THE EFFECTS OF CONTACT WITH FARMERS ON HUNTER-GATHERERS' LITHIC ASSEMBLAGES:

USE-WEAR ANALYSIS OF STONE TOOLS FROM HOLKRANS, NORTH WEST PROVINCE, SOUTH AFRICA

P.B. MacLaren Law-de-Lauriston

A Thesis submitted to the Faculty of Science, University of the Witwatersrand, in fulfilment of the requirements for the degree of Doctor of Philosophy

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DECLARATION

I declare that this Thesis is my own, unaided work. It is being submitted for the Degree of Doctor of Philosophy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

Law de Lauriston

P.B. MacLaren Law de Lauriston

This 31st day of October, 2014 in Johannesburg

ABSTRACT

Early contact between Later Stone Age hunter-gatherers at Holkrans rock shelter (BFK 1), in the Vredefort Dome, North West Province, South Africa, and food producers occurred within the last 500 years. Evidence presented in this study suggests that a more probable time frame was sometime between the early 16th and 17th centuries AD.

Holkrans chronology comprises two phases, pre-ceramic and ceramic, with three superimposed components: a lower, pre-contact/ pre-ceramic period; a middle, early contact/ ceramic period; and a terminal period. Use-wear analysis of lithics from the lower and middle components provided the medium through which changes or continuity in cultural and behavioural practices between the pre-contact/ pre-ceramic and early-contact/ ceramic periods were interpreted, with a view to shedding light on the nature and impact of contact on the shelter's hunter-gatherers with food producers.

The results of analysis, supported by additional archaeological evidence, suggest that the Holkrans hunter-gatherers experienced early contact and subsequent interaction with food producers as an 'extended pioneer phase'. Over time, as food producers subdued land and began to permanently settle in the area, the Holkrans hunter-gatherers appear to have maintained this extended pioneer phase; that is, a primarily hunter-gatherer way of life up to the terminal occupation of the shelter, probably in the early 19th century.

For my Parents... my true heroes.

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CHAPTER 1

Introduction and thesis structure

Part I

1.1 The introductory chapter

The purpose of this research is to determine the nature and impact of early contact between Later Stone Age (LSA) indigenous hunter-gatherers and outsider food producers at Holkrans rock shelter, North West Province, South Africa, which evidence suggests occurred within the last 500 years (see section 1.2 and Ch.'s 4, 8 and 9). There is no clear archaeological evidence to support Holkrans hunter-gatherers assimilating to a food producing way of life. I therefore argue that whatever the exposure to and degree of interaction the indigenes had with food producers, there is evidence to suggest continuity of a primarily traditional hunter-gatherer way of life up to the terminal occupation of the shelter in the early 19th century. The data presented and interpretations and conclusions drawn from analysis focus upon the type and extent of interaction that Holkrans' hunter-gatherers had with food producers.

Stone tools provide an excellent medium for investigating group identities and behaviours, as they comprise the use of long-lasting materials, may reveal the mental templates of the manufacturers, and offer clues as to tool movement and placement in space and time. My interest lies in understanding what use-wear analysis of the most complete lithic assemblage from Holkrans can tell us about cultural and behavioural changes or continuities of the rock shelter inhabitants, and in understanding the nature and impact of their contact with food producers.

Section 1.2 briefly introduces Holkrans (further explained in Chapter 4) and its relevance for this study. Section 1.3 introduces and discusses

Frontier Theory and its applications in defining and analysing contact between indigenous hunter-gatherers and food producers. Section 1.4 presents different scholars’ views on the nature of contact and the material record.

Part II: section 1.5 provides outlines and discussions of contact models and settlement patterns and how each generally relates to changes or continuities in lithic assemblages. Section 1.6 defines and provides background on the study problem, outlines hypotheses related to the study problem research and how models of contact and lithic assemblages may be applied to the Holkrans lithic assemblage analysed for this thesis, and explains the research design. Section 1.7 explains the rationale and significance of the study.

Part III comprises section 1.8, which discusses potential theoretical biases when considering the study. Section 1.9 outlines the structure of the remainder of the thesis.

1.2 Introduction to Holkrans rock shelter

Holkrans remains to date the only excavated LSA rock shelter in the Vredefort Dome area. (See Chapter 4.) The shelter is located in one of several different biomes in the dome area, situated in a locale that contains abundant raw materials, a river with aquatic food sources, and a variety of flora and fauna. The site is relevant in analysing contact between hunter-gatherers and food producers for several reasons: a) there is a record of both pre-contact and post-contact dates; b) the excavations and depth of material deposits have yielded ample material for serious lithic analysis, in order to determine how interaction with food producers may have impacted the behaviour of the hunter-gatherers as reflected in their lithic assemblages, and; c) there are ruins (e.g. remnants of Iron Age (IA) stone wall features) in the shelter vicinity, which indicate that hunter-gatherers and food producers were in close proximity to each other. The questions to be answered are: to what extent did they interact? And what was the nature of this interaction? Understanding what contact means, in terms of interaction (section 1.1) and the various forms it can take and impacts it can have is necessary for answering these questions.

1.3 Defining and theorising contact

The history of the study of contact is a more recent research focus in anthropology. Changes in material cultural and spatial organisation, and what these mean in terms of transforming the lifeways of participants on both sides of the contact scenario, remain debated among scholars. Despite the interest in acculturation studies in the 1930's, contact did not become a topic of serious consideration until the 1980's, focusing primarily on Native Americans and colonising Europeans. Interest in the study of contact grew in the 1990's and the first decade of the 21st century, including studies of culture contact and colonialism in Latin America, Mesopotamia, western Africa and southern Africa (e.g. Alexander 1998; Cusick 1998; Schortman and Urban 1998; Dominguez 2002; Lyons and Papadopoulos 2002; Stein 2002; Gosden 2004), up to the present where contact is being researched on a more global scale (Silliman 2005:55-74).

There has been some criticism in use of the term 'contact' when referring to the implications it has on the culture(s) of two or more groups encountering and interacting with one another (e.g. Silliman 2005). I use the term (*sensu* Thomas 1991) as a heuristic device for analysing encounters of different groups that resulted in cultural interactions, or in some cases, the rejection of interaction after an initial encounter. This definition is important, as contact is often redacted to a simplistic pre- and post-colonising imagery. However, encounters and subsequent interactions are not necessarily defined by violence or power struggles. More recent studies of contact situations reject the coloniser/ colonised dichotomy that emphasise the ideas of power of one group over another and the interruption of indigenous peoples from links to their past (Silliman 2005; Voss 2005: 461; Wilcox 2009; Panich 2013). Pauketat (2001), Stein (2005), Alt (2006), and Jordan (2009) explain that, even in significantly imbalanced encounters, dominant groups do not bring about all-encompassing change. Groups filter objects and ideas through the lens of their own perspectives. Archaeologists have often presumed that change or continuity from contact results in recognisable material remains that can be attributed to the culture that produced the materials. This conclusion presents a problem when inferring that single types of material items or cultural practices and behaviours represent a single group or identity of people (Loren 2001; Silliman 2009).

This highlights a problem for archaeologists when interpreting cultures in contact situations. Material items require some form of classification in order to make sense of them, and data must be placed into meaningful categories (e.g. to identify space or time variability). Silliman (2009: 213) cautions that these pre-defined classifications cause problematic expectations of what identities should look like archaeologically. He suggests that this approach does not permit consideration of the differential treatment of objects by diverse groups.

In order to avoid the problems associated with *a priori* classification, more recent work has stressed cultural behaviours for the evaluation of social identity (Lightfoot *et al.* 1998; Dobres 2000; Pauketat 2001; Hegmon and Kulow 2005). Wills (2009: 296) explains that the focus should be placed on the way people made things and used things, which will, in the material record, reflect choices that are learned in discrete social and cultural settings. To understand the complexity of contact situations, it is therefore through a multi-strand approach, examining the material objects, spaces and the daily cultural and behavioural practices of people that we will better understand the structure of group identity and the forces that result in change or continuity of their lifeways.

1.3.1 Frontier theory

The seminal theory of how contact changed people and forged new societies can be attributed to Frederick Jackson Turner, who argued in his 1893 Frontier Theory address to the American Historical Association that it was the western expansion in the United States that contributed to the success of the nation and shaped its people. He defined the frontier as, “the outer edge of the wave-- the meeting point between savagery and civilization” (Turner 1893: 1). As people moved further west in the United States, they abandoned colonial antecedents and forged a new, American identity (*ibid.*).

Turner’s thesis has been criticised for overlooking mitigating influences (e.g. race, class distinction, gender) (e.g. Pierson 1942; Riley 1993); American western expansion as a finite process (e.g. Limerick 1987); the catalysts for a moving frontier (e.g. Wade 1959); considering the American situation as unique (e.g. Hacker 1933); and the cursory treatment that Turner gives contact and interaction with Native Americans and how this affected the shaping of the American pioneer (e.g. White 1999), although White (1999: 47-53) admits that Turner was a key architect in the way American frontier expansion is understood. Turner’s ideas have, nevertheless, been acknowledged as having a significant impact on how scholars, authors, filmmakers, and educators look at territorial expansion and the creation of new social groups and ontologies (e.g. Micheaux 1913, 1917; Mikesell 1960; Billington 1967; Guelke 1976; Alexander 1977; Cronon 1987; Ridge 1991; Boles 1993; Slatta 2001; Moos 2002).

Turner’s views of a frontier, and how the interaction in a frontier or borderland zone may change social and cultural behaviours of peoples, or even forge new identities of groups due to contact and interaction with other groups, have been debated among scholars from several disciplines since Turner’s 1893 address. The debate has yielded various theories and definitions to explain a frontier, and what the various forms of contact and interaction may look like in a frontier zone.

Lightfoot and Martinez (1995: 471-473) define places of contact as interaction zones where encounters take place between peoples from diverse homelands which result in the creation of “socially charged places where innovative cultural constructs are created and transformed.” Naum (2010: 101-102) explains a frontier as “a zone of separation and junction helping to define the identities of places and people on either side of the imaginary or real border through the negotiations that take place in the frontier”, and defines contact as the interaction between two or more culturally different groups in an in-between place (*ibid.*: 103-104). And Green and Perlman (1985: 45-54) define contact as interactions between different groups, and the social, political economic factors that guide these interactions.

Problems, however, arrive when attempting to provide a simplified explanation of a complex situation. Naum (2010: 104) argues that contact zones and the interactions that take place within these zones are fluid and mobile. Sahlins (1989: 93) writes that most traditional views of contact are a dichotomy of indigenous versus colonising peoples, an “us” versus “them” mentality, which leads to a construct of opposition – dominance and resistance. This dichotomy implies relatively homogeneous groups encountering and interacting with each other across clearly defined boundaries, such as seen in ethnographic maps of indigenous areas and colonial territories. The reality, however, is likely more complex and, as Naum stated, contact zones should be seen as moving and fluid. Finding sharply defined contact zones and spheres of interaction is probably rare in archaeology.

Ericson and Meighan (1984: 143-152), when analysing contact zones and attempting to define tribal boundaries in California, employ the term “cultural noise” to describe the edges of different societies interacting with each other. The authors describe “haziness in and along border areas… the hybridization of material items”, and the “creolization” of material objects in culture contact situations. One must consider, then, that each frontier situation may be unique, and the interactions that occur between groups involved in contact may vary according to place and social, political and cultural systems.

1.4 The effects of contact

Sahlins (1989: 106) writes that contact:

> “led to confrontations with different cultural and social traditions. These confrontations caused responses and actions involving both people and material culture. However, the character of these responses might have differed considerably. It could have spanned from confusion, misunderstanding and tensions to elaboration of common cultural ground—from growing conservatism, prejudice or even racism to creation of unique practices and identities.”

A commonly accepted view of contact, particularly in terms of a group’s expansion into new territories, is that group identity and the delineation of boundaries intensify when people are competing for space, resources and control (Barth 1969; Wobst 1977; Hodder 1982; McGuire 1982; Sampson 1988; Athens 1992). Yet there are various reasons why some people choose to adopt, partially borrow or create new cultural constructs. For example, indigenous people may consider as advantageous the abandonment of their traditional lifeways for systems that provide access to prestige goods and new opportunities. People inter-marrying between groups may consider the forging of new identities as important for their children. Lower-class ethnic group members may see advantages, such as access to food and support groups, in establishing close relationships with outsiders (Deagan 1990; Mouer 1993; Crowell 1994). This view is further supported by McGuire (1982: 164) who notes that adopting the symbols, behaviours and ideologies of the higher ranking group is often necessary for lower-ranking group members to attain higher status.

Martinez (1994: 41-46), offers a different perspective, and explains that there also various reasons why people in contact situations prefer to remain “traditionalists”. For example, some indigenous groups see the adoption of new ontologies as undermining their own values and prestige systems. There would be little advantage, then, in forging alliances with outsiders. “Cultural transformation of material items do not occur simply because ideas, goods and mates are exchanged between people” (*ibid.)*. People, particularly in multi-ethnic contact situations, are regularly exposed to new or different materials and ideologies, but may choose to adhere to their traditional way of life.

Members of a community who break from tradition in order to attain higher status or the advantages of close ties with outsiders may create an atmosphere of what Haselgrove (1987) and Headeager (1987) describe as factional competition and segmental alliances. Brumfiel (1994: 12) notes that this is particularly true for contact situations in which members of different ethnic groups are involved. The interactions between the different groups defy and cut across cultural and geographical boundaries and in some way ultimately change the cultural and behavioural landscape. It is important to note that the exchange of culture and behaviours from contact and interaction may come from either side or both sides of the perceived boundary, as new cultural constructs are created. Sahlins (1989:93) contends that, whatever combination of factors that brings different peoples together or keeps them apart (e.g., social, political, economic), the results should be visible in the archaeological record; that intercultural relationships are "broadcast as the results of day-to-day activities".

Moore (1985: 94) describes food producer / hunter-gatherer frontiers as "a cultural mosaic of interspersed communities with varying subsistence and settlement requirements." He explains that food producers moving into hunter-gatherer territory, exploiting and competing for resources, and bringing in domestic animals that disrupt the ecological balance, necessarily affect hunter-gatherer lifeways (e.g., interrupting mobility patterns). Moore used computer modelling to simulate the incursion of sedentary food-producers into hunter-gatherer territories, and found that "even a small number of interspersed sedentary settlements disrupt the seasonal settlement shifts of hunter-gatherer groups" (*ibid.*: 103). Thorp (1996: 58) disagrees, stating that long-term contact situations in Africa and Asia demonstrate that food producers do not necessarily displace hunter-gatherers. The argument may be one of semantics: displacement versus disruption of settlement shifts.

Moore, nevertheless, explains various strategies that hunter-gatherers might choose to compensate for impeded mobility. One option is developing client/ patron relationships with food producers (Moore 1985: 108). Ellenberger and Macgregor (1912: 56) write about historical sources documenting herding and hunting services performed by hunter-gatherers for food producers; and Lee (1979: 79-80) and Cashdan (1987: 127) discuss ethnographic descriptions of hunter-gatherers receiving milk in return for herding services. Wiessner (1982) and Barnard (1992: 141) explain another possible solution: *hxaro*, gift exchange for access to water and floral resources. Moore (1985: 106) writes that consumables (e.g. meat) were exchanged among hunter-gatherers as a means of reducing social tensions. The underlying point that Moore

(1985: 108) stresses is that in this “mosaic frontier” setting, mediation may become necessary as a substitute for mobility.

1.4.1 Contact and changes in the material record

Wiessner (1984: 113) writes that artefacts are emblems that send messages, distinguish group identities and delineate boundaries, and that these aspects of artefacts should be visible in the archaeological record. Cohen (1987: 96) elaborates further on material culture and changes by explaining that “seemingly innocuous activities” (e.g. how people define, build and use space; the kinds of foods they prepare and eat; the kinds of goods they exchange; and the value they place on material items) provide significant information about group identities and social relations among indigenous peoples and arriving outsiders. The retention or change of material items, demonstrating retention or change in cultural traits, act as symbols and send messages in contact situations.

However, Spence *et al.* (1984: 117) and Cordell & Yannie (1991: 24) caution against placing too much credence in material items as symbols of group identity, particularly in a frontier contact zone, where material items may be widely shared among groups. Spence *et al.* (1984: 101) note that in a dynamic, fluid environment, such as a contact zone, artefacts that are meant to serve as symbols of identity may be “manipulated, allowing an individual to renegotiate group identity and allegiance as new opportunities become available.” Spence also notes that archaeologists should not expect to find neat, observable contact boundaries and correlating artefacts, given that artefacts have life histories of their own. This fluidity of behaviours and material items is what Ericson and Meighan (1984) (section 1.3) describe as cultural noise or the haziness across perceived boundaries in contact and interaction zones.

Ericson and Meighan (1984), Findlow and Bolognese (1984), and Hughes (1986) assert the importance of studying the spatial analysis of materials that have been moved and exchanged across boundaries and cultural groups. Their assumption is that one should see patterns of different material items diminishing, varying according to circumstances and other relevant factors, as they are moved across boundaries and between discrete social groups. Conversely, a logical extension of their assumption would be that one may also see patterns of increase in certain materials items that are moved across boundaries and between discrete social groups. Recognising patterns of fall-off or increase in material items, specifically lithic types, will be important in the diachronic analysis of Holkrans rock shelter, and in drawing conclusions as to the nature and impact of contact between the rock shelter's hunter-gatherers and outsider food producers.

1.4.2 Frontier theory and contact in South Africa

For general principles relating to frontiers and contact in Africa, John Alexander (1977, 1984), complemented by Kopytoff's work (1987), adapted Turner's 1893 Frontier Thesis to postulate what Alexander described as a continual cycle of spread, settlement, break-off, and further spread of peoples and material culture. Alexander and Kopytoff suggest that the cumulative results of small-scale movements of people, facing different choices in fluid contact zone situations, are better representations of the evolution of various cultural groups, rather than large-scale diffusion of peoples and material cultures.

Anquandah and Haddock (1982), Sinclair *et al.* (1993), Pwiti (1996), and Pikirayi (2001), maintain that every significant event in cultural and behavioural evolution of African peoples (e.g. the stone enclosures of Zimbabwe, the cities of Ghana, the Kingdom of the Kongo, etc.) has wrongly been credited to the influence of an elite iron age group that swept across vast regions of land to impose their authority and culture.

In southern Africa, Great Zimbabwe was the focus of most contact archaeology for the greater part of the twentieth century (e.g. Hall and Neal 1902; Caton-Thompson 1931; Robinson *et al.* 1961; Huffman 1972, 1977; Garlake 1973). Attempts were being made to understand the diachronic development and spatial extent of the area with relation to cultural settings. Sinclair *et al.* (1993) believe that there must have been extensive settlement hierarchies and other urban centres on the Zimbabwe plateau and surrounding areas, such as Mozambique, to support Great Zimbabwe. Today, developments in areas of Limpopo (e.g. Mapungubwe) are known to pre-date Great Zimbabwe. Regions in and surrounding Zimbabwe and the Limpopo basin are understood to have been engaged in significant internal and external trade networks (Sinclair 1987; Huffman 1989).

Alexander (1984) focuses on southern African frontiers associated with expansion by agro-pastoralists. These include the spread of a caprid complex, through (debated) processes, into Namibia and the Western Cape *ca.* 2000 BP (Reid *et al.* 1998; Sadr 1998, 2003; Smith 2005, 2006), and a later expansion southward of a combined caprid-bovid and sorghum/ millet/ pulses complex across the Zimbabwean Plateau and southern African highveld and nearby eastern coastal plains (Maggs 1984; Bousman 1998; Pwiti 1996; Pikirayi 2001). A northern expansion of wheat, maize and bovids and caprids, associated with European farmers, occurred even later, after AD 1500 (Guelke 1976; Penn 1987). Additional, less noticeable frontiers may have expanded across parts of the sub-Saharan regions *c.* 1500 BP, such as a possible mixed farming complex that placed more emphasis on bovids (Voigt 1987). Faunal and botanical data from archaeological sites across Africa, and evidence for the rates of spread of plant and animal domesticates also signal multiple frontiers spread across the continent (van der Veen 1999; Blench and MacDonald 2002; Marshall and Hildebrand 2002).

Biesele *et al.* (1989: 122) state: “It is apparent that there are real contradictions between the organisation and ideology of farming and that of foraging.” Smith (1990a: 67) writes that “different sets of social relations” create obstacles, impeding hunter-gatherer groups from adopting a herding-farming lifestyle. Hall (1987a) and Hindess and Hirst (1975) provide examples of obstacles for hunter-gatherers in adopting farming, such as, “complex division of labour or accumulation of the product on a substantial scale by individuals or specific segments of the community” (Hall 1987a: 1-17).

Thomas (1959: 183) explains that at the most fundamental level, the differences between farmer and hunter-gatherer economies will change the “relations of production”; i.e., how subsistence is perceived and managed by the two different social groups. Among the differences, Thomas lists location as most distinguishing. Food producers’ activities revolve around a single locale, which may result in a variety of coetaneous variables (e.g. accumulation of possessions, permanent structures, and crops that must be tended to from planting to harvesting). During favourable seasons, surplus may accumulate and can be used in exchange relations. This stands in contrast to hunter-gatherer societies who may engage in cooperation and exchange, but do not create surplus and “do their best not to be in any way different from their neighbours” (*ibid.*).

Hitchcock (1978: 296) explains the pressure among hunter-gatherers to remain egalitarian, or to be no different than their neighbours, as part of a hunter-gatherer primary directive of reciprocity. “Sharing arrangements among families and groups are such that if a person receives a beast, he comes under intense social pressure to share it, and that usually means killing it and giving away the meat.”

Woodburn (1988: 31-64) explains that hunter-gatherers who might consider as advantageous the sharing and delayed consumption of food would be more inclined to adopt farming subsistence practices; but that hunter-gatherers would continue their own subsistence practices unless "relations of production shifted to include a greater than purely economic role of commodities (that is in exchange, inheritance and symbolic value)."

If, indeed, the different social and cultural ideologies and practices of hunter-gatherers and farmers are obstacles for hunter-gatherers to transition to a farming lifestyle, what, then would contact and interaction between the two groups have looked like? Smith (1990a: 59) writes:

> "Early colonists were black Africans introducing new economic variables to a Southern Africa already occupied by Later Stone Age hunter/ foragers… the social relationships between black African agro-pastoralists and the indigenous hunters… ultimately resulted in the hunters adopting a new economy. "

Smith explains (1990a: 57) that, due to differences in modes of production (e.g., foraging versus food production), it would have been difficult for hunter-gatherers to change subsistence practices and cultural values. The model that Smith establishes provides for a dominant farmer society marginalising and subordinating hunter-gatherers, whose "contribution is unskilled labour which means they have little to compete with." Wilson (1969: 63) and Smith (1986: 40) believe that, in Southern Africa, this marginalisation and subordination often took the form of client-patron relationships, with hunter-gatherers accepting their lower status and working for farmers as needed by farmers. Smith (1990a: 57) writes: "There was probably little in the way of formal ties between the two groups, such as marriage alliances. Payment for services rendered would be in the form of food, for example, milk or a sheep, but not breeding stock."

He argues that these conditions would have been seen at least as far back as 2000 years ago when black African farmers encountered indigenous hunter-gatherers south of the Zambesi. Sanford (1980: 30) suggests that, while hunter-gatherers do not wish to be subjugated and assimilated, their lack of material assets and education leave them no way to compete successfully with food producers.

Contact and interaction between food producers and indigenous hunter-gatherers in Smith's model, then, suggests that even if hunter-gatherers preferred to become farmers, their social and cultural restrictions would have prevented successful transition. He allows for the possibility of transition when an established hierarchical system was in place. However, his model suggests that the transition would mean a farmer-dominant patron-client relationship for hunter-gatherers. This explanation of contact and subsequent interaction seems reductionist and simplistic, when reality was probably far more complex.

Dennell's (1985) dendrogram (Fig.1.1) of a hunter-gatherer/ food producer contact zone provides more potential scenarios and nuances of specific types of contact, and correlates with Moore's (1985) explanation of a mosaic frontier (section 1.4), which allows a number of variations for the possible outcomes and subsequent interactions in frontier situations. Dennell goes a step further in proposing details of the variations between the initial stage of contact (a mobile frontier), the ultimate development of subsequent interaction (a static frontier), and by adding a third category (impervious) which, in all permutations, leads to drastic change to or the end of the hunter-gatherer lifeway.

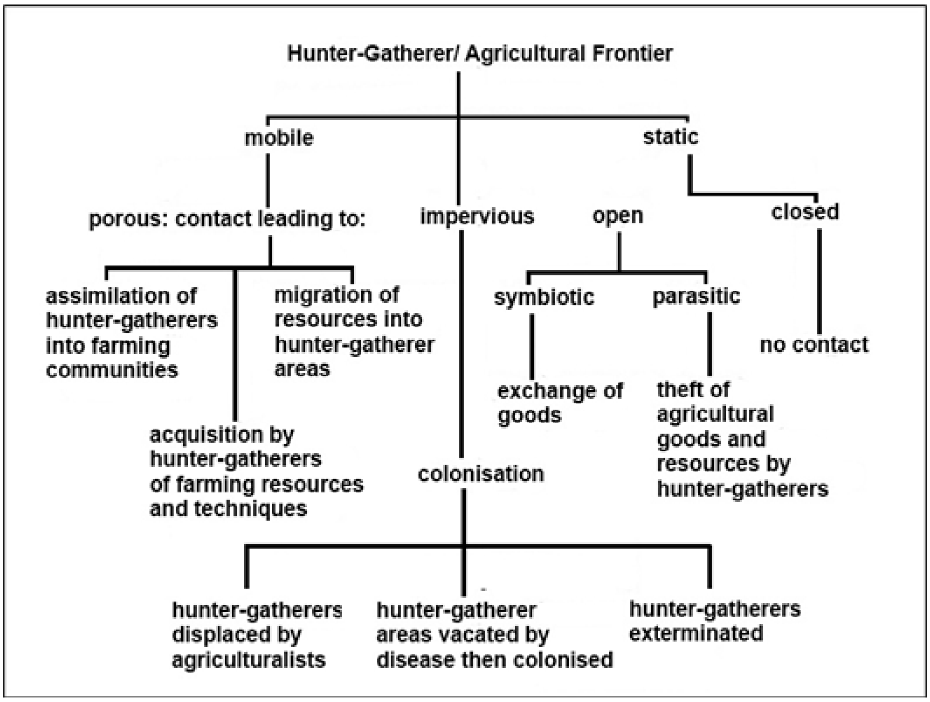


Fig. 1.1 Hunter-gatherer/ food producer frontier (based on Dennell 1985, modified: extermination leaf added to colonisation clade)

The underlying principle to be considered from the study of contact zones and frontier theory is that cultural uniformity, homogeneity and a presumed notion of scarce resources and the simple delineation of clear boundaries, and of power-brokers and decisions-makers versus a *tabula rasa* existence of indigenes until a superior people came along, are not realistic lenses through which to view the encounters and interactions of discrete cultural groups.

1.4.2.1 Examples of varying African contact/ interaction responses

The Zu/’hoasi, southern Africa

Prior to the 20th century, the Zu/’hoasi (or Ju/’hoansi, a !Kung-speaking San group who refer to themselves as Zu/’hoasi, meaning “the real people”) were a highly mobile San group divided into small bands spread across parts of Botswana, Namibia, and Angola with an interior centre on the borders of Botswana and Namibia. Group membership was fluid and subsistence risk was reduced by the pooling of resources. Clothing consisted of *Kaross*, animal hide cloaks with the hair left on. Draper (1975a, b) describes primary subsistence consisting mainly of hunting kudu (*Tragelaphus strepsiceros*) and gemsbok (*Oryx gazella*) with bow and poison arrows; snaring warthogs (*Phacochoerus africanus*), duiker (*Sylvicapra grimmia*) and brown hare (*Lepus capensis*) with knotted hide or fibre nets; and stick digging for ants and burrowing animals. Lee (1979:143-144) writes that warthogs were chased down by dogs, and then speared. Gathered nuts and fruits were carried in knotted fibre nets or hide bags. Knives, springhare (*Pedetis capensis*) hooks, and stone knives and spears comprised the remainder of their toolkit. They maintained autonomy, a distinct language, which was different from non-foraging neighbours, and had little interaction with food producers until later in the 20th century (Draper 1975a, b), and may be considered a closed, static boundary according to Dennell (1985; see also Fig. 1.1).

They moved closer to the Bantu agro-pastoralists in the 1970's and began practising mixed forager-farmer subsistence. The Zu/'hoasi were lent firearms and were paid to hunt for the food producers. The introduction of money allowed the Zu/'hoasi to acquire goods, resulting in a more sedentary lifestyle leading to food production and less foraging (Draper 1975a, b). Smith (2001: 20) describes the Zu/'hoasi in 1997 having African trade goods (e.g. glass beads, copper, iron and potsherds) and European goods (e.g. rubber, glass bottles, metal, cloth, string and bullets). When open interaction finally did occur between the Zu/'hoasi and the Bantu food producers, it appears to have been peaceful and mutually beneficial (Fig.1.1 porous and open/ symbiotic, Dennell 1985). For an alternative perspective, see Wilmsen (1989).

The Khoe-Kwadi, Juu and Tuu, southern Africa

The pre-cursors to and ancestors of Khoe-Kwadi pastoralists represent a diverse and complex group of peoples who, as Güldemann (2008: 124) cautions, have often been incorrectly grouped together as southern African Khoisan. Based on linguistic evidence, Khoe-Kwadi, non-Khoisan peoples that Güldemann proposes as likely candidates for bringing food producer culture to the area, when the Kalahari had more favourable environmental conditions, arrived in the Kalahari basin sometime after the Ju/'hoan and the Tuu.

Güldemann believes Khoe–Kwadi proto-language speakers entered modern-day Botswana approximately 2000 years ago from the north east, where they had acquired agricultural technology from migrating Bantu. Some Kwadi ancestors continued migrating west. Others settled in the Kalahari and absorbed speakers of Juu languages, resulting in the Khoe language family having a Juu influence. These immigrants were ancestral to the north-eastern Kalahari peoples (Eastern Tshu–Khwe branch linguistically), whereas Juu neighbours (or perhaps Kx'a neighbours more generally) to the southwest who shifted to Khoe were ancestral to the Western Tshu–Khwe branch (*ibid.*). Güldemann (2008: 125) explains that the evolution of the various dialects began with a “stable bilingualism”; then involved the borrowing and sharing of words, and ultimately to the development of a new language or new dialects.

The adoption of hunter-gatherer practices, correlating to the later desiccation of the Kalahari, preserved assimilation and absorption of some Kalahari peoples by food-producing Bantu as the latter migrated. Those who continued south-westward retained pastoralism and mixed extensively with speakers of Tuu languages, absorbing features of their languages.

Ikeya (1999: 19-32) describes the interaction and evolution of relationships between the Kalahari Bakgalagadi Bantu food producers and the San hunter-gatherers, who have been interacting for centuries. They have had interaction with the Bantu Bakgalagadi herder-farmers, primarily in southwest Botswana for approximately 2000 years. The landscape of the Kalahari is semi-desert, with poor soil for vegetation, no surface water, and unpredictable periods of rainfall and drought. This necessitated a subsistence strategy that could cope with such an environment. Ultimately, it was the Bakgalagadi who adopted some of the cultural behaviours of the Khutse hunter-gatherers (*ibid.*). Güldemann (2008: 125) agrees with Ikeya, and notes that the reverse effects of hunter-gatherer/ food producer interaction are not often mentioned in the literature. He notes that a strong influence of hunter-gatherers on food-producers is often overlooked because of the assumed lower social standing of hunter-gatherers. However, he maintains that food producers learning to adapt to an environment like the Kalahari would need the survival knowledge of a different food procurement system.

Kent (2002: 57) describes the diachronic relationship between the Bakgalagadi and those Kalahari hunter-gatherers with whom they interacted as ranging from exchange and tolerance to occasional conflict and attempts by the Bakgalagadi to subjugate the hunter-gatherers. This represents the spectrum of Denell's hunter-gatherer/ food producer frontier (Fig.1.1): at times impervious with attempts at subjugation; at other times open and symbiotic, allowing exchange; and ultimately, to some extent, inverse-porous, as the Bakgalagadi adopted some hunter-gatherer practices.

The Efé pygmies, central Africa

In her accounts of relations between the Efé pygmies of the iTuri rainforest and the Lese farmers, both located in what is now the Democratic Republic of the Congo, Kent (2002) describes an open, symbiotic and part-time porous form of interaction (after Dennell's 1985 model, Fig. 1.1.) The Efé spend seven months of the year working with Lese farmers. Women tend to crops and gardens while the men hunt together. In essence, the pygmy women partially assimilate as food producers (part-time porous), while the Lese men partially assimilate as hunter-gatherers (part-time inverse porous). In return, the pygmy men are given shares of the hunted meat and hides, and the women are given portions of the agricultural products they help produce. The Lese also provide the pygmies with tobacco, marijuana, alcohol and farmer household goods. Both groups perform certain ritual acts together (e.g., the initiation of boys into manhood). When not working together, the Efé hunter-gatherers are rarely further than a five hour walk from the Lese villages. This open, symbiotic and seemingly mutually-respectful relationship in which cultural behaviours are exchanged and practiced by both sides, if only for part of the year, stands in contrast to the interaction responses suggested by various scholars (section 1.4.1, e.g. Thomas 1959; Hindess and Hirst 1975; Hitchcock 1978; Sanford 1980; Smith 1990b).

Shaw *et al.* (2001), using the example of food acquisition, note that the systems used to acquire or produce food require and, indeed, demonstrate in African archaeology flexible responses to varying circumstances. In more general terms, the authors suggest that, while it may have taken a hundred years or more, archaeology has come to terms with the fact that contact and interaction come in forms of varying cultural responses in the face of varying conditions (e.g., societal, environmental).

1.4.3 References for global contact/ interaction

For a broader perspective of varying contact and interaction situations: see Kent (2002), Ethridge (2006, 2009, 2010), and Birch (2012) who describe Native American and colonial forces' interactions, which include multiple indigenous reactions and consequences, ranging from cooperation to isolation, subjugation and slavery, and extermination -- in essence, all potential scenarios depicted in Dennell's 1985 schematic (Fig.1.1). Annetta Cheek's 1974 doctoral thesis discusses the role that distance played in contact between Spanish Jesuit missions and changes in the indigenous material record. She found a direct correlation between distance from Pima Indian households to Jesuit missions and the frequency and variety of European material items in Pima households. Contact, interaction and distance is also explained in Castetter and Bell (1942), Fontana (1961) and Gilmore (1969).

Effects of the Spanish *entrada* on South American indigenes, and the subsequent fall of the Incan empire are discussed in Hemming (2003), Haas *et al*. (2004), and Mann (2005). Downey (2010) discusses complex Andean societies, interaction and expedient tool use; the latter also found in Parry and Kelly (1987), Gero (1989), Nelson (1991), and Jeske (1992).

Zvelebil and Dolukhanov (1991) discuss the spread, but slow transition of hunter-gatherers to food production as a result of interaction with Neolithic and later Bronze Age agro-pastoralists, and the retention of traditional practices by some indigenes, up through recent antiquity and the historical period in Central Europe. (See also Testart 1982; Rowley-Conwy 1983; Akazawa 1986; Zvelebil 1986; Gifford-Gonzalez 1998.) For varying subsistence adaptations as a result of contact and interaction between different cultural groups in pre- and proto-historic periods see: Binford (1968); Cohen (1977); Stark and Voorhies (1978); Dolukhanov (1979); Yesner (1980); Akazawa (1981); Zvelebil (1981); Binford (1983).

Mallory and Adams (1997) describe the *Linearbandkeramic* (LBK) culture that cut a large swathe across Europe from approximately 5500 – 4500 BC, noted for specialised mining centres that distributed materials to LBK pottery manufacturing areas regardless of ethnicity, language, and political boundaries. Bentley *et al.* (2002) used strontium isotope analysis to compare genetic differences among people from different LBK geographical regions, concluding that, despite the paucity of evidence for indigenous adoption of migrating LBK food producers' practices, hunter-gatherers chose agro-pastoralism to some degree as a consequence of LBK culture colonising efforts.

A not yet published study, but from interviews with Anders Götherström, Pontus Skoglund, Helena Malmström and Mattias Jakobsson, key members of the Uppsala evolutionary biology research team, Mark Prigg (Daily Mail, UK), 24 April 2014, reports that the team has sequenced the DNA of four Scandinavian Later Stone Age settled farmers' human remains, and seven Scandinavian Later Stone Age coastal hunter-gatherer remains, dated approximately 5000 to 7000 years old. The information has thus far revealed that the food producers and hunter-gatherers came from distinct genetic lines, but that the hunter-gatherers, men and women, merged with the farming communities as they spread across Europe.

Part II

1.5 Lithic assemblages, changes in technology and settlement pattern models

John Alexander's (1978) specific, analytical treatment of frontiers and contact involves explaining the varying nature of frontiers. At different points in time, they may be fluid, at other times fixed, contested or scarcely recognised. The differences in the nature of the frontier during a given period in history will result in different social relations between those on opposite sides of a frontier, and these differences will be seen in different forms of material expression. He considered the 'moving frontier' and subsequent formation of the ‘static frontier’ to be most important for archaeologists.

In a moving frontier, initial contact between hunter-gatherers and food producers has occurred. New technologies, opportunities, threats, and socio-political and economic ideologies have been introduced onto the cultural landscape. Alexander includes in a moving frontier the exploration of indigenous areas by outsiders who have little or no intention of subduing land or indigenes.

Formation of a static frontier begins when food producers move into an area and transform the land, thereby causing a transformation in the lives of the pre-existing inhabitants. Stasis is achieved when, “either all currently usable (in terms of existing technology) land is taken up” or when “the limits of the climatic tolerance of the plants and animals currently domesticated, (or the physical boundaries of the region) are reached” (Alexander 1978: 14).

Alexander’s model of a moving frontier, or initial contact and early-stage interaction, is relevant to the study of the nature and impact of contact between the inhabitants of Holkrans rock shelter and arriving food producers, and will be applied to hypotheses specific to Holkrans in section 1.6. Alexander’s ideas have influenced archaeologists researching hunter-gatherer/ food producing transition in South Africa (Sampson 1984; Hall 1987b: 32-45; Wallace 1997). Lane (2009) notes how diverse and complex the transition to food-producing can be, even among small, restricted spatial boundaries.

1.5.1 Technology and lithic assemblages

Clarkson (2007) suggests that hunter-gatherer technology has two primary goals: reducing risk and optimising subsistence. He explains (2007: 200) that the evidence may be seen in the following:

- A wider range of technologies for specific tasks during periods of greater economic risk
- Increased portability of toolkits during periods of frequent mobility
- Increased on-the-move manufacture of stone tools during periods of frequent mobility
- Increased standardisation of forms to increase reliability and efficiency during periods of economic risk
- Flexibility in toolkits and the introduction of new tools during periods of uncertainty or opportunity
- Increased curation of tools during periods of economic risk, time-sensitive foraging and uncertainty of resource availability
- Increase in better quality raw materials to improve tool performance and reliability during periods of greater tool-use demand

Clarkson further explains that because hunter-gatherers must make complex decisions in order to survive, analysing their lifeways from the view of optimisation, i.e., increased utility and the reduction of risk, archaeologists can propose models of behaviour, even if hunter-gatherers did not think or consistently act according to the characteristics outlined in models. By considering subsistence as the primary motivator in the hunter-gatherer mindset, Clarkson believes that we should see the likely contributors to technology-based problem solving strategies (*ibid.*).

Kuhn (1995) developed a provisioning model to explain changes or continuities in lithic technology, and the underlying factors that drive change or continuity, considering the nature, timing and location of tool use. Success in optimisation requires taking into account the predictability of mobility, the requirements for resource exploitation, the diversity of available foraging opportunities, and the availability of replacement raw materials. Kuhn proposes two strategies that hunter-gatherers may have used to solve the problem of maintaining a supply of efficient tools when mobility and access to resources varied: individual provisioning and place provisioning. These strategies include the understanding of curated and expedient tools respectively (*ibid.*: 22).

Individual provisioning is a response to situations where strategic, logistical planning must be done in advance, with uncertainty about when and where tool maintenance will be required (Binford and Binford 1966: 238-295). This strategy is seen in periods of high mobility, in variable environments, where foraging opportunities and the re-provisioning of raw materials may not coincide. Longer travel time and limited encounters with valued hunting prey, as well as climatic variability may also be noted.

Toolkits designed for individual provisioning will be planned well in advance, be portable, versatile, maintainable and on-hand when needed. Shott (1986: 15-51, 1989: 9-30) explains that toolkits used for this strategy will be lightweight and the tools will probably be small. In other terms, planned curation of the tools was necessary, requiring a certain degree of standardisation; they were likely made of higher-quality raw materials; and if small and lightweight for high mobility, they were probably used in composite (e.g. hafted) (Keeley 1982; Bleed 1986; Odell 1989; Dibble 1995; Kuhn 1995; MacGregor 2005). This list of individual provisioning features is not exhaustive and is intended to provide a general understanding of the strategy, which should have recognisable archaeological correlates.

