a dating framework. Consequently, although the limited evidence currently available indicates that dating surface sites by reference to assemblage composition may require a sophisticated framework, it also suggests that such an edifice can be built.

## CONCLUSION

This paper has argued that two broad systems of stone procurement and use are likely to have existed in the Moreton Region. These systems are identified on the basis of geological patterns and largely correspond to the coastal and subcoastal zones. On the basis of known archaeological and environmental characteristics it was concluded that the subcoastal zone offered the greatest opportunities for establishing a technological sequence and using it to date surface sites. One approach to achieving that end has been outlined, and this paper, in conjunction with others in this volume, highlights the current findings. Even within the subcoastal zone there are difficulties which must be overcome, such as the absence of dated open sites and the effects of raw material properties, but the analytical approach gives every indication of providing a robust, sensitive and widely applicable dating framework. Technological change within the coastal zone may also be studied when there are sufficient assemblages from dated sites to reconstruct the spatial variation of a contemporary reduction system.

Developing a dating system, relative or absolute, based upon assemblage composition, will not be accomplished rapidly. And yet, the benefits of such a framework are significant, and justify the energy expenditure. Working from the small number of radiometrically dated sites, several researchers have inferred demographic change in the Moreton Region (eg. Hall 1982, 1987; Morwood 1986, 1987). Unless the much greater numbers of undated surface sites are incorporated into the temporal schemes, however, it will be impossible to differentiate demographic change from settlement restructuring. For example, Morwood (1987:343) hypothesised that increases in population and social complexity will be archaeologically observable in six characteristics of sites dated by radiocarbon techniques:

1. Increases in the rate of site formation.
2. Increases in the number of sites associated with symbolic activities.
3. Increases in occupation intensity at sites.
4. Changes in site content.

5. More intensive economic strategies and the use of new resource types and areas.
6. Increased restrictions on the access to localities and knowledge.

The first three criteria relate directly to the rate at which cultural material was discarded at any particular site, while the last three involve changes in activity location and site function. Alterations to economic and settlement patterns could produce these archaeological patterns, and there is no reason to prefer increases in population and social complexity as the explanation unless it can be shown that settlement strategies did not change. To do this, it is necessary to study more than the 25 dated sites available to Morwood (1987:343).

One difficulty with the use of these six criteria is the implicit assumption that radiometrically dated sites are representative of undated sites. Within the subcoastal zone, all dated sites are large rockshelters which appeared to contain deep deposits, whereas in the coastal zone, most of the dated sites are shell middens. In both subregions there are many sites, particularly surface scatters of artefacts, which have not been dated, and cannot be, using conventional radiocarbon procedures. Hall (1987:18) notes that over 1,000 sites have been recorded in the Moreton Region, a figure which highlights the inadequacy of 25 dated sites (2.5%) as a sample. Only a proportionately small shift in preferred activity location would be needed to create marked increases or decreases in the frequency of discard within subcoastal rockshelters. Changes in assemblage composition would probably accompany such shifts in activity location, without necessarily implying an alteration to the overall pattern of activities. This mechanism will be most convincingly tested only by developing a way to date surface sites.

These difficulties are compounded by the recent identification of coastal sites dating from the late Pleistocene and middle Holocene (Hall and Lilley 1987; Neal and Stock 1986; Walters *et al.* 1987) suggesting that the apparent recent increase in middens may, at least in part, be due to the destruction of earlier middens. In this connection, Hall and Lilley (1987) argue for an earlier Holocene shoreline somewhat landward of the present coast where the post-2000 BP middens have been found. The elimination of earlier middens would leave an archaeological record consisting of recent middens containing datable material and undated artefact scatters from a range of time periods. Again, this would only be apparent if we had some means of dating open artefact scatters.

Discussions of mid-late Holocene change in Australia are largely involved with the direction and rate at which cultural material was discarded, and consequently, archaeological investigations depend heavily on issues of dating (eg. Hiscock 1986; Lourandos 1984; Ross 1985). Thus far, interpretation of the archaeological record has been limited because of the inability to integrate data from numerous open surface sites into the chronological scenarios derived from excavations of stratified sites (cf. Hiscock 1986:46-48). This paper has discussed one approach by which that integration may be achieved, and concluded that the development of a dating system for artefact assemblages in the Moreton Region is a realistic objective.

## ACKNOWLEDGMENTS

I thank Jay Hall, Ian Lilley, Ian "McMidden" and Norma Richardson for their comments on the ideas contained within this paper. This research was partly supported by a grant from the Australian Research Council (Grant No. A58715922 - The Moreton Region Archaeological Project - Stage II).

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