Conversely, a place provisioning strategy may be seen when mobility is low and the location and timing of future activities is fairly predictable. Diversity or abundance of subsistence opportunities is greater, likely nearby; yields from foraging and hunts are more predictable, and raw materials are moved over relatively short distances to a residential base. Stockpiling of materials would not be uncommon (Parry and Kelly 1987), and there would be little need to pre-process materials before transport. Although Kuhn notes that a distance decay relationship should still exist -- i.e. time spent traveling to procure raw material reflecting type and amount of raw material, its use, and time elapsed before the next procurement.

Toolkits in place provisioning need not be well planned, nor will the tools necessarily reflect higher quality raw materials. Simple blocks that can be shaped with sharp edges to meet various needs may be all that is required. Kuhn, then, has in simple terms, equated curation and higher quality raw materials with a toolkit designed for high mobility in unpredictable circumstances, and expedient toolkits with low mobility (e.g. a residential base) and the use of lower quality materials. Clarkson (2007: 141) cautions, however, that the quality of tools cannot be “directly measured”, as tools cannot be distinguished from non-tools in archaeological assemblages without conducting use-wear analysis to determine the function, if any, of the lithic items in the assemblage.

1.5.2 Raw material procurement and changes

The provisioning strategies chosen by hunter-gatherers have obvious impacts on raw material choices, limited by resource availability. Tool modification and standardisation change based upon provisioning, and, when feasible, higher-quality materials are used when strategies require maintainable, highly efficient tools.

Lower-quality materials for lithic manufacturing (e.g. quartz, quartzite) have some advantages over higher-quality materials, among which is relative abundance and availability, particularly in areas where higher-quality materials may only be procured from great distances. Bleed (1986) explains, however, that lower quality materials have several disadvantages, and that as the mental template of lithic manufacturers change, higher-quality materials may be sought for specific purposes. For example, quartz and quartzite do not make durable or maintainable small tools. They are more suitable as expedient use materials. They also produce a large amount of unusable debris, which on an economic scale, makes their use undesirable, particularly in locations or during periods of scarce food resources (Yi 2000). Luedtke (1984: 67) explains that if the cost of procurement of high-quality material can be rewarded by manufacturing a sufficient amount of formally more effective tools, indispensable for coping with the increasing frequency of high risks, the pattern of raw material utilisation will eventually change from easily acquired low-quality to superior ones, even though the latter have a more limited distribution.

With restricted high-quality raw materials, the morphology of tools tends to be standardised due to highly systematic reduction sequences and enhanced precision in manufacturing the intended toolkits (Jeske 1989). Standardisation is closely related to efficiency. For example, the most efficient way of mass-producing blades is by sequentially detaching the blades from a well-prepared prismatic core. This uniformity and technological consistency of blade production is a successful economising strategy.

Various conceptual frameworks and related methods have been devised for and applied to the interpretation of patterns and dynamics of hunter-gatherer provisioning strategies (e.g. Binford 1979, 1980; Binford and O’Connell 1984; Kelly 1988; Nelson 1991; Kuhn 1995; and Morrow 2001). Mobility patterns and their effects on lithic technology can be seen by correlating evidence with 1) the procurement of raw material sources (e.g. Kelly 1988, Mallol 1999), 2) special design considerations of lithic tools (e.g. Bleed 1986; Nelson 1991; Hayden *et al.* 1996), 3) the degree and intensity of the tool modification sequence (e.g. Barton 1990; Rolland and Dibble 1990), and 4) the "size-effect" for transportation of tools (Kuhn 1994, 1995). The importance of size for mobile toolkits has been effectively illustrated elsewhere (e.g. Kuhn 1995), and the transportation and portability of raw materials have been treated in the research of site formation processes (e.g. Schick 1987; Féblot-Augustins 1993; Mallol 1999).

1.5.3 Residential and logistical settlement patterns and material assemblages

Binford (1980: 5), while recognising the variability group size, location and availability of resources, and other intangible factors (e.g. ontologies), proposes two primary settlement patterns for hunter-gatherers: a) residential and b) logistic. A residential strategy is one in which hunter-gatherers move to encamp near resources. This strategy may require frequent residential moves. Binford (1980: 17) terms this "mapping on" on to a location, or "moving consumers to resources", and considers the viability of longer duration settlement low unless critical resources are within foraging range of the base.

A logistical strategy consists of what Binford (*ibid.:* 18) describes as having field camps. This type of strategy may be useful when people are located near one critical resource, but far from another. The residential base may be near the available resource, while task groups (collectors) are sent out to field camps to procure and return with other, specifically needed resources. Resources are brought to the consumer. The field camp is meant to sustain the collectors until they can return to base with the targeted resources. Frequency of residential moves is generally lower than seen in the residential strategy

Logistically based strategies are a response to the location and availability of critical resources. A shift toward logistical-settlement strategy may also be seen when climatic changes cause a decrease in the growing season, and when conditions inhibit the normal mobility of hunter-gatherers (*ibid.*).

Both strategies have implications for the material record. Binford (1980: 17) writes that material assemblages that have accumulated over a longer period of time, such as a year, may be considered “coarse-grained” in that correlation of archaeological remains with specific events is poor. While higher correlation between material items and events (“fine-grained”) may be seen from short duration events, such as a field camp used only for a few days. He adds that mobility is directly linked to the grain of assemblages. High mobility produces fine-grained assemblages, while low mobility produces coarse-grained assemblages. Variability seen in assemblages is due to event responsiveness (e.g. basic climatic changes, such as periods of rainfall or sun).

Synthesising Clarkson’s (2007) organisation of technology and Kuhn’s (1995) provisioning models with Binford’s (1980) residential and logistical strategies, the following characteristics for lithic toolkits may be proposed: a) logistical strategy-settlement toolkits will be individually provisioned, well-planned, likely standardised to some degree while containing specialised tools made of better quality materials to ensure efficiency and maintainability (curation), and will have a high-degree of portability; b) residential strategy settlement toolkits will be place provisioned, with no specific need for serious advance planning, possibly made of poorer quality materials, with little need for standardisation, specialisation or long-term maintainability (i.e. expedient), with a lower priority placed on portability, as the tools will be used within foraging distance of the residential base.

1.6 The study problem background

Food producer material assemblages

Comparison to accepted models of lithic changes across time may provide evidence of cultural and behavioural changes among hunter-gatherers. However, in order to better understand what constitutes stone toolkit changes of hunter-gatherers as a result of contact and interaction with food producers, a general understanding of the material culture of food producers is necessary.

The grouping of most Early Iron Age (EIA) material assemblages (technology, materials and livestock), of eastern, south-central and southern Africa has been termed the *Chifumbaze* Complex (Mitchell 2002: 261). The complex, named (by Phillipson 1974, 1977) after the excavated site in Mozambique, comprised distinctive iron tools and pottery styles that were notably homogeneous over approximately nine million square kilometres of southeastern and eastern Africa. The complex is subdivided into two pottery traditions: the *Urewe*, further subdivided in to *Kwale* and *Nkope* traditions, associated with areas of iron ore deposits and arable land, and possessing pottery with high frequencies of fluted rims on bowls and bevelled rims on jars, spreading southward along the central east and eastern regions of the continent; and the *Kalundu* tradition, which some see as a post-Bambata pottery style (Prinsloo 1974; Denbow 1986; van Waarden 1990), moving southward and south-easterly from the western sub-equatorial region of the continent. The movement and styles of pottery are associated with the southerly migration of food producers (e.g. farmers, or herders and agro-pastoralists) (Phillipson 1993). (See also Phillipson 1977; Collett 1987; Hall 1987a, b; Huffman 1989.)

Evidence of iron metallurgy is linked to approximately the seventh century BC in West Africa, 1000 BC in East Africa, and later, *c.* AD 400 in southeastern Africa (Denbow 1986). The earliest Chifumbaze complex site has been dated to *c.* 500 BC on the western portion of Lake Victoria. One of the later complex sites dates to approximately 1700 years ago in what is KwaZulu-Natal today (Chirikure 2007). Similarities in material evidence, dating approximately to the second or third centuries BC in Chad, the Democratic Republic of the Congo, Angola and Cameroon, led to a theory that the Chifumbaze technology was spread by iron-using food producers approximately 1800 years ago across a 3000 km region that included Zambia, Zimbabwe, and southeastern South Africa, reaching indigenous groups in what are now South Africa and Namibia *c*. AD 1500. The rate of migration has been suggested to be approximately 350 km every twenty years (Hall 1987a, b; Phillipson 2005; Bostoen, 2007).

Artefacts were different from earlier sites because of iron implements. Sites also represented what may be the first evidence of permanent village settlements, the herding of domestic animals, cultivation of crops (e.g. millet, sorghum, cowpeas) and pottery manufacturing. This package of multiple, simultaneous cultural changes spreading across the continent from west to east, and then southward, has been interpreted by some as large migrations of food producers (Hall 1987a; Connah 2004; Phillipson 2005; Bosteon 2007; Chirikure 2007).

According to Murray (2007: 470-472), these food producers used iron axes, hoes, arrow points, and spearheads. Hoes and grindstones have been interpreted as tools used in agricultural production. Sheep, goat and cattle remains have been found, with cattle becoming more prevalent in the southeastern region of the continent *c*. the seventh century AD. Murray (2007: 471) explains that the migration of food producers did not necessarily mean the displacement of indigenous hunter-gatherers. “There is evidence that they [hunter-gatherers] adapted to this migration [of food producers] by moving on and/ or by trading with them.”

Mitchell (2002) explains that the impact of food producers in a given area varied. For example, in the former Transkei (now part of the Eastern Cape), food producers settled in lower-altitude, wooded areas. While in the Thukela basin, the absence of formerly present nyala (*Nyala angasii*) indicates “progressive clearance of dense riverine woodlands”. In some areas, the later appearance of floral species and the decline of indigenous woody species suggest the clearance of forests. In other areas, a slash and burn method of agriculture may have resulted in more frequent moves by food producers (Mitchell 2002: 276).

Mitchell also offers a different perspective on the correlation between iron tools and an explanation for the spread of farming. He notes that the debris associated with iron agricultural implement production (e.g. furnace fragments, slag, tubes used for oxygen flow to furnaces, etc.) is rarely found. He continues by stating that jewellery (e.g. beads, pendants, etc.) are the most abundant items in the material record, but that metal points, arrows, adzes, chisels and spatulas have been recorded. He suggests that the production of non-utilitarian items (e.g. jewellery) may indicate a group’s readily available access to metal over those with less access (Mitchell 2002: 76).

Synthesising, one would expect to see in a food producer’s material assemblage versus the material assemblage of hunter-gatherers (see section 1.5): metal (iron) implements (e.g. hoes, adzes, axes, chisels, points, arrows, and jewellery); higher frequencies of faunal remains that suggest herding and, later, domestication, particularly of bovids; distinctive stylistic pottery (e.g. as in the *Urewe* and *Kalundu* traditions); and settlement patterns that represent a low-mobility pattern (e.g. villages).

Hunter-gatherer lithics and classification schemes

The rationale for the classification of archaeological materials is that it is easier to assess groups than individual components. Morphology is frequently used in the analysis of lithic assemblages to distinguish one lithic item from another (e.g. a scraper from a projectile), and is most often the principal method for placing lithic types into categories. Descriptions have been used in an effort to standardise typologies; but the overall approach tends to be subjective and not easily verifiable. Odell (2004: 104) stated what he believed to be weaknesses in morphological type-categorising: a) it is non-hierarchical, unlike biological taxonomies; b) it is intuitive in nature; and c) it does not address tool function, but maintains the use of “historically-derived functional names for objects”.

Odell (2004) explains that the non-hierarchical nature of lithic morphology is due to not knowing “the contribution of the underlying attributes to the type structure”. He described the intuitive weakness in terms of the subjectivity of perception; i.e., the type constructs that different people create would likely be different; and even if agreeing upon a typological structure, it is unlikely that the specific objects that each of us assigned to discrete categories would the same. And he attributes the functional-use names of morphological types to historical antecedents; that these names have been passed down through history “by untrained avocational archaeologists, as most archaeologists were in the old days” (Odell 2004: 104).

Morphological categories are described in functional terms (e.g. scraper, point, etc.) and based on the perceived use of similar objects in traditional society, rather than studies of the artefacts themselves. Morphologically-typed changes in lithic assemblages (e.g.an increase or decrease in the frequencies and types of tools and the inferred activities associated with the tools) and inter-assemblage variability have been linked with cultural and behavioural changes due to the arrival of outsiders (e.g. food producers) (Smith 1995: 224), rather than with a possible internally-driven elaboration or evolution of activities and tools. However, “to answer questions of culture change, adaptation, and so forth, it is crucial to know the activities in which ancient peoples were engaged" (Odell 1981: 321).

My study of later LSA hunter-gatherers' contact and interaction with food producers is focused on what changes or continuities hunter-gatherer lithic assemblages may reveal about the nature and impact of contact and interaction. While including brief discussions of other materials, to establish comparisons of and correlations to people and places and their cultural and behavioural traits, as well as relevance to the reflection of change and/ or continuity in the material record, keeping the primary focus on lithics was best explained by Odell (2004: 9):

> "Given the ubiquity of stone artefacts in the prehistoric record of all continents and all but the most recent periods, this medium serves as a vital element in our understanding of the archaeology of these periods. For many sites, stone tools constitute our only source of information"… "They can be employed to grapple with issues of behaviour, lifestyle, social and economic structures and organisational principles."

1.6.1 The study problem defined and research design

The focus of this thesis is to determine the nature and impact of contact between Holkran's rock shelter hunter-gatherers (Ch. 4) and food producers viewed through the lens of changes or continuities observed in the Holkrans' hunter-gatherer lithic assemblage. Based upon the discussions of the literature presented in sections 1-1.6 of this chapter, I believe that clear differences are evident between the material assemblages and activities of hunter-gatherers and food producers, and that the changes or continuities of hunter-gatherer lithic assemblages should reflect the nature of their exposure to food producers and the impact that contact and interaction had upon the culture and behaviours of the shelter's hunter-gatherers.

Adapting Alexander's (1977, 1984; and see section 1.4.1) interaction model to the Holkrans' lithic assemblage being analysed, Table 1.1 presents my expected observations in cultural and behavioural changes or continuities reflected in the hunter-gatherer material record at initial contact and during potential subsequent interaction with food producers.

Table 1.1 Expected Holkrans indigenes reactions to food producers

Food Producers (e.g. farmers, herders)	*Holkrans Hunter-gatherers*
Pioneer Phase (Early contact) → Pioneers exploring/ exploiting wilderness, seeking land, pasture, wild products', escape routes. *Archaeological signatures:* Transient camps/ settlements. Occasional traces of domesticates and food producer material culture.	**If:** Interaction with pioneer food producers, **Then:** Exchange of wild products (e.g. hunted meat, hides) for food producer material culture (e.g. exotica or non-indigenous items of material culture or raw materials). Minimal or no change in toolkit during food producers' transient / exploratory phase. **If:** No interaction, indigenes not open to encounters and exchange, **Then:** No change in hunter-gatherer lithic assemblage, no traces of non-indigenous material culture.
Substitution Phase → Food producers subduing land: acquiring arable land, access to water and local raw materials, creation of permanent settlements, potential for symbiotic or conflict interactions (e.g. exchange, patron-	**If:** Symbiotic relationship with food producers, **Then:** A peak or 'hyperactive phase' (Sadr 2004: 216-217) in production of specific tool types (e.g. scrapers) to meet

client relationship, or warfare, raiding) *Archaeological signatures:* modification of habitats, investment in permanent settlements and monuments; changes in social organisation of production; possible changes in mDNA of population.	exchange demand or to accommodate a patron-client relationship; the appearance of new technologies acquired from food producers (e.g. metal implements); evidence of specialised tools for specialised activities reflecting relationship with food producers; evident changes in material record (e.g. acquisition of non-indigenous material culture, changes in dietary practices); new diseases; possible inter-marriage between groups. **If:** Closed to ongoing interaction with food producers, **Then:** Possible retreat from shelter to maintain isolation; little or no traces of non-indigenous material culture; possible peak in production of specialised tools needed for defence (e.g. points, bladelets) or for logistical settlement strategies (See Section 1.5.3).
Consolidation → Intensification and development of new production technologies; increased exploitation of local resources; restriction of population; increased conflict (e.g. with other food producers or hunter-gatherers or both); development of prestige hierarchies. *Archaeological signatures:* introduction of agricultural systems (e.g. terraces); expansion of land acquisitions; increase in circulation of weapons; greater material expression of wealth and status differentiation	**If:** Assimilation into food producers' way of life, **Then:** Ultimate demise or absence of sites attributable to hunter-gatherers; disappearance of hunter-gatherer toolkit and means of subsistence; dispersal of hunter-gatherer communities; consolidation of relationships leading to a dominant non-indigenous material record. **If:** Resistant to encapsulation or assimilation into food producers' way of life, **Then:** Possible destruction and forced dispersal of hunter-gatherer communities;

	evidence of conflict (e.g. warfare with food producers; skeletal remains); evidence of destruction of hunter-gatherer sites; if defending, high priority in toolkit on items used for defence or killing (points, blades, etc.); if dispersing, potential dramatic decrease in all tool types or abandonment of non-essential specialised tools in favour of variable use, possibly expedient tools.

(Based on Alexander 1977, 1984 with modifications)

To summarise: Using Alexander's model of potential cultural and behavioural changes due to contact and subsequent interaction between food producers and hunter-gatherers, I would expect to see the following in the Holkrans lithic assemblage: 1) If contact between food producers and hunter-gatherers led to patron-client relationships, there should be an increase in tools needed to meet the demands of these relationships, such as tools used for butchering and the processing of hides (e.g. scrapers) and exchange of materials between groups (e.g. exotica) and appearance of new technologies (e.g. iron use); 2) If the relationship between food producers and hunter-gatherers was one of subjugation, changes in hunter-gatherer lithic assemblages that, while they might vary from group to group, should reveal patterns, such as a notable increase or decrease in certain tool types (e.g., an increase in specialised or formal tools). Additionally, in a subjugation scenario, there should be an introduction of food producers' material items (such as the use of metal items in the Early Iron Age [EIA] period) in the hunter-gatherer material record, even possibly altogether replacing traditional hunter-gatherer lithic items; 3) If the relationship between hunter-gatherers and food producers consisted of occasional encounters, with no evolution of the relationship into one of regular trade/ exchange, no forced subjugation or assimilation by food producers, and a continuity in the way of life of the hunter-gatherers, there should be little change in the pre- and post-contact hunter-gatherer lithic assemblages; and 4) If the post-contact relationship between food producers and hunter-gatherers involved hunter-gatherer transition and voluntary assimilation into the farming community, there should be a decline in all lithic items in the hunter-gatherer toolkit and cultural and behavioural changes that would reflect an inevitable terminal phase of the hunter-gatherer lifeway at Holkrans.

1.6.1a A lithics model for comparative analysis

In order to augment Alexander's cultural and behavioural model of varying responses to contact, and to better understand how the Holkrans lithic assemblage may be accurately recorded in the southern African later LSA record, I found in the literature what appeared to be an often accepted diachronic perspective of LSA lithic assemblages, which I refer to as the Smith model. Smith (1990 a, b) and Smith *et al.* (1991) propose archaeological signatures that distinguish hunter-gatherer sites from food producer sites, perhaps in response to Deacon's (1984b: 3) explanation of general attributes that the Later Stone Age should not be viewed as a sequence of industries, but is rather one technological tradition that comprises accreted traits over time. Smith *et al*. (1991) generally argue that hunter-gatherer site assemblages are comprised of more formal tools and fewer traces of pottery; while food producer sites show higher densities of pottery, an informal tool industry and faunal remains of domesticated stock. Deacon (1984a: 303) does note, however, that more archaeological data is needed before "identity-conscious" groups are distinguished by their stone artefact assemblages. Interaction between the two different cultural groups should, nevertheless, be evident in their material assemblages, particularly if contact and interaction led to changes in hunter-gatherer subsistence practices.

There are scholars who have supported Smith's model of formal to informal tools and a change in raw material choices across the hunter-gatherer/ food producer boundary. Wadley (1996), Hall & Smith (2000), Sadr (2002) and van Doornum (2005) agree that the composition of hunter-gatherer lithics (e.g. the frequencies of scrapers and backed lithic items) changes with the extent to which hunter-gatherers interacted with food producers. Kent (1992, 2002), Sadr (1997, 2002), van der Ryst (1998) and van Doornum (2005) point to the inclusion of exotic or non-indigenous material items at hunter-gatherer sites as evidence of these interactions.

Synthesising the Smith model scholars' view: changes seen in early contact, what Alexander might consider a bridge between the food producers' pioneering and substitution phases (see Table 1.1), include lithic assemblages that reflect a decrease in the diversity of tools. Coarser materials (e.g. quartzite) may be used in favour of finer-grained materials (e.g. chert or cryptocrystalline silicates). Scraper frequencies increase, while segments and other backed pieces decrease – suggesting, perhaps, that knives and arrows were being produced for hunting and the dressing of hides. Adzes and planes for working wood and bone may also be present. An increase in pottery at hunter-gatherer sites is another potential indicator of the extent to which they interacted with food producers.

Changes or continuities in the frequencies of scrapers, raw materials and the diversity and types of stone tools across the pre-ceramic and ceramic horizons, reflecting pre- and post-contact frontiers, will be important indicators in the analysis of the Holkrans lithic assemblage and Holkrans hunter-gatherer reaction to contact, as scrapers, raw material choices and the diversity of the Holkrans toolkit may imply the types of cultural and behavioural changes that correlate with Alexander's frontier/ contact model and the Smith model of material assemblage differences between hunter-gatherer and food producer sites, as well as the changes to the material assemblages when interaction occurs between the two cultural groups. (Discussed further in Chapter 2.)

1.6.1b Testing the model

The primary goal of this study is to determine what the analysis of the Holkrans lithic assemblage reveals about the nature and impact that food producers had on the shelter's hunter-gatherers. Changes or continuities in stone tools reflect changes or continuities in activities, which may indicate changes or continuities in cultural practices and group identity. Having researched and identified what appeared to be a broadly accepted stone tool assemblage model (Smith) of the impact of contact on indigenous lithic assemblages, I then chose to compare and contrast the model with other models of lithic changes across pre-ceramic and ceramic horizons (Chapter 2). I next employed the model to quantify and compare the lithics from a few, select sites that are polythetically similar to Holkrans, then to the Holkrans lithic assemblage in order to determine the validity of the model. Lastly, I performed use-wear analysis on the Holkrans lithics in order to compare the actual (functional) use of the stone tools with their morphological types.

1.7 Rationale and significance of the study

Morphological typing is the predominant scheme used for classifying lithic assemblages, both for the scholars' model being tested in this thesis and generally in the analysis of stone tools. The comparison of morphologies among sites is not done for morphology's sake, but rather is justified in examining how morphological assessment of assemblages is used to interpret cultural and behavioural changes.

Changes reflected in lithic types may be significant in that they can reflect changes in behaviour which may indicate a particular form of contact (e.g. patron-client, subjugation and assimilation or limited). However, the morphological form of lithic tools does not necessarily equate to the use function of the tools. For example, the view of LSA lithic assemblage changes across pre-ceramic and ceramic horizons referring to an increase in a particular tool type is a morphological, form equal function assumption. Thus, the classification of assemblages according to morphological typing, which is then used to make inferences and interpretations of cultural and behavioural changes is problematic. Odell (2004: 105) states: “[Functionally analysed] types bear a closer correlation to the activities in which the pieces were engaged than is the case with traditional, morphology-based typologies.” Knowing the functional use of tools in an assemblage will reveal the activities in which the tools were used, which should shed more light on changes or continuities in cultural practices and behaviours than the subjective and intuitive assessment of behaviours inferred from morphological types.

The use-wear analysis of the Holkrans lithics is therefore not being done for the sake of use-wear, but rather is justified in testing from a functional view the validity of whether or not interpretations based upon morphological assessment hold true. Additionally, observations of change or continuity in functional use of the Holkrans lithics can shed light on change or continuity in activities, reflecting changes or continuities in cultural practices and behaviours, ultimately providing insight into the nature and impact that contact with food producers had on Holkrans hunter-gatherers.

In a broader sense, the contribution of this study is to impart the significance of understanding tool function when classifying lithic assemblages, as the interpretations of lithic assemblages are often then used to make cultural and behavioural assessments of other archaeological materials or interpretations of archaeological sites in general. This leads one to a logical conclusion: if the form and function of tools in one archaeological assemblage do not correlate, there is, then, reason to question their correlation in other assemblages.

Part III

1.8 Possible theoretical biases

Jolly (1996: 291) explains that some anthropologists see hunter-gatherers as “tabula rasa until the advent of agro-pastoralists interaction.” Indeed, my perception when researching LSA technologies and contact/ interaction theory was that some scholars tend to view hunter-gatherer populations as having been stereotypically “imprinted” (e.g. that it is a commonly held view that non-traditional hunter-gather goods, such as livestock and pottery, arrived from somewhere ‘outside’), rather than these populations being fundamentally capable of evolving without external influences. However reality must have been more complex and regionally variable than the reductionist view of contact used by some anthropologists. This “imprinted” perspective may skew, in my opinion, the data and conclusions drawn by various scholars referenced in this study. Alternative perspectives are therefore also presented where possible.

Shaw *et al.* (2001) also point out that various debates on any given number of archaeological topics (e.g. associating particular material items with discrete cultural groups) have resulted in as many perspectives as there are scholars to write about them, and as many supporters on a given topic as dissenters. Where possible, multiple perspectives are presented; however the research presented in this study is not intended to be exhaustive or represent all perspectives on a given topic.

In morphological classification of lithics, there is subjective or intuitive bias. Although morphological categories employ functional nomenclature – a result of historical antecedents, or the intuitive inference that a particular item appears as though it should be used for a specific task and is thusly named – it is unlikely that different people will categorise and classify objects in the same way, even if descriptive sets of category characteristics have been predetermined and agreed upon. (See section 1.6, ‘Hunter-gatherer lithics and classification schemes’.) For example, Spaulding (1954) believed that types are inherent in objects, manufactured to certain standards, thus their classification would necessarily follow the distinctions the makers had intended. Ford (1954) on the other hand, did not believe that types are inherent in artefacts, but are rather constructs of archaeologists, created and existing to answer questions about the archaeological record, resulting in as many types as there are archaeologists to conceive them.

Lastly, there is always probable cause for what may be termed ‘chronological biases’. When analysing lithics, one must ask how much bias in analysis may be the result of artefact re-use. While function of a tool, the material on which a tool was used, the motion and angles of use, the age of a tool, etc. can be ascertained, micro-wear analysis, residue analysis, and other forms of scientific equipment-enhanced analyses cannot precisely indicate how often a tool was used or curated.

1.9 Structure of thesis

Chapter 2 briefly introduces varying perspectives on the Later Stone Age (LSA) in southern Africa, which is followed by the discussion of the testing model of lithic changes that should be seen from pre-ceramic/ pre-contact to ceramic/ post-contact periods in the LSA. Chapter 3 presents testing and discussion of the model applied to representative sites broadly similar to Holkrans.

Chapter 4 presents Holkrans rock shelter: the shelter’s geo-climatic conditions, food sources, the lithic assemblage compared to sites in Chapter 3, and a detailed profile of the analysis samples used in morphological comparisons and functional use (use-wear) examinations. Chapter 5, complemented by Appendix A, provides a background in various micro-wear methods, along with the advantages and disadvantages of each approach and the approach used for this study. Chapter 6 presents evidence, based on information in Chapters 4 and 5, regarding the suitability of the Holkrans assemblage sample for analysis and the potential impediments to accurate analysis.

Chapter 7 presents the experimental archaeology that I performed in order to build a comparative collection similar to the Holkrans assemblage sample, and to familiarise myself with the workability of the raw materials from the site. The equipment, protocols and terms used for analysis of the experimental tools are explained, which are the same as those used for analysis of the artefact assemblage. The chapter also includes the results and discussion of a four-part blind test series, which served to confirm my abilities as an analyst and my analysis of the artefact assemblage. Chapter 8 includes the results of extensive use-wear analysis of the Holkrans assemblage sample, with descriptions, interpretations, and observations of the continuities and changes in the pre-contact pre-ceramic/ pre-contact and early contact/ ceramic phases.

Chapter 9 concludes the study with a discussion on the time frame for and nature and impact of contact, recommendations for further research and brief summary of the thesis.

CHAPTER 2
The Later Stone Age (LSA) and lithic assemblages

2.1 Purpose for analysing varying perspectives on the LSA

Morphological typing and type site naming are the conventional methods used in southern Africa archaeology, which I view as a contributing factor to the lack of agreement among scholars (see sections 1.7, 1.8, and section 2.2). Archaeologists might broadly agree on temporal occurrences and associated characteristics of industries; but there remain unresolved arguments on how even the broader points of agreement may be used in the demarcation of temporal sequences and the definitions and classifications of LSA lithic assemblages, often used to infer interpretations of cultural behaviours and group identities.

I believe that conclusions drawn from a morpho-typing only approach may lead to erroneous information becoming part of the archaeological record. For example, Deacon and Deacon (1999: 127) maintain that one cannot infer subsistence strategies from particular tool assemblages. "…formal tools like scrapers and backed bladelets are not directly linked to what people ate and the way they obtained their meat and vegetables". Functional analysis (e.g. use-wear), however, *can* provide information that directly links specific tools to specific activities and often to specific materials, which affords archaeologists a more scientifically based perspective for inferring subsistence strategies (see chapters 5-8 of this study).

To remain objective, my goals in analysing various perspectives on the later LSA are to: first, develop from the literature a morphologically-based model; next, to determine the usefulness of the model in interpreting varying sites and assemblages; then, to determine the applicability of the model to my study area and emphasis, Holkrans rock shelter's lithic assemblage; and finally to assess if application of the model to Holkrans lithics can provide information on the nature and impact of contact on Holkrans hunter-gatherers (see section 1.2, and Ch. 4) with food producers (see section 1.6 for discussion of food producer material record characteristics).

Remaining objective while analysing the literature and developing a morphological model also means that I must consider and evaluate: 1) the nomenclature used in describing various industries and lithic assemblages; 2) the origins of this nomenclature – a lexicon based on historical antecedents (i.e. intuitive and visual, lithic items often given functional names corresponding to a perception of how items should have been used); and 3) the evolution of this nomenclature over the years.

2.2 Perspectives on defining and classifying the LSA

Goodwin and van Riet Lowe (1929) first defined the LSA by describing two complexes: Smithfield, a southern African hunter-gatherer complex characterised by an absence of microliths and sectional scrapers; and Wilton, a microlith-producing culture, typified in the Cape and eastern southern African rock shelters over the last 8000 years, whose toolkit was noted for small, convex scrapers, crescent-shaped backed microliths, adzes and backed blades.

Sampson (1974) distinguished four complexes (see Table 2.1): the Oakhurst (with regional variations: Albany in southern Cape; see also Klein 1974; H.J. Deacon 1976; J. Deacon 1978, 1984 a, b; and Lockshoek in the Karoo; see also Bousman 1991); the Wilton, the Smithfield, representing Smithfield B (youngest in Smithfield sequence); and the Strandloper, a late, coastal LSA industry (see also Humphreys and Thackeray 1983; J. Deacon 1984a; Mitchell 2002).

Table 2.1 Sampson LSA sequence

Oakhurst 12 000 – 7500 years ago	Wilton Originally described as ≈ 8000 – ≈4000 years ago	Smithfield < 1000 years ago	Strandloper (tentative grouping, Sampson 1974) Within last 3000 years (Per Deacon 1984a,b)
Characterised by: un-backed pieces, large 'concavo-convex' scrapers (duckbill scrapers); polished bone tools, few or no microliths. Often coarse-grained materials used.	Diversity of microlith tools (e.g. borers), small scrapers (< 25 mm), double segments with steep retouch, ornaments, polished bone tools.	Assemblages with backed bladelets and long end scrapers at the end of the sequence in the Karoo.	Macrolithic, few formal tools, large, untrimmed flakes.

Sampson's sequence shows a general trend of scrapers throughout, becoming smaller after 8000 BP, and a continuation of some formal tool types. Deacon and Deacon (1999: 115) write that by the mid 1970's, assemblages older than Oakhurst had been recovered. They were categorised as Robberg, named after the peninsula at Plettenburg Bay. Their LSA lithic sequence is shown in Table 2.2.

Table 2.2 Deacon and Deacon LSA sequence

Robberg 22 000 – 12 000 BP	Oakhurst 12 000 – 8000 BP	Wilton 8000 – 4000 BP	Post-Wilton 4000 – 2000 BP	Smithfield 1000 – 100 BP
A generally informal assemblage with bladelets, backed pieces, bladelet cores, and a small range of scrapers.	A shift to large scrapers, large adzes, few backed tools, and a variety of polished bone tools.	Small scrapers, high frequencies and varieties of backed tools, ornaments and polished bone tools.	Pre-ceramic assemblages contained few formal tools, but did include small scrapers and backed tools.	Pre-ceramic assemblages included informal tools on coarse materials. Ceramic assemblages included tools of finer-grained materials such as shale, quartz or silcrete.

Deacon and Deacon (1999) note technological changes in tools, still being used for the same tasks, as changes in material culture. They created an LSA checklist of innovations that include: rock art, decorated stones, deliberate burial, microliths, preserved organic materials (e.g., 'string', leather and wood), bows and arrows, tools hafted with mastic, 'polished' bone tools (e.g., awls, arrowheads) and decorative items (e.g., shell and ostrich eggshell beads, pendants, flasks) and pottery. The general trends according to Deacon and Deacon's (1999) sequence are a continuation of, but a reduction in size of morphological scrapers; the diminishing frequencies of formal tools after 4000 BP; and pre-ceramic lithic assemblages tending toward coarser materials after 2000 BP.

Wadley (1987) explains that the Oakhurst, a non-microlithic technology complex, replaced the Robberg approximately 12 000 years ago. Oakhurst assemblages are common at open-air sites (e.g. in the Karoo and Free State), which Wadley suggests may be due to increasing populations in the terminal Pleistocene – a wetter, more ecologically productive period -- and are common in areas that appear to lack LSA populations in earlier periods. She notes the widespread nature of Oakhurst assemblages, found in Namibia and Zimbabwe, as well as South Africa, Lesotho and Swaziland, which she proposes may be evidence of expanded exchange networks.

Phillipson focuses on microlithisation, which involved "far more economical use of raw material, and the facility to repair or modify tools without resorting to their total replacement" (1993: 99-100), and views regional variation as a means of distinguishing temporal associations and change. He dates the earliest backed microlith industry to approximately 19 000 years ago in eastern Zambia (e.g. Nachikufan assemblages, Kalemba rock shelter), "broadly contemporary" with the Robberg industry of southernmost South Africa (Phillipson 1993: 71). Twelve thousand to 8000 years ago represents a "poorly understood industry" across widely scattered sites from Zimbabwe, Namibia and the Cape, with assemblages containing large scrapers, but noted for an absence of microliths and backed pieces. This was followed by a subsequent proliferation of microlith industries in southern Africa, most of which have unfortunately been labelled ‘Wilton’, which has “helped to obscure the very real differences between most of the assemblages so designated” (Phillipson 1993: 71).

Phillipson sees a correlation between microlithisation at coastal sites and sea levels rising to their approximate current levels and the resumption of exploitation of marine food sources (*ibid.*). He believes backed microlith technology may be related to a shift in hunting smaller, solitary prey found in closed habitats rather than larger, “gregarious herbivores preferred in earlier times” (1993: 100). He also notes exceptions to the proliferation of microlithisation, as in greater parts of the Kalahari, “which seems to have been largely uninhabited from *c.* 9500 until 4500 ka” (Phillipson 1993:71; see also J. Deacon 1974). In general, Phillipson marks “a decrease in artefact size with the passage of time” (1993: 72; see also Phillipson 1977).

Lombard *et al.* (2012: 125) propose an updated Stone Age sequence for South Africa and Lesotho. A summary of their LSA sequence is show in Table 2.3. MIS’s (marine isotope stages) are sometimes used to refer to assemblages that are not securely affiliated to a particular technocomplex, and to place assemblages within a broad time frame (Lombard *et al.* 2012: 125). Their general LSA sequence begins with an unstandardised microlithic industry and bipolar manufacturing up to 18 000 years ago; moves toward systematic microlithisation (e.g. bladelets) with few formal tools up to 12 000 years ago; is followed by a flaked-based industry with scrapers and adzes up to 7000 years ago, which overlaps a fully developed and highly standardised microlithic tradition with high frequencies of formal tools from 8000 to 4000 years ago; ending with a

Table 2.3 Lombard *et al.* updated LSA sequence (summary)

Later Stone Age **< 40 000 years ago**		
South African LSA Technocomplex	Also known as (including regional variants)	General characteristics
ceramic final Later Stone Age < 2000 years ago MIS - 1	ceramic post-classic Wilton, Late Holocene with pottery (Doornfontein, Swartkop)	Contemporaneous with, broadly similar to, final Later Stone Age, but includes ceramics • Economy may be associated with hunter-gatherers or herders • Stone tool assemblages often microlithic • some areas dominated by long end scrapers and few backed microliths; in others formal tools absent or rare • Grindstones common, ground stone artefacts, stone bowls and boat-shaped grinding grooves may occur • Includes grit- or grass-tempered pottery • Ceramics can be coarse, or well-fired and thin-walled; sometimes with lugs, spouts and conical bases; sometimes with decoration; sometimes shaped as bowls • Ochre, OES common • Metal objects, glass beads and glass artefacts also occur
final Later Stone Age 100 – 4000 years ago MIS - 1	post-classic Wilton, Holocene microlithic (Smithfield, Kabeljous, Wilton)	Hunter-gatherer economy • Much variability • Variants include macrolithic (similar to Smithfield [Sampson 1974]) and/or microlithic (similar to Wilton) assemblages • Assemblages mostly informal (Smithfield) • Often characterised by large untrimmed flakes (Smithfield) • Sometimes microlithic with scrapers, blades and bladelets, backed tools and adzes (Wilton-like) • Worked bone, OES, Ochre common • Iron objects rare • ceramics absent
Wilton 4000 – 8000 years ago MIS - 1	Holocene microlithic (Springbokoog)	Fully developed microlithic tradition, numerous formal tools • Highly standardised backed microliths and small convex scrapers • OES, Ochre common • Bone, shell and wooden artefacts occur

South African LSA Technocomplex	Also known as (including regional variants)	General characteristics
Oakhurst 7000 – 12 000 years ago MIS - 1	Terminal Pleistocene / early Holocene non-microlithic (Albany, Lockshoek, Kuruman)	Flake-based industry • Characterised by round, end, and D-shaped scrapers and adzes • Wide range of polished bone tools • Few or no microliths
Robberg 12 000 – 18 000 years ago MIS - 2	Late Pleistocene microlithic	Characterised by systematic bladelet (<26 mm) production and the occurrence of *outils écaillés* • Significant numbers of unretouched bladelets and bladelet cores • Few formal tools • Some sites have significant macrolithic element
early Later Stone Age 18 000 – 40 000 years ago MIS – 2 to 3	Informal designation; Late Pleistocene microlithic	Also known as transitional MSA-LSA • Overlapping in time with final Middle Stone Age • Characterised by unstandardised, often microlithic, pieces and includes bipolar technique • Described at some sites, but not always clear whether assemblages represent real archaeological phase or mixture of LSA/MSA artefacts

hunter-gatherer economy whose assemblages are informal, with macrolithic and microlithic variants, few backed microliths and few formal tools up to 100 years ago – in which a distinct *ceramic final* Later Stone Age falls, dated by the authors as < 2000 years, similar to the period of 4000 to 100 years ago, and noted as a possible hunter-gatherer economy, but with pottery. The general shift toward formal toolkits occurs approximately 8000 years ago, with a reversion to informal toolkits taking place approximately 4000 years ago. The sequence is based on technocomplexes, industries within complexes and phases within both, which are named after or associated with discrete type sites.

Given the problems that may arise when attempting to generally describe lithic changes with overlapping time horizons and/ or regional variations, Orton (2006: Table 2, 2014: Table 2) devised a five-category nomenclature classification sequence for the LSA in South Africa, Lesotho and Swaziland (shown in Table 2.4), avoiding the use of technocomplexes based on type site names.

Table 2.4 Orton LSA sequence

Technocomplex	*Temporal Occurrence*
Early LSA	Pre- 18 000 BP
Late Pleistocene microlithic	19 000 – 9500 BP
Terminal Pleistocene / early Holocene non-microlithic	12 000 – 7000 BP
Holocene microlithic	Post- 8000 BP
Late Holocene assemblages	Post- 3000 BP

Orton (2014: Table 1) provides definitions for ‘microlithic’, ‘non-microlithic’, and ‘macrolithic’ (shown in Table 2.5).

Table 2.5 Size definitions

Assemblage Character	*Flakes*	*Retouched component (if present)*
Microlithic	Vast majority less than about 30 mm long	Flake tools mostly less than 30 mm long, often based on bladelets
Non-microlithic	Generally in range of 30 - 50 mm long, but smaller and larger flakes not uncommon	Flake tools mostly between 30 – 50 mm long
Macrolithic	Mostly > 50 mm long, but smaller flakes occur	Flake and core tools generally greater than about 100 mm long

According to Orton’s LSA sequence (Table 2.4), of note is the transition away from a Late Pleistocene microlithic industry in the Terminal Pleistocene/ Early Holocene and the transition back to a microlithic industry in the Holocene, which includes approximately 2500 years of overlap between 12 000 BP and 9500 BP during which Late Pleistocene microlithic industries were coeval with Terminal Pleistocene/ Early Holocene non-microlithic industries, and approximately 1000 years during which Terminal Pleistocene/ Early Holocene non-microlithic industries were coeval with Holocene microlithic industries. These transitions, which correlate with Deacon and Deacon's temporal divisions (Table 2.2); and Sampson's temporal divisions (Table 2.1), describe a paucity of microliths from 12 000 to 7000 BP. Lombard *et al.* (Table 2.3) refer to the period 12 000 to 7000 BP as 'non-microlithic'. Thus, despite disagreements over classification schemes and the naming of temporal divisions, there seems to be a generally broad agreement among the aforementioned scholars that microlithic industries appeared before approximately 12 000 BP and again approximately after 7000 BP, with a microlith hiatus in the interim.

One possible explanation for the shift away from and subsequent return to certain tool type categories and sizes (e.g. large versus small scrapers), found in Sampson (1974), Deacon and Deacon (1999), Lombard *et al.* (2012) and Orton's (2006, 2014) LSA temporal categories is that southern Africa was experiencing the end of an aridity maximum *c.* 13 000 ^{14}C years ago, followed by a warmer, much moister climate, the Holocene Optimum of rainforest and vegetation *c.* 11 000 ^{14}C years ago, lasting until approximately 8000 ^{14}C years ago. Climate change affected the floral and faunal species in southern Africa and would have presumably necessitated adaptations in toolkits for hunting and gathering (Adams *et al.* 2009: 43-66). (See sections 1.5.1, 1.5.2 for factors influencing lithic technology changes.)

2.3 Developing a model for interpreting later LSA lithic assemblages

Having researched and considered various perspectives on: technological change and lithic assemblages (e.g. Clarkson, Kuhn, sections 1.5, 1.5.1); raw material procurement and changes (e.g. Luedtke; Jeske section 1.5.2); settlement patterns and lithic assemblages (e.g. Binford, section 1.5.3);

defining and classifying the LSA (e.g. various scholars presented in section 2.3); characteristics associated with food producer material records (section 1.6); and cultural and material record implications of hunter-gatherer/ food producer contact and interaction (e.g. Dennell, Alexander, section 1.4.1); I found in the literature what I believed to be an often accepted diachronic perspective of later LSA lithic assemblage changes (based on Smith 1990a, 1995; and Smith *et al.* 1991). I then synthesised this perspective with various scholars who support specific and/or general tenets of Smith (1990b, 1995) and Smith *et al.* (1991).

Cultural and behavioural implications of hunter-gatherer/ food producer contact and interaction were discussed in depth (sections 1.4, 1.6). I focus here on the construct of the testing model. As a heuristic device, and for ease of reference, I refer to this as the *Smith model* (or simply *the model*). The Smith model's general tenet is that hunter-gatherer site artefact assemblages are comprised of more formal tools and fewer traces of pottery; while food producer sites show higher densities of pottery, an informal tool industry with low frequencies of formal tools, and faunal remains of domesticated stock.

The model can be divided into pre-ceramic and ceramic periods, which include: a marked change from formal to informal tools and a change in raw material uses across the hunter-gatherer/ food producer contact and interaction frontier. The *pre-ceramic* phase (before 2000 BP) is associated with lithic assemblages comprised of large scrapers (with a gradual move toward smaller scrapers), backed pieces (e.g. segments, points, bladelets), higher frequencies of formal tools, with retouch focused mainly on scrapers (Humphreys and Thackeray 1983; H.J. Deacon 1992), a proliferation of adzes across southern Africa, and the use of finer-grained materials, such as cryptocrystalline silicates (see Deacon 1984b; Mitchell 2002).

The *ceramic* phase (*c.* 2000 BP) marks a shift in the reduction of backed pieces (e.g. blades), an increase in smaller scrapers, a developed microlith industry, greater use of local raw materials (generally moving from fine to coarse – *c.* AD 1750 according to Beaumont *et al.* 1995), and a gradual reduction of the frequency of formal tools (see Sampson 1974; H.J. Deacon 1992; Beaumont et al. 1995; Mitchell 2002). Terminal LSA assemblages across southern Africa are generally dominated by scrapers (see Deacon 1984b, Lombard *et al.* 2012). According to Sadr (2013) some scholars link the increase in scrapers and the decrease in backed lithics with the ingress of Khoekhoe pastoralists (Beaumont and Vogel 1984; Smith *et al.* 1991; Beaumont *et al.* 1995; *cf*. Parsons 2007). However, Deacon (1984b: 323) notes that "…sites where both pre- and post-pottery/ domestic stock assemblages occur show no significant difference in the stone artefacts through this sequence".

Wadley (1996), Hall and Smith (2000), Sadr (2002) and van Doornum (2005) agree that the composition of hunter-gatherer lithics (e.g. the frequencies of scrapers and backed lithic items) changes with the extent to which hunter-gatherers interacted with food producers. Kent (1992, 2002), Sadr (1997, 2002), van der Ryst (1998) and van Doornum (2005) point to the inclusion of exotic or non-indigenous material items at hunter-gatherer sites as evidence of these interactions

Smith's interpretations of the LSA often come from characteristics and patterns that he has derived from sites in the Western Cape (e.g. Smith 1986); and Smith and colleagues (Beaumont, P.B., Meterlerkamp, W., Mills, G., Morris, A.G., Mussgnug, U., Penn, N., and Vogel, J.), in Smith's (ed.) 1995 "Einiqualand", draw many of their conclusions and perceived patterns from sites associated with the Orange River Valley. Smith describes pre-2000 BP as pre-ceramic, but defines two, distinct post-2000 BP ceramic industries: the *Swartkop* (Beaumont and Morris 1990), associated with hunter-gatherers “found mostly away from the river”, whose lithic assemblages contain many formally retouched tools; and the *Doornfontein* (Beaumont and Morris 1990), associated with herders “focused on the river”, whose lithic assemblages have few formal tools (Smith 1995: 300).

The faunal remains component of the Smith model general tenet (p. 54) is problematic for Deacon and Deacon, specifically related to the period between 1800 and 300 years ago. They explain (1999: 183-184) that the Western Cape sites excavated by Smith, with assemblages containing high frequencies of formal tools, few or no sheep bones, and low frequencies of pottery, are assumed (by Smith) to have been occupied by hunter-gatherers; but that “this pattern does not seem to hold for all sites... formal tools occur with relatively large numbers of sheep bones and potsherds at Die Kelders and Byneskranskop”, which Deacon and Deacon explain as being unclear whether the two latter sites were occupied by hunter-gatherers or herders (Deacon and Deacon 1999: 183-184).

Their argument, however, does not contradict the Smith model general tenet. The model does not exclude sheep faunal remains from hunter-gatherer sites, nor does it exclude formal tools from existing in a food-producer assemblage. The latter is generally agreed upon to be of lower frequency. Deacon and Deacon (1999: 184) state that Beaumont and Morris (1990) “have shown a consistent correlation between their microlithic Swartkops industry and backed bladelets and...hunter pottery, and between their Doornfontein informal industry and herders”. Deacon and Deacon also mention that “Boomplaas Cave in the Cango Valley was certainly used by herders”...and “there are few formal tools” (1999: 184).

In general, scholars supporting and synthesised into the Smith model, agree on the pre-ceramic (before 2000 BP) and ceramic (after 2000 BP) temporal divisions, and the shift across the pre- to post-ceramic horizon away from higher frequencies of formal tools. I also believe that between the model-inclusive scholars a broad agreement on temporal divisions (pre- and post-ceramic) and the differences between hunter-gatherer and food producer lithic assemblages has been established.

Of interest and particularly relevant to this study are alternative views on the term *formal tool,* in an otherwise *sensu latiore* agreement on later LSA lithic assemblage characteristics. J. Deacon (1972) defined formal tools as artefacts that possess secondary working intended to produce a functional and/or standardised form. The classification of a lithic item as *formal* is often broadly encompassing, including “all artefacts with deliberately flaked retouch and in this context includes scrapers, adzes, backed tools (segments, backed bladelets, borers) and miscellaneous retouched pieces” (Deacon *et al.* 1978: 47).

The broad definition of *formal tool* (e.g. Deacon *et al.* 1978) is challenged by Close and Sampson in their 1998 report on backed microliths from eight rock shelters in the Seacow Valley. In the report, they question whether backed microliths (e.g. bladelets) were finished (i.e. formal) tools, or the non-tool by-products of lithic manufacturing. The authors explain (1998: 71) that the assumption that backed microliths were finished tools has resulted in “increasingly elaborate tool-management models which predict variations in microlith output, driven by such factors as hunter-gatherer range, mobility and curation strategies”.

They use the spatial distribution of the studied microliths to indicate a potential problem in morpho-type classification. The backed pieces they studied were not random in distribution. Only tanged arrowheads and awls occurred consistently outside dense debitage, while the ‘overwhelming majority’ of other backed pieces were consistently located in the dense debitage surrounding manufacturing stations. They conclude by suggesting that ‘much of the backed microlith data available to archaeologists pertains to waste', i.e. not to finished tools (Close and Sampson 1998: 71).

Keeley, however, using data from his microwear analysis of artefacts from the Verberie site in the Paris Basin (France), indicates potential problems when using spatial distribution to interpret lithic assemblages. "Spatial patterns are static distributions" and only by understanding the dynamics can we understand the patterns (Keeley 1991: 258).

He explains (*ibid.*) that the prehistoric 'cleaning up' of domestic areas and the disposal of waste will affect how artefacts are entered into the archaeological record. He adds that this is further complicated by the duration of occupation of a site. Longer occupations mean more cleaning up of domestic areas and, therefore, more disposal of waste (e.g. discarded tools). His main concern, however, is the retooling of hafted artefacts, explaining that once-hafted tools "accumulate where they were replaced in hafts, not necessarily where they were used...[whereas] unhafted tools tend to accumulate at or closer to the loci of their last use" (Keeley 1991: 258).

From a morphological classification perspective, Close and Sampson's (1998) findings may indicate a potential problem with the broadly encompassing term *formal tool* (e.g. Deacon *et al.* 1978). Alternatively, from a combined microwear and dynamics perspective, Keeley's (1991) findings indicate potential problems with interpretations of the spatial patterning of lithics (e.g. Close and Sampson's conclusions) and, due to the nature of the method (microwear), indirectly challenge the meaning of *formal tool*, and more generally, the term *tool* (see also section 1.8, p. 43, Ford/ Spaulding debate).

While the aforementioned two perspectives are based on different analytical approaches that yielded different results, they both nevertheless indicate, directly or by inference, potential problems with the use and/ or definition of *formal tool.* Yet, having examined the lithic data from a number of southern African LSA sites, and having commonly seen in archaeological literature (e.g. section 2.2), I note that the backed pieces mentioned by Close and Sampson are conventionally classified as formal/ finished/ utilised or simply otherwise *tools*, not waste (see also section 1.8).

I also note, with respect to Keeley's study, that morphological classification is dominant in the interpretation of lithic assemblages, and well entrenched in the literature, and I suspect will remain so until other methods (e.g. microwear, residue analysis, etc.) are more extensively used and the data from these methods become available. I, therefore retain the conventional terminology for the purposes of the application of the Smith model to the selected LSA test sites' lithic assemblages.

Constituent characteristics of the model

Synthesising the scholarly perspectives that construct the Smith Model, the trends moving from pre-ceramic to post-ceramic periods, in which pre- and post contact periods occur, include: a) lithic assemblages that reflect a decrease in the diversity of tools; b) a gradual reduction in the frequencies of formal tools; c) a gradual decrease in the use of finer-grained materials (e.g. cryptocrystalline silicates) and a gradual increase in the use of coarser materials (e.g. quartzite); and d) an increase in scraper frequencies, while segments and other backed pieces decrease – suggesting, perhaps, that knives and arrows were being produced for hunting and the dressing of hides. Adzes and planes for working wood and bone may also be present. An increase in pottery at hunter-gatherer sites is a potential indicator of the extent to which they interacted with food producers.

Continuities or changes noted in the frequencies of scrapers, raw materials and the diversity and types of stone tools across later LSA pre-ceramic and ceramic periods, in which pre- and post-contact periods occur, may imply cultural and behavioural continuities or changes that could assist in proving or disproving my hypotheses (see section 1.6.1, Table 1.1), and will aid in evaluating the applicability and usefulness of the Smith model in interpreting later LSA lithic assemblages.

Evaluating the model's construct

Through adaptation and synthesis, I constructed what I believe is an accepted morphological typing model for interpreting later LSA lithic assemblages. My next step was to test the applicability and usefulness of the model. Applicable and useful means: a) the model can be used in interpreting later LSA lithic assemblages from varying archaeological sites; and b) there will be a reasonable degree of similarity between the model and the characteristics of the lithic assemblage to which the model is applied.

Basic terminology

Later LSA is to be understood *sensu* Orton's (2006) post-3000 BP Late Holocene, to maintain chronological relevance to this study, and to eliminate potential biases that may result from scholarly disagreements on type-site named industries and characteristics. I define *reasonable degree* as polythetic (i.e. sharing a number of characteristics which occur commonly in members of a group) – similar to the way that Lombard *et al.* (2012: 124) use polythetic as 'having many but not all properties in common' in their definition of 'technocomplex'.

2.4 Selecting sites for testing the model with respect to Holkrans

Finding sites and associated lithic assemblages that are highly comparable to Holkrans is currently improbable. Holkrans remains to date the only excavated LSA shelter site in the Vredefort Dome – a unique eco-geologic feature on the African continent (see Ch. 4). Inter-site comparison, however, was necessary for determining the applicability and usefulness of the model.

Site selection criteria

The best alternative was to apply the model to a selection of polythetically comparable later LSA sites whose lithic assemblages represented both pre- and post contact periods. I framed the selection process broadly enough to avoid overlooking reasonable comparisons, yet specifically enough to exclude the disparate, according to the following criteria: a) sites are shelters with archaeological evidence of LSA usage/ occupations; b) later LSA shelter usage periods are broadly comparable to those thus far known for Holkrans (see Table 4.1); c) like Holkrans, shelter function shows 'residential/ mapped on' (Binford 1980) characteristics; d) shelter lithic assemblages include the *c.* pre-2000 BP/ post-2000 BP horizon up to the terminal/ near present (i.e., in which both pre- and post-contact periods occur).

Application of the model is not intended to be an all-inclusive analysis of potentially comparable sites nor the entirety of a particular site's LSA lithic assemblage record (see [b] and [d] above; see also sections 1.6.1, 1.6.1b and 1.7). It is rather intended to be a brief, but in-depth and meaningful test of the model applied to representative shelters and their associated later LSA lithic assemblages from among a number of shelters that may meet the aforementioned criteria. The final selection of shelters was based upon: a) varying geographic locations, which include two coastal access or near coast sites and two inland sites; b) varying eco-geologic zones or regions (rationale: inter-site variations in raw materials and variations in stone tool adaptations to microclimates may be revealed); c) the potential for inter-site variations in the nature and impact of contact between hunter-gatherers and food producers: two sites relate to contact between hunter-gatherers and pastoralists (San and KhoeKhoe), the other two relate to contact between hunter-gatherers and agro-pastoralists (San and Bantu), (rationale: a wider range of contact circumstances and results to which Holkrans can be compared; a more refined understanding of the nature and impact of contact at Holkrans); and e) the author finds the selected shelters and their geographic locations and eco-geologic settings particularly interesting.

Chapter 3 presents the application and inter-site comparison of the model to: coastal access sites *Geduld*, Kunene Region, Namibia, and *Witklip*, Western Cape Province coast, South Africa, and inland sites *Roosfontein*, Gumtree area, eastern part of Free State Province, South Africa and *Clarke's Shelter*, Cathedral Peak State Forest, KwaZulu-Natal, South Africa.

Application of the model to the Holkrans lithic assemblage and comparison of the Holkrans results to Chapter 3 applications and inter-site comparisons are presented in Chapter 4.

CHAPTER 3

Inter-site application of the Smith Model

3.1 Introduction

This introduction section presents terms used in this thesis which may require further clarification for a better understanding of the interpretations of the application of the model to the selected site assemblages.

Residential **and** ***logistical***

I use Binford’s (1980) *residential* and *logistical* terms (discussed in section 1.5.3) in this study, rather than terms of *aggregation* and *dispersal* (e.g. as developed by Conkey 1980 and used by Wadley 1986). The defining and understanding of the latter rely heavily on San ethnography. (For cautions on the use of ethnography see: Trigger 1984: 276; Zvelebil and Fewster 2001: 154; Humphreys 2007: 98; Finlayson 2009: 176.) Binford’s *residential* and *logistical* strategies allow for both to coincide and may be viewed as two parts of a whole acting in tandem, rather than discrete phases of life (e.g. public/ aggregation versus private/ dispersal).

Debitage, ***waste***, **and unmodified stone pieces**

Unretouched or minimally retouched stone may serve as effective tools, with low investment of time and energy. They are also potentially limited to a short usage life and narrower range of tasks. Unworked edges may be fragile and easily damaged (Cowan 1999). Attempting to classify unmodified debitage is subjective. There is no standard by which to measure whether an unmodified piece was intentionally produced and intended to be used in the same way as a modified tool (although functional analysis can provide information on actual use). It is also problematic to classify all unmodified pieces as manufacturing by-products or waste/ discarded pieces. Debitage may be seen as flexible in potential use. Yet there is disagreement as to what should be categorised as debitage or waste (e.g. see section 2.3: 55-59), and disagreement on the broader categorisation of stone pieces. I therefore retain the stone classifications designated by the relevant scholars for each of the shelters discussed in this chapter.

Model application sites and ^{14}C dates

For relevance and inclusion of ^{14}C dates, see section 2.3: *Evaluating the model's construct*, and section 2.4. For site selection criteria and choices, see Ch. 2, section 2.4.

Statistical analyses

To demonstrate whether or not there is significant difference between pre-ceramic and ceramic stone assemblages at each site, results are provided from statistical analyses of *formal tools* (FT). The data used in the analyses are derived from each site's stone assemblage table, and are needed for the application of the Smith model. Continuities or changes in three formal tool categories (scrapers, backed pieces and 'other' formal tools) will assist in testing the usefulness and applicability of the model. Analysis results for two additional categories, waste and unretouched pieces and other stone, are provided for a more complete understanding of the stone assemblages.

The analyses use $\chi^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$ to determine whether or not there is a relationship between pre-ceramic and ceramic categorical values, and whether or not the outcomes are occurring in frequencies that would indicate significant changes. The conventional rule of the Chi-Square test is that the *expected* frequency values will be > 5, a convention from a time when calculations 'were exceedingly tedious and error-prone. Now that we have...computers, it's time to retire the expected less than 5 rule' (McDonald 2014: 41-43). McDonald however advocates pooling similar data (*ibid.*), which is shown in tables with chi-square test results. Pooling or collapsing similar data into appropriate categories will be used throughout the remainder of this thesis when applicable (i.e. when doing so will not skew results).

With the aforementioned terms and analytical procedures explained, I turn now to the presentation and discussion of the selected comparative sites and their lithic assemblages.

3.2 Geduld shelter

The site (20°17’ S, 15°50’ E) is a rockshelter above the north bank of the Ugab River, in the Outjo constituency of the Kunene Region, Namibia (Smith and Jacobson 1995: 4) (Fig.3.1). The geological setting is described as part of the Damaraland igneous province, with igneous intrusions and Damara granite intrusions, soils of medium to low fertility, major ephemeral rivers, in a watershed area, with productive fractured (geologic term) to moderately productive aquifers and little ground water (Mendelsohn 2002: 36-67). The vicinity’s ecological setting is described as a mixed mopane savanna, mountain savanna, and Karstveld and Damaraland thornveld, which provides good pasture and water conditions, even in dry seasons, due to aquifer retention in the Ugab valley (Wellington 1967: 60; Smith and Jacobson 1995: 4).

Game in the vicinity, before historic fencing off projects disrupted migration routes, included: large numbers of springbok, ostrich, zebra, gemsbok kudu, duiker, steenbok, lion, leopard, cheetah, wild dog and jackal (Köhler 1959:72). The high frequencies of lions in the area would have posed threats to pastoralists, and were still considered problematic up to the 1950’s (Smith and Jacobson 1995: 4).

Excavations, stratigraphy and ^{14}C dates

Excavations were undertaken between 1978 and 1986 under the supervision of Leon Jacobson. Eight, 1 m^2 pits were sunk to a maximum depth of one meter, using arbitrary 3 cm spits and natural stratigraphy

(Smith and Jacobson 1995: 4). Figures 3.2 and 3.3 illustrate the site plan and stratigraphy respectively.

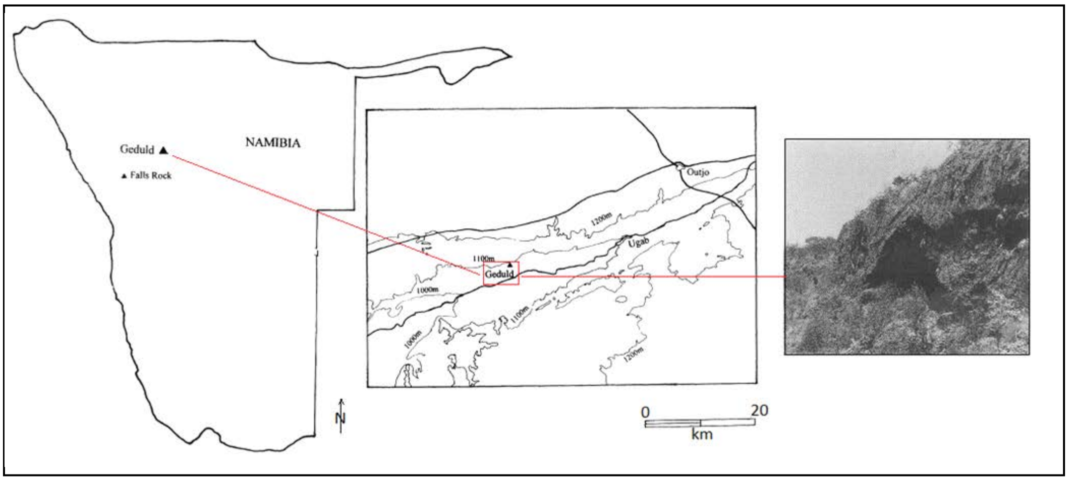


Fig. 3.1 Map location of Geduld (images Smith and Jacobson 1995, modified)

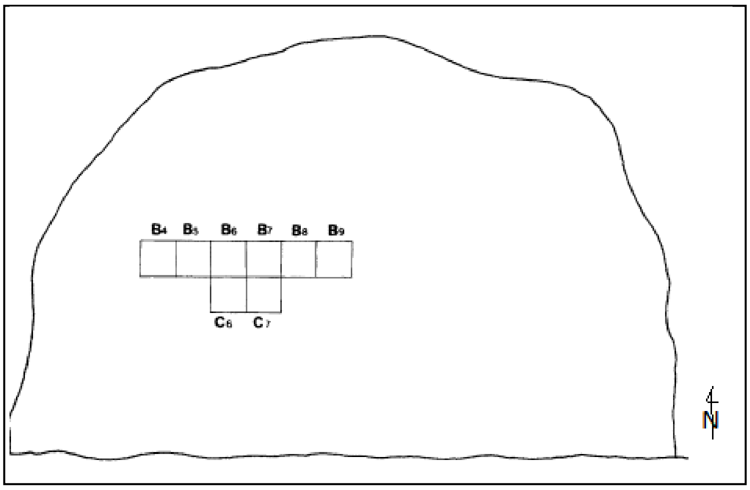


Fig. 3.2 Geduld site plan, squares = 1 m^2 (image Smith and Jacobson 1995) Shelter dimensions are approximately 18 m wide by 11 m deep.

The stratigraphy ‘consisted of layers of soft ash interspersed with organic bedding material (often burnt) and brown sterile soils and occasional consolidated dung layers’ (Smith and Jacobson 1995: 4).

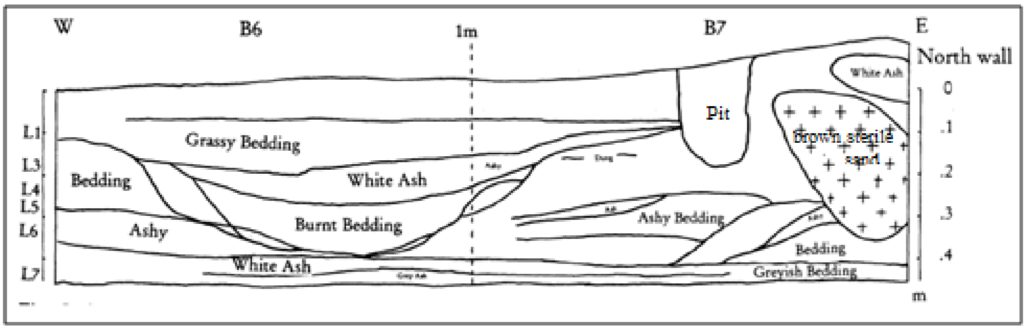


Fig. 3.3 North wall stratigraphy (image Smith and Jacobson 1995)

The obtained ^{14}C dates are presented in Table 3.1. Smith and Jacobson (1995: 6) explain that level 4 (not dated) should be associated with lower level clusters and suggests a (non-^{14}C) date of approximately 1790 BP. They further suggest that, while there is no direct proof, the medium-size bovids from levels 7 (1980 ± 50 BP [Pta-4413]) and 8 (1970 ± 40 BP [Pta-5875]), could be sheep, and that “the introduction of ceramics coincided with the first appearance of domestic stock around 2000 BP” (*ibid*.).

Table 3.1 Geduld ^{14}C dates

Dates ^{14}C BP	*Notes*
Ceramic associated: 800 ± 50 BP (Pta-4416) 1790 ± 80 BP (Pta-4419)* 1790 ± 50 (Pta-2720) 1980 ± 50 (Pta-4413) *Pre-ceramic:* 1970 ± 40 (Pta-5875) 2090 ± 45 (Pta-5871) 2040 ± 50 (Pta-5873) 2110 ± 60 (Pta-4414) 2300 ± 50 (Pta-5872)	All obtained from charcoal, except (*) *obtained from dung, isotope analysis revealed a mixed C_3/C_4 diet;; was compared to modern sheep and modern goat dung, differences from sample and modern comparisons interpreted as (unspecified animal) was ‘browsing’ not grazing (Smith and Jacobsen 1995: 6) Pottery first appears in Level 7, 1980 ± 50 BP (Pta-4413). Medium size bovid remains (sheep size) appear in levels 7 and 8 (1970 ± 40 BP [Pta-5875]); sheep bone identification does not appear until level 4 (undated); Level 5 yielded a 1790 ± 80 BP (Pta-4419) date obtained from dung.

Cultural material – non lithic

Bone items include one bone point, long bone fragments, a notched bone, a fragment of a tortoise carapace with a polished rim, and part of a tortoise shell with ochre on the interior and exterior. *Ostrich eggshell* is represented by 262 finished and 94 unfinished beads, which increase in diameter and opening width over time. *Marine shell* is represented by a few shell fragments and one shell bead (Smith and Jacobson 1995: 7-10).

Pottery artefacts include 910 sherds, 69 of which, including 34 rims, have impressed decoration. The authors describe the pottery as well-fired and being mostly thin-walled, from which they conclude that the technology was brought in from the outside. *Iron* items include one small triangular blade, one flat spatulate, and one blunt-end tip (*ibid.*). There are no ^{14}C dates directly associated with the iron artefacts, but dates of *c.* 800 BP or later can be inferred from known ^{14}C dates and excavation descriptions (*ibid.*).

Other Organic remains include four seed beads strung on fibre (no direct, but an inferred dates of post 1970 BP), six small pieces of two-ply rope, three of which were knotted (in top four levels, from which dates of post 1790 BP may be inferred), a reed shaft with fibre wrapping (no direct, but inferred dates *c.* 800 BP or later), a wooden point with rounded base (inferred dates of post 1790 BP, given ^{14}C date of 1790 ± 80 (Pta-4419) for same pit, one level below), a piece of resin, and six small pieces of leather (associated with levels for which ^{14}C dates are known of 1790 ± 80 (Pta-4419), 1790 ± 50 (Pta-2720), and 1980 ± 50 (Pta-4413) (*ibid.*).

Faunal remains include small Damara dik-dik (*Madoqua kirkii*), common duiker (*Sylvicapra grimmia*), hartebeest (*Alcelaphus buselaphus*), and steenbok (*Raphicerus campestris*). Larger bovid bones recovered could not be identified as particular species. Recovered sheep remains (consisting of one talus bone, one second phalange, one upper pre-molar, and two first phalanges) are associated by Smith and Jacobson with a ^{14}C date in a nearby excavation unit of 1790 ± 50 (Pta-2720). Marine mammal remains include seal phalanges (unusual in the area). Non-mammalian faunal remains include tortoise shell, ostrich eggshell, francolin, guinea fowl, dove, and the bone of a monitor lizard (*Varanus niloticus*). Remains from twenty-four plants were recovered, sixteen of which have been identified at species level. Most plants were food sources. The remainder are suggested to have been part of the occupants' pharmacopeia, or used in craft work (e.g. the reed plant *Phragmites australis*) or as tick and flea prevention (e.g. *Thramnosa africana*) (Smith and Jacobson 1995: 9-11).

Cultural material – lithics

Smith and Jacobson report that 99.2% of the 23,828 excavated stone items consists of waste materials and cores. Formally retouched stone tools represent only 0.3%, and include a variety of forms shown in Table 3.2. They note a higher frequency of formal tools in lower levels than in upper levels (1995: 7). Following their description, this may be marked at pre-ceramic levels associated with ^{14}C dates of 2300 ± 50 (Pta-5872) and 1970 ± 40 (Pta-5875), and ceramic levels with ^{14}C dates of 1790 ± 50 (Pta-2720) and 800 ± 50 BP (Pta-4416).

However, they explain a 'consistency in formal tool frequency' in upper levels which 'contrasts markedly' with the scarcity of retouched pieces in the lower pre-ceramic levels (e.g. one segment and one scraper). The authors see no cultural break between pre-ceramic and ceramic layers, but remark that a 'definite resurgence of retouched microliths... seems to coincide with the appearance of ceramics' (*ibid.*). They further add that specularite was used for decorative purposes (e.g. one specularite pendant) and found only in ceramic associated levels, while ochre was found throughout the sequence. Of note, they suggest that the single radial core was a recycled Middle Stone Age (MSA) piece (Smith and Jacobson 1995: 7).

Raw material components (only briefly treated in authors' excavation reports) are derived from Mendelsohn's (2002) geologic description of the area and Kinahan's (1984: 13-27) report on Falls Rock Shelter (14º35' E, 21º10' S), the latter of which is used throughout Smith and Jacobson (1995) for comparison, and is similar to Geduld in mixed eco-geologic makeup, overlooking an ephemeral Hungarab tributary. Fine-grained materials (e.g. basalt, hornfels, vein and crystal quartz, and CCS) reflect greater than 99% of materials used in lithic manufacturing throughout the sequence. Coarse-grained materials (e.g. granite, quartzite) reflect less than one percent throughout the same sequence (see Table 3.1).

Smith's (2008: 55), description of Western Cape hunter and pastoralist lithic assemblages explains that hunters preferred finer-grained materials (e.g. silcrete), while pastoralists 'ignored [it], even when it was freely available on the surface', choosing quartzite, for example. Both groups used quartz, but hunter-gatherer quartz lithics showed high degrees of retouch (*ibid.*). If indeed comparable to Falls Rock, as Smith and Jacobson (1995) note, Geduld hunter-gatherers preferred finer-grained materials in formal tool manufacturing throughout the known later LSA sequence and only infrequently used coarser materials.

See Table 3.2 for the Geduld stone assemblage components. Smith and Jacobson (1995) state that 'there was no significant change in the stone tool industry with the introduction of ceramics' (*ibid.*: 11) and 'the stone tool industry remains similar before and after the introduction of both ceramics and stock, indicating cultural continuity in the upper Brandberg and Geduld' (*ibid.*: 12), which they compare to Smith *et al.'s* (1991) similar findings in Western Cape small rock shelters.

Table 3.2 Geduld stone assemblage

Category		Subdivisions (see Table 3.1)	
Waste and unretouched pieces		*Pre-ceramic*	*Ceramic*
Chips	19481	5877	13604
Chunks	1397	329	1068
Flakes	2314	555	1759
Blades	160	42	118
Cores	263	120	143
Pièces esquillées	13	6	7
Total:	23628	6929	16699
% of stone assemblage	99.2%	29.3%	70.7%
Formal tools		*Pre-ceramic*	*Ceramic*
Scrapers	6	2	4
Backed blades	8	0	8
Backed points	9	1	8
Segments	28	5	23
Misc. backed pieces	12	2	10
Misc. retouched pieces	4	0	4
Adzes	1	0	1
Total:	68	10	58
% of stone assemblage	0.3%	0.05%	0.25%
Other stone items		*Pre-ceramic*	*Ceramic*
Manuports	2	0	2
Hammerstones	7	1	6
Grindstones upper	4	0	4
Grindstones lower	2	0	2
Flaked cobbles	2	0	2
Polished shale	5	5	0
Soapstone	3	0	3
Radial core	1	1	0
Specularite	87	0	87
Ochre	19	5	14
Total	132	12	120
% of stone assemblage	0.6%	0.05%	0.5%
Total all	*23828* *100%*	6951 29.2%	16877 70.8%

Statistical analyses

The result of the chi-square test for formal tools (as explained in section 3.1) is shown in Table 3.3. There appears to be no significant difference between the pre-ceramic and ceramic formal tool assemblages ($0.2805 > p < 0.05$).

Table 3.3 Formal tools pre-ceramic/ ceramic changes
Table 3.2 formal tool data pooled into (3) categories for model application

Formal Tools (FT)

Observed	pre-ceramic	ceramic	total	*Expected*	pre-ceramic	ceramic
scraper	2	4	6	scraper	0.8824	5.1176
backed	8	49	57	backed	8.3824	48.6176
other FT	0	5	5	other FT	0.7353	4.2647
	10	58	68		10	58

χ2 test:	*Count*	*Rows*	*Cols*	*df*
	68	3	2	2
			Alpha	*0.05*
		chi-sq	*p-value*	*significant*
		2.5423	0.2805	no

However, chi-square test results derived from the data in Table 3.2, show that there is a statistically significant difference between pre-ceramic and ceramic periods ‘waste and unretouched pieces category’ (2.027^10^{-19} < p < 0.05). This is may be largely due to the increase in frequency of chips in the ceramic period. Plausible explanations for this increase are: a) curation of tools on site; b) lithic manufacturing on site followed by tool transport and loss/ disposal elsewhere; c) manufacturing technique (e.g. bipolar percussion produces more debitage). Any one or all of these might satisfactorily explain a significant increase in chips in the ceramic period without a significant increase in ceramic period stone items found at the site.

There is also a significant difference between pre-ceramic and ceramic ‘other stone’ assemblage items, including specularite (6.21^10^{-13} < p < 0.05) or omitting specularite (0.0053 < p < 0.05) – using Dixon’s *Q*-test for outliers, where *Q*=gap/range ($Q = 0.8589 > 0.568 = Q_{99\%}$).

Table 3.4 presents an alternative format of the information shown in Table 3.3 in order to assist with the application of the Smith model.

Table 3.4 Nuanced data for application of model

Table is normalised for each phase (pre-ceramic and ceramic) to 100% for each row.

	Scrapers	*Scrp %*	*Backed*	*Bck %*	*Oth. FT*	*Other %*	*Formal*	*FT %*
ceramic	4	6.9	49	84.5	5	8.6	58	100
pre-c.	2	20.0	8	80.0	0	0.0	10	100
Total	6		57		5		68	

There is a percentage decrease in scrapers, while backed and other formal tools show an increase. However, the small sample size does not provide a reliable basis for interpretation, and the chi-square test result suggests that there is no significant difference in the formal tool category in the pre-ceramic and ceramic periods. Smith and Jacobson's (1995: 11 - 12) observation that the Geduld stone tool industry is similar before and after the introduction of both ceramics and livestock is a justifiable description of Geduld's pre-ceramic and ceramic period stone assemblages.

Application of the Smith Model

Table 3.5 presents the interpretation of the application of the model to the later LSA Geduld lithic assemblage and, more broadly, to the later LSA occupations of the shelter.

Table 3.5 Model applied to Geduld

(Ch. 2, pp.54, 59)

Specific tenets	*yes*	*no*
Decrease in diversity of tools		✓
Reduced frequency of formal tools		✓
Increase in scraper frequency	✓	
Decrease in segments / backed pieces		✓
Shift from fine to coarse raw materials		✓
Adzes, planes may be present	✓	
General tenets	*yes*	*no*
More formal tools		✓
Low frequencies of pottery	✓	

The Geduld lithic assemblage does not readily conform to the model. While some tenets of the model hold true, others do not. In the strictest sense, the model is not *reasonably applicable* to Geduld. However, the model was *useful* in an unexpected way. The lack of applicability provided important insights. The results of the test indicate a lack of change between the pre-ceramic and ceramic periods, which is noteworthy.

Discussion

Smith and Jacobson (1995: 12-13) explain that the cultural continuity seen in the stone assemblage suggests ‘the overlay’ of pottery and livestock onto a hunter-gatherer economy. The authors point to the introduction of ceramics and livestock *ca.* 1800 years ago, and ask if the occupants of Geduld were: 1) fully-fledged pastoralists, or rather 2) hunter-gatherers ‘on the periphery’ of pastoral communities, as the origin of the ceramics and livestock are ‘unknown’. They further add that limited numbers of stock (sheep) would not prevent the shelter occupants from continuing a primarily hunter-gatherer way of life (*ibid.*).

While the first (number 1 above) is possible, the paucity of livestock remains, the relative abundance of indigenous faunal remains, and the wide range of botanical remains seem to indicate that the second (number 2 above) is more likely true. The ‘introduction of livestock’ (*ibid.*) is based on identified sheep remains (1 bone, 3 bone segments and 1 pre-molar) associated with (non-species identified) ^{14}C dated 1790 ± 80 BP (Pta-4419) dung (revealing a diet that *included* mixed C_3/C_4 plant foods) from a nearby excavation unit. I do not view the few sheep remains and dung as compelling evidence for suggesting that the shelter occupants were engaged in more than some form of exchange or, as an alternative perspective, the theft of stock.

The seal phalanges, tortoise carapace, and marine shell suggest some form of contact with or knowledge of the coast, if only through indirect exchange. The few iron items (see *Cultural material – non-lithic*) and non-hunter-gatherer pottery (of which only sherds remain) or other non-traditional hunter-gather material items could have been exchanged and/ or scavenged.

The nature of occupations appears to have been residential, rather than logistical. The material record contains an elaboration of items associated with various activities and aspects of life (e.g. subsistence, ritual/ exotica). Viewed through the lens of Dennell's possible scenarios for hunter-gatherers and food producers in a static frontier (see Fig. 1.1), Geduld shelter occupants appear to have experienced contact and interaction in an *open* (symbiotic or parasitic) way. Using my hypotheses on contact and subsequent interaction (see Table 1.1), the material assemblage at Geduld seems to reflect an ongoing 'pioneer phase', but lacks indications of evolution beyond this phase (e.g. substitution and consolidation).

Mitchell (2002: 246) writes that Geduld "went out of use by 700 BP", explaining that "stone huts and enclosures superseded rock shelters as choice settlements...'. His reference is to the Hungorob area (> 200 km flying distance from Geduld) and Hungorob sites 'dating 450-150 BP' (*ibid.*) The excavator-authors, however, do not suggest a terminal date for occupation/ use, only that Geduld occupants continued their hunter-gatherer way of life on the periphery of pastoralist groups (Smith and Jacobson 1995: 13). It would be speculative to suggest when the shelter fell into disuse or why – the reasons for which may be various and numerous (e.g. adoption of new subsistence practices, inter-marriage with non-hunter-gatherers, conflict, eviction, etc.).

3.3 Witklip shelter

Witklip shelter (32°55'1" S, 17°59'1" E) (Fig. 3.4) is perched above the peninsular town of Vredenburg on a large granite intrusion (Smith *et al.* 1991: 71), approximately 10 km from the coast. The peninsula is surrounded by the bays of St. Helena (north) and Saldanha (south) in the Western Cape Province. Cape Town is approximately 100 km southeast. The ecological setting is in part of the Fynbos biome, which includes the mountains of the Cape Fold Belt and adjacent coastal forelands, in the south-western corner of the sub-continent. The area has plentiful year-round rainfall. Dominant vegetation is schlerophyllous shrub and heathland, similar to the Mediterranean, with wide varieties of plant species, insects and larger animals. Geophytes, fish, shellfish and tortoise would not have been uncommon staples in pre-historic diets. Cape grysbok (*Raphicerus melanotis*), steenbok (*R. Campestris*), and common duiker (*Sylvicapra grimmia*) are common 'browsing species' in the area (Mitchell 2002: 22-23, 188). (Faunal remains recovered at Witklip are discussed further in *Cultural material – non-lithic*.)

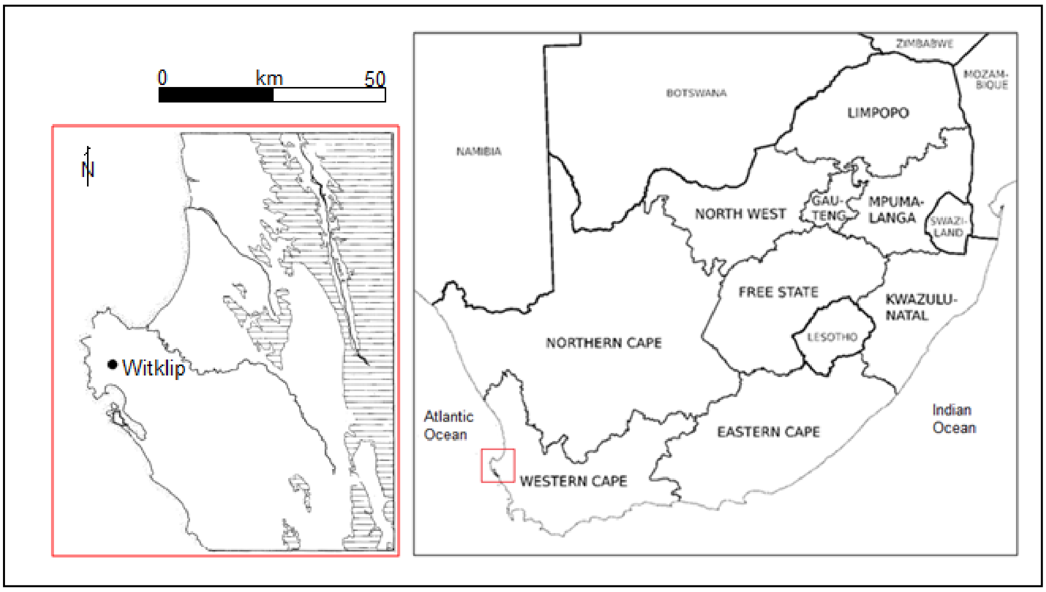


Fig. 3.4 Map location of Witklip

Excavations, stratigraphy and ^{14}C dates

Initial excavation of one, 1 m^2 pit (F1) was undertaken in 1987. Two additional 1 m^2 pits (I1, J1) were excavated in 1990. All pits were sunk to a depth of 'more than a meter'. I note a maximum depth of approximately 1.3 m, and removed contents were sifted through a 3 mm mesh sieve

(Smith *et al.* 1991: 71). Figures 3.5 and 3.6 illustrate the site plan and stratigraphy.

The authors describe the matrix as ‘a shell midden’ with interspersed ashy layers, and gypsum accumulation in some levels, resulting in ‘speckling’. They attribute the brown compact soil near the top to termites. The top 3 cm were omitted from samples submitted for ^{14}C analyses due to what appeared to be disturbance caused by dune moles (*ibid*.: 72).

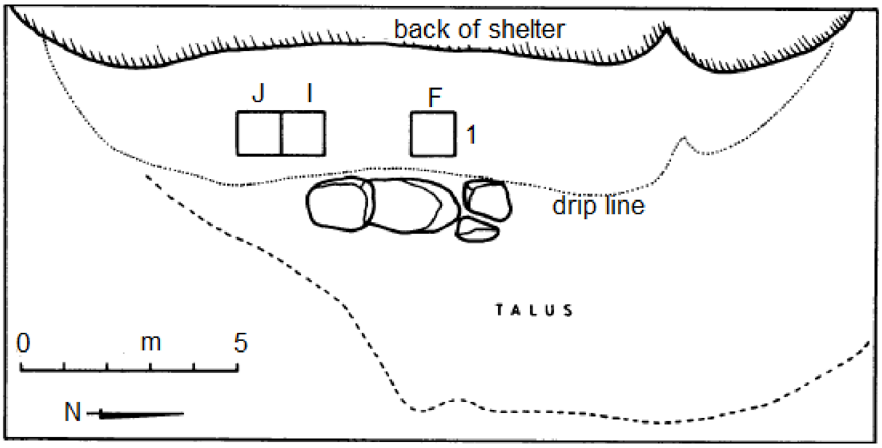


Fig. 3.5 Witklip site plan (image Smith *et al.* 1991, modified) The shelter is approximately 15 m wide and 3 m in depth.

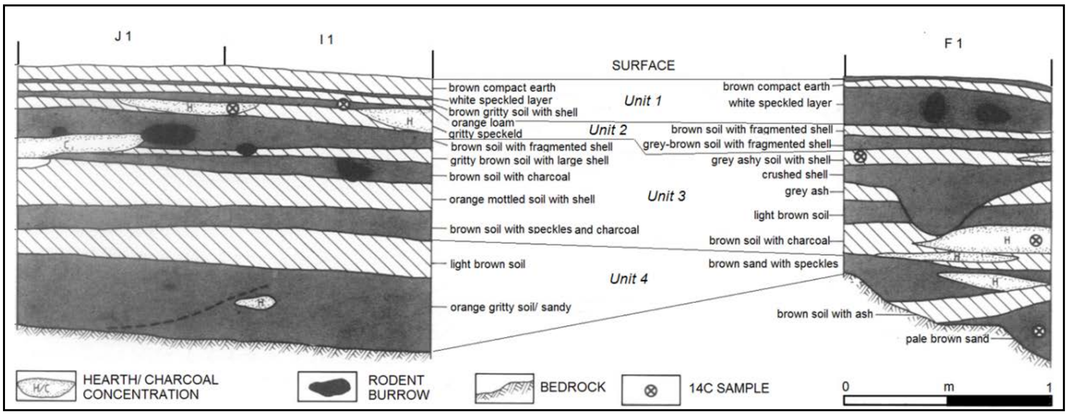


Fig. 3.6 West wall stratigraphy (image Smith *et al.* 1991, modified) Stratigraphic layers were combined into four units based on ^{14}C dates (Smith *et al.* 1991: 71). See Table 3.6.

Brown soil with fragmented shell and grey-brown soil with fragmented (both pit F1) shell are undated and are included in Unit 2. The total number of pottery sherds recovered was twenty-seven, from Units 1, 2 and 3. Smith *et al.* (1991: 73) note that the small number does not allow for analysis of change through time.

Table 3.6 Witklip ^{14}C dates

Dates ^{14}C BP		*Notes*
Ceramic associated		*Pottery sherds n=27*
500 ± 50 BP (Pta-5469)	Unit 1	Pit I-1, depth 12-15 cm, orange loam, 9 sherds
330 ± 45 BP (Pta-5467)	Unit 2	Pit I-1 , depth 15-30 cm, hearth below orange loam, 5 sherds
1380 ± 50 BP (Pta-4608) 1860 ± 50 BP (Pta-4609)	Unit 3	Pit F-1, depth 40 cm grey ashy soil with shell
Pre-ceramic 3060 ± 60 BP (Pta-4607)	Unit 4	Pit F-1, depth 80 cm, hearth below light brown soil, Unit 3 – 13 sherds

Cultural material – non-lithic

Bone is represented by: a polished bone tube with two incisions on each side found at a depth of 31 cm in brown soil with fragmented shell (Pit I-1, border of Units 1 and 2); a bone awl found at a depth of 71.9 cm in sandy soil (Pit J-1, Unit 4); a broken bone awl found at a depth of approximately 30 cm in orange loam (Pit I-1, border of Units 1 and 2); and a worked bone fragment found at a depth of approximately 60 cm in orange mottled soil with shell (Pit I-1, Unit 3) (*ibid.*: 74).

Pottery, represented by the twenty sherds found in Units 1-3, with a mean thickness of 6.3 mm), contain two diagnostic pieces, found in levels associated with Unit 3 – both rims, each with a lip. Smith *et al.* add that the sherds conform to the Kasteelberg (38°48'8" S, 17°56'8" E) ceramic sequence (*ibid.*: 73), 12 km north of Witklip. Sadr and Smith (1991: 111-112) explain that the two diagnostic sherds, both with bevelled lips, are ‘of lower KBB and KBA types'. Lower KBB and KBA decorative motifs are primarily shell-edge stamped. Sadr and Smith nevertheless note that decorated sherds are 'a rarity' in both lower layers (*ibid.*: 108).

Other organic materials represented include an oblong abalone (*Haliotis midae*) pendant with a hole at one end and notched sides (from Pit J-1, Unit 3); a sea snail shell (*Bullia laevissima*) pendant with top removed (from Pit F-1, Unit 3); two (non-specified) perforated marine shell pendant fragments (from Pit F-1, Unit 4); and 20 surf clam (*Donax serra*) shells, three of which (from Unit 3) had 'the characteristic flaked edge, indicating their use as scrapers' (Smith *et al.* 1991: 74). Ostrich eggshell remains include a 15 mm diameter 'water container mouth' (from F-1, Unit 3) and 144 'small' beads, of which only some had been perforated and a few had traces of red ochre (*ibid.*).

Faunal recoveries include sixteen mammalian species, such as dune mole rat (*Bathyergus suillus*) and honey badger (*Mellivora capensis*), but the authors state that small bovids (cf. *Raphicerus*) represent the majority (62.5% of number of identified species, 37% minimum number of individuals) (*ibid.*). A remarkable faunal constituent is that of African buffalo (*Syncerus caffer*), which Smith *et al.* explain (1991: 75) 'has not been previously identified from late Holocene sites in this part of the south-western Cape'. A 'small number' of sheep bones and grey duiker were recovered from Unit 3 of Pits I-1 and J-1, but the authors write that they cannot be sure which of the two dominated (*ibid.*). Few seal remains are present, despite the 10 km proximity to the coast. Among *shellfish*, of the 2165 shells recovered, over 51% are mussels and over 43% are limpet, which the authors write is consistent throughout the sequence (*ibid.*).

Cultural material – lithics

Smith *et al.* (1991: 72) write that 'over half the lithic raw materials are quartz, with a further 27% in silcrete'. Silcrete, however, was used for

73.9% of the 178 formal tools (Tables 3.7 and 3.8), the largest number 71 (40.3%) are adzes, followed by 37 (21%) convex scrapers.

Table 3.7 Witklip stone assemblage

Category		Subdivisions (See Table 3.8)	
Waste and unretouched pieces		*Pre-ceramic*	*Ceramic*
Chips Chunks Flakes Blades — Smith *et al.* (1991: 73) *categorised as debitage*	2902	658	2244
Cores	68	15	53
Pièces esquillées	40	13	27
Total:	3010	686	2324
% of stone assemblage	86.5%	19.7%	66.8%
Formal Tools		*Pre-ceramic*	*Ceramic*
Convex scrapers	37	13	24
Backed scrapers	18	4	14
Endscrapers	3	1	2
Backed blades	6	2	4
Backed points	2	0	2
Segments	4	0	4
Misc. backed pieces	15	5	10
Misc. retouched pieces (MRP)	19	0	19
Drills	1	0	1
Adzes	71	12	59
Retouched flakes	2	0	2
Total: 178		37	141
% of stone assemblage	5.2%	1.1%	4.1%
Other		*Pre-ceramic*	*Ceramic*
Grindstones upper	1	0	1
Ochre	289	48	241
Total:	290	48	242
% of stone assemblage	8.3%	1.3%	7%
Total all	3480 100%	771 22.2%	2707 77.8%

Three of the seventy-four cores recovered were bladelet cores. Backed pieces include: 6 (3.4% of formal tools) backed blades, 4 (2.3%) segments, 2 (1.1%) backed points and 16 (9.1%) backed scrapers – found throughout the sequence (*ibid:* 72-73). Other stone assemblage items include 289 pieces of ochre (8.2% of total stone recovered), consistent throughout the sequence, and an ochre stained upper grindstone (Smith *et al.* 1991: 73).

Table 3.8 Witklip stone assemblage raw materials

Category	Quartz		Silcrete		CCS		Granite		Quartzite		Other	
Subdivisions*	PC	C	PC	C	PC	C	PC	C	PC	C	PC	C
Waste and unretouched pieces	417	1485	180	569	1	7	0	7	1	6	59	170
Cores	8	31	7	19	0	1	0	0	0	0	0	2
Pièces esquillées	11	23	2	3	0	1	0	0	0	0	0	0
Total: 3010	436	1539	189	591	1	9	0	7	1	6	59	172
Formal Tools												
Conv.	9	15	4	9	0	0	0	0	0	0	0	0
Scraper	0	1	4	13	0	0	0	0	0	0	0	0
Bck. Scraper	0	0	1	2	0	0	0	0	0	0	0	0
Endscraper	1	0	1	4	0	0	0	0	0	0	0	0
Bck. Blade	0	0	0	2	0	0	0	0	0	0	0	0
Bck. Point	0	3	0	1	0	0	0	0	0	0	0	0
Segments	1	5	4	5	0	0	0	0	0	0	0	0
Misc. backed	0	5	0	13	0	0	0	0	0	0	0	1
MRP	0	0	0	1	0	0	0	0	0	0	0	0
Drill	0	0	0	1	0	0	0	0	0	0	0	0
Adze	1	2	11	54	0	2	0	0	0	0	0	1
Retouched flk	12	31	25	108	0	2	0	0	0	0	0	2
Total:178												
Other												
Grindstn. Up	0	0	0	0	0	0	0	0	0	0	0	1
Ochre											48	241
Total: 290											48	242
Σ_{total} 3480 % (pc/ c subdivisions)	Σ 448 % 22.2	Σ 1570 % 77.8	Σ 214 % 23.4	Σ 699 % 76.6	Σ 1 % 0.1	Σ 11 % 99.9	Σ 0 % 0	Σ 7 % 100	Σ 1 % 14.3	Σ 6 % 86.7	Σ 107 % 20.5	Σ 416 % 79.5
% of **total** assemblage	Quartz 58.1%		Silcrete 26.2%		CCS 0.3%		Granite 0.2%		Quartzite 0.17%		Other 15.08%	
% of formal tools	25.3%		72.5%		1.1%		0		0		1.1%	

PC=Pre-ceramic, C=ceramic; percentages for pc/ c subdivisions standardised to 100% for each raw material type to observe change in each material type between pc/ c.

Quartz and silcrete (by half) dominate the raw materials in the assemblage. However, as Smith *et al.* (1991: 72) explained, silcrete represents greater than 70% of materials used in the manufacture of formal tools. Finer-grained materials are seen in vast majority throughout the sequence, representing greater than 90% of all raw materials recovered from both pre-ceramic and ceramic periods.

Statistical analyses

Despite a visually perceived difference, there is no significant difference between pre-ceramic and ceramic periods waste/ debitage and unretouched pieces (0.335195 > p < 0.05). There is also no significant difference between time periods for the two items (upper grindstone, ochre) in 'other' stone (0.6555 > p < 0.05). Table 3.9 presents the results of analysis on formal tools (as in section 3.2).

Table 3.9 Formal tools pre-ceramic/ ceramic changes

Formal Tools (FT)						
Observed	pre-ceramic	ceramic	total	*Expected*	pre-ceramic	ceramic
scraper	18	40	58	scraper	12.0561	45.9438
backed	7	20	27	backed	5.6124	21.3876
other FT	12	81	93	other FT	19.3314	73.6685
	37	141	178		37	141
χ2 test:		*Count*	*Rows*	*Cols*	*df*	
		178	3	2	2	
				Alpha	*0.05*	
			chi-sq	*p-value*	*significant*	
			7.6425	0.0219	yes	

There is a significant difference between the pre-ceramic and ceramic formal tools assemblages (0.0219 < p < 0.05). Percentage changes in categories (Table 3.10) show a decrease in scrapers and backed pieces, and an increase in other formal tools from pre-ceramic to ceramic periods.

Table 3.10 Nuanced data for application of the model

	Scrapers	*Scrp %*	*Backed*	*Bck %*	*Oth. FT*	*Other %*	*Formal*	*FT %*
ceramic	40	28.4	20	14.2	81	57.4	141	100
pre-c.	18	48.6	7	19.0	12	32.4	37	100
Total	58		27		93		178	

Shown in Table 3.7, adzes account for a large portion (42%) of the *other formal tools* percentage (Table 3.10) in the ceramic period, suggesting an increase in activities such as woodworking. It is plausible that such an increase is related to food procurement strategies (e.g. digging up geophytes and/ or in the manufacture of microlith hafts for hunting), which could have been due to changes in climate and food supply, an increased population, or both.

Application of the Smith Model

Table 3.11 presents the interpretation of the application of the model to the later LSA Witklip lithic assemblage and, more broadly, to the later LSA occupations of the shelter.

Table 3.11 Model applied to Witklip

(Ch. 2, pp.54, 59)

Specific tenets	*yes*	*no*
Decrease in diversity of tools		✓
Reduced frequency of formal tools		✓
Increase in scraper frequency	✓	
Decrease in segments / backed pieces		✓
Shift from fine to coarse raw materials		✓
Adzes, planes may be present	✓	
General tenets	*yes*	*no*
More formal tools	✓	
Low frequencies of pottery	✓	

The Witklip lithic assemblage does not readily conform to the model. Some tenets of the model hold true, others do not. In this sense, the model is not *reasonably applicable* to Witklip.

Discussion

Smith *et al.* (1991: 86-90) explain that Witklip is significant for several reasons: a) a sequence spanning the last 3000 years; b) one of the best dated sequences in the south-western Cape; c) an evident cultural package associated with hunter-gatherers; and d) a site representing a continued hunter-gatherer economy at least up to colonial occupation sometime in the early to mid 1600's. The cultural package mentioned by the authors is noted for 'microlithic stone tools (mostly in silcrete), small ostrich eggshell beads, Donax scrapers and a predominance of hunted animals (particularly small bovids, such as *Raphicerus* spp.)' (*ibid*.: 86-87).

The authors provide convincing evidence that 'the people who used the shelter were part of the same cultural tradition that continued throughout the occupation up to the beginning of the new colonial period' and that these people were hunter-gatherers (*ibid.*) (e.g. high incidence of small bovid remains, and differences in the lithics, ostrich eggshell bead sizes and ceramic frequencies of hunter sites versus sites with domesticated stock). Lower frequencies of pottery and more formal tools are associated with hunter-gatherers, while fewer, less formal lithics and higher ceramic frequencies are associated with food producers. Smith *et al.* (1991: 87) explain that such low frequencies of pottery at Witklip suggest that the occupants were not potters, in fact used few pots, and probably obtained their pottery from groups like those represented at Kasteelberg (see *Cultural material – non-lithic*, this section).

Continuity of a hunter-gatherer lifeway at Witklip well into the colonial period is plausible, based upon the data and analyses presented prior to this discussion. Smith *et al.* (1991), however, appear to have difficulty in presenting, or perhaps agreeing upon, their interpretations of Witklip occupants and the material record. In their discussion of ostrich eggshell beads, for example, they state that 'the early pottery period bead assemblage...represents a preference for beads of small size...which can be traced back into pre-pottery times' (p. 87), and 'beads smaller than 5.5 mm in diameter... with holes less than 2 mm remain an important component of... Witklip Units 1 & 2 assemblage (*c.* 40%) (*ibid.*). Of note: they offer this as further evidence that the same people are responsible for the pre-ceramic and ceramic (through terminal) occupations of the shelter (*ibid.*). The authors explain (p. 89) that 'small beads show continuity from the earlier pre-pottery period through to the onset of the colonial period', while large beads in the Witklip upper units are 'indicators' of a one-way exchange: Witklip hunter-gatherers received larger beads from 'herders', but gifts (of smaller beads) were not reciprocated, based upon 'insignificant numbers of small beads in the herder assemblages' (*ibid*). This refers to further comparisons with Kasteelberg sites and to a seasonal mobility pattern between hunters and herders that Smith proposed (1984: 140) where foragers 'would replace herders at the coast in serial fashion once they had moved inland from their winter/spring pastures'.

The nature of occupations appears to have been residential. The faunal remains (including sheep) indicate at least knowledge of and some interaction with pastoralists in the area. The material record contains an elaboration of items associated with various activities and aspects of life. The shell items (some of which are presumed to have been used as tools) and shellfish remains suggest a logistical foraging strategy at the coast, rather than Witklip being used as the logistical, non-residential site.

Among Dennell's possible scenarios (see Fig. 1.1), Witklip shelter occupants appear to have experienced contact and interaction in an *open* (symbiotic or parasitic) way, although sheep remains and large (gifted) beads as noted by Smith *et al*. (1991), would seem to suggest symbiotic, rather than parasitic (i.e., no need for hunter-gatherers to steal stock, despite Smith *et al.'s* (1991: 90) conclusion that hunter-gatherers were relegated to the fringes of pastoralist society). The hunter-gather/

pastoralist relationship seems, nevertheless, to have been hierarchical (*ibid.*: 89). Using my hypotheses on contact and subsequent interaction (see Table 1.1), the material assemblage at Witklip seems to reflect an ongoing ‘pioneer phase’, with aspects of ‘substitution’ appearing, but without ‘consolidation’ (i.e., the complete elimination of a hunter-gatherer lifeway in the new colonial era). It appears that, as Smith *et al.* (1991) ultimately conclude, Witklip hunter-gatherers continued their cultural and behavioural practices up to the early colonial period (*ibid*.: 86). There is no conclusive information indicating a terminal period or abandonment of the shelter.

3.4 Roosfontein

Roosfontein shelter (28°49’ S, 27°44’ E) is located near Ficksburg in the Gumtree area of the eastern part of the Free State Province. The shelter faces north, affording plentiful sun, with a stream passing near the north-western corner (Klatzow 1994: 9) (see Fig. 3.7).

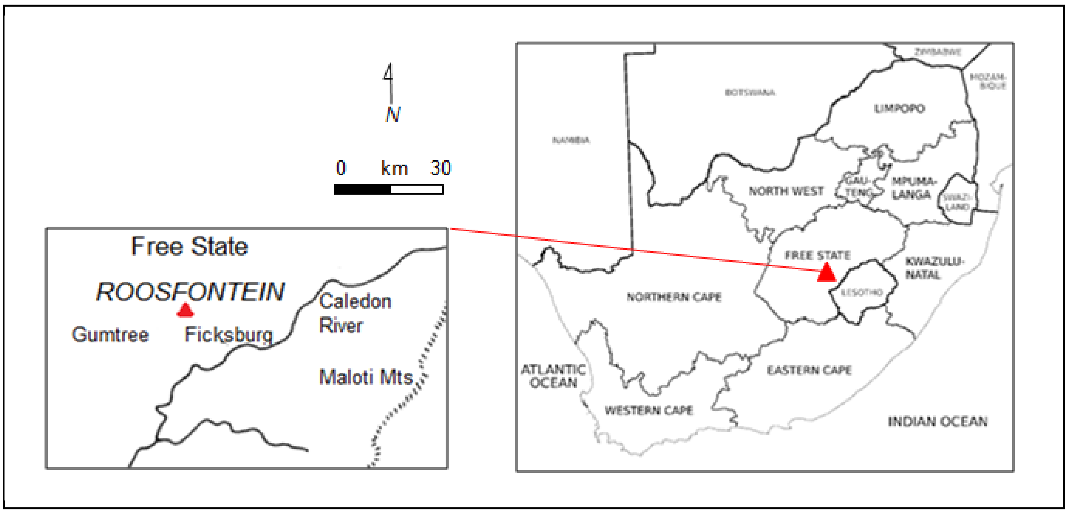


Fig. 3.7 Map location of Roosfontein

The Maloti (also *Maluti*) Mountains in Lesotho, part of the Drakensberg system, extend 100 km into the Free State. Roberts (1968: 261) describes the partially mountainous geology of the area, an overlay of the Drakensberg, Stormberg and Beaufort series, as having dolerite dykes and low dolerite hills and small flat-topped sandstone ranges in the south; sandstone cliffs overlain with basalt in the southeast, and undulating limestone and red sand, with heavier soils and high surface runoff, drained in central and south parts by the Orange, Vaal and Caledon rivers.

The ecological setting of the shelter is in a Highland Sourveld (humid grassland) and Themeda Veld transition zone bordered by what is currently part of the Grassland Biome (formerly Acocks [1953] False Upper Karoo) (Mentis and Huntley 1982: 2). Short dense grassland and scrub forest in sheltered ravines are characteristic (Roberts 1968: 247-249).

Excavations, stratigraphy and ^{14}C dates

Klatzow focused 1994 excavations of a 3 m x 4 m area in the centre of the shelter labelled RM (Fig. 3.8). She identified three stratigraphic layers: a surface layer of loose, brown soil; a compacted, fine soil grey ashy layer; and a lower light grey, compacted ashy/ rocky layer which proved to be difficult to excavate (*ibid.*: 10). Figures 3.8 and 3.9 illustrate the 1994 site plan and stratigraphy.

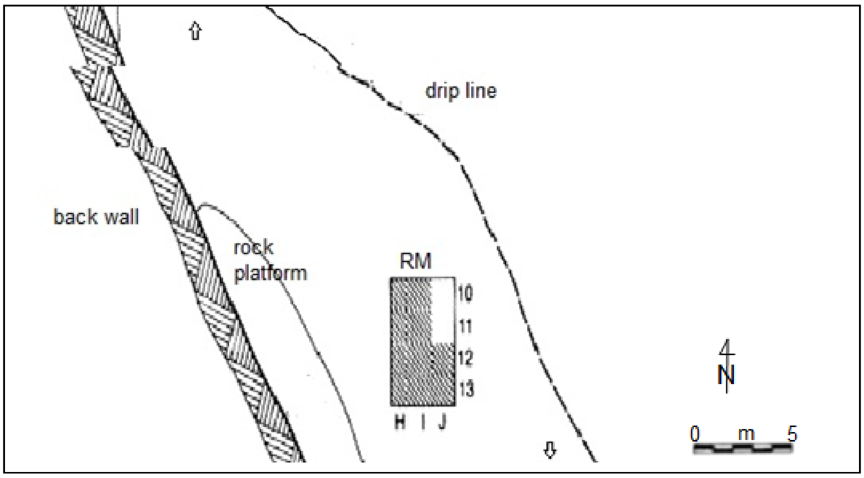


Fig. 3.8 Roosfontein site plan (image Klatzow 1994, modified)

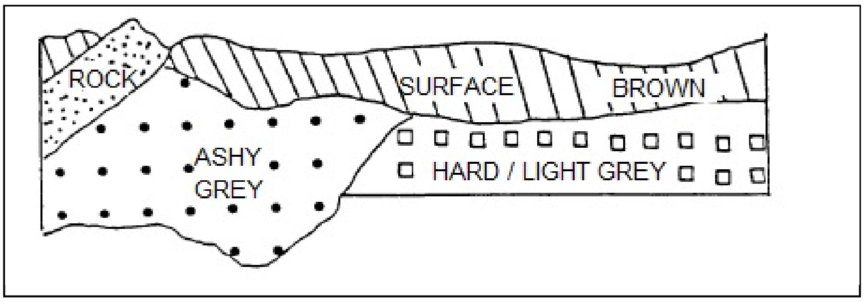


Fig. 3.9 south section, H-13 (image Klatzow 1994, modified)

The shelter is relatively large, 60 m wide and 10 m in depth. Two 14C dates were obtained from charcoal: a pre-pottery level date of 1920 ± 60 BP (Pta-5932) at 20 cm deep, and a pottery-associated date of 1290 ± 50 BP (Pta-5931) at 4 cm deep (Klatzow 1994: 10). What makes Roosfontein interesting and potentially important are the pre- and post pottery associated dates, the lithic assemblage, and the interpretations of contact with non-hunter-gatherers and subsequent interactions (see Cultural material – non-lithic, Cultural material -- lithic and Discussion sections).

Cultural material – non-lithic

Faunal remains from the shelter include wildebeest (*B. connochaetes*), eland (*B. taurotragus*), impala (*Aepyceros melampus*) and bovid remains that could only be identified as to size, thus allowing for the possibility of domestic stock (Klatzow 1994: 13-14). Wadley (1995: 576) writes: ‘organic preservation at the site is poor, which may explain why no ostrich eggshell or worked bone is present’. She adds that ‘faunal remains are scarce and highly fragmented’. She is, however, enthusiastic about the stone assemblage (see Cultural material – lithic). Klatzow (1994: 13) confirms the state or organic materials by explaining that preservation of bone was poor and ‘most of the bone remains were undiagnostic’.

There are over fourteen plant species in the immediate shelter vicinity, ten of which have been identified to species level (e.g. *Olea africana, Euclea crispa, Heteromorpha trifioliata*). Plant remains, mostly from trees and shrubs, were identified from charcoal analysed by A. Esterhuysen, and correspond to those which grow near banks of rivers and streams (*ibid*.). Tyson and Lindesay (1992: 276) suggest regular temperature changes of alternately warmer and cooler periods every 200 to 300 years over the last 2000 years in southern Africa. They explain a noticeable change in the environmental conditions near Clarens (in the foothills of the Maluti Mountains, approximately 80 km east / south-east of Roosfontein) *ca.* AD 1350, during the 'Little Ice Age'. Klatzow explains that ‘fairly mesic conditions prevailed through time [at Roosfontein]’ and that the non-temperature specific plant species at the shelter do not indicate temperature changes and have remained similar over the last 2000 years (Klatzow 1994: 14).

Recovered pottery pieces include 213 sherds (94% grit tempered, 6% grit with some grass tempered), of which 201 are body sherds and 12 are rim sherds, with a mean thickness of 6-8 mm. One hundred twenty-six sherds (59%) were recovered from the brown ‘surface’ level; seventeen sherds (8%) from the ‘hard light grey’ compacted second level; and seventy sherds (33%) from the ‘ashy grey’ level. Grit temper occurs throughout the sequence. Grit with grass occurs only in the ashy grey and surface levels (*ibid.*: 12-13). C. Thorp analysed the sherds. All are undecorated, unburnished and ‘buff brown-grey in colour’ (*ibid.*: 12). Thorp (1996: 60) writes, ‘no diagnostic agro-pastoralist sherds and no ochre burnished fragments were found’.

Klatzow (1994: 13) explains that the pottery associated date of 1290 ± 50 BP (Pta-5931) is early for this eastern part of the country. An early date at Roosfontein, however, may be supported by early dates for pottery levels from sites in Lesotho and Natal. These eastern sites show pottery pre-dating the arrival of Iron Age (IA) agriculturalists by 400 years (Mazel 1992: 3). Mazel analysed pottery from nine eastern sites, showing early dates for pottery, from which he concluded that pottery in this eastern part of the country may have been introduced as early as 2100-2200 BP. He also notes (*ibid.*: 5) that the earliest IA pottery from the eastern area has a mean thickness of 21.3 mm, compared to 7-8 mm from Stone Age sites. This places Roosfontein's (mean 6-8 mm thickness) pottery in Mazel's early pottery, pre-agriculturalist category.

Cultural material – lithic

Wadley (1995: 576) writes: 'Roosfontein contains a rich stone industry dominated by small, convex scrapers and small end-struck flakes made on opaline.' She adds that 'bladelets, borers and bifacially pressure-flaked bladelets are present in all levels and tanged arrowheads in surficial levels'. Klatzow (1994:11) notes that formal tools in the assemblage (see Table 3.12) were manufactured primarily from opaline, 'including agates and chalcedonies' from 'nodules washed down by the Caledon river... approximately 10 km from Roosfontein rock shelter'.

Opaline (*sensu ampliore*) was the preferred raw material throughout the sequence, representing greater than 90% of all formal tools. Scrapers represent 61% of the formal tool assemblage in the pre-ceramic period and 39% in the ceramic period. Of interest is the bifacially pressure-flaked tanged arrowhead, which 'was not found in a datable context' (Klatzow 1994: 12) in the ceramic associated period. 'Few arrowheads have been found in datable contexts' (*ibid.*). Humphreys (1991: 42) suggests that arrowheads were first produced *ca.* 1500 BP, and adds that the distribution of tanged arrowheads is limited to the central interior: Free State, Lesotho and the northern area of the Cape Province. The tanged arrowheads may indicate cultural markers and that surface level occupation(s) post-date 1500 BP.

Table 3.12 Roosfontein stone assemblage

Category		Subdivisions	
Waste and unretouched pieces		*Pre-ceramic*	*Ceramic*
Chips	3651	2339	1312
Chunks	1267	637	630
Flakes	972	511	461
Blades	11	8	3
Cores	155	30	125
Total:	6056	3525	2531
% of stone assemblage	95.2%	55.4%	39.8%
Formal tools		*Pre-ceramic*	*Ceramic*
Scrapers	153	94	60
Backed bladelet	8	5	3
Misc. backed	1	0	1
Bifac. press. flk. bladelet	4	1	3
Bifac. press. flk. arrowhead	1	0	1
Bifac. press. flk. tanged arrowhead	1	0	1
Adzes	9	3	6
Spokeshave	17	10	7
Awl	1	0	1
Borer	5	4	1
Misc. retouched (MRPs)	8	3	5
Recycled MSA tool (sic)	1	1	0
Total:	210	121	89
% of stone assemblage	3.3%	1.9%	1.4%
Other		*Pre-ceramic*	*Ceramic*
Ochre	93	80	13
Total	93	80	13
% of stone assemblage	1.46%	1.26%	0.2%
Total all	6359	3726	2633
%	100%	59%	41%

Statistical analyses

There is a significant difference between pre-ceramic and ceramic periods 'waste and unretouched pieces category' (7.05^$10^{-41} < p < 0.05$). This is largely due to the decrease in frequency of chips in the ceramic period. One possible explanation for a decrease in formal tools from pre-ceramic to ceramic periods is that tools were being maintained/ curated, and that loss and disposal were being minimised. The frequency of cores in the ceramic period suggests that lithic manufacturing was not being abandoned in favour of other materials and technology. No iron is present, and the arrowheads suggest knowledge of an advanced lithic manufacturing strategy. Later shelter occupation lithic production may have taken place away from the shelter. Table 3.13 presents the statistical analysis results for formal tools.

Table 3.13 Roosfontein formal tools pre-ceramic/ ceramic changes

Formal Tools (FT)

Observed	pre-ceramic	ceramic	total	*Expected*	pre-ceramic	ceramic
scraper	94	60	153	scraper	88.7333	65.2666
backed	6	7	13	backed	7.4904	5.5095
other FT	21	22	43	other FT	24.7761	18.2238
	121	89	210		121	89

χ2 test:	*Count*	*Rows*	*Cols*	*df*
	210	3	2	2
			Alpha	*0.05*
		chi-sq	*p-value*	*significant*
		2.7953	0.2471	no

There is no significant difference between the pre-ceramic and ceramic periods formal tool assemblages (0.2471 > p < 0.05). Table 3.14 shows the nuanced data in percentages.

Table 3.14 Nuanced data for model application

	Scrapers	*Scrp %*	*Backed*	*Bck %*	*Oth. FT*	*Other %*	*Formal*	*FT %*
ceramic	60	67.4	4	4.5	25	28.1	89	100
pre-c.	94	77.7	5	4.1	22	18.2	121	100
Total	154		9				210	

While there is a percentage decrease in scrapers, and percentage increases in backed pieces and other formal tools, the changes are not statistically significant. This suggests continuity in activities and behaviours from pre-ceramic to ceramic periods.

Application of the Smith model

Table 3.15 shows the interpretation of the model applied to the later LSA Roosfontein lithic assemblage and more broadly to the later LSA occupations of the site. Among the *specific tenets*, the model was partially applicable, in that half of the tenets hold true, while the remaining half do not. The general tenets of the model hold true.

Table 3.15 Model applied to Roosfontein

(Ch. 2, pp.54, 59)

Specific tenets	*yes*	*no*
Decrease in diversity of tools		✓
Reduced frequency of formal tools	✓	
Increase in scraper frequency		✓
Decrease in segments / backed pieces	✓	
Shift from fine to coarse raw materials		✓
Adzes, planes may be present	✓	
General tenets	*yes*	*no*
More formal tools	✓	
Low frequencies of pottery	✓	

Discussion

Klatzow (1994: 14) writes that the ^{14}C date of 1290 ± 50 (Pta-5931) BP date associated with grit-tempered pottery suggests contact with pastoralists, albeit early, as she explains (*ibid.*: 9) that ‘between the sixteenth and the eighteenth centuries, there was a southward movement of Bantu-speaking, mixed agriculturists across the Vaal River’ who ‘moved into the eastern Orange Free State and came into contact with hunter-gatherers in that area’. She does not believe that the ceramic bearing deposit or the formal tools and ceramics associated with this early date are the result of non-anthropogenic depositional forces (e.g. trampling, bioturbation, etc.). This leads her to conclude that the early arrival of pottery and livestock in the area were due either to bartering with agriculturalists ahead of their arrival, or an exchange system with herders during seasonal moves (*ibid.*) – technology and goods spreading faster than or ahead of migrating people.

Klatzow notes that if pastoralists and/or agriculturalists were in / migrating into the area *ca.* AD 770, based on the1290 ± 50 (Pta-5931) BP date, the hunter-gatherers at Roosfontein were not restricted by the new arrivals. A high percentage of formal tools were manufactured on opaline – the origin of which was likely the Caledon River approximately 10 km from the shelter (*ibid.*). She further notes that the stone tool assemblage 'does not exhibit any major changes' between pre- and post-contact periods (*ibid.*). The possible exceptions are the arrowheads, which Klatzow suggests may coincide with hunter-gatherer pastoralist contact and a reaction to stress in the form of intensified ritual activity (see Parkington *et al.* 1986), with the arrowheads serving as a form of *hxaro* (*ibid*.).

The migration of Bantu agriculturalists into the area (16th-18th centuries) described by Klatzow appears to have led to a period of cooperation between the new arrivals and the hunter-gatherers, until conflict in the early nineteenth century (Klatzow 1994: 14). Campbell (1987: 96) explains that especially the San in the Caledon River Valley were engaged in the conflicts (wars and continuous Korana raids) during the 1820's and 'suffered accordingly' (see also Ellenberger 1969). Klatzow, however, does not see evidence of this in the Roosfontein archaeological record (Klatzow 1994: 14). She notes (*ibid.*: 9) that the lack of pastoralist evidence in the shelter's material record makes it difficult to determine the timing, nature and impact of contact.

The nature of the occupation appears to be residential. The elaboration of items in the shelter's lithic assemblage indicates a diverse toolkit for a variety of activities of everyday life. The eco-geologic setting would afford logistical strategies to be employed (e.g. the Caledon River within 10 km of the shelter), particularly if the mobility of the hunter-gatherers remained unimpeded after the arrival of food producers.

Viewed through Dennell's interaction dendrogram (Fig. 1.1), it appears that the hunter-gatherers at Roosfontein lived in a static or partially open/ symbiotic frontier – at least for some time, but without indications of regular interaction. Using my hypotheses for contact and subsequent interaction (Table 1.1), Roosfontein hunter-gatherers experienced an extended 'pioneer phase' of contact and subsequent interaction. Although not evident in the Roosfontein material record, if Campbell is correct about the indigenes' involvement in and suffering from the 1820's conflicts, then according to my hypotheses, the shelter's occupants would have enjoyed a brief 'substitution' phase followed by rapid 'consolidation', during which their hunter-gatherer lifeway would have been eliminated. The archaeological evidence, however, makes it speculative to suggest anything other than a continued hunter-gatherer lifeway at Roosfontein until the shelter fell into disuse, possibly as late as the early 20th century.

3.5 Clarke's Shelter

Clarke's Shelter (29° 01'15" S, 29° 18'58" E) is a north-northwest facing open rockshelter, located in the southern portion of Cathedral Peak State Forest, KwaZulu-Natal (see Fig. 3.10), with a mostly all-day sun view of the Mhlwazine Valley, on a tributary of the Mhlwazine River, which joins the Mlambonja, a tributary of the Tugela (Mazel 1984: 17). Situated in the Clarens Formation, 'a lower Jurassic stratigraphic unit, forming the uppermost part of the Stormberg Group of the Karoo Supergroup in south-central Africa' (Catuneanu *et al.* 2005: 211), the site, at an altitude of 1768 m, is near the top of *Protea* savanna, with Mountain *Podocarpus* Forest in the valley base directly below the shelter (Mazel 1984:17). Occupants of the shelter would have had access to the sub-alpine and Fynbos grassland, Mountain *Podocarpus* Forest, *Protea* Savanna and Themeda Highland grassland. Cable (1982: 88-89) writes that spring and summer in the highland sourveld 'was a time of peak resource productivity with abundant plant foods, particularly the corms of various species of

Iridaceae, large aggregations of antelope and seasonal spawning runs of freshwater fish'.

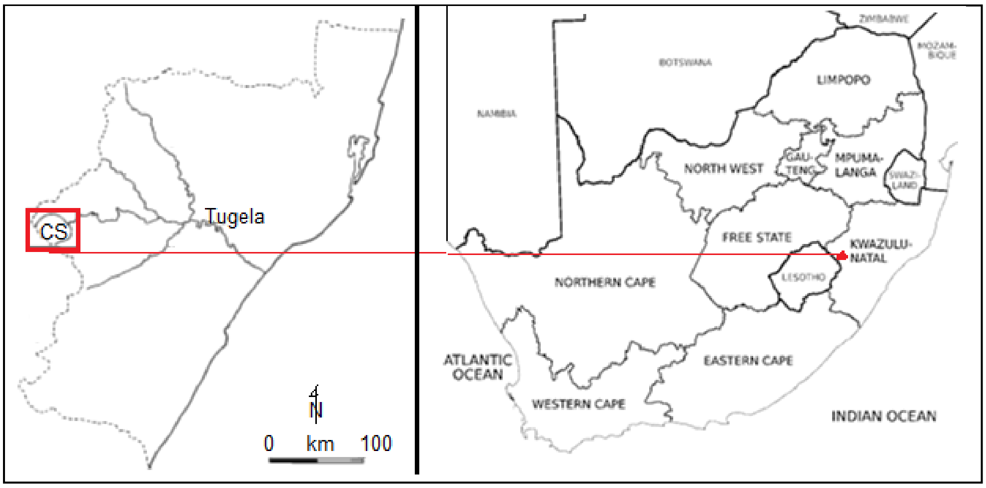


Fig. 3.10 Map location of Clarke's Shelter (image Mazel 1984, modified)

Excavations, stratigraphy and ^{14}C dates

Test excavations were undertaken by Mazel in May, 1980 with further work continuing in May 1981. Ten m^2 were excavated in the western portion of the shelter (see Fig. 3.11), using natural stratigraphy and arbitrary spit levels when natural stratigraphy was indiscernible. Two square-metre units were sunk to bedrock, but abundant cultural and faunal deposits were recovered from the top 30 cm (Mazel 1984: 22).

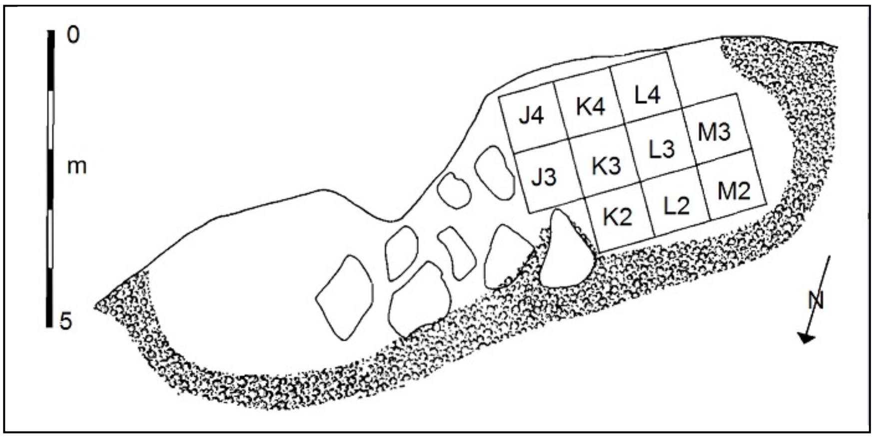


Fig. 3.11 Clarke's Shelter site plan (image Mazel 1984, modified)

The shelter is approximately 12 m wide and 4 m in depth.
Four stratigraphic levels were identified and designated (from top) 1-4 (see Fig. 3.12). Roots were present throughout and denser near the back wall and in lower levels (*ibid.*).

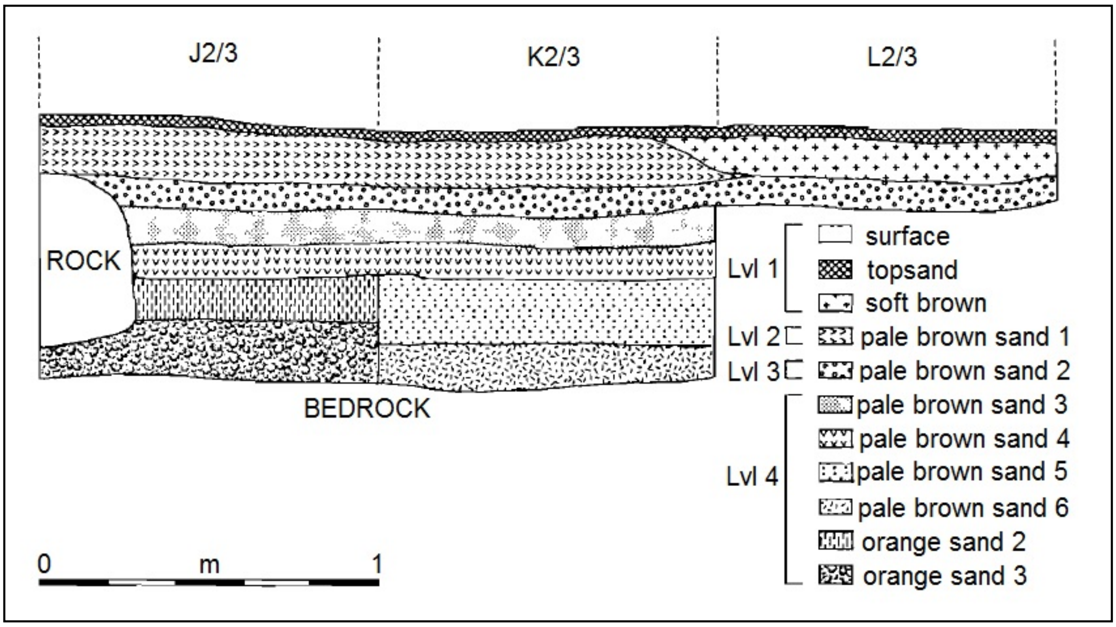


Fig. 3.12 Stratigraphy 2/3 sections (image Mazel 1984, modified)

Level 1 consists of three units: surface scrapings, a *topsand* subsurface of loose, pale brown sand with abundant dassie (*Procavia capensis*) faeces, and a soft brown unit of loose brown sand. More compact than Level 1, Level 2 consists of pale brown sand (also with abundant dassie faeces). Level 3 is subdivided into three units (not distinguished by Mazel in stratigraphic profile): pale brown sand similar to Level 2, red-brown sand, and Hearth 1, a hearth of white ash. Level 4 was excavated to bedrock, consists of pale brown, orange and white sands becoming uniformly lighter as bedrock is reached. Few cultural or other remains were recovered from this level (Mazel 1984: 46-49).

Table 3.16 presents the known ^{14}C dates, all obtained from charcoal samples. Mazel (1984: 50) explains that there is no indication of initial occupation of the shelter, as Level 4 excavations yielded no charcoal and few cultural or other remains, and that ‘more regular occupation’ beginnings appear to be represented in the top 10-15 cm of Level 4. Comparison of the lithic assemblage with his excavated material at Diamond 1 (28°29’32” S, 28°56’52” E), Mazel concludes that occupations began post-3000 BP (*ibid.*).

Table 3.16 Clarke’s Shelter ^{14}C dates

Dates ^{14}C years BP	*Notes* (based on Mazel 1984)
Ceramic	Level 1: (no ^{14}C date) – 35 pottery sherds recovered, stratigraphic unit layers 2-4 cm thick.
1580 ± 50 years BP (Pta-2973) →	Level 2: 38 pottery sherds recovered
Pre-ceramic	
2160 ± 50 years BP (Pta-2971) →	Level 3: 9 pottery sherds recovered, but considered uncertain/ possibly intrusive into Level 3. (explained further in cultural material sections)
2380 ± 50 years BP (Pta-3247) →	
	Level 4: Hearth 1, no ceramics, paucity of cultural and other remains, occupations beginning post-3000 BP.

Cultural material – non-lithic

Mazel states (1984: 57) that ‘although the pottery sample is small and undecorated it is significant’. Of the eighty-two sherds recovered, rim sherds (from Levels 1 and 2) indicate vessels of ‘U-shape’ or bag-shape. No rim sherds were recovered from Level 3. The intrusion of sherds into Level 3 is possible, particularly given the ^{14}C date, but

Mazel is confident that the sherds from Levels 1 and 2 were found *in situ* (*ibid.*) – hence the *uncertain* categorisation in Table 3.20 and inclusion in the pre-ceramic period. Burnished sherds occur in all three levels, all of which are dark except one red burnished sherd.

Thicker sherds suggest that storage vessels were used at the site. Eight sherds in Level 2 and 10 in Level 1 show an increased thickness above the mean of approximately 10 mm. In personal communication from Maggs, who looked at the assemblage, Mazel relates that the pottery 'is similar to the Later Iron Age (LIA) pottery of adjacent areas', but adds that the pottery associated with Levels 1 and 2 'predates the advent of the LIA...by at least 500 years' (Mazel 1984: 57, 66).

Mazel's conclusion is that pottery was being used by LSA inhabitants of the Drakensberg and adjacent areas by 1500 years BP, for which he offers three possible explanations: a) pottery technology was developed locally; b) Early Iron Age (EIA) peoples passed on technology; and c) pottery was 'passed on from elsewhere' (*ibid.*: 66). Mazel's only speculation relates to the third scenario, mentioning Beaumont and Vogel's (1984) postulate that herders with pottery entered the Northern Cape before 2100 BP (*ibid.*), inferring, it seems, that it then spread by some means to the area of Clarke's Shelter by 1500 BP.

Other non-lithic material items classified by Mazel include forty-two pieces of ochre (only one piece designated as utilised, found in Level 1); six undiagnostic worked bone fragments, one fragmented bone point, and one wood shaving all from Level 2); and 'one heavily corroded piece of shaped iron', with a mass of 6.6 g, which Mazel states (*ibid.*: 58) is precluded from being an arrowhead, but might possibly have been a small spear point or knife. Although Mazel does not speculate, one could envision a possible link between this piece of shaped iron and the two latter of the three possible scenarios he proposes for pottery at the site, as potential evidence for contact with non-hunter-gatherers *ca.* the often-mentioned 1500 BP date.

Faunal remains are represented by 50% antelope, the majority of which are small to medium in size and represent 95% of edible meat weight. The remaining 50% of remains, include 26% unlikely to have been eaten (e.g. baboons, jackals, wildcats, a genet and a monkey – unusual in the area), and 24% that may have been a food source (e.g. dassies, hares, a tortoise, a snake and a mongoose) (Mazel 1984: 59). *Floral* remains include one unidentified seed from Level 1, and ‘adiagnostic sticks and twigs’ from Levels 1-3 (*ibid.*).

Rock paintings

One hundred seventy-seven individually painted images were recorded (see example, Fig. 3.13), 15% of which have both human and animal characteristics, the type of which Mazel states represent only 2% of the approximately 22 000 rock paintings that he had previously recorded in the ‘Natal Drakensberg’ (Mazel 1984: 42). The ratio of humans to animals painted at Clarke’s Shelter is also of interest. In Mazel’s large, previous count, human figures represent 56% of paintings and animals represent 28%. At Clarke’s Shelter, however, humans are represented by only 20% and animals by 35% of painted figures. Mazel (*ibid*.) explains that further numerical discrepancies exist, but the aforementioned is sufficient to demonstrate that Clarke’s Shelter rock paintings differ from the Drakensberg norm. He is uncertain whether or not these differences are vital for understanding the cultural assemblages from the site, but ‘superficially’ does not believe that they are.

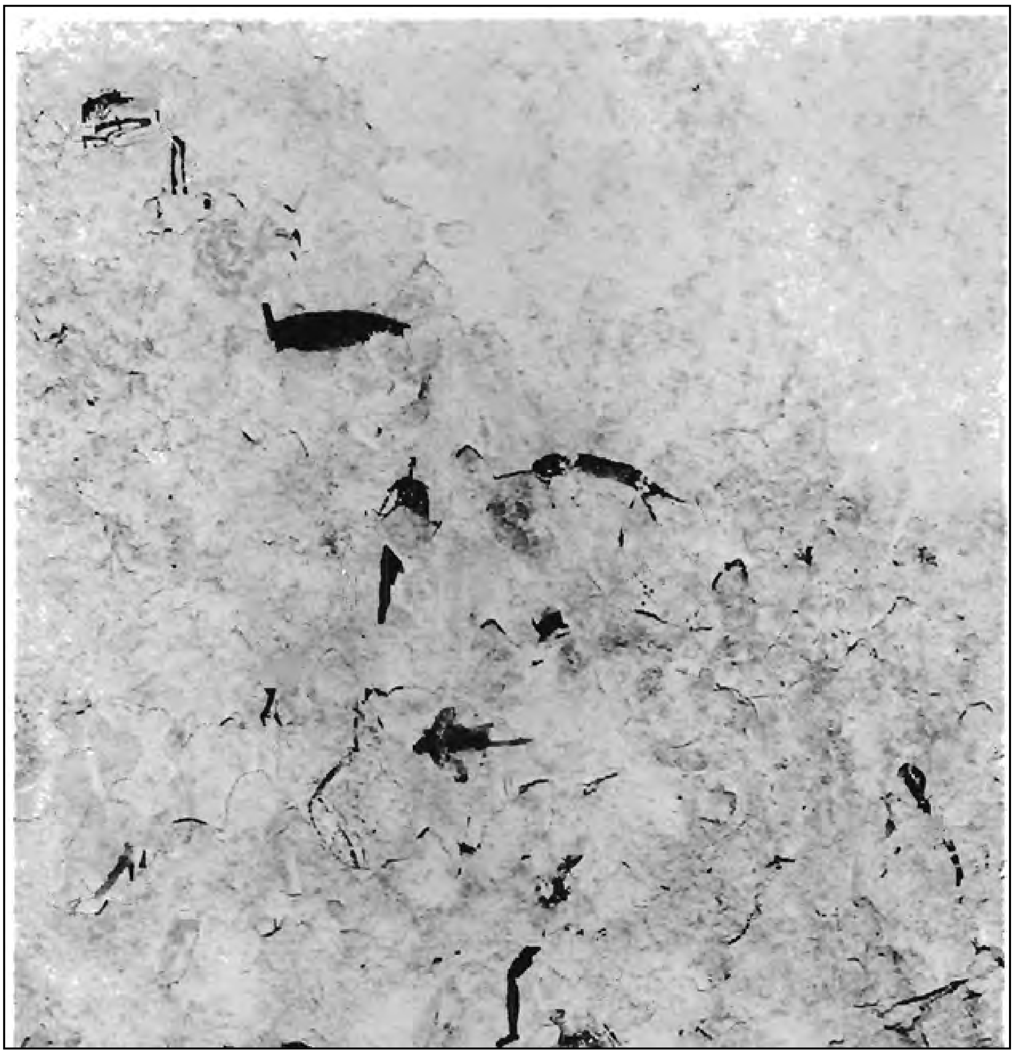


Fig. 3.13 Rock painting from Clarke's Shelter (image Mazel 1984) (For scale: the largest, solid 'black' image near top left is approximately 5 cm in width.)

Cultural material – lithic

Mazel (1984: 63) writes: 'No attempt will be made to pigeon-hole the lithic assemblages into any of the Industries...' He adds:

> 'Past researchers, although aware that a *perfect fit* never existed between their assemblages and the scheme outlined by Goodwin and Van Riet Lowe (1929), continued classifying their assemblages according to that scheme, thereby adding to the confusion of the nature of the Northern Drakensberg assemblages. Continued use

> of these terms... coined for other areas of southern Africa, and relating to specific assemblages, would mask the true nature of the northern Drakensberg assemblages' (Mazel 1984: 63-64).

Mazel (1984: 50) states that the 'lithic assemblage... represents the site's primary cultural component', with 5400 pieces recovered (see Table 3.17). Ninety percent of the assemblage is 'waste', of which 98% comprises chips, chunks, and flakes, with the remainder represented by cores and grindstone fragments (*ibid.*). CCS comprises the majority of raw materials (over 85% of waste and 95% of formal tools), followed by quartzite, hornfels, basalt, dolerite, calcite and quartz.

Table 3.17 Clarke's Shelter stone assemblage

Category		Subdivisions	
Waste		*Pre-ceramic*	*Ceramic*
Chips, chunks, flakes	4975	1341	3634
Cores	41	8	33
Grindstone fragments	8	1	7
Total:	5024	1350	3674
% of stone assemblage	93%	25%	68%
Formal tools		*Pre-ceramic*	*Ceramic*
Scrapers	182	42	140
Backed pieces	82	24	58
Adzes	16	3	13
Borer	1	1	0
Groundstone	1	0	1
Misc. retouched (MRPs)	7	3	4
Palette	1	0	1
Total:	290	73	217
% of stone assemblage	5.4%	1.4%	4%
Other		*Pre-ceramic*	*Ceramic*
Utilised flakes	74	10	64
Lower grindstones	5	1	4
Rubbers	6	2	4
Hammerstones	1	0	1
Total	86	13	73
% of stone assemblage	1.6%	0.02%	1.4%
Total all	5400	1436	3964
%	100%	26.6%	73.4%

Statistical analyses

There is no significance between the pre-ceramic and ceramic periods waste categories ($0.3700 > p < 0.05$). There is also no significance between the pre-ceramic and ceramic periods ‘other’ stone assemblage items ($0.5784 > p < 0.05$). Table 3.18 presents the results of analysis of formal tools.

Table 3.18 Clarke’s Shelter formal tools pre-ceramic/ ceramic period changes

Formal Tools (FT)

Observed	pre-ceramic	ceramic	total	*Expected*	pre-ceramic	ceramic
scraper	42	140	182	scraper	45.5137	136.1862
backed	24	58	82	backed	20.6413	61.3586
other FT	7	19	26	other FT	6.5448	19.4551
	73	217	290		73	217

χ*2 test:*	*Count*	*Rows*	*Cols*	*df*
	292	3	2	2
			Alpha	*0.05*
		chi-sq	*p-value*	*significant*
		1.1962	0.5496	no

There is no significant difference between pre-ceramic and ceramic period formal tool assemblages ($0.5496 > p < 0.05$). Tables 3.19 presents the nuanced data needed for the model application in item numbers and percentages.

Table 3.19 Nuanced data for application of the Smith model

	Scrapers	*Scrp %*	*Backed*	*Bck %*	*Oth. FT*	*Other %*	*Formal*	*FT %*
ceramic	140	64.5	58	26.7	19	8.8	217	100
pre-c.	42	57.5	24	32.9	7	9.6	73	100
Total	182		82		26		290	

Despite a slight percentage increase in scrapers, and slight percentage decreases in backed pieces and other formal tools, these changes are not statistically significant.

Application of the Smith model

Table 3.20 presents the interpretation of the model applied to Clarke's Shelter. The results show that the model is not highly applicable to Clarke's shelter. While some tenets hold true, others do not. Its usefulness can again be assessed by its lack of applicability. Continuity, rather than change, is seen from pre-ceramic to ceramic periods.

Table 3.20 Model applied to Clarke's Shelter

(Ch. 2, pp.54, 59)

Specific tenets	*yes*	*no*
Decrease in diversity of tools		✓
Reduced frequency of formal tools		✓
Increase in scraper frequency	✓	
Decrease in segments / backed pieces		✓
Shift from fine to coarse raw materials		✓
Adzes, planes may be present	✓	
General tenets	*yes*	*no*
More formal tools	✓	
Low frequencies of pottery	✓	

Discussion

Clarke's Shelter is a regional anomaly in terms of its cultural and other material (e.g., rock painting numerical data, unusual faunal remains). Mazel's conclusions are tentative in terms of how and when pottery appeared and when contact was made. One crude iron instrument does not prove early contact with Iron Age people or that pottery was introduced by outsiders. It does however beg the logical questions of whence, how and from whom the piece was obtained.

Huffman (2006: 108), for example, describes certain changes in pottery styles in the early second millennium AD in KwaZulu-Natal, Limpopo and

Mpumalanga, which may be viewed by some as signalling the arrival of outsiders bringing in new technology. Whether or not a similar situation surrounds the iron piece and the hunter-gatherers of Clarke's Shelter brings one into the forum of debate and frequently asked questions (e.g. Do technology and material items precede the movement of people [newcomers]? Are livestock and pottery a package or do they arrive independently at different times? If a migration theory is the answer, which theory is most plausible for a given set of people and circumstances?).

From the material record evidence that Mazel (1984) provides for Clarke's Shelter, a suggested date of 1580 ± 50 years BP (Pta-2973) and one of three of his possible speculations (*ibid.*: 66-67) – that EIA people passed on pottery technology by this date to the inhabitants of Clarke's Shelter -- seems implausible. Mazel's personal communication with Maggs, who explained that the pottery resembled *LIA* pottery in the region, precedes the possibility by 500 years, according to Mazel's own conclusions (Mazel 1984: 57, 66).

Additionally, the non-lithic and lithic cultural artefacts and faunal remains do not seem to suggest any form of contact prior to 1500 BP and no on-going interaction thereafter. While speculative, it is possible that pottery technology, including the later thicker, larger vessels for storage, was conceived by local hunter-gatherers and the technology shared between them. The prolific and regionally anomalous rock art at the shelter would seem to suggest a certain capability for creativity and innovation.

The occupation signature indicates a residential strategy. While some may interpret the rock paintings as a gathering place for ritualistic activities or a reaction to economic or social stress, the faunal remains, indicating heavy meat consumption, the lithic assemblage, which shows a variety of tools used for everyday activities, and the sherds of storage vessels would indicate a base for daily life, rather than a logistical strategy site or place reserved for ritual. There is no evidence in material record to support increased stress or conflict, and Mazel's explanation of the rock paintings suggests images of hunting or wildlife observations and the esoteric (e.g. the *Abraxas* images).

According to Dennell's dendrogram of possible scenarios (Fig. 1.1), the hunter-gatherers at Clarke's shelter maintained a primarily static/ closed existence, with limited, perhaps calculated opportunities for experiencing open/ symbiotic interaction. According to my hypotheses on contact and interaction (Table 1.1), the shelter inhabitants experienced a limited 'pioneer phase' which may have been abruptly ended by 'consolidation' (e.g. the abandonment of the shelter by choice or by force), as there is no evidence for a 'substitution' phase during which ongoing interaction may lead to partial or full assimilation into a new lifeway.

3.6 Chapter Summary

The construction of the Smith Model in Chapter 2 and its applications to the selected sites in this chapter have been enlightening. Table 3.21 presents a summary of the model's application thus far.

The model's *general* tenets (Ch.2, p. 54) of more formal tools and lower frequencies of pottery at hunter-gatherer sites (with the inverse applicable to food producer sites) hold true for all site applications. No site conforms to the *specific* tenets (Ch.2, p. 59) of a decrease in the diversity of tools or a shift from fine-grained to coarse-grained materials in the ceramic period. Witklip, Roosfontein and Clarke's Shelter all show increases in the frequency of scrapers, or percentage increases, but the increases are not statistically significant. Variations in different tenet categories occur at each of the sites. In the strictest sense, the model has not been applicable to these sites. My original evaluation of *useful* was to be determined by how applicable the model was in application. In this sense, the model is not useful.

However, it proved to be useful in an unexpected way. Its lack of applicability was directly related to a continued hunter-gatherer way of life after contact and during subsequent interactions with outsiders, although the nuances of contact and interaction for each of the sites' occupants may be interpreted as different. This is noteworthy.

Table 3.21 Model application summary

GEDULD	*Specific tenets*	*yes*	*no*
	Decrease in diversity of tools		✓
	Reduced frequency of formal tools		✓
	Increase in scraper frequency		✓
	Decrease in segments / backed pieces		✓
	Shift from fine to coarse raw materials		✓
	Adzes, planes may be present	✓	
WITKLIP	*Specific tenets*	*yes*	*no*
	Decrease in diversity of tools		✓
	Reduced frequency of formal tools		✓
	Increase in scraper frequency	✓	
	Decrease in segments / backed pieces		✓
	Shift from fine to coarse raw materials		✓
	Adzes, planes may be present	✓	
ROOSF.	*Specific tenets*	*yes*	*no*
	Decrease in diversity of tools		✓
	Reduced frequency of formal tools	✓	
	Increase in scraper frequency		✓
	Decrease in segments / backed pieces	✓	
	Shift from fine to coarse raw materials		✓
	Adzes, planes may be present	✓	
CLARKE'S	*Specific tenets*	*yes*	*no*
	Decrease in diversity of tools		✓
	Reduced frequency of formal tools		✓
	Increase in scraper frequency	✓	
	Decrease in segments / backed pieces		✓
	Shift from fine to coarse raw materials		✓
	Adzes, planes may be present	✓	

The model, intended for general application, is flawed in probably several respects. Of note: while site selection criteria included varying eco-geologic settings (for reasons stated in Ch. 2), the application of this general model is not able to yield interpretative results that indicate the variability in eco-geologic settings. For example, the diversity in tool types, such as marine shell scrapers in the Witklip assemblage, or a preference for opaline from the Caledon River near Roosfontein, may be seen in the specific site data, but is not reflected in the application of a general model, such as the Smith Model. This is unfortunate, as the choice of materials used by a group of people and the ways in materials are used may reveal important aspects about their culture, such as a behavioural code or belief system. I believe it may prove fruitful for those who have accepted and employed a general model (e.g. such as the Smith model) for interpreting material assemblages, used to infer cultural and behavioural practices, to re-examine their data statistically (e.g. Forssman's work [2011, 2014] on the Greater Mapungubwe landscape).

As a lesson learned, I see that, rather than constructing a general model that could aid in the interpretation of specifics, I rather more constructed a model that may only be highly applicable and useful in certain circumstances, such as for uniform site types in a specific area. While still viewing a morphological-only approach to the analysis and interpretation of lithic assemblages as problematic, the serious analytical and interpretive work necessary for the construction and application of a morphological testing model has afforded me new insights into and a deeper appreciation of past and present scholars who work to provide a coherent basis for understanding the material record of the past.

The following, Chapter 4, includes the final application of the Smith model, which is to Holkrans, and also includes comparison of the Holkrans model interpretation to the shelters presented in Chapter 3. An adjusted residuals table of chi-square test results for Holkrans and the comparative sites is provided as an additional analytical and interpretive aid.

CHAPTER 4

Holkrans rock shelter

4.1 Introduction

Holkrans Rock Shelter (BFK1: $26^{o}51'30.49"$ S, $27^{o}17'8.36"$ E) (Fig. 4.1), situated on the Thabela Thabeng farm, which overlooks the Vaal River, is located in the outer rim of the Vredefort Dome, in the Potchefstroom District, North West Province, South Africa, approximately 120 km southwest of Johannesburg between Parys and Potchefstroom.

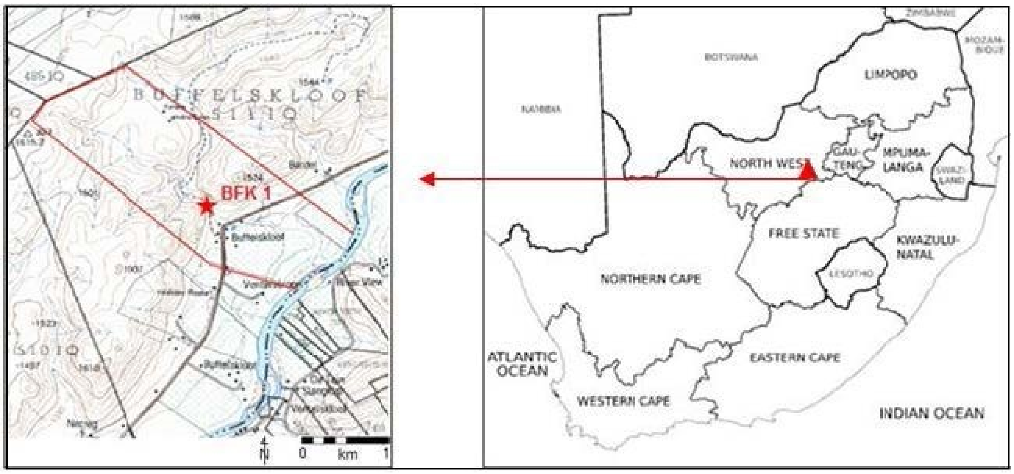
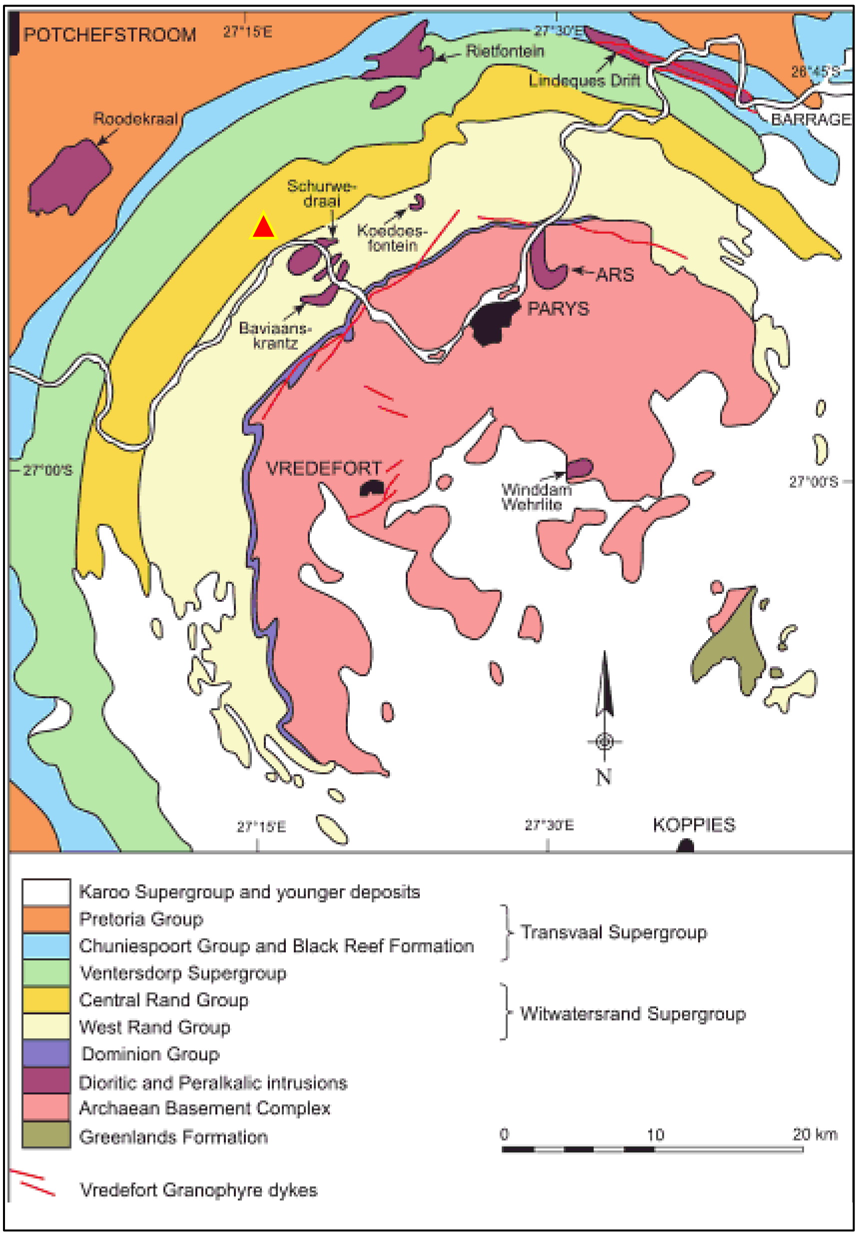


Fig. 4.1 Map location of Holkrans

The Vredefort Dome (Fig. 4.2), the result of a 2000 million year old, 10 km in diameter meteorite impact (astrobleme), straddles the North West Province and the Free State. The central uplift and subsequent erosion from impact left an incomplete enclosure in the Witwatersrand Basin. The impact uplift brought metal ores (e.g., gold and platinum) to a discoverable and mineable level and is the reason that South Africa has its precious metals mining legacy. The area is also the type locality for pseudo-tachylite breccia, a 'melt rock', formed under compression from the shock of impact (Reimold and Gibson 2005: 13). The size of the dome (approximately 70 km in diameter with a core zone of approximately 30 111 ha), the Vaal River, a tributary of the Orange River which originates in the Drakensburg Mountains and is the only waterway passing through a meteorite impact site, as well as the variability in topographies and landscapes result in different micro-climates within the dome.



Holkrans lies in the vicinity of the red triangle. ▲

Fig. 4.2 Geologic map of Vredefort Dome (Reimold and Gibson 2005)

The northwest area of the dome is comprised of a central area of flat farmland with folds of the outcropping quartzite rim, the flat plains of Potchefstroom, and the Witwatersrand Supergroup further north. Soils were formed from underlying shale and dolerite of the Karoo Supergroup (ca. 300-180 MA). The incomplete ring at the outer edge of the dome is roughly vertical volcanic and sedimentary rock from the Dominion Group (ca. 3074 MA), the Witwatersrand Supergroup (2950-2710 MA), the Ventersdorp Supergroup (c. 2710 MA) and the Transvaal Supergroup (2650-2150 MA). The 50 km area surrounding the dome structure is known as the Potchefstroom syncline, which reaches part of the Witwatersrand Basin, and is delineated by the Rand anticline. Along the ring-like boundary or collar of the dome are exposed granite layers, which were described as folded (Reimold and Gibson 2005: 130-132).

4.2 Holkrans micro-climate and shelter vicinity

The rock shelter (Fig. 4.3) rests upon a quartzite shelf approximately 1396 m above mean sea level (AMS), in an area classified as Bankenveld (hilly open grassland with wiry grasses). Rainfall is 570-650 mm per annum, mostly from October through March. Summers are hot and wet with temperatures averaging between 15°C and 30°C. Winters are cold and dry with frosts, with temperatures averaging between -10°C and 18°C.

Ninety-nine plant species have been identified in the vicinity, including woody, flowering and fruit-bearing plants, such as sweet thorn (*Acacia karoo*), hook-thorn (*Acacia caffra*), white stinkwood (*Celtis africana*), flame-leaf sumac (*Rhus lanceolata*), buffalo thorn (*Zizyphus mucronata*), wild peach (*Kiggelaria africana*) and sugar bush (*Protea caffra*) (Balkwill 2005). There are over 200 bird species in the area, including Cape vulture (*Gyps coprotheres*) and lesser kestrel (*Falco naumanni*), and over seventy butterfly species. Larger animals formerly indigenous to the area were displaced by farming. Medium-size and fifty species of smaller animals that remain, some of which are uncommon in the region, include Cape baboon (*Papio ursinus*), brown hyaena (*Hyaena brunnea*), black-backed jackal *Canis mesomelas*), serval (*Felis serval*), steenbok (*Raphicerus campestris*) and a variety of other small buck, rooikat (*Caracal caracal*), aardwolf (*Protelas cristata*), leopard (*Panthera pardus*), rock dassie (*Procavia capensis*), spotted-necked otter (*Lutra maculicollis*), and white-tailed rat (*Mystromus albicaudatis*) (*ibid*.).

The Vaal River is approximately 1.5 km south of the shelter. Riverine life includes several varieties of fish, such as sharptooth barbel (*Clarias gariepinus*), common carp (*Cyprinus carpio*), yellowfish (*Labeobarbus kimberleyensis*) mudfish (*Labeo capensis*), and several turtle, tortoise, other amphibious and reptilian species (Bakker *et al.* 2004).

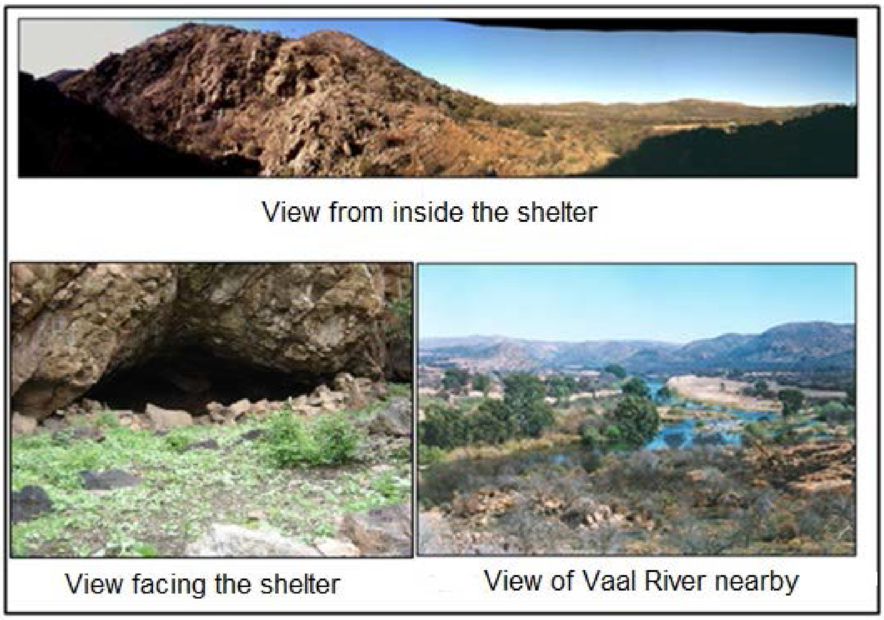


Fig. 4.3 Holkrans rock shelter (bottom row images courtesy of Sadr)

4.3 Previous research in the area

Various archaeological and geologic surveys and studies have been undertaken in the Vredefort Dome area (Mason 1968; Maggs 1976; Simpson 1977; Taylor 1979; Loubser 1985; Boonzaier and Laurens 2002;

Pelser 2003; Bakker *et al.* 2004; Waanders *et al.* 2005; Nkhasi-Lesaoana 2008; Sadr 2008, 2009; Reimold and Gibson 2009; Bradfield and Sadr 2011), with identified sites pertaining to various time periods (Pelser 2009). Information on Iron Age (IA) sites is not lacking, however there is a paucity of Stone Age research in the area (Reimold and Gibson 2005). Early Stone Age (ESA) material has been recovered from eroding gravels near the Vaal River, and Middle Stone Age (MSA) and Later Stone Age (LSA) materials have been found in surface scatters (Bakker *et al.* 2004; Reimold and Gibson 2009).

Holkrans remains to date the only excavated rock shelter in the Vredefort Dome. The shelter's material record and ^{14}C dates assign the excavated layers to the late Holocene. Periods of the ceramic phase at Holkrans may be contemporaneous with Late Iron Age (LIA) stone-walled structures in the shelter's vicinity. Contact with non-hunter-gatherers probably occurred within the last 500 years. Holkrans was given a grade III rating (i.e. medium significance) by SAHRA's cultural heritage survey and management plan for the Vredefort Dome (Bakker *et al.* 2004), which grades archaeological sites according to potential significance and how they may aid in understanding the cultural significance of the larger area.

4.4 Physiography, excavations and ^{14}C dates

The shelter is approximately 7 m wide by 4 m in depth with a maximum height of approximately 3.5 m. The back wall is largely made up of a single, unbroken triangular piece of weathered quartzite slab that fell from the roof and landed (tip downward) on a large existing slab at an angle of approximately 50 degrees. This formed a natural barrier between the shelter and a rear crawlspace chamber (see Fig. 4.4), accessible through a narrow opening at the southern end of the wall.

View inside chamber of crawlspace entrance

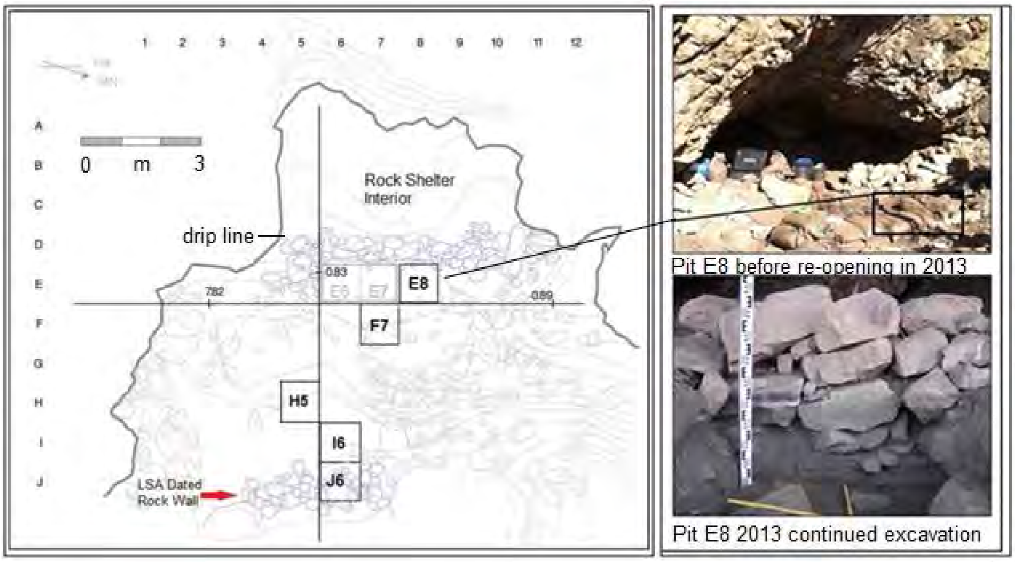
North wall of chamber

Fig. 4.4 Crawlspace behind shelter (images Law de Lauriston)

The largest portion of the fallen slab comprises the base of the chamber, which is approximately 15 m wide and 10 m in depth, with a maximum height of 1.5 m. During the 2013 field school, near the northwest corner of the chamber, T. Lambert and I found a cache of porcupine quills and three large, thick (yet unidentified, and what appear to be) long bones with gnaw marks. No formal investigative work has been planned for the chamber. It is plausible, however, that the space could have been used by shelter occupants (e.g. protection, storage, etc.).

4.4.1 Excavations

Excavations, supervised by Karim Sadr, were undertaken during WITS field schools between 2008 and 2013. Methods used were developed by Sampson *et al*. (1989) for recovering material items from LSA deposits and chosen based on preliminary site and lithics observations. A site plan (see Fig. 4.5) with an alpha-numeric grid was used for spatial control. Units consisted of 1m x 1m squares, further subdivided into sixteen 25 cm x 25 cm quadrants, and sunk in 3 cm spit levels to depths of 30-50 cm without reaching the bottom of material finds. Spit levels were recorded using a theodolite. Recovered materials were sieved through 1 mm wire mesh. Artefacts were sorted into bone, lithic, ceramic, botanical and charcoal categories and temporarily stored in plastic bags to await analysis.



Pit E8 before re-opening in 2013

Pit E8 2013 continued excavation

Fig. 4.5 Holkrans site plan (map image Sadr 2013, modified)

4.4.2 Unit E-8

The Holkrans lithic assemblage analysed in this thesis is from excavation unit E-8, which is currently the only unit for which all lithics have been sorted and morphologically classified. To date the unit has been sunk to a depth of approximately 50 cm. From personal observation and according to Sadr (pers. comm. 2013) artefacts recovered from other units (Fig. 4.4), still undergoing formal sorting and preliminary analysis, are similar to those from E-8.

Unit E-8 lies immediately adjacent to a stone wall of uncertain date and origin at the mouth of the rock shelter, which excavations indicate was built atop the most recent LSA layer (Fig.4.5). Mortar between portions of stone layers at the north end of the wall suggests that it was constructed ‘after European contact’ (Bradfield and Sadr 2011: 77), which here means during the 1830’s (Bakker *et al.* 2004: 55). Excavations to date have identified three phases of LSA occupation (Fig.4.6): a pre-contact period (spits 9-13) poorly representing a diagnostic LSA assemblage in early levels; a middle phase (spits 5-8), representing a rich early contact period; and a late contact or terminal period (spits 1-4) of minor LSA representation. My focus is on the pre-contact and early contact phases, which are represented by spits 10-13 and spits 5-8 (which contains ceramics) respectively.

4.4.3 Comparison to Radiepolong

Comparing Holkrans to Radiepolong is useful as both are quite similar in occupation phases and representations of the later LSA. (Sadr 2002: 38) explains that a three-phase sequence can be seen: a pre-contact level with a poor LSA representation in early levels (i.e., few diagnostic LSA artefacts); an early contact middle phase with diagnostic LSA lithics, and a clearly identifiable late contact or terminal phase. There is no perceivable natural stratigraphy, and the vertical distribution of materials allows the demarcation of three occupation phases.

The site is a small granite boulder shelter on an outcrop located four kilometres from Thamanga Hill, in the Metsemotlhaba River valley in southeast Botswana. K. Sadr and University of Botswana students excavated approximately 5 m^2 in 1996. Distinction between the terminal or late contact, with one ^{14}C date of (Beta 107630) 200 ± 60 BP, calibrated (2σ) as AD 1535-1545 and AD 1635-1950, and early contact periods is seen by a pronounced decrease in bone and lithics and an increase in ceramics in the terminal phase (*ibid.*: 39).

The material record of the early contact period is similar to the pre-contact period, the former distinguished by the presence of ceramics, which indicates contact, but ‘no indication of subjugation, assimilation or dependence on herder-farmers’ (*ibid.*: 42-43). Bone is abundant in both pre- and early contact periods. With early contact at Radiepolong beginning before the earliest IA settlements in southeastern Botswana in the sixth century AD, ‘it is assumed that early contact was at long distance and probably took place through intermediaries’ (*ibid.:* 44). The end of the early contact has been ^{14}C dated from charcoal samples and calibrated (2σ) to AD 1065-1075, AD 1155-1295 and 1035-1295 (*ibid.:* 43). (See Sadr and Plug 2001; Sadr 2002.)

4.4.4 Topography and stratigraphy

The floor inside the quartzite shelter is currently covered in hyrax (*Procavia capensis*) excreta and loose brown soil. The ground outside the shelter, which slopes gently for a few metres to a retaining wall, contains quartzite cobbles and boulders strewn across dark organic soil, with ‘flaked stone, bones and potsherds eroding out of the matrix’ (Bradfield and Sadr 2011: 77) (Figs. 4.3, 4.5). The positions of the base of the retaining wall and dated excavated layers indicate that the base can be placed in the early ceramic period of the site (Fig. 4.6). Outside of the retaining wall, the terrain slopes steeply down approximately 20 m to a vehicle track serving the Thabela Thabeng guest cottages.

Beneath the dark organic surface soil, down to a depth of approximately 50 cm in Unit E-8, the soil is loose and uniformly grey (Fig.4.5), which is likely the result of water leaching. The matrix contains dense roots throughout the upper levels and randomly dispersed cobbles and small boulders which fell from the cliff above. The LSA ceramic phase levels contain more cobbles and quartzite fragments, which Bradfield and Sadr (*ibid.*) suggest may be attributed to a period of accelerated rock fall during colder conditions such as the ‘Little Ice Age, dated between AD 1300 and AD 1800 (Holmgren *et al.* 1999).

Fig. 4.6 Retaining wall excavation unit J-6, facing toward Vaal River (image Bradfield and Sadr 2011)

4.4.5 Radiocarbon dates

Currently known ^{14}C dates and calibrated BC/AD dates are presented in Table 4.1.

Table 4.1 ^{14}C dates from Holkrans
OxCal v.4.2.3, Ramsey (2014). Southern Hemisphere Atmospheric Curve (SHCal04) McCormack *et al.* (2004). SD = standard deviation, calibrated dates (calBC/calAD) range labelled (2σ) low and high.

Lab	*Number*	*Context*	*BP*	*SD*	*Low*	*High*
Beta	*304272*	*H5.C4.2*	*60*	*40*	*1697*	*out/range*
Beta	*287474*	*J6.B4.4*	*140*	*40*	*1674*	*1954*
Beta	*265301*	*F7.B2 & B3.7*	*190*	*40*	*1657*	*1953*
Beta	284940	E8.A1,2, B5	270	40	1506	1805
Beta	304271	H5.C3.7	760	40	1223	1385
Beta	304270	H5.B3.5	900	40	1046	1271
Beta	304269	H5.B2.3	970	40	1027	1202
Beta	287473	J6.B3.10	1080	40	898	1140
Beta	304273	H5.D4.9	1430	40	585	768
Beta	284941	E8.A3,4, B9	1830	40	132	381
Beta	265300	F7.A2.11	2320	50	-406	-196

Three occupation phases are recognisable (Fig. 4.7) in all known dates plotted in chronological model and adjusted for southern hemisphere atmospheric conditions. The model calibrations include date ranges with likelihood.

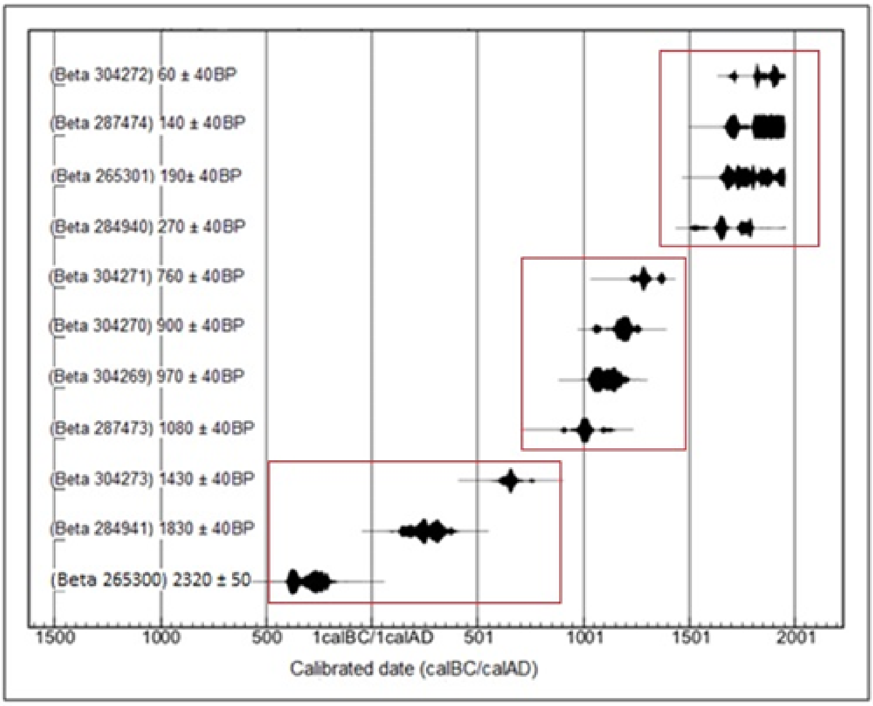


Fig. 4.7 Chronological multiple plot of Holkrans ^{14}C dates (OxCal v.4.2.3, Ramsey (2014). Southern Hemisphere Atmospheric Curve (SHCal04) McCormack *et al.* (2004)

Not all dates and spit levels or units perfectly align as the units were excavated at different times. Generally, however, like at Radiepolong, one can see two groupings of three superimposed layers, representing a non-ceramic pre-contact period and a two-phase ceramic period of early and late contact that differ in material signatures. Considerations of the known components of the E-8 material record follow. What I seek to determine in the analysis of the lithic assemblage is what type of frontier existed when early contact occurred, and what impact this had on the Holkrans hunter-gatherers (discussed further in Chapters 8 and 9). Of general note, in addition to stone tools, pottery sherds, and yet unidentified botanical and faunal remains, other site materials consist only of: two pieces of a coiled copper item, approximately 7 mm long and 4 mm in diameter when placed together, which Huffman (pers. comm. 2013) stated were parts of a bangle and could be as old as 2000 years, thus being of little use in relative dating of artefacts at the site, and one corroded piece of metal, approximately 70 mm in length and 5 mm in diameter. There are no ostrich eggshell remains or beads.

4.5 Unit E-8 Cultural materials

The vast majority of the Unit E-8 material record is represented by stone. However, comparison of the unit's lithics with pottery and still unidentified faunal remains will help demonstrate the three phases of occupation. A description of other materials thus far recovered from E-8 precedes the comparison.

4.5.1 Other

Seeds were recovered in Unit E-8 spits 4, 6 and 10, with weights of 0.2g, 0.1 g, and 0.1 g respectively. Botanical remains await analysis. Charcoal was present in spits 2-9, 11 and 12, with a total weight of 23.9 g. Over half (52.3% or 12.5 g) was recovered from the early contact phase (spits 5-8), while only 1.7% (0.4 g) came from pre-contact spits 10-13. The remainder was recovered from spits 1-4 (40.6% or 9.7 g) and spit 9 (5.4% or 1.3 g).

4.5.2 Pottery, bone, and stone

Pottery sherds of both thick-walled and thin-walled were present in spits 1 through 8 and a 5 g (0.5% of total sherd weight) representation in spit 13, probably the result of intrusion. The majority of sherds, 877.9 g, or 87.5%, were recovered from the top 4 spits. Sherds in spits 5-8 represent 120.3 g or 12%. How pottery aligns with bone and lithics is shown in Table 4.2.

Bone is represented throughout unit E-8. Formal analysis remains to be done. Over half of all bone (59.4% or 295.1 g) in unit E-8 was recovered from spits 5-8, while 11.4% (56.7 g) was found in spits 9-13. The majority of the remaining bone was found in spits 1-4 (29.2% or 145.2 g), and 11.9% (59 g) in spit 9. Concentrations and distribution of bone may be attributed to several factors, such as heightened hunting activities, perhaps the result of a larger community population, in the early contact period (spits 5-8), and less reliance on hunting activities in the terminal phase. The uniformly grey matrix (section 4.4.4) and indications of leaching may also have differentially affected faunal remains preservation.

Gram weight for lithics in E-8 is 13309.6, represented by 2042.7 g (15.35%) in spits 1-4, 4632.4 g (34.80%) in spits 5-8, and 6634.5 g (49.85%) in spits 9-13. Of note, there is a slight increase in lithic numbers from the lower to middle sequence, followed by a decrease in the terminal sequence. Between the lower or pre-contact and middle/ early contact sequences, we see a continuation of the gradual shift toward finer-grained materials. While each of the above-mentioned categories is discussed further, a side-by-side table comparison is first made (Table 4.2).

Table 4.2 Three phase comparison of pottery, bone and stone (*numerical values are weight in grams*)

Spit	*Pottery*	*Bone*	*Stone*	Π
1	13.2	10.8	106	130 g
2	62.4	20.2	389.6	472.2 g
3	378.7	39.4	633.1	1051.2 g
4	423.6	74.8	914	1412.4 g
5	58.7	103.1	2029.8	2191.6 g
6	52.3	65.7	955.6	1073.6 g
7	0.7	56.8	800.7	858.2 g
8	8.6	69.5	846.3	924.4 g
9	/	21.4	823.5	844.9 g
10	/	15.8	2613.4	2629.2 g
11	**/**	6.9	886.2	893.1 g
12	**/**	9.1	1307.6	1316.7 g
13	**5**	3.5	985.5	994 g
Π	1003.2 g	497 g	13291.3 g	14791.5 g *100%*

Total gram weight is represented by 45% in spits 9-13, 34% in spits 5-8, and 21% in spits 1-4. Stone weight makes up the largest portion of total gram weight in the pre-contact lower spits. Spits 5-8, however, show the largest amount of bone and the introduction of pottery, which increases steadily throughout the terminal sequence (spits 1-4).

Spits 4 and 5 are of interest as they may suggest a turning point in the cultural behaviour of Holkrans inhabitants. Stone and bone show appreciable increases from spit 8 to spit 5, but sharply decrease in spit 4, as pottery continues to increase. Spit 5 may represent a heightened phase of production as a result of contact and interaction with non-hunter-gatherers. Spit 4 may represent steps toward a mixed economy of hunter-herding. A secure date (Table 4.1) for this possible cultural transition period for pit E-8 is between AD 1506 and 1805. Spit 5 also represents the highest gram weight of bone, decreasing sharply thereafter. These three phases and changes between them are similar to the Radiepolong sequence (section 4.4.3); though it appears that early and later contact periods may have come later to Holkrans. A more in-depth study of the largest component of the E-8 material record, the stone assemblage, may further clarify the contact periods.

4.6 Unit E-8 lithics and raw materials

The E-8 stone assemblage (Table 4.3) consists of 4358 pieces excluding chips (which have been excluded from debitage counts from all excavations in sorting and analysis 2008 - present). The category of debitage and unretouched pieces includes chunks and flakes (general debitage), cores, and blade-like pieces (blade/bladelet) which comprise approximately 97% of the stone assemblage. Formal tools represent 1.1% and other stone pieces (ochre and specularite) represent 1.8%.

While the percentage of formal tools according to morphological classification may appear low, we shall see from functional analysis throughout chapter 8 that a wide variety of tools and activities are represented at Holkrans.

Table 4.3 Holkrans stone assemblage

Category		Subdivisions	
		Pre-ceramic/ Pre-contact (spits 10-13)	*Ceramic/ early contact (spits 5-8) and late contact/ terminal (spits 1-4)*
Waste and unretouched pieces (excluding chips)		*Pre-ceramic*	*Ceramic*
Chunks and Flakes	4074	1648	2426
Cores	43	21	22
Blade/ bladelet	115	44	71
Total	4232	1731	2519
% of stone assemblage	97.1%	39.3%	57.8%
Formal Tools		*Pre-ceramic*	*Ceramic*
Scrapers	24	3	21
Point	1	0	1
Segments	2	0	2
Misc. backed pieces	1	0	1
Misc. retouched pieces (MRP)	18	6	12
Adzes	1	1	0
Total:	47	10	37
% of stone assemblage	1.1%	0.23%	0.85%
Other		*Pre-ceramic*	*Ceramic*
Specularite	15	7	8
Ochre	64	31	33
Total:	79	38	41
% of stone assemblage	1.8%	0.87%	0.94%
Total all	4358	1761	2597
	100%	40.4%	59.6

4.6.1 Raw materials

The raw materials used at Holkrans (Table 4.4) show a preference for quartz, quartzite and cryptocrystalline silicates (CCS). *Other* among the table categories refers primarily to pseudotachylite (see section 4.1 and Ch.8) and difficult to identify stone. The table is divided into the previously discussed three periods: terminal/ late contact ceramic (spits 1-4), early contact ceramic (spits 5-8) and pre-contact (spits 9-13).

Table 4.4 Holkrans identified raw materials in material assemblage
Values shown are number of pieces followed by percentages below each value.
Row totals are sum of all pieces and percentages to equal 100%. Column totals are sums only of pieces in each column.

Spit Group	Quartz	Quartzite	CCS	Hornfels	Andesite	Dolorite	Shale	Basalt	Other	Ochre	Specular-ite	Σ
1 – 4 Upper levels	36 4.8	425 56	114 15.1	35 4.6	71 9.4	19 2.5	25 3.3	11 1.5	15 2.0	6 0.8	0 0	757 100%
5 – 8 Ceramic levels	203 11.0	605 32.8	410 22.7	114 6.2	245 13.3	62 3.4	94 5.0	28 1.5	44 2.4	27 1.5	8 0.4	1840 100%
9 – 13 Pre-Ceramic	489 27.7	911 51.7	153 8.7	11 0.6	53 3.0	16 0.9	42 2.4	8 0.5	40 2.3	31 1.8	7 0.4	1761 100%
Σ	728	1941	677	160	369	97	161	47	99	64	15	4358

There is a decrease in both quartz and quartzite between pre-ceramic and ceramic periods, though quartzite dominates throughout the sequence. Finer-grained materials (e.g. CCS, andesite) increase between pre-ceramic and ceramic periods. Of the formal tools, quartz decreases from three tools to two between pre-ceramic and ceramic periods, while CCS increases from five to thirty-two tools between the two periods, suggesting a preference for finer-grained materials for formal tool manufacturing in the ceramic period. In chapter 8, functional analysis shows that quartzite was used expediently. Of note is a bifacially worked tanged and bilaterally barbed arrowhead (Fig. 4.8), made of chert, and recovered from Unit E-8 (quadrant B, spit level 6). (Analysed and discussed further in Ch.8 along with all arrowheads thus far recovered from Holkrans.) The arrowhead is 13.2 mm in length and 7.62 mm in width.

Fig. 4.8 Tanged barbed arrowhead from unit E-8
(image Bradfield and Sadr 2011)

According to Bradfield and Sadr (2011: 84) it is among the smallest examples thus far recorded in southern Africa, and probably dates to within the last 500 years (discussed in detail in Ch. 8, section 8.5.1).

The decrease in all tool types and raw materials probably corresponds to the nature and intensity of interaction from early to late contact. Aligning these decreases with pottery from unit E-8 (Table 4.2) and the concentrations in the early contact period are probably contemporaneous with the stone-walled structures in the vicinity (section 4.9). Phases of heightened lithic production toward the end of the early contact period, followed by a decrease in the late/ terminal levels, may suggest changes in the hunter-gatherer lifeway.

4.7 Nuanced data for application of the model

The data in Table 4.3 appear as if they might be significant due to the frequency increases in formal tool categories between the pre-ceramic and early contact/ ceramic periods. The nuanced data is presented in Tables 4.5 and 4.6.

4.5 Chi-square test for Holkrans pooled data

Formal Tools (FT)						
Observed	pre-ceramic	ceramic	total	*Expected*	pre-ceramic	ceramic
scraper	3	21	24	scraper	5.1063	18.8936
backed	0	4	4	backed	0.8511	3.1489
other FT	7	12	19	other FT	4.0246	14.9574
	10	37	47		10	37

χ2 test:	*Count*	*Rows*	*Cols*	*df*
	47	3	2	2
			Alpha	*0.05*
		chi-sq	*p-value*	*significant*
		4.93316	0.0848	no

The chi-square test result shows that there is no significant difference (0.0848 > p < 0.05) between pre-ceramic and ceramic period formal tool assemblages. Despite McDonald’s (2014) explanation of the > 5 expected value being an outdated convention (section 3.1 *Statistical Analyses*), the low and missing values in the backed items category may be considered by some to be unreliable for statistical analysis. I therefore note the results with caution.

Table 4.6 Nuanced data for model application

(*Pre-ceramic/ pre-contact = spits 9-13. Ceramic includes early and late contact, spits 5-8 and 1-4 respectively.)*

	Scrapers	*Scrp %*	*Backed*	*Bck %*	*Oth. FT*	*Other %*	*Formal*	*FT %*
ceramic	21	56.8	3	8.1	13	35.1	37	100%
pre-c.	3	30	0	0	7	70	10	100%

There is a noticeable percentage increase in scrapers and backed items, and a noticeable percentage decrease in other formal tools. Again, however, changes perceived as potentially significant may not be reliable due to small and missing values.

4.8 Application of the Smith model

Table 4.7 presents the interpretation of the application of the model to the Holkrans E-8 lithic assemblage and, more broadly, to the LSA occupations of the shelter.

Table 4.7 Model applied to Holkrans

(Ch. 2, pp.54, 59)

Specific tenets	*yes*	*no*
Decrease in diversity of tools		✓
Reduced frequency of formal tools		✓
Increase in scraper frequency	✓	
Decrease in segments / backed pieces		✓
Shift from fine to coarse raw materials		✓
Adzes, planes may be present	✓	
General tenets	*yes*	*no*
More formal tools in pre-contact/ pre-ceramic		✓
Low frequencies of pottery at Hunter-gatherer sites pre-contact	✓	

As with the sites interpreted in Chapter 3, the model does not prove to be highly applicable to Holkrans, which in the strictest sense means that the model is not useful. Although the Holkrans formal tool category is small, it does not correspond to Smith's conception of hunter-gatherers adopting or participating in some way in an alternative economy (e.g. pastoralism or agro-pastoralism). There is other potential evidence for this (section 4.9). The raw materials trend from pre-ceramic to ceramic periods is toward finer-grained materials, rather than toward coarse-grained materials. According to the model, interaction with food-producers should reflect in a shift toward coarse-grained materials and less formal tools.

According to Dennell's dendrogram of possible scenarios (Fig. 1.1), the hunter-gatherers at Holkrans probably maintained a primarily static/ closed existence, with limited, perhaps calculated opportunities for experiencing open/ symbiotic interaction. There are few 'outsider' items (e.g. metal) in the site material assemblage. This is, however, without taking into consideration the stone-walled structures in the area. According to my hypotheses on contact and interaction (Table 1.1), the shelter inhabitants experienced a limited ‘pioneer phase’ which may have been abruptly ended by ‘consolidation’ (e.g. the abandonment of the shelter by choice or by force); yet the stone-walled structures in the vicinity may be evidence for a ‘substitution’ phase during which ongoing interaction lead to co-operation with food producers and changes in the Holkrans hunter-gatherer economy.

Before considering the stone-walled structures, I present the comparative sites in Chapter 3 and Holkrans as a final evaluation of the Smith model (Table 4.8).

Table 4.8 Summary comparison of sites and application of model

Summary
(Model tenets Ch. 2, pp.54, 59)

Geduld (G), Witklip (W), Roosfontein (R), Clarke’s Shelter (C), Holkrans (H)

Specific tenets	*yes*	*no*
Decrease in diversity of tools		G, W, R, C, H
Reduced frequency of formal tools	R	G, W, C, H
Increase in scraper frequency	W, C, H	G, R
Decrease in segments / backed pieces	R	G, W, C, H
Shift from fine to coarse raw materials		G, W, R, C, H
Adzes, planes may be present	G, W, R, C, H	

General tenets	*yes*	*no*
More formal tools in pre-contact/ pre-ceramic	G, W, R, C	H
Low frequencies of pottery at Hunter-gatherer sites pre-contact	G, W, R, C, H	

Across all sites, the specific tenets of the model hold true approximately 67% of the time. The general tenets hold true approximately 90% of the time, with Holkrans as the exception to the tenet of more formal tools in the pre-contact/ pre-ceramic period than in the post-contact/ ceramic phase. However, as has been shown, this exception is not statistically significant. Comparison of statistical significance of the three pooled lithic categories used in the model application for all sites (Table 4.9) shows that only the Witklip formal tool assemblage shows significant difference between pre-ceramic and ceramic periods.

Table 4.9 Comparison of statistical test results

Summary Comparison *Alpha 0.05* *ss = statistically significant, nss = not statistically significant*			
Site	*Waste, unretouched value$_p$*	*Other stone items value$_p$*	*Formal tools value$_p$*
Geduld	2.027^10^{-19} ss	6.21^10^{-13} ss	0.2805 nss
Witklip	0.335195 nss	0.6555 nss	0.0219 ss
Roosfontein	7.05^10^{-41} ss	n/a /	0.2471 nss
Clarke's shelter	0.3700 nss	0.5784 nss	0.5496 nss
Holkrans	0.3399 nss	0.9012 nss	0.0848 nss

Geduld and Roosfontein show significant differences in the waste and unretouched category between pre-ceramic and ceramic periods. Only Geduld shows a significant difference in the other stone items category between pre-ceramic and ceramic periods. Implications of these differences were discussed in the previous chapter (Ch. 3).

To more closely examine the formal tool components, adjusted residuals for the ceramic period formal tool assemblages are presented in Table 4.10. Using a 0.05 level of significance, values of ≥ 1.96 or ≤ -1.96 are significant. Other values do not represent statistically significant variations from pre-ceramic formal tool assemblages.

Table 4.10 Adjusted residuals for ceramic period formal tools

Site	*Formal Tools (FT)* Pearson’s (standardised residual) Adjusted residual ≥ 1.96 or ≤ -1.96 significant values at 0.05 level of significance		
	Scrapers	Backed items	Other FT
Geduld	-0.49 -1.32	0.05 0.33	0.36 0.97
Witklip	-0.88 [-2.32]	-0.30 -0.71	0.85 [2.66]
Roosfontein	-0.66 -1.65	0.63 0.85	0.89 1.31
Clarke’s Shelter	0.33 1.10	-0.43 -1.02	-0.10 -0.21
Holkrans	0.48 1.50	0.48 1.09	-0.76 [-2.13]
No brackets = not statistically significant [ ] = lower or higher than expected values			

Three sites (Geduld, Roosfontein and Clarke’s Shelter) do not significantly vary from their pre-ceramic formal tool assemblages in any category. Witklip has a lower than expected value of scrapers and higher than expected value of other formal tools. Holkrans has a lower than expected value of other formal tools, but the overall formal tool assemblage does not significantly vary from the pre-ceramic period (Table 4.5). The absence of backed items in the pre-ceramic and the low value of backed items in the ceramic period may be unreliable for testing purposes. When running the chi-square test on scrapers and formal tools only, simply as a heuristic device, there is still no significant difference between the Holkrans pre-ceramic and ceramic period formal tool assemblages ($0.061 > p < 0.05$).

The exception of the formal tool category in the Witklip assemblage is explained in Chapter 3, section 3.3, and sufficient archaeological evidence is provided to suggest the continuity of a hunter-gatherer lifeway from the pre-ceramic through early contact/ ceramic periods. Otherwise, the general conclusion that can be reached is that between the pre-ceramic and ceramic periods there appears to be continuity, rather than significant change in the Geduld, Roosfontein, and Clarke's Shelter lithic assemblages. The Holkrans formal tool category also suggests continuity in pre-contact/ pre-ceramic and early contact/ ceramic periods. The stone-walled structures in the vicinity may shed some light on the nature of early contact at Holkrans.

4.9 Stone-walled structures

Pre-colonial stone-walled structures are often associated with Later Iron Age farmers (Huffman 2007); yet there is evidence that some stone-walled features were built by LSA herders and hunter-gatherers (Humphreys and Thackeray 1983; Noli and Avery 1987; Webley 1997; Jerardino and Maggs 2007; Humphreys 2009; Sampson 2010; Sadr 2012). There are several stone-walled features in the Holkrans vicinity (Fig. 4.9). One has what appears to be a furnace for smelting iron nearby.

To date, there is no evidence to suggest that any of these structures were built and used by Holkrans inhabitants. They may have witnessed the construction and use of the structures in an early contact (or 'pioneering phase' according to my hypotheses, Ch.1, Table 1.1) with food producers, stated to be sometime within the last 500 years according to Bradfield and Sadr (2011: 77). Yet some group of people invested in a stone retaining wall feature outside of the rockshelter, which has been dated to the LSA (see section 4.4.4). Whether or not it was the shelter hunter-gatherers or nearby food-producers who built the retaining wall, or whether technology was shared between groups or witnessed then replicated by hunter-gatherers is uncertain. It would be speculative to currently suggest that Holkrans hunter-gatherers were keeping livestock, even if only as loaned stock. There are few non-hunter-gatherer items in the thus far known material assemblage, and faunal remains await formal sorting and analysis. The investment in a stone retaining wall is nevertheless noteworthy, and suggests that the shelter was used for more than an occasional, logistical hunting site (see also section 4.2 for a description of the abundant natural resources in the Holkrans vicinity).

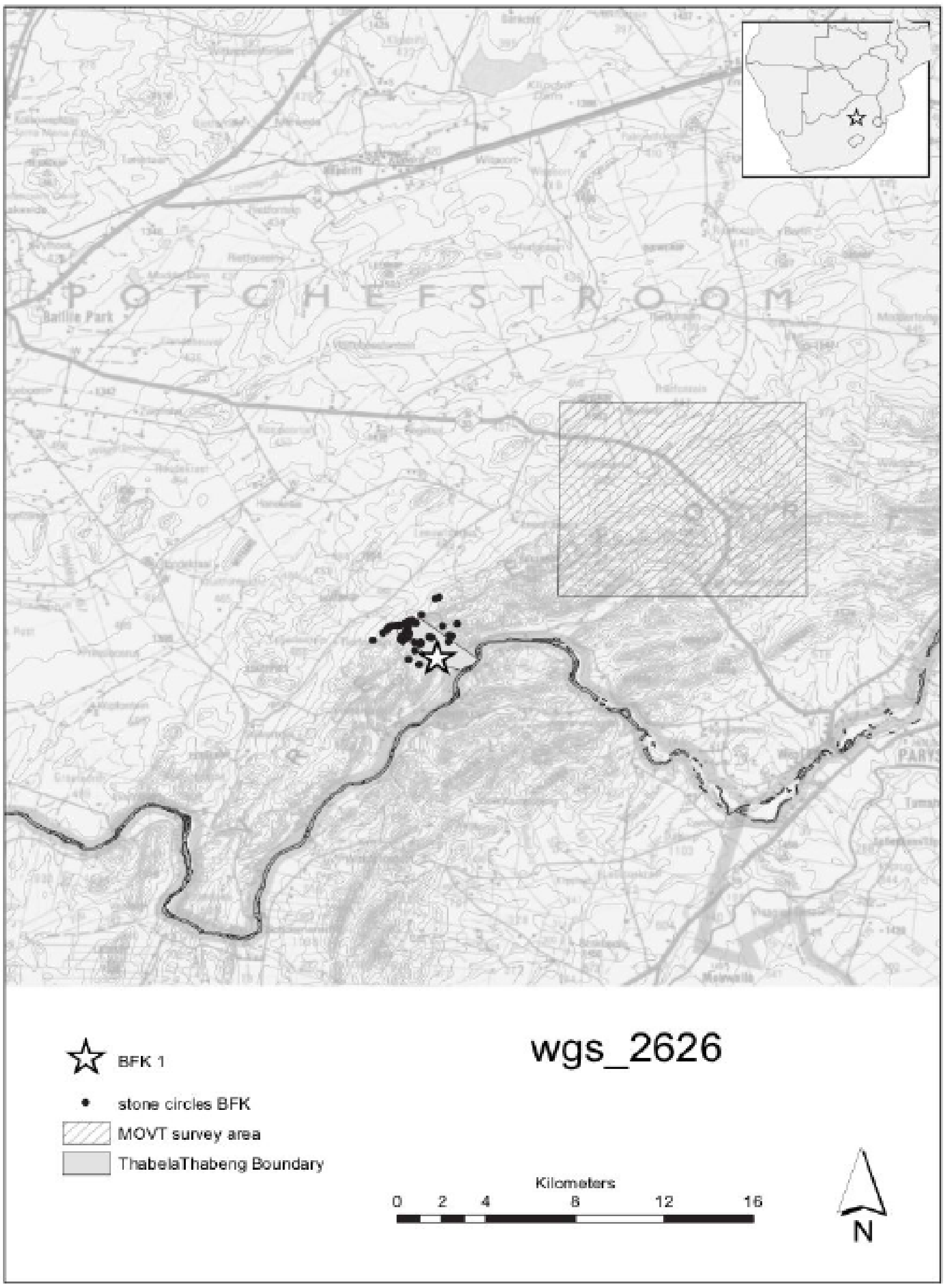


Fig. 4.9 Stone-walled structures near Holkrans (BFK 1)
(Bradfield and Sadr 2011)

Hunter-gatherers and IA farmers co-existed on the landscape (Dreyer 1990), which resulted in the interaction between distinct LSA and IA cultures (Klatzow 2000). Similar contact/ interaction phases have been identified in KwaZulu-Natal and the Free State (Phillipson 1989, Wadley 1986) and late contact rock shelters in Limpopo (e.g. Holt 2009) and southeast Botswana (e.g. Radiepolong, section 4.4.3).

Aerial surveys helped in identifying a number of IA sites. Work by Mason (1968), Maggs (1976), Taylor (1979), and Nkhasi-Lesaoana (2008) aided in explaining the distribution of these sites, and a proposed classification scheme based on architectural styles has aided in understanding site time periods and cultural affiliations. Byrne (2012) undertook a geographical spatial patterning study of these structures and concluded that the architecture and use changed over time. He explained that the locations of many of the structures, often on steep slopes and hillsides, would not be advantageous from the perspective of an agro-pastoralist, but that possible advantages of rugged terrain would be increased security, particularly in times of duress (*ibid*.: 95). Pelser (2003) excavated nearby Aaskoppies structures, which included a human burial with a copper ear ring and one glass bead, and was ultimately able to date the structures to between AD 1650 and 1800.

Taylor (1979) excavated six structures approximately 10 km from Holkrans, in part to research an area that had been excluded from Maggs' (1976) LIA research south of the Vaal River, and in larger part to establish in the Vredefort Dome 'the sequence of archaeological entities that existed there during the last 500 years' (Taylor 1979: 1). He established spatial patterning, correlation between pottery styles and settlement patterns, and the nature of contact between Sotho and Tswana, and the boundaries between cultures (discussed further in Ch. 8, section 8.5.1).

4.10 Chapter conclusion

Holkrans rock shelter has three distinct components, similar to Raidepolong (section 4.4.3): a pre-ceramic/ pre-contact phase, and a ceramic phase, recognisable as an early contact period and a late contact period. The early contact period has the richest material record (ceramics, faunal remains and lithics). The late contact or terminal phase retains few characteristics of the LSA.

The lower two components reveal morphological and raw material differences which in some ways conform to the Smith model and in other ways do not. There are no statistical significant differences between the pre-ceramic/ pre-contact and early contact / ceramic period lithic assemblages. Formal tools are nevertheless relatively low in number. In Chapters 5-8, I explain and apply use-wear analysis to the lower two components of the site, pre-contact/ pre-ceramic (spits 10-13) and early contact/ ceramic (spits 5-8), to determine if further light may be shed on the nature and impact of contact and how the Holkrans hunter-gatherers responded (further elaborated on in Ch. 8, section 8.5.1; resolved and explained in detail in Ch. 9, section 9.2).

CHAPTER 5

Research in and approaches to lithic use-wear analysis

> *'It would be unwise to base elaborate reconstructions of activity differentiation on evidence of variation in tool kit composition as measured by morphological criteria of forms that are not crucial to function or by typological categories that do not reflect standardisation of form' (Isaac 1977: 87).*

5.1 Introduction

One aspect of this thesis includes examining the applicability and usefulness of a morphological model applied to later LSA lithic assemblages to interpret changes from pre-ceramic to ceramic periods at selected southern Africa sites, and what light may be shed on the nature of contact and cultural and behavioural changes reflected in the associated lithic assemblages. Morphology, however, does not necessarily reflect function, but function may be revealed through use-wear analysis. When choosing a use-wear method for analysis of a lithic assemblage, it is important to understand the various analytical approaches that can be applied to excavated materials and the suitability of these approaches for analysis. This chapter presents different research approaches used in lithic use-wear analysis and examines the advantages and limitations of each.

5.2 Previous research

Keeley (1974b: 323) states that the goal of use-wear is to 'reconstruct, as completely as possible, the economic activities of prehistoric groups'. Odell (1975: 237) explains that use-wear permits archaeologists to ‘examine questions of culture process and change by way of prehistoric activities’. Analysis of stone tool function can shed light on: a) subsistence strategies (e.g. Shea 1988); b) cognitive abilities involved in the manufacture and use of stone tools (e.g. Rots and Van Peer 2006); c) behaviour with regard to the environment, such as raw material procurement and use (e.g. Keeley and Toth 1981); and d) the curation of lithic materials (e.g. Rots and Van Peer 2006).

Although a relatively recent branch of archaeological specialisation, the beginnings of use-wear can be found in the work of John Evans, English archaeologist and geologist. His 1872 book, *The Ancient Stone Implements: Weapons and Ornaments of Great Britain*, is regarded by more recent pioneers in the field (e.g., Tringham *et al.* 1974:172) as a seminal work in micro-wear studies. Evans described what he believed to be various stone tool types and manufacturing techniques, suggested uses for the tools, and included sketches of what he categorised as different flaking techniques and traces left from use, such as edge damage and polish. The term traceologies was initially used to describe damage and scarring on lithics. Curwen (1930, 1935), surgeon and archaeologist, probably best known for his survey and excavation work of Neolithic causewayed encampments, undertook early research in stone tool function through experimental work and ethnographic studies of remote peoples in the Hebrides. Hayden and Kamminga (1979) credit Curwen with valid propositions about prehistoric stone tool function, but a scientific approach was necessary to establish lithic analysis as a legitimate avenue of archaeological investigation.

Soviet archaeologist Sergei Semenov published *Prehistoric Technology* in 1964, in which he described how tool morphology in conjunction with microscopic use-wear (analysis of edge damage, fractures, striations, etc.) could be used to explain tool function (cutting, scraping, etc.), and worked materials (wood, bone, hide, etc.). Hayden and Kamminga (1979) point to the notable increase in interest in lithic analysis as a testament to the significance of Semenov's work. What then was not considered a problem, but today is considered unacceptable in terms of comparison is that Semenov's use-wear analyses were originally performed on metallic instruments that were machine shop manufactured according to his specifications. Odell (1975) pointed out significant flaws in Semenov's method, wherein wear traces were being linked to hypothesised functions of a particular tool, rather than wear that may be left from a variety of uses. Keeley (1974a) advocated finding a new approach to ensure that observed use-wear could not be mistaken for anything other than the purpose for which the tool was used, or be the result of other processes, such as original manufacturing techniques.

The perceived deficiencies in Semenov's methodology did not stop western analysts from initially embracing the Soviet approach – using binocular microscopes at <100x magnification to examine wear according to hypothesised function. Tringham *et al.* (1974) credit Semenov's pioneering studies with providing a truly analytical framework for prehistoric technology analysis which superseded typological classifications of lithics. The late 1970's and early 1980's saw recent pioneering archaeologists (e.g. Newcomer 1977; Diamond 1979; Del Bene 1979; Kamminga 1979) exploring new methods of identifying wear, establishing methodologies for experimentation and analysis (e.g. Binneman 1982, 1984), and working toward a common, uniform terminology to be used by researchers (Cotterell *et al.* 1979). Schiffer (1979) describes this time as one of great optimism, where the belief was held that use-wear analysis would provide unquestionable evidence to explain changes in culture, economies and behaviour.

The following two decades brought debates over techniques and methods, particularly concerning the effectiveness of high power microscopy and low power microscopy (e.g. Tringham *et al.* 1974; Newcomer and Keeley

1977; Keeley 1980; Odell and Odell-Vereecken 1980; Hurcombe 1988, 1992), and the value and pitfalls of blind-testing, where the analyst is provided with tools to examine, not knowing how the tools were used (e.g. Unrath *et al.* 1986; Bamforth 1988). Other researchers (e.g. Levi-Sala 1986; Grace 1990) were more concerned with the limitations of analysing tools from assemblages and how these limitations may impede interpretations of behavioural inferences drawn from analysis.

Debates over techniques and methods have left some in the archaeological community wary of or sceptical about the value of micro-wear analysis. Grace (1990) maintains that no single approach is satisfactory and that it places artificial limitations on the analysis with regard to the question being asked. Shea (1987), however, suggested that the technique and methodology should be adapted to the question being asked, thus providing valuable data without the artificial limitations perceived by Grace. Experimental archaeology, for example, could be used to aid in better understanding the functional analysis of artefacts (e.g. Binneman and Deacon 1986). Multi-stranded approaches (e.g. both high and low power microscopy) should not be seen as mutually exclusive, but rather could be used in conjunction if the analysis and question being asked required both.

The last ten to fifteen years in micro-wear studies has seen a shift away from the processualist New Archaeology, the primary tenet of which is that if the scientific method is applied, then objective conclusions may be reached, toward a more post-processualist or interpretive archaeology, recognising the pitfalls of stricter materialist interpretation and accepting the subjectivity of interpretation. There has been wider acceptance of more flexible and multi-stranded or integrated approaches to micro-wear analysis (e.g. Donahue and Burroni 2004; Wadley et al. 2004; Rots and Van Peer 2006; Lombard and Pargeter 2008).

5.3 Approaches to the analysis of tool function

Macroscopic analysis (e.g. Young and Bamforth 1990), low power microscopy (e.g. Tringham *et al.* 1974; Odell 1981), high power microscopy (e.g. Keeley 1980) and the still evolving residue analysis (e.g. Bruier 1976; Lombard 2003) have become the most accepted and best known approaches for the analysis of stone tool function. In order to fully comprehend lithic use-wear analysis, it is crucial to first understand and consider: a) the basics of fracture mechanics; b) the differences between natural and human agency; c) the differences in ground and chipped stone analysis; and the role of debitage analysis, particularly as it relates to the analysis of materials from different chronological periods. [Extensive discussions on each of these topics comprise **Appendix A**.]

A brief introduction to determining tool function (section 5.3.1) precedes the explanation and discussion of the aforementioned analytical approaches, along with the limitations and advantages of each. This is followed by an explanation of how use-wear techniques have been employed to analyse Later Stone Age (LSA) lithics in southern Africa.

5.3.1 Tool function

Two practical ways to determine tool function are through replicative experimental tool manufacturing and use and knowledge of regional archaeological sequences. However the ‘most critically interpretive parameter of all [is] how individual tools were utilised’ (Odell 2004: 135). Much of 19th and 20th centuries literature reads with a bias toward what tools should have been used for, based upon morphological attributes or incorrect ethnographic (etic) classifications. (For cautions on the use of ethnography see: Trigger 1984: 276; Zvelebil and Fewster 2001:154; Humphreys 2007: 98; Finlayson 2009:176.) François Bordes, for example, suggested in his *Reflections on typology and technology in the Palaeolithic (1967: 25-55)* that, ‘an implement can be defined in two different ways, by use and by form, and these two aspects are often related'.

Sergei Semenov's response to Bordes' assertion in *The forms and functions of the oldest tools* (1970: 1-20) was: "A concept of 'functional typology' proposed by F. Bordes can't be accepted. One must deal with typology and functionology as with two quite different approaches to study archaeological data…" Bordes also suggested that Semenov's studies in how tools were actually used could only complement, but never replace morphological typology. However research done around the world found that specific morphological tool types were often used in ways that were dramatically different from Western notions of tool use, proving that form does not equal function (e.g. Heider 1967, 1970; White 1968, 1969; White and Thomas 1972; Hayden 1977).

Today we have decades of research and trial and error from noted archaeologists who have provided us with the methods, techniques and information to undertake that single most important aspect of determining tool function: how the tool was actually used (rather than what it looks like or what we believe it should have been used for). The following sections describe the various methods employed in use-wear analysis.

5.4 Macroscopic analysis

Macroscopic use-wear analysis is done by unaided visual inspection or with a 10x magnifying lens. Microscopy is not used. The objective is to identify macroscars (e.g. edge fractures), polish and striations in instances where these can be seen without magnification. Odell (2004) states, and analysts generally agree, that microscopic magnification is necessary in order to reliably identify wear resulting from tool use. The macroscopic approach (e.g. Andrefsky 1998) is, therefore, generally excluded from use-wear discussions.

5.4.1 Limitations of and problems with macroscopic analysis

Only thin-edged tools, used on hard materials (e.g. bone, antler) would leave suitable traces for macroscopic observation. Tools prehended for activities like cutting soft animal or vegetal material do not induce sufficient force on relatively thick faces and edges to scar lithic materials that would leave macroscopically observable striations, rounding, polish or other wear. Damage from various things, such as rock falls, excavation and the manner in which artefacts are handled and stored can produce wear that appears to have come from use; but a microscope is needed to be able to tell the difference (Odell 2004).

Even with macroscopically visible wear, determining tool function and worked material is nearly impossible. However, functional wear resulting from a large impact load (or material displacement, e.g. a projectile point) (Odell and Cowan 1986) (Fig. 5.1), or well developed accretions (e.g. sickle gloss) (Andrefsky 1998), or tools that have been subjected to use for long periods of time may be suited to macroscopic observational analysis (Donahue and Burroni 2004).

Wear that can be macroscopically observed is rarely formed. In a given assemblage, information about tool function obtained from this approach may be applicable to only a very small number of lithics. While macroscopic analysis might identify a worked edge of a tool, it is unreliable for determining motion and contact material. Odell (2004: 139) states that it is impossible to put the observable macroscopic wear 'into any kind of functional context'. The only information that may be gleaned is the possible use of a tool. Keeley (1974b) and Odell (1975) apply a basic rule when considering use-wear analysis: the wear must not have developed through other means (e.g. bioturbation – the disturbance of soil or sediment by living things). This principle tenet would, then, exclude macroscopic analysis of stone tools from an acceptable method for determining function and worked material.

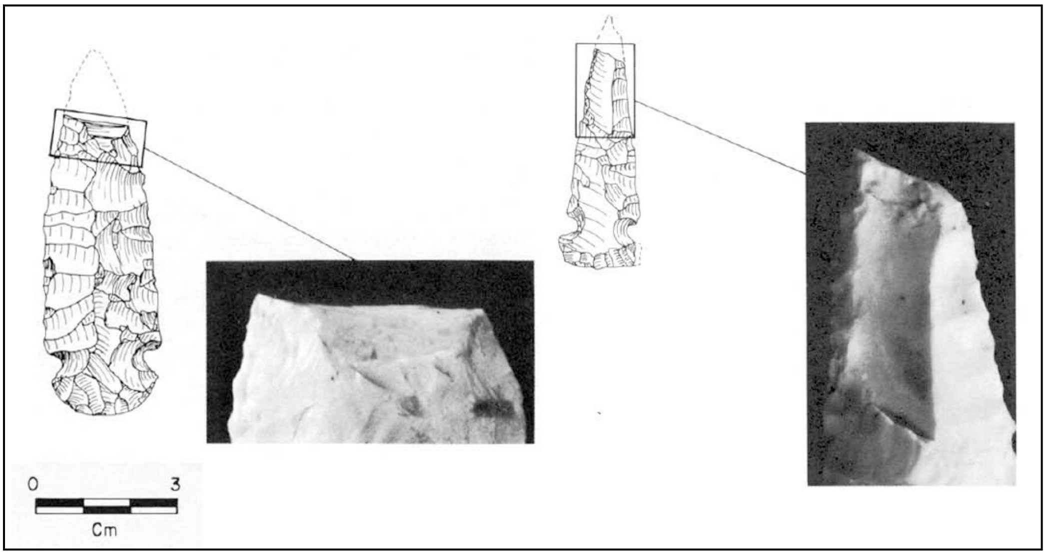


Fig. 5.1: Macroscopic observations of wear on experimental bifacial projectiles. Left: snap fracture has removed tip before terminating in a step fracture. Right: elongated step termination. (Odell and Cowan 1986)

Other problems with macroscopic analysis may come from the manufacturing process, impact upon the stone tools, and deposition of the tools. Flake detachment from a core can result in edge damage that might be confused for wear when examined macroscopically (Newcomer 1976). Simply dropping a flake from a height no greater than the seated knapper could cause damage that might look like retouch when macroscopically observed (Moss 1983a). The deposition or burial of stone tools can lead to edge damage (Levi Sala 1986). Damage caused by excavation and curation is often confused for wear traces using macroscopic analysis (Young and Bamforth 1990). Only with microscopic analysis can the patterns and appearances of traces from use and non-use be properly distinguished.

Advantages of macroscopic analysis are few. Morphological type categories can be assigned; the method is inexpensive, quick and can be done in the field with a hand lens. However, information on tool function, motion and contact material is unreliable. Young and Bamforth (1990) determined through experimentation using macroscopic analysis that tool function can rarely be determined without the aid of microscopy. They achieved an accuracy level of < 25% when describing tool use, and stated that microscopic analysis should be employed whenever possible.

5.4.2 Macroscopic analysis summary

The limitations of macroscopic analysis of stone tools render the approach undesirable, save for suggesting a possible thick working edge that has undergone extensive use. The reliability of gleaning even the sparsest information (e.g. a worked edge in relation to contact material) is low (Young and Bamforth 1990). While significant applied force can leave macroscopic traces, the origin and patterning of the traces can only be distinguished by microscopic analysis. Macroscopic analysis, therefore, does not appear to be suitable for analysis of the Holkrans assemblage.

5.5 Low power microscopy

The low power approach uses a stereoscopic microscope, with wear being observed from <10x – 200x magnification. The object of analysis is illuminated by reflective light (a separate light source with articulating arms) that enhances shadow effects and depth of field necessary for interpreting topographic features stereoscopically.

It is important to note that a common mistake found in archaeological literature (e.g. Vaughn 1981) is the incorrect distinction between or definition of reflective and incident lighting. This may be due to how the terms are used outside of the scientific community (e.g. in photography).

However in microscopy, a result of how the viewing instruments are constructed, the terms are clearly defined and are not interchangeable. Reflective light sources can be manually manipulated, to achieve the optimal light and shadow balance for the particular object under analysis. Light strikes the object diagonally. Incident lighting in microscopy is built into the scope and the light strikes the object under analysis from directly above. (The advantages and disadvantages of both are further discussed below.)

Use of stone tools will usually result in microscopic wear (striations, scarring, crushing, rounding, polish, etc.) on the edge, surface and part of the tool that made contact with the material being worked. Observations of traces around tool edges can provide information about which part of the tool made contact with worked material. The orientation of striations can indicate motion (how the tool was prehended and used) (Odell 1981). However, crushing, rounding and/or the pattern of scarring observed on both dorsal and ventral edge perspectives provide the best information on tool use (Odell and Odell-Vereecken 1980; Odell 1981).

While some (e.g. Vaughn 1981; Levi-Sala 1986) describe low-power microscopy as simply observing micro-wear patterns, others (e.g. Tringham *et al.* 1974; Keeley and Newcomer 1977; Moss 1983a; Rots 2002) have shown that low-power microscopic analysis of scarring (wear patterns) to be reliably informative for discerning tool function, categorisation of worked (contact) material and duration of use.

The same variables (e.g., raw material, initiation and termination) that one considers at the macroscopic level are affected at the microscopic level (Odell 2004). Figure 5.2 shows wear at 40x magnification. Tringham *et al.* (1974) proved through experimentation that these variables, as well as use-motion, edge angle during use and spine plane angle (the angle measured from the ventral plane to the dorsal plane nearest the edge in question) affect microwear scarring patterns.

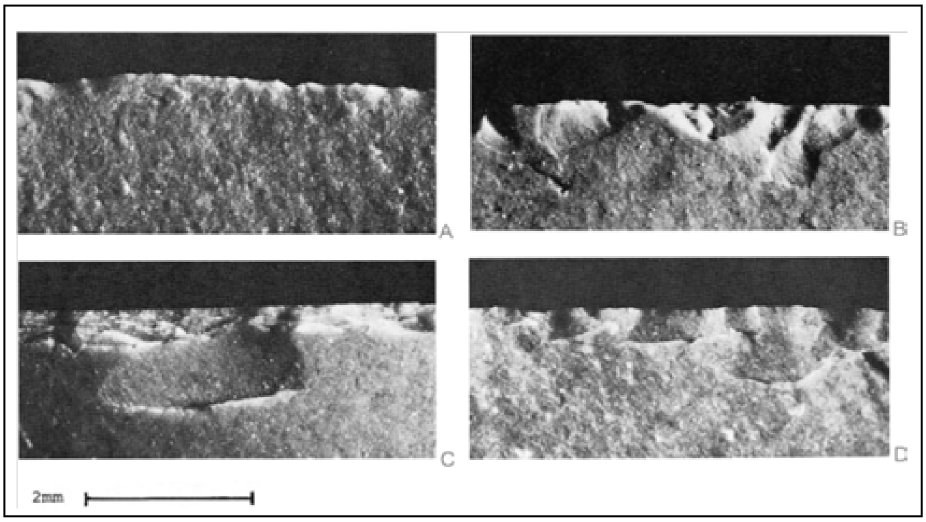


Fig. 5.2 Experimental tool use-wear: a) cutting animal flesh, b) sawing soft-medium wood, c) scraping animal bone, d) scraping soft-medium wood (Akoshima 1987)

5.5.1 Limitations of and problems with low power microscopy

Vaughn (1981) and Moss (1983a, b) maintain that the variability in microwear trace patterns from working different materials with different use-motions was too great to infer function. Moss (1983a) also commented that implements with relatively straight edges showed little damage at all, further stating that amount of damage could not be related to worked material and that inferences were spurious. Here it is important to note that Vaughn and Moss both used scarring patterns as their sole criteria for determining the value of low-power microscopic analysis. This stands in stark contrast with analysts who use low-power analysis. As Odell (1990) explained, all forms of wear (scarring, rounding, crushing, polish, etc.) must be considered when analysing any piece.

The greatest probable limitation in low-power analysis is determining precise contact material (Tringham *et al.* 1974; Odell and Odell-Vereecken 1980; Odell 1981, 1990). Observed wear on material can be seen as wear on a different material of similar hardness. Akoshima's 1987 experimental analysis of 400 tools confirmed that functional use and hardness of material (e.g. soft, medium, hard and sub-categories, such as animal or vegetal soft, soft-medium, medium-hard, etc.) can be distinguished, but that tool function on a specific, named material (e.g. cow hide) was not reliable.

Some archaeologists (e.g. Chambers 1974; Newcomer 1976; Moss 1983a; Levi-Sala 1986; and McBrearty *et al.* 1998) shared concerns that microwear and patterning could be misinterpreted from other causes, such as soil movement across stone surfaces, alluvial action, dropping a stone during manufacturing or animal and human trampling. A significant amount of research and experimentation has been done to address each of these concerns (see Appendix A, section A1.4 for detailed discussions).

5.5.2 Advantages of low power microscopy

The advantages of observing use-wear at magnifications of greater than 10x - 200x are several. Most diagnostic wear can be readily detected at 40x – 60x magnifications. It is significantly more accurate than macroscopic observation (Young and Bamforth 1990). Shea (1987: 45) explains that, when compared to high-power microscopy, tool function is derived (interpreted) fairly quickly. This affords information from larger, statistically significant assemblages and thus makes it possible to determine differences in tool use behaviour across time and space (Odell 1977, 1990, 2004).

For low power analysis, harsh chemicals (e.g. hydrochloric acid [HCl]) needed to remove organic residues before analysis are not necessary. And as Rots (2002: 14) explained, artefact stabilisation under the low-power microscope is not necessary. The direct association of terminations, striae, rounding, polish, etc. can be appreciated in context with the topographical and morphological characteristics of the tool. As an analyst who uses both low and high power (among other) approaches, I consider the ability to view all aspects of analysis at once to be one of the principal advantages of low-power microscopy. (One can hold and turn in any direction needed an item being analysed, easily alter the reflective lighting as needed, and observe multiple forms of wear at once. Magnification levels can be easily and quickly changed to suit the needs of both the analyst and the analysis being performed.) Blind tests have repeatedly confirmed the effectiveness of low-power analysis. The results of my blind tests are presented in Chapter 7. Shea (1987) reported that it is possible to distinguish worked materials (e.g., animal versus vegetal soft, medium and hard, and inorganic materials, soft, medium, and hard).

5.5.3 Low power microscopy summary

Few analysts have disputed the validity of the low-power approach, those who considered it more in terms of deficiencies rather than strengths probably did so from an erroneous understanding of what low-power analysts do in the observation and interpretation of tool use (Odell 1990). The basic principles of low-power use-wear microscopy have been firmly established and are now accepted for providing accurate information about edge utilisation, use motion and resistance (relative hardness of contact materials – although the microwear community is still debating its reliability in identifying exact worked material). It is significantly advantageous over high-power microscopy in terms of time needed for analysis which can be more effectively utilised in the analysis of large lithic assemblages and the comparison of different assemblages, providing information on the functions and changes in lithics through space and time.

The results of Odell's pioneering efforts in and continued contributions to use-wear analysis (until his death in 2011) have become convention among both high power and low power analysts around the world. His standardised codes for describing observed wear, a polar-co-ordinate system for edge analysis, and definitions and terminology are today used internationally. His method provides a complete picture, including the value and pitfalls of blind testing analysts, the sourcing and procurement of raw materials, the detailed fracture mechanics of producing stone tools, the modification of lithics, the analysis of debitage, determining use of tools, and what these things say about the technology, mobility and behaviour of the manufacturers and users of the tools (see also Odell 1980a, 1981, 2004). It is his methods, techniques, terminology and interpretative lens that I generally use in lithic analysis when the research question requires a more complete picture of a larger number of tools through time. The approach appears most suitable for analysis of the Holkrans assemblage.

5.6 High power microscopy

High power analysis uses a binocular scope with bright field illumination (objects lit with white light below and observed from above, appearing as a dark object on a bright background) and dark field illumination (objects lit from above, with an illumination block that causes the directly transmitted light to miss the lens, allowing only the scattered light to produce a visible image, appearing as a bright object on a dark background). Metallurgical high-power microscopes use frontal illumination. Observation magnifications are generally from 200x-400x, and a large degree of surface variation enables the interpretation of polishes responsive to specific contact materials which are the focus of most high power analyses.

Analysts who often used a low-power approach (e.g. Semenov, Tringham, and Odell) considered polish as a secondary indicator of tool use and motion. In the late 1970's, Lawrence Keeley began to examine the role of surfaces polishes observable at higher magnifications and reported distinct types of polish associated with different materials: wood, bone, antler, hide, meat and woody plants, stating in 1980 that polishes from different materials are distinguishable. Keeley and Newcomer (1977: 37) maintained that while all aspects of use are considered, polish is the most diagnostic element in high power analysis and provides information on which edge of tool has been used. Despite Keeley's admonition that all wear-traces must be considered, examining polish at high magnification became the focus for many analysts (e.g. Diamond 1979; Kamminga 1979; Anderson-Gerfaud 1980; Meeks *et al.* 1982; Moss 1983b; Unger-Hamilton 1984; Levi-Sala 1996; Ollé and Vergès 2003). Kimball *et al.* (1995) proposed three primary causes of polish on stone tools: silica gel, abrasion and fusion of particles as a result of friction. Grace (1996) and Levi-Sala (1996) explain, however, that scanning electron microscopy (SEM) has shown that abrasion is generally the most common cause of polish accretion on lithics.

5.6.1 Limitations of and problems with high power microscopy

Vaughn (1981) studied the formation of polish and found that its accretion on tools goes through various stages and can only be considered diagnostic of worked material after prolonged use. Vaughn (and Newcomer *et al.* 1986; Moss 1987) stated that even well-developed polishes overlap when resulting from use on different contact materials, which can lead to inaccurate use interpretations. Polishes from different worked materials do not cluster in discrete formations (Grace 1990). For example, visual observations of polish on a tool used on wood then on antler share similar enough characteristics that lead to an incorrect interpretation of the worked material. Moss (1987) also noted problems with quantifying polish. Using the example of polish on flint, both polished stone and unpolished stone had to be analysed due to the lack of uniformity of the polish. Moss (1987) and Bamforth (1988) further explain that microtopographic features on a tool used by analysts to decipher worked (contact) material cannot be used when quantifying polish.

Shea and Odell (1987) point out that pre-screening at lower magnifications is often required, and although fracturing and edge damage are visible at high power, they are difficult to observe in a more complete context due to the fixed stage upon which the artefact must be viewed and the high power microscope's narrow depth of field. Further, a significant amount of time must be invested in locating the small-scale wear visible at high magnification, which generally makes it suitable only for small, typologically-structured samples of larger archaeological assemblages (Gendel and Pirnay 1982; Bamforth 1985; Beyries 1987). The tendency among high-power analysts, then, is to use only partial evidence (e.g., polish and striations) for inferring tool function (Odell 1987).

High magnification wear can also develop from non-use functions, such as transportation (e.g. Rots 2003a) and subsurface soil movements (e.g. Levi-Sala 1986). Levi-Sala's tumbling experiments (see Appendix A), replicating the prolonged burial of artefacts, showed that contact with sediments and other artefacts resulted in post-depositional surface modification (PDSM) as sheen or bright spots (concentrated areas of highly reflective surface polish) that were observed to imitate, alter or altogether obscure or eliminate actual use-wear polish. Keeley (1980) and Anderson-Gerfaud (1980) reported that several analysts excluded anywhere from 25 - 40% of their analysis specimens after microscopically observing the above-mentioned PDSM false polish problem. The results of high power analysis are based on a small number of tools in the overall assemblage, particularly when examining very old stone tools (e.g. Keeley and Toth 1981).

Keeley (1980) explained additional problems of high power analysis which are based in procedural requirements. The cleaning of specimens, involving a solvent (e.g. diluted hydrochloric acid [HCl]), in order to remove all organic and inorganic residues is necessary, as they can mimic or obscure polishes. Artefacts for analysis must also be stabilised (secured on the microscope viewing platform), and due to higher magnification, only very small portions of an item can be viewed at any given time. This makes it difficult to establish a clear relationship between the use wear patterns and the overall morphology of the tool. This makes the high power analysis of lithics much slower and more time-demanding when trying to apply and answer questions about intra and inter assemblage functional variability (Odell 2004).

5.6.2 Advantages of high power microscopy

Moss (1983a, b) states that a clear advantage of high power over low power analysis is that it [has the potential to] precisely identify the worked (contact) material (e.g. meat, bone, etc.), and that more precise technological and functional interpretations of a tool can be made. Rots (2003a, b) wrote that the use traces visible only at higher magnifications (e.g. polishes and striations from manufacture and secondary modification) can assist in distinguishing between manufacture and use, and aid in better understanding the life history of a tool. Burroni *et al.* (2002) add that higher magnification can afford a better appreciation of the post-depositional processes that a stone tool has undergone.

However, these claims have been challenged and debated, particularly when blind-testing for several variables (notably precise contact material) were in question. Newcomer and Keeley (1977), in what has been called the first blind test (of high power lithic analysis), reported the following accuracy rates: 87% in identifying the used part of the tool, 75% for use motion, and 62% for worked material (specifically identified). Holley and

Del Bene (1981) contested the results, stating that accuracy for determining worked material correlated more to guessing at general categories of materials (e.g., soft, medium and hard) – an accusation that Keeley (1981) denied. Unrath *et al.* (1986) and, interestingly, Newcomer *et al.* (1986) stated that multi-analyst blind tests confirmed that high power analysis does *not* allow an accurate determination of precise worked material.

Newcomer *et al.*'s (1986) report of high power analyses performed by several microwear analysts at the London Institute of Archaeology revealed that the analysts achieved very poor accuracy ratings inferring worked materials from polishes observed on the examined stone tools. The analyses results were later challenged by participants and other analysts as not accurately representing Keeley's method, which included the analysis of microtopographic features (e.g. Moss 1987, Kimball *et al.* 1995).

The debate did result in some positive contributions. For example, it brought further attention to and discussion on the interpretation of poorly developed or obscure micro-polish observations. According to Rots (2003a,b), current high power analysts continue to affirm the efficacy of polish analysis because wear traces observed at higher magnifications provides a more holistic understanding of the history and use-life of a tool than can be achieved through low-power or macroscopic analysis. However, given the focus on polishes, the discussion on problems with polish observation and other limitations of high power analysis (section 5.6.1), Rots's comments seem to be perpetuating the incorrect interpretation of low power analysis that Odell sought to clear up in several of his publications (e.g. 1987, 1990, 2004).

5.6.3 High power microscopy summary

High power analysis allows the determination of the used edge of a tool and tool motion with a high degree of accuracy, and may provide the information necessary to infer precise worked material. (It is an approach that I use [along with scanning electron microscopy and other natural science approaches] when the research question requires highly detailed information on a limited number of aspects and a small number of pieces.) Vaughn (1981) cautions that surface polishes can overlap and be misinterpreted, particularly in the early stages of polish accretion, and that polish cannot be used as a diagnostic indicator of function. Unknown prehistoric duration of use and taphonomic processes (Levi-Sala 1986) can lead to false polish, ambiguity and incorrect interpretation of polishes and use. Akoshima (1987) stated that polish is but one qualitative indicator that should be considered with all other available use-wear traces.

The high power approach, while potentially able to provide more detailed analysis of fewer representative artefacts, does not appear to be the best approach for analysis of the Holkrans assemblage, for which the objective (section 6.2) is to analyse several hundred artefacts, experimentally manufactured pieces, and an assemblage of pieces made and used for blind-test purposes, which in terms of time needed for analysis and the "bigger picture" that can be observed when analysing a piece with low power, will provide more information on the assemblage through time.

5.7 Hafting and prehensile mode

Most previous research (macroscopic, low power and high power analysis) has been primarily concerned with identifying the wear on stone tools in order to infer use motion and worked materials, perhaps site and assemblage specific, to provide more detailed information on technology and functional variability through space and time, but more generally to provide information on the cognitive abilities of the manufacturers and users of the tools, as well as the addressing larger issues of culture, behavioural practices and relationships to the environment. This focus on the worked edges of tools and contact materials often meant overlooking the prehensile aspects of the tools (prehended – handheld, or hafted – attaching the tool to another object, e.g. a projectile point into a shaft). It is has also led to the misidentification of prehensile wear as use-wear (Unrath *et al.* 1986: 162). Odell (1980b, 1981), Odell and Odell-Vereecken (1980), and Moss and Newcomer (1982) were among the few researchers who invested time in prehensile analysis. More recent research includes comprehensive studies of the matter, and experimental work and analysis have shown that prehensile wear on stone tools does have interpretable pattern regularity (e.g. Nuzhnyi 2000; Rots and Vermeersch 2004; Wadley *et al.* 2004; Williamson 2004; Lombard 2006; Rots *et al.* 2006).

5.7.1 Prehensile and hafting wear

Odell and Odell-Vereecken (1980) comparing wear on lithic artefacts with wear on experimental tools with known use found that traces from prehension (hand-held) (Fig. 5.3) occurred away from the area of active use of the tool, and that one of the principal factors causing prehension wear was the angle at which force was applied by the fingers of the user to the edge, and the angle of the edge itself. This can result in varied terminations (e.g. feather, step, hinge, etc.) and may alternate between edge aspects (unifacially or bifacially).

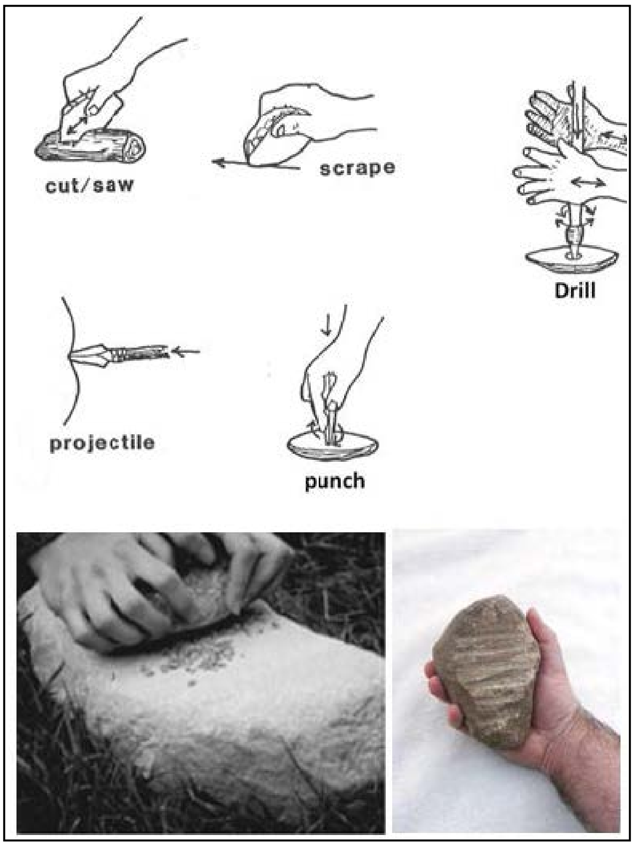


Fig. 5.3 Prehensile modes and wear

The amount of force exerted and the morphology of the edge will also affect the scarring pattern. Rots (2004) focuses on the polish left from prehension, stating the polish is more indicative than microwear traces of hand-held tools (Fig. 5.4). She explained that the polish is the result of detachments of material getting under the hand while a tool is being used, and that it is distinguishable from use-wear (which is usually continuous and distributed along a worked edge) because it forms in concentrated, distinct patterns.

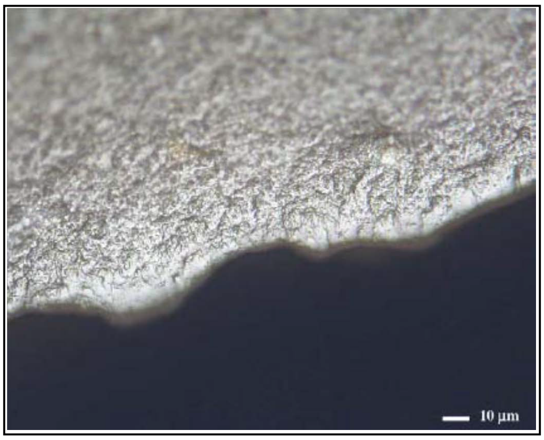


Fig. 5.4 Experimental tool polish caused by prehension (x 200 magnification) (Rots *et al.* 2006)

(See Rots 2002: 192-197, 239-246 and Rots 2004 for more detailed explanations of wear resulting from prehension.)

5.7.2 Hafting

Hafting traces are widely varied and depend upon a number of factors: the hafted stone tool (e.g., the raw material of the tool, tool morphology, secondary modification, etc.), hafting material (e.g., wood, bone, antler, etc.), materials to secure the tool to the haft (e.g., resins, grasses, etc.), hardness of the worked material, duration of use and the force used (e.g. chopping, use as a projectile, etc.). Haft types (Figs. 5.5, 5.6) are often categorised as juxtaposed and slotted or inserted (e.g., inserting a stone tool into a shaft) (Rots 2008: 44-45).

Hafting traces can be interpreted based on their association with unused parts of a tool – surfaces and edges away from those upon which microwear from use is observed. Rots (2003b: 48) states that clear delineation between the use edge and hafting are discernible by ‘the start of distinctly different polish, the abrupt start of scarring, bright spots, striations or a combination of these’.

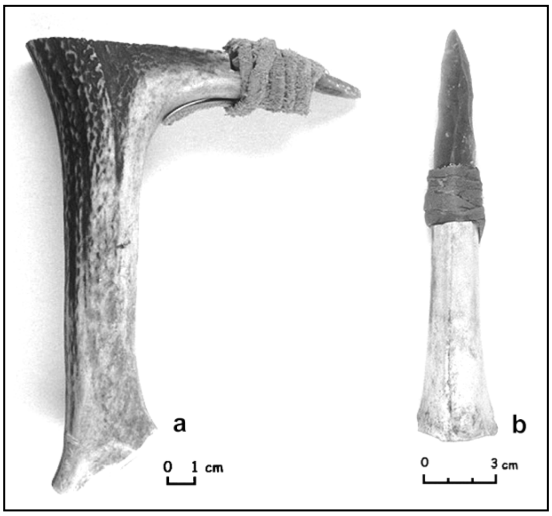


Fig. 5.5 Juxtaposed hafting: a) latero-distal hafting on antler, b) terminal hafting on bone (image Cleeren)

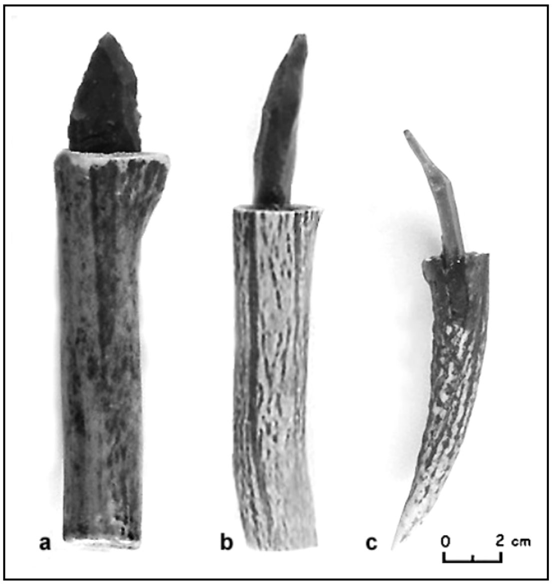


Fig. 5.6 inserted hafting: a) and b) terminal hafting in antler, c) split terminal hafting in antler (image Cleeren)

Rots (2002) demonstrated that hafting traces appear on sections of a tool that did not have direct contact with the worked material. In a 2006 blind test Rots *et al.* reliably distinguished the hafted and prehended traces from the worked edges of tools. However, she cautioned that all microscopic evidence should be considered when interpreting hafting and prehension wear. Hafting polish, while generally distinguishable from use polish, can be confused with use if the same material is used for both tool and hafting (e.g. hafting a wooden tool with wood).

Although identical to use polish on a microtopographical level (Rots 2004: 18), there is an inverse relationship between hafting polish and the distance from the edge (Rots 2003b: 48). Polish intensity is determined by the hardness of the worked material. (The harder the material, the more quickly polish develops.) Pronounced points in the topography of the tool are generally the locations where hafting polish is observed to develop evenly. This, however, may be affected by the manner in which the tool was hafted. While adhesives (e.g., animal fats and glues, bitumen) and bindings (e.g., vegetal materials, animal intestines and hide straps) used to secure a stone tool to the haft, making it a more efficient composite tool (Rots 2003a), the use of adhesives often prevent the development of hafting polish (Rots 2002) and bindings often produce polish due to friction with the surface and edges of the hafted tool (Fig. 5.7).

Scarring is also an important indicator of the prehensile method in which a tool was used. Rots (2004: 21) explains that hafting scar size is usually larger than those left from prehension (e.g. >1-2mm wide for lesser-force impacts, and >5mm wide for greater-force impacts, such as chopping). I.e., the more force involved in an activity, the greater the hafting scarring. Rots (2008: 49) further added that tool morphology and the type(s) of binding used has a direct correlation with the type of scarring produced. Bending forces, resulting from binding material used to haft a tool to a handle, may cause ‘sliced-into-scalar’ scars (Fig. 5.8), or scalar scars if force is exerted directly into the tool. Haft material and edge morphology determine the type of scarring, which is usually different from the distinguishable marks left by bindings (Rots 2004: 21).

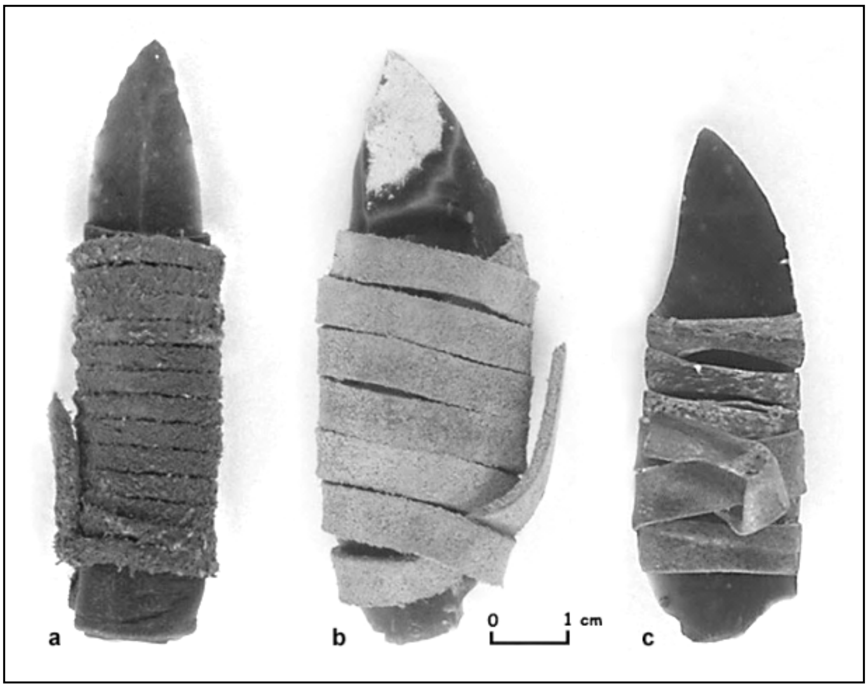


Fig. 5.7 a) leather wrap and bindings, b) leather bindings, c) wet leather bindings (image Cleeren)

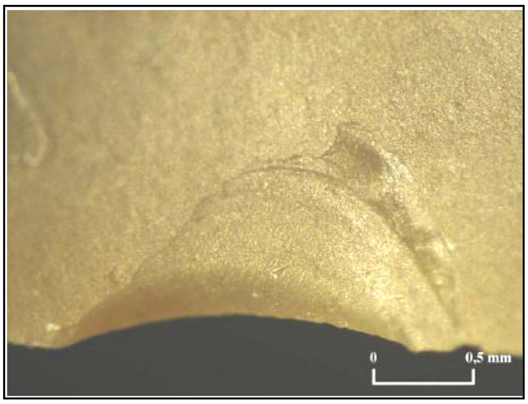


Fig 5.8 Slice-into-scalar scar (x 50 magnification): from haft bindings of lithic to a handle (image Cleeren)

Spallation (ejection of material fragments as a result of force or impact) on a micro-scale (micro-spallation) causing bright spots (concentrations of intense polish) is another possible consequence of hafting. This is due to the friction during micro-spallation against the hafted worked material. Levi-Sala (1986) states that these areas of concentrated polish are a result of sub-surface soil movements (see Appendix A). Rots (2003b: 49) rebutted by stating that hafting bright spots are distinctive enough to determine whether the spots originate from hafting or sediment or anthropogenic causes. The bright spots occur in association with and generally demarcate the extent of the haft or that part of the tool that has included in the haft (Fig. 5.9). Of note: low power-observation was used for Figures 5.8 and 5.9, as Rots (2003a, b) writes that polish, striae, and bright spots (along with their use-wear) can be distinguished and placed in association with one another using only low power and high power microscopy (e.g., as opposed to macroscopic observations).

Residue analysis to provide evidence for hafting, on the other hand, has yet to be sufficiently demonstrated, and hafting residues are rare. Lombard (2008) compared artefacts with experimental tools in an attempt to demonstrate that, like use-wear traces, residue analysis can determine whether or not a tool was hafted, the material to which the tools were hafted, and the bindings and/or adhesives that were used in hafting. Rots and Williamson (2004) stated that perhaps in terms of detail, residue analysis makes a contribution to microwear, but because each hafting method is different, residue analysis cannot provide the detail of patterning. Thus residue analysis in determining hafting and particularly when inferring tool use still faces the limitations of and problems with residue analysis in general (section 5.8).

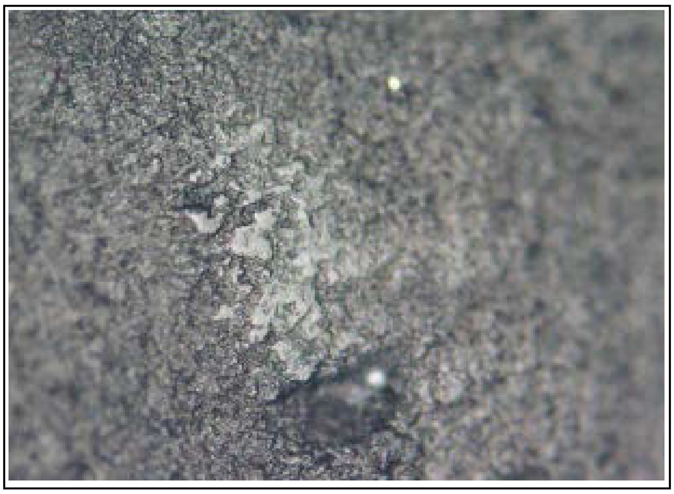


Fig. 5.9 Hafting bright spots (100x magnification) from hafted stone tool used to scrape wood (Rots *et al.* 2001)

5.7.3 Hafting summary

Rots and van Peer (2006) have provided compelling evidence in their experimental work that it is possible to determine the prehensile wear on stone tools and that this wear can be distinguished from use-wear. The success of prehension and hafting studies has added to the general trend in microwear studies over the last eight to ten years – one of a more holistic approach, taking into consideration all viable data when interpreting an artefact assemblage and particularly when undertaking functional analysis of tools in the assemblage. However, using residue analysis without the consideration of all aspects of use-wear (e.g. Wadley *et al.* 2004; Wadley and Lombard 2007; Lombard 2008) cannot provide sufficient evidence and may be considered speculative (see Crowther and Haslam 2007).

5.8 Residue analysis

Residues as a means of identifying tool function and contact material identification can prove problematic. Taphonomic processes acting upon surface materials have been considered too substantial to warrant this kind (residue) of analysis (Davis 1975; Briuer 1976; Barton 2009; Cooper and Nugent 2009). Subsurface finds encounter similar problems. Fletcher *et al.* (1984) reported that blood, for example, lost all immunological activity (necessary for its identification) within 16 months. Sensebaugh *et al.* (1971a, b) found that protein-based specimens lost all 'physiological viability' in less than 10 years in a clean, dry laboratory setting. Child *et al.* (1993) isolated and identified more than 200 micro-organisms that can destroy proteins in materials as stable and enduring as teeth and bones. While micro-organisms are considered the most serious detriment to preserving residues, Barton and Matthews (2006) point out that physical and chemical processes (e.g., moisture content, water flow, pH levels, oxygen content and temperature) also significantly affect the biological activity in sediments.

Moisture levels may assist in microbial activity; water flow may cause residue redistribution throughout sediments; high temperatures can destroy residues; and soil pH strongly affects residue preservation. According to Tuross and Dillehay (1995) soil pH is only generally measured and reported when an archaeological site has exceptional preservation conditions (e.g., the preservation of collagen, blood and proteins at Monte Verde, Chile, due to a rare combination of slightly acidic and anaerobic conditions). Despite medical and scientific evidence, advocates of archaeological residue analysis (e.g. Kooyman *et al.* 1992) maintain that residues, such as blood, can remain on tools for over 5,000 years and that crossover electrophoresis (the separation and characterisation of proteins and their reaction with antibodies) can be used to detect them. Archaeological residue analysis is undoubtedly currently experiencing the growing pains of scrutiny and trial and error. The efforts of current researchers (e.g. Lombard, Pargeter, Williamson and Wadley), may eventually result in residue analysis being accepted as a reliable method for establishing stone tool function. However, the matter is currently debated and is not the focus of this thesis.

5.9 Lithic use-wear analysis and the African LSA record

There is a need for use-wear analysis of African lithic assemblages, not only to address possible differences between morphological type categories and functional uses, but to address the general paucity of functional analyses in the African archaeological record. What we may understand as behavioural changes as reflected in lithic assemblages could be clarified by the application of use-wear to these assemblages. Only a handful of analysts have explored the Early Stone Age (ESA) (e.g. Keeley and Toth 1981; Binneman and Beaumont 1992; Loy 1998; Dominguez-Rodrigo *et al.* 2001). Fewer have undertaken use-wear work on the Middle Stone Age (MSA) (e.g. Donahue *et al.* 2004; Lombard 2005a; Rots and Van Peer 2006). Later Stone Age (LSA) analysis has been done, to some extent, by Phillipson and Phillipson (1970), Clark and Prince (1978), Binneman and Deacon (1986), Binneman (1994),Wallace (1997), and Binneman and Mitchell (1997).

Macroscopic analysis has been used by Lombard (2005b) to identify that 21% of MSA backed tools from Howiesons Poort at Klaises River had impact fractures resulting from use (according to definitions from Fischer *et al.* 1984); and by Villa *et al.* (2009) to infer function of Still Bay points from Blombos Cave (also using definitions from Fischer *et al.* 1984) and comparing them to North American Paleo-Indian points.

Low power analysis was used by Phillipson and Phillipson in 1970, and by Clark and Prince to examine LSA quartz tools. However, using the approach in its nascent and misunderstood form, they did not consider various taphonomic processes when stating that the tools had lain ‘undisturbed and unburied since they were deposited’. Rots and Van Peer (2006) used lower power analysis on quartz tools because the very nature of quartz (e.g. translucency) severely limited their ability to study polish at > 200x magnification.

High power analysis has been most frequently (even if scarcely) used in analysing African lithics (e.g. Keeley and Toth 1981; Binneman and Mitchell 1997; Donahue *et al.* 2004); however, high power analysis is the least efficacious approach in the overall study of African lithics because few tools were made of fine-grained, opaque rocks. Coarse-grained rocks are problematic when using high-power analysis (Rots and Williamson 2004). Wadley and Binneman (1995) excluded quartz lithics from their study because the high power observation and interpretation of micro-polish on quartz is difficult and inconclusive. This problem may be avoided in low power analysis by including wear aspects with the distribution, not interpretation, of polish on quartz (Rots and Van Peer 2006).

Thus, the use-wear analysis of African lithic items has been generally limited to fine-grained materials, such as chalcedony and hornfels (e.g. Binneman 1984), and various cherts (e.g. Clark and Prince 1978; Binneman and Beaumont 1992; Donahue *et al.* 2004). The exclusion of finer materials (e.g. quartz) in favour of coarser materials, often due to the approach used (e.g. high power) has resulted in selection bias and analyses and reports based on small samples: Keeley and Toth (1981) analysed 9 tools; Binneman and Beaumont (1992), 2 tools; Wadley and Binneman (1995), 7 tools; Donahue *et al.* (2004), 15 tools; Rots and Van Peer (2006), 14 tools.

In contrast, the Holkrans Rock Shelter lithic assemblage as a whole (e.g. > 4000 lithics from one [BFK1.E8] of several pits still under excavation), and the analysed sample (366 lithic items from spits 5-8, and 10-13 of 13 existing spits in BFK1.E8 – representing pre-contact/ pre-ceramic and early contact/ ceramic periods) is prolific by comparison, and the site continues to yield large numbers of stone tools and other artefacts. The problems mentioned with macroscopic and high power analyses help confirm my choice of low power analysis of artefacts and the value of experimental work, using tools made from Holkrans site materials as a comparative collection.

5.10 Chapter summary

This chapter provided the historical background of wear analysis on stone tools, explained the types activities and materials (and other factors, e.g. binding) that leave traces to interpret wear, and discussed the various approaches and their advantages and limitations in determining tool function. Going forward it is clear that a flexible, integrated approach centred upon questions and interests of the academic community, using goal-oriented research, is necessary for filling possible gaps in the lithic analysis record. It seems evident that the approach, appropriate to the question being asked and the artefacts being analysed, should include all viable aspects in any comprehensive line of investigating stone tool use and the materials upon which they were used. In order for this to be successfully applied to the lithics from the Holkrans Rock Shelter lithic assemblage sample, their suitability in light of artefact conditions and their association with pre-contact/ pre-ceramic and early contact/ ceramic occupations must be established (*Chapter 6*).

CHAPTER 6

Suitability for analysis of the Holkrans lithic assemblage

6.1 Introduction

Chapter 6 turns to the appropriateness for analysis of the sample from BFK1.E8 of the known Holkrans lithic assemblage and currently sorted pre- and ceramic spits from excavation pit E8. The chapter builds upon information in Chapters 2, 4 and 5.

The following sections explain the suitability of the materials for use-wear analysis based on the logical extension of information provided in Chapter 5 (Research in and Approaches to Lithic Use-Wear Analysis). Knowing the limitations and pitfalls of previous research methods, as well as the strengths and advantages of their methodologies will provide the most accurate information on changes in the Holkrans lithic assemblage, and perhaps shed light on behavioural changes reflected in the lithics across pre- and ceramic periods. The Holkrans Rock Shelter site formation and stratigraphic integrity are discussed, including taphonomic processes. The examination of suitability will provide context for the discussion of methods applied to materials in the experimental scheme and blind-test series (Chapter 7), and analytical applications to the artefact assemblage samples (Chapter 8).

6.2 Taphonomic processes and the potential effects on lithic assemblages

Holkrans (BFK1) pit E8 lies directly in front of / adjacent to the wall at the edge of the rock shelter. The stratigraphy from just below surface (e.g. 3 cm) through spit 13 consists of a loosely compacted, grey, fine to medium grained loam soil (N4 to N5 on the Munsell colour chart) that develops over crystalline complexes, which at Holkrans is the Archaean basement, touching the Vredefort Granophyre Dyke, and bordered by the Lower Witwatersrand Supergroup (see Ch. 4, Sections 4.1 and 4.2). This fairly uniform grey colour is common in soils exposed to alluvial action, leaching minerals over time, or soils in an anaerobic environment (Morgan 2001).

Attempting to understand the life history of the Holkrans stone tools will aid in understanding post-cultural use (e.g. discard) and other sources that could affect samples chosen for analysis and explain problems that may be encountered during analysis (e.g. obscuration of wear-traces). Natural processes (mechanical and chemical) have the potential to add to or obscure use-wear traces on the assemblage stone tools. The only way to reliably asses anthropogenic and non-use damage (wear) is by microscopic analysis.

While soils may have yielded (e.g. as a result of alluvial action) or been compacted (by anthropogenic and non-anthropogenic forces), there is no current evidence that suggests that there has been significant disturbance of the materials in Pit E8 (e.g., anthropogenic, bioturbation, solifluction, etc.). Table 6.1 shows the potential processes, effects on the artefacts and the probability of occurrence for Pit E8 materials.

The Holkrans artefacts have encountered rain actions over time which may have resulted in subsurface yielding of the soil, resulting in potential discolouration (or patination) and non-use surface and edge scarring. However, the excavation area seems to have suffered little in the way of overland flow (e.g. slope wash) or bioturbation (i.e., no significant evidence).

Table 6.1 Taphonomic processes and potential effects

PDSM = Post-depositional surface modification

Posit	Process	Potential Effect/ PDSM	Probability
Artefacts exposed to / found on surface (e.g. lost or discarded)	Weathering and trampling	Patination, non-anthropogenic macro-fractures, edge damage (e.g. crushing, rounding)	Possible, but not quantifiable in terms of duration, time of occurrence, etc.
In Situ	Weathering and sub-surface soil movements	Patination, non-anthropogenic macro-fractures, edge damage (e.g. crushing, rounding)	Possible Patination, surface and edge scarring and contact with other artefacts
Yielding of Matrix	Weather and sub-surface soil movements	Patination, non-anthropogenic macro-fractures, edge damage (e.g. crushing, rounding)	Possible Patination, higher probability of contact with other artefacts, possible surface and edge scarring
Excavation	Contact with excavation materials / equipment	Micro and macro fractures, non-use surface and edge damage, non-use striations	Possible and variable (according to excavation methods and excavators)
Post-excavation	Contact with other artefacts	Micro and macro fractures, non-use surface and edge damage, non-use striations	Possible and variable (according to curation methods)

Dr Christine Sievers[1] during a September 2013 tour of the site (and in subsequent personal communication) stated that being in the vicinity of a

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[1] Archaeobotanist at University of the Witwatersrand

river like the Vaal (and the microclimate of the rock shelter area) means the flora probably would not have changed much in the last few thousand years.

6.3 Method, sampling strategy, and artefact condition

As Hurcombe (1992:1) exhorted: the method of investigation must depend upon the information being sought to answer the archaeological question, taking into consideration the practical constraints imposed by field conditions, cost and archaeological survival. Choice of method for analysing the Holkrans assemblage (low power microscopy) has been determined based upon condition of the artefacts (good), the preservation of use-wear traces (good), and the large number of pieces being analysed (over 300) to provide a more complete picture of the assemblage. Choice of method also takes into account Beyries' (1987) caution that the alteration of tool surfaces increases with time because of post-depositional processes of burial, which would render certain approaches (e.g. macroscopic examination) useless. For a viable analysis, it is necessary that the wear on the artefacts survived previously discussed (Ch. 5 and Appendix A) potential hazards to the obscuration or elimination of wear (which may prevent high power microscopy, for example, from being a reliable approach). (For advantages and limitations of approaches, see Chapter 5, Sections 5.3-5.8.)

Prior to microscopic analysis of Holkrans E8 lithics, a dual-strand sampling strategy was used, consisting of both random and arbitrary sampling strategies. First, a stratified, statistical random sample was performed on lithics from the two lower of the three site components: spits 5-8 and spits 10-13 (clear demarcation of early contact/ ceramic and pre-contact/ pre-ceramic components respectively) yielding 326 lithic items for analysis. Morphological type categories for testing a morphological model were discussed in previous chapters (2-4). The remainder of this thesis focuses on the functional analysis of Holkrans E-8 lithics. While all pieces selected can be classified morphologically (e.g. even if only as flake or debitage), it is the functional interpretation supported by use-wear analysis that is of interest, not the visually observed type category.

The strata are the spit levels in each of the two aforementioned components. Optimum allocation (larger samples taken in strata with the greatest variability to generate the least possible sampling variance) was used to ensure that at least one member of each stratum's population was chosen, even if the probability of being chosen was < 1. This is an efficient way to partition sampling resources among groups that vary in their means, and to maintain a true representation of the population. Statistical sampling using a computer-generated random number table was then used to select items from each stratum. Odell (1977, 2004) advocates statistical random sampling when analysis of an entire assemblage is not feasible (e.g. due to size of the assemblage). Second, an additional twenty lithic items were arbitrarily selected for uniqueness (e.g., microliths points and items determined by the author to be unusual in size, shape and/or raw material).

The 346 artefact items (whose analysis is supplemented by the manufacture, use and analysis of thirty-two experimental tools and a four-part series of thirty-seven blind-test tools, similar to those in the artefact assemblage, and manufactured from raw materials from the rock shelter site) were initially examined (microscopically), to assess their use-wear potential in low power analysis, and were determined to be viable for reliable analysis in terms of artefact condition and preservation of wear. Viability was determined by: post-use influences on edges and surfaces in relation to striae and effects of post-use processes on the survival and ability to reliably observe and interpret use micro-scarring and edge rounding.

A potential problem that analysts may face is the misinterpretation of post-depositional processes and non-use surface modification on lithics (PDSM) as use traces. The ability to recognise the difference comes from understanding these processes and from experience over time. In addition, replicative experiments can assist the analyst in honing his/ her understanding and critical observation skills. (For more complete information on nature versus anthropogenic causes of wear and PDSM see Appendix A.) The following discusses influences or processes (Table 6.1) in order to confirm the choice of low power analysis of the Holkrans assemblage sample.

6.4 Low power analysis and post-use wear

As discussed in Chapter 5 (section 5.5), low power analysis observes and interprets micro-scars, edge rounding and crushing, and patterns of striae (Fig. 6.1) and polish resulting from use (Odell 1990).

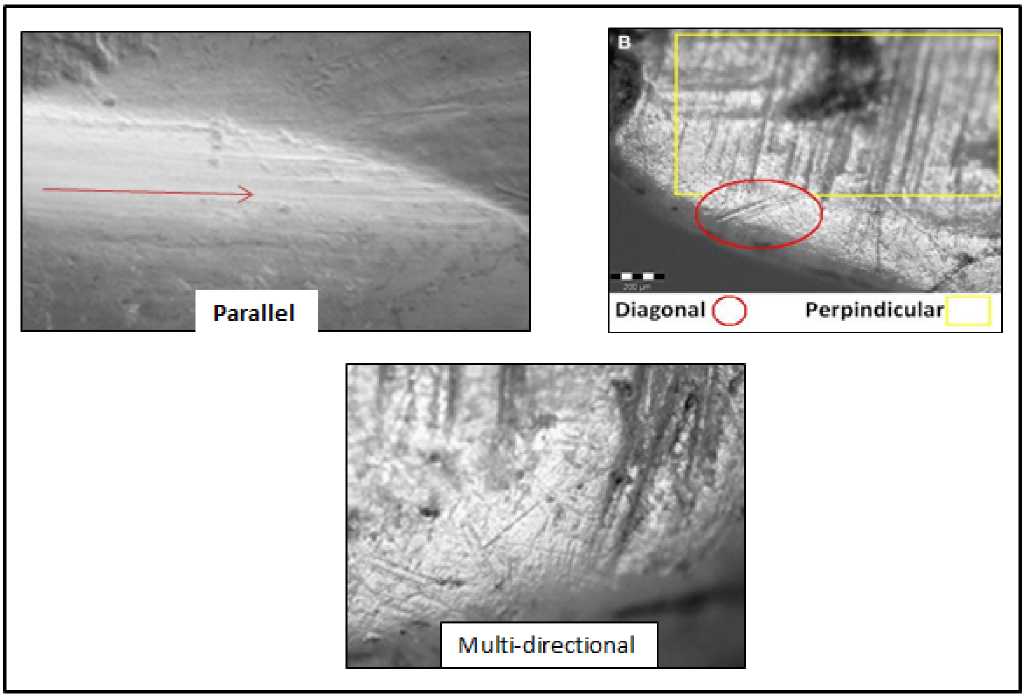


Fig. 6.1 Striations: parallel, diagonal, perpendicular, multi- directional

One of the most informative attributes helpful in low power analysis is micro-scarring (Keeley and Newcomer 1977; Odell and Odell-Vereecken 1980; Odell 1981; see also Ch. 5). Rots (2002) established the following breakdown of scarring, which is useful in the discussion of scarring of Holkrans lithics: Small is defined as <0.5 mm; Medium is 0.5 – 1.0 mm; Large is 1-2 mm; and Very Large is >2 mm (or macroscopic). Micro-scarring has survived on the Holkrans lithic assemblage sample and will aid in determining function (motion), relative hardness of worked material, location and type of damage, and prehensile wear, if any (Rots 2002; Rots and Van Peer 2006).

6.4.1 Patination

There is currently no method for measuring the severity of patination. Burroni *et al.* (2002) suggest using the amount of surface area of a lithic item for determining the degree of patina. Chemical composition, temperature, soil pH, water, organic mechanisms and duration of exposure of a stone tool to these factors determine the extent to which patination occurs, which is through the leaching of soluble components of lithic items in the presence of water (Luedtke 1992). Keeley (1980) noted that patination occurs at an inconstant rate, which makes it unusable for dating a lithic item’s age.

The Holkrans lithic assemblage does not readily show the effects of patination. However, the chemical composition of locations in the Vredefort Dome, which has varying microclimates, makes it probable that chemical weathering has left traces on the stone tools. Semenov (1964: 11) stated that ‘a shallow patina hardly changes the micro-relief of the surface…and so does not affect the traces of use on the tool’. So even if the stone tools being analysed have undergone chemical weathering, this should not impede reliable low power microscopic analysis.

6.4.2 Rounding

Primary observations of wear patterns come from analysis of worked edges. The tool, its ‘wearability’, the raw material and manufacture of the tool, duration of use, and the contact material upon which the tool was used, will determine the intensity (or invasiveness) of the wear damage left on the tool. Distinguishing between rounding left from non-anthropogenic activities (such as weathering, bioturbation, etc.) and rounding from use is important in interpreting tool function.

In the simplest terms, rounding is the dulling of a tip or edge (Fig. 6.2). One method for assessment is comparing an unused tool with a used tool of the same type category.

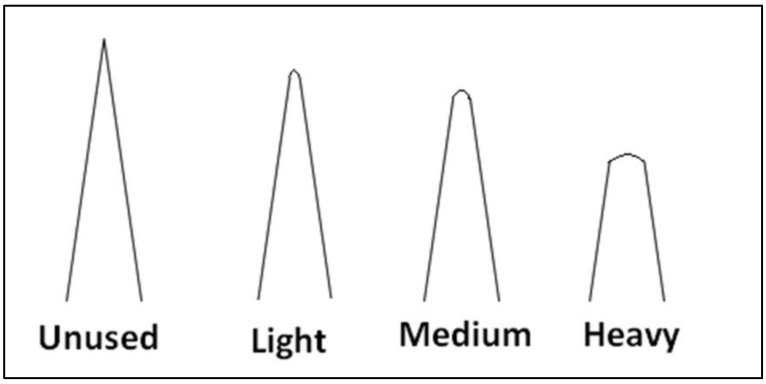


Fig. 6.2 Rounding

Shackley (1974: 501) defines rounding as ‘both chipping of the implement by other natural and humanly worked nodules’. It is an abrasive, ‘mechanical’ process, which she explains as developing in three primary stages: 1) the formation of stress cracks; 2) cracks developing a braided appearance caused by materials striking the edge(s) at acute angles (e.g., which may dislocate chips of material; and 3) the abrasive, grinding of the braided edge while increasing width of the ridge. Shackley originally undertook a study of rounding due to what she considered a lack of uniform and clear descriptions of the types of rounding used by different archaeologists.

Burroni *et al.* (2002) performed a series of controlled experiments to better explain the mechanical processes involved in rounding. While they were able to record the rounding process as occurring in stages, which decreased the weight of lithic items, they noted that there was no constant rate of change, making it impossible to determine the rate of rounding when correlated to a particular tool and its duration of use.

Shackley (1974: Table 1) proposed a system for defining rounding (abrading), show in Table 6.2 below.

Table 6.2 Observed ridge width and descriptions

Observed ridge width (µm)	Common verbal descriptions	Suggested index value
0 – 9	Mint condition	0
10 – 19	Very fresh	1
20 – 49	Fresh	2
50 – 99	Slight abrasion	3
100 – 199	Abraded	4
200 – 299	Heavily abraded	5
300+	Very heavily abraded	6

In the Holkrans assemblage samples, all items fall between slightly abraded to very heavily abraded. Figure 6.3 shows an example of artefact rounding.

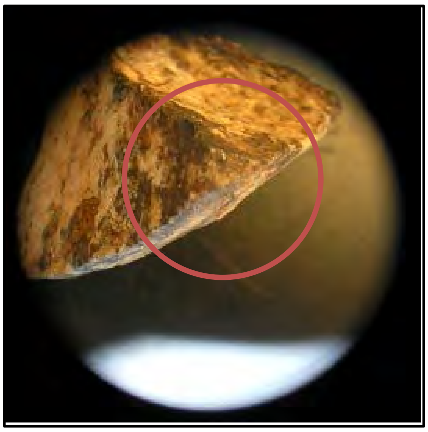


Fig. 6.3 Tip crush, heavy rounding/ dulling and dulling of adjacent edges. Striations diagonal and clockwise to tip and adjacent edges. This piece of quartzite was used to drill hard material (e.g. bone).

6.4.3 Post-use wear

Whether through intentional discard or loss, post-use and post-depositional wear can affect the wear patterning on tools, which can interfere with microscopic analysis. (See Appendix A for a detailed discussion of post-discard wear.) Low power microscopic analysis consists of observing and interpreting micro-scarring, edge rounding and crushing, and the patterning of striations and polishes on tool edges and surfaces from use (Odell 1990). However, an attribute of wear that is one of the most informative when determining artefact function is use-generated micro-scarring (Keeley and Newcomer 1977; Odell and Odell-Vereecken 1980; Odell 1981).

Upon preliminary examination of the artefact assemblage samples, it was determined that the wear patterns / micro-scarring were well intact and suitable for observation and interpretation using low-power microscopic analysis. Had this not been the case, developing an alternative approach would have been necessary (e.g., both high and low-power, high-power only, etc.). This would, however, have drastically changed the number of artefacts sampled and analysed.

6.4.3.1 Scarring

Cotterell *et al. (*1979) state that the initiation and termination of scars is necessary for interpreting the forces that a tool edge has encountered. The observation of scar initiation and termination is influenced by two primary factors: 1) scar size (the intensity or intrusiveness of the scar on the tool); and 2) the extent of edge and surface rounding. While fine detail of scarring may be lost in even low-impact activities on soft to medium contact materials, low power microscopic interpretive analysis (explained in detail in Chapter 5) uses all available information (e.g., edge rounding, striations, polish, and the intrusiveness of micro-scars). It is therefore possible to determine function, resistivity and type of worked (contact) material and prehensile mode when analysing the Holkrans artefact assemblage sample.

6.4.4 Excavation and post-excavation wear

The manner in which excavation takes places, the removal of artefacts, and post-excavation curation can potentially damage the artefacts and make it difficult to properly analyse and interpret the wear on them. At Holkrans, excavations are done in 1 m x 1 m pits, divided into 16 quads. Spit levels are dug in approximately 3cm increments and are scraped with trowels and hand brushes.

On-site, material removed from the pit is initially screened through 1 mm wire mesh to remove loose dirt, then bagged and sent to a second station. Work at the second station includes additional screenings through 1 mm mesh and the sorting of materials on lab trays. The sorted materials are then bagged and sent back to the lithics lab at the University of the Witwatersrand for additional sorting, cleaning and re-bagging.

It is possible that at any point in the above-mentioned procedures, lithic items could be damaged. However, recent damage (e.g., from excavation, curation, bag wear, etc.) is distinguishable from ancient wear. Some of the indications of recent damage include: 1) sharpness of fracture (at initiation or termination); 2) colour of scarring or damage (e.g., freshly exposed material versus the material of weathered, buried materials; 3) roughness of recent damage or the lack of sheen that would otherwise be present; 4) localised damage (e.g., localised edge crushing). Not all indications may be helpful in determining post-excavation wear. For example, on coarser materials such as quartzite, edge crushing may not be indicative or recent damage. However, colour changes (fresh versus ancient) can be telling in the observation of almost any lithic piece. (For detailed discussion on ancient anthropogenic, non-anthropogenic and other causes of damage see Appendix A.)

6.5 Chapter Summary

As discussed previously in this chapter, not all types of wear may be distinguishable on the Holkrans lithic assemblage samples. However, using all available forms of extant wear during microscopic analysis and interpretation of wear will provide sufficient data to determine tool use, prehensile mode, resistivity of material and general category type of contact material. Although layers in Holkrans Pit E8 may have compacted, there is otherwise no indication of serious disruption to the layers (e.g. flooding, sub-surface soil movements in large degrees, bioturbation, etc.). From preliminary analysis of the assemblage and the samples for analysis, the artefacts have been fairly well-preserved, thus affording a more complete and accurate analysis.

Considerations for viability and suitability for analysis included: a) the degree of post-discard processes (e.g., mechanical and chemical) to which artefacts were subjected over time; b) the raw materials of recovered lithic items and the way in which different natural processes affect different materials (e.g., the weathering of, trampling upon a thick quartzite flake versus a thin CCS flake); and c) the plausible taphonomy of individual lithic items (e.g. manufacture, use, discard). As long as non-cultural alterations to the assemblage lithics are correctly distinguished, a realistic degree of validity can be assigned to the functional analysis of the lithics.

CHAPTER 7

Experimental scheme, blind tests, and results

7.1 INTRODUCTION

Theoretical and methodological approaches and LSA technology have been discussed in previous chapters in order to provide the framework for better understanding the Holkrans assemblage. Changes and/or continuity in lithic manufacture (morphological type category) and use (functionality) address the heart of this thesis, comparing morphology to the conventional view of LSA lithic assemblage changes, and comparing functional use with morphology of the Holkrans sample. Identifying and interpreting the use of stone tools in the assemblage through microscopic analysis provides an avenue for determining what behavioural changes may have occurred between pre-ceramic and ceramic periods, and perhaps shed some light on the nature of contact between the indigenous hunter-gatherer-foragers and food-producers in the Holkrans rock shelter vicinity of the Vredefort Dome.

After careful consideration of various lithic analysis approaches (Ch.5) and suitability of methodology and the Holkrans assemblage (Ch.6), experimental work was performed, using raw materials from the site to manufacture tools similar to those in the assemblage, to analyse the use-traces on the experimental tools using low-power (< 200x magnification) microscopy as a comparative collection for the artefact assemblage. A series of four blind tests, using a separate (from experimental) set of tools, manufactured and used by WITS post-graduate students and WITS ARCL III field school participants, were administered to supplement the experimental work by way of confirming the observations and interpretations that I made when analysing sample from the artefact assemblage (Section 7.4 this chapter).

The questions I asked myself during experimental work were: For which activities could the Holkrans stone tools have been used? Will there be sufficient use-wear analysis data to confirm use type? How do functional use and morphology correlate? After knowing the functional use of the tools, can the use-wear data versus morphological data reveal behavioural changes across pre-contact/ pre-ceramic and early contact/ ceramic horizons at Holkrans – perhaps shedding light on the nature of contact?

Using low-power microscopic analysis, it is possible to determine: resistivity (relative hardness) of worked material, low or high impact activities (e.g., striations, edge rounding, impact stress, etc., according to Odell 1981), raw material source, edges and non-related surfaces used, prehension, and general categorisation of contact material (e.g., animal, wood, bone, etc.).

7.2 The experiments

Experimental work provides a meaningful reference collection of tools with known use that provide the foundation for the analyst to compare the experiments to an archaeological assemblage (Keeley 1980). This affords a better understanding of: variability in use-trace development and patterning as a result of independent attributes (e.g., duration of use, edge morphology, raw material, etc.; Tringham *et al.* 1974); variability and patterning of use-wear traces due to different use motions and contact materials (Odell and Odell-Vereecken 1980; Odell 1981); and the differences between use and non-cultural use-wear traces on stone tools (McBrearty *et al.* 1998).

The initial requirements of the experiments were to:

1) Manufacture stone tools similar to those in the artefact assemblage, using raw materials from the Holkrans rock shelter vicinity;

2) Use the tools on a variety of materials and in various use motions;
3) Observe the wear patterns created during use for comparison with the samples from the artefact assemblage.

To meet these goals, the manufacture, use and analysis of 32 experimental tools was undertaken. Raw materials were retrieved from Holkrans rock shelter and the surrounding area and thus correlate with the artefacts in the assemblage. The following explains the technology and method used. The experiments and results are then presented.

7.2.1 Equipment and procedures

A Nikon SMZ 745-T stereo-microscope with reflective lighting was used for all microscopic analyses. The scope has interchangeable 10x and 20x eye pieces and a 2x viewing tube attachment that allows magnification of 90x – 180x respectively. Microscopic photos were taken with a Nikon DS-Fi1 microscope attaching camera, with 2742 x 1942 resolution (5MP). Macroscopic photos were taken with an Olympus C-500 wide zoom. Both cameras were attached to a PC desktop for optimal viewing.

For low power microscopy, harsh cleaning agents (e.g. HCL) are not necessary (see Ch. 5). Cleaning of the experimental tools was done with liquid dish soap and water. Any additional cleaning for microscopic analysis was done as necessary using a toothbrush and acetone (e.g. finger nail polish remover).

Definitions and terms are from Odell (1981 and 2004) after the nomenclature presented by the HoHo Nomenclature Committee at the 1979 use-wear conference in Vancouver (Cotterell *et al.* 1979). Polar co-ordinates (PC's) of wear location are based on an (8) polar co-ordinate system (Fig. 7.1).

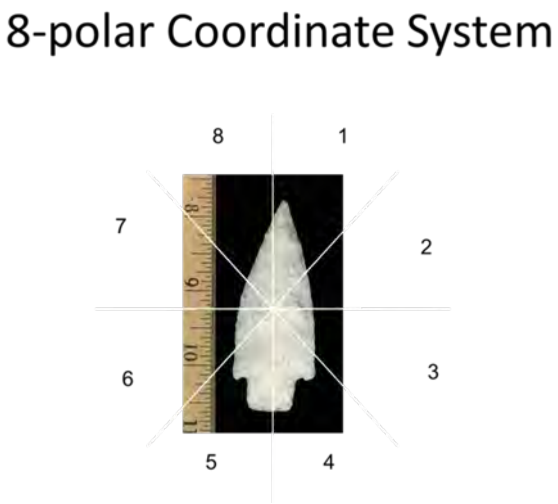

8-polar Coordinate System

Fig. 7.1 Polar co-ordinate graph for lithic analysis

Lithic items are placed mesial section to centre of the polar co-ordinate graph. Wear can then be identified and discussed according to its corresponding polar co-ordinate. Activity, material resistivity, abrasion and scarring are categorised according to the Illinois Codes for use-wear inventory, developed by Odell for his work in the 1990's in the Illinois Valley. Distinctions are made within categories when known (e.g. soft-medium, dry versus fresh, etc.).

Prehensile mode, when known or observed, is distinguished by prehension (held in the hand) and hafting (stone tool attached to another implement for use, e.g. a tree branch to make a composite projectile point). Hafting is commonly referred to as slotted (where the stone tool has been placed in a wedge or slot, e.g., a tree limb slotted at the tip in which the point is placed, then secured by some means) and juxtaposed (where the stone tool has been placed next to, but not slotted in, a haft, e.g. placing a stone tool on a tree limb and securing it by some means).

Details of experiments were recorded on the use-wear inventory form (developed by Odell, modified by Shen, further modified by Odell and this author) that is used with the Illinois Codes. This use-wear inventory form has been used throughout all lithic analyses for this thesis: experimental, blind tests and artefact analysis. Photographs were taken before use (if hafted, then in-haft). Microscopic photos were taken during wear analysis. (If hafted, the lithic items were removed from the haft before microscopic analysis.)

7.2.2 Protocols and analysis goals

To minimise limitations on the value of the experimental data obtained, strict protocols were followed during the experimental work. Only materials available pre-historically were used in both manufacturing and replicating use: wood, mastic (e.g., tree sap, animal fat), bindings (e.g., *Cyperus involucratus* sedge, leather strips), bone (e.g. rodent, sheep, bovine). All experimental tools were manufactured from raw materials procured from the Holkrans Rock Shelter site vicinity and correspond to the materials in the artefact assemblage.

The most meaningful experiments take place in conditions that most closely represent prehistoric conditions (Keeley 1980). Some experimenters (e.g. Binneman and Deacon 1986) took this to mean ‘dirty conditions’ and deliberately added dirt or some other abrasive substance during use replication or that soiled/ dirty hands were necessary when using the tools. However, I disagree with the deliberate addition of materials that may not have been present during use, as they arguably affect the development of polish and striations. I therefore did not follow their example in this regard.

After tool manufacture (some done indoors due to lack of light and some outdoors during the daytime), experiments were done outdoors, in an area that has rock formations (the geology of which is similar to the Vredefort Dome due to the meteorite impact spread), loamy soil and sand, wet areas with *Cyperus involucratus* sedge and other grasses. Some experiments were conducted in broad daylight, while others were conducted at dusk and early nightfall, to capitalise on various conditions of natural light (or lack thereof).

After use, a preliminary microscopic analysis was done on the tools to observe what was known to be anthropogenic manufacture damage and wear traces. Tumbling, by placing the tools in a linen bag and rotating them in small plastic barrel for ten minutes at approximately 40 rpm, was done to observe any trampling and bioturbation wear that might accrue on the tools.

The primary goals of experimental work and analysis were to:

1) Create the conditions (i.e., replication and use) whereby the micro-wear on experimental stone tools similar to those in the artefact assemblage could be observed first-hand;
2) Identify how a range of variables (e.g., type of use, duration of use, stone tool raw materials, contact materials) affect the micro-wear on experimental stone tools similar to those in the artefact assemblage (not to investigate every possible result that may or may not be due to any single variable);
3) Identify how prehensile mode affected wear patterning;
4) Clearly distinguish between used and non-used edges, ridges and surfaces unrelated to the edges;
5) Replicate conditions that would simulate non-anthropogenic causes of wear.

The use-wear results of experimental tools – manufactured and used by me (not to be confused with the tools in the blind test series) – are recorded in Table 7.1. This is followed by macroscopic and microscopic photographs of some of the experimental tools and a description of the lessons learned from the experimental work that I performed.

Table 7.1 Experimental tools: use-wear

PC = polar co-ordinates of wear; morphological category (from Deacon 1984b) presented for comparison and relevant to form versus function in artefact analysis (Ch. 8). For additional information on use motions (i.e. ‘used as/ to’ in table) see Appendix B; also see Tringham *et al.* (1974); Odell and Odell-Vereecken (1980).

Exp. N^0	Used as / to	Worked material	PC	Abrasion (type, location)	Scarring (location, distribution, size and termination)	Raw Material	Strokes (number and length), Use-time	Morpho-logical type category
1	slice/cut	sedge grass (C*yperus involucratus*)	4-5	light rounding ventral and dorsal, faint striations parallel/ diagonal to edge	ventral and dorsal close, small, ill-defined feather, chipping	basalt	1000, 5-6 cm over 20 minutes	flake fragment
2	scrape	green wood (*Halleria lucida*)	5-7	heavy rounding ventral and dorsal, striations diagonal too edge	ventral and dorsal, uneven denticulation, small, ill-defined feather	dolerite	2100, 3-4 cm over 15 minutes	chunk
3	grind	sheep fat for hafting	7-8	light rounding ventral and dorsal striae perpendicular to edge	ventral and dorsal slight denticulation and small, uneven ill-defined feather	quartz	1800, 3-4 cm over 15 minutes	lame à crête
4	scrape slot haft, sedge /sheep fat onto tree branch	sheep hide (*Ovis aries*)	4-5	ventral and dorsal light rounding, striae perpendicular. and diagonal to edge	ventral and dorsal slight denticulation, close, run-together small feather	quartz	2014, 4-5 cm over 15 minutes	blade
5	projectile point slot haft, sedge /sheep fat on tree branch	pig fat/ flesh wrapped around cow bones (*Bos-indicus*)	8, 1 (tip), and 2, 7	impact tip crush, spallation, striations diagonal to edge, developed polish	ventral and dorsal abrasion on adjacent pc’s to tip and clumped, ill-defined feather	CCS	350, 8cm over 3 minutes	flake
6	scrape (multi-use)	scrape sheep skin (1 edge), scrape tree bark (different edge)	7-8 animal 8, 1 wood	light rounding and striae diagonal to edge pc’s 7-8, heavier rounding pc’s 8,1, ventral and dorsal	ventral and dorsal close, uneven feather pc’s 7-8, clumped, uneven ill-defined feather pc’s 8,1	CCS	1500 for each activity, 3-4 cm each activity, 15 minutes each activity	end scraper

7	grind	sheep fat on bone	3-6	medium rounding and striae diagonal and perpendicular. to edge, ventral and dorsal	dorsal and ventral, slight, uneven denticulation, ill-defined feather pc's 4-5	CCS	1700, 2-3 cm over 17 minutes	chunk
8	scrape (slot hafted with sedge and sheep fat) onto tree branch approx. 3-4 cm in diameter	green wood *Podocarpus falcatus*	8,1 (edge)	heavy rounding, dorsal and ventral, striae diagonal to edge	dorsal and ventral, close denticulation and feather	pseudo-tachylite	1156, 4-5 cm over 15 minutes	flake fragment
9	point (spear)	sheep and cow bone wrapped in hide	8,1 tip	tip crush, heavy rounding, striae parallel and diagonal to adjacent edges	dorsal and ventral uneven feather	CCS	1920, 6-8 cm, over 15 minutes	flake
10	drill	green wood *Halleria lucida*	6,7	held to use tip of 6,7, tip heavy rounding, striae diagonal, clockwise to edge, dorsal and ventral	dorsal and ventral ill-defined feather and hinge fracture pc 6	CCS	1125, small (<1cm) rotating motion, over 15 minutes	chunk
11	scrape	seasoned wood *Grewia occidentalis*	6-8	heavy rounding, striae perpendicular. and diagonal to edge	ventral and dorsal uneven denticulation and small-medium feather	CCS	1955, 5-6 cm over 17 minutes	chunk
12	drill juxtaposed hafted, sedge and sheep fat onto cow bone (*Bos indicus)*	dried sheep bone (no marrow)	8,1 (tip)	heavy rounding, tip crush pc's 8, 1, slight striae dorsal and ventral clockwise on small <5mm edges adjacent to tip	ventral and dorsal parallel ill-defined feather	quartzite	1020 clockwise rotations (<1cm) over 15 minutes	chunk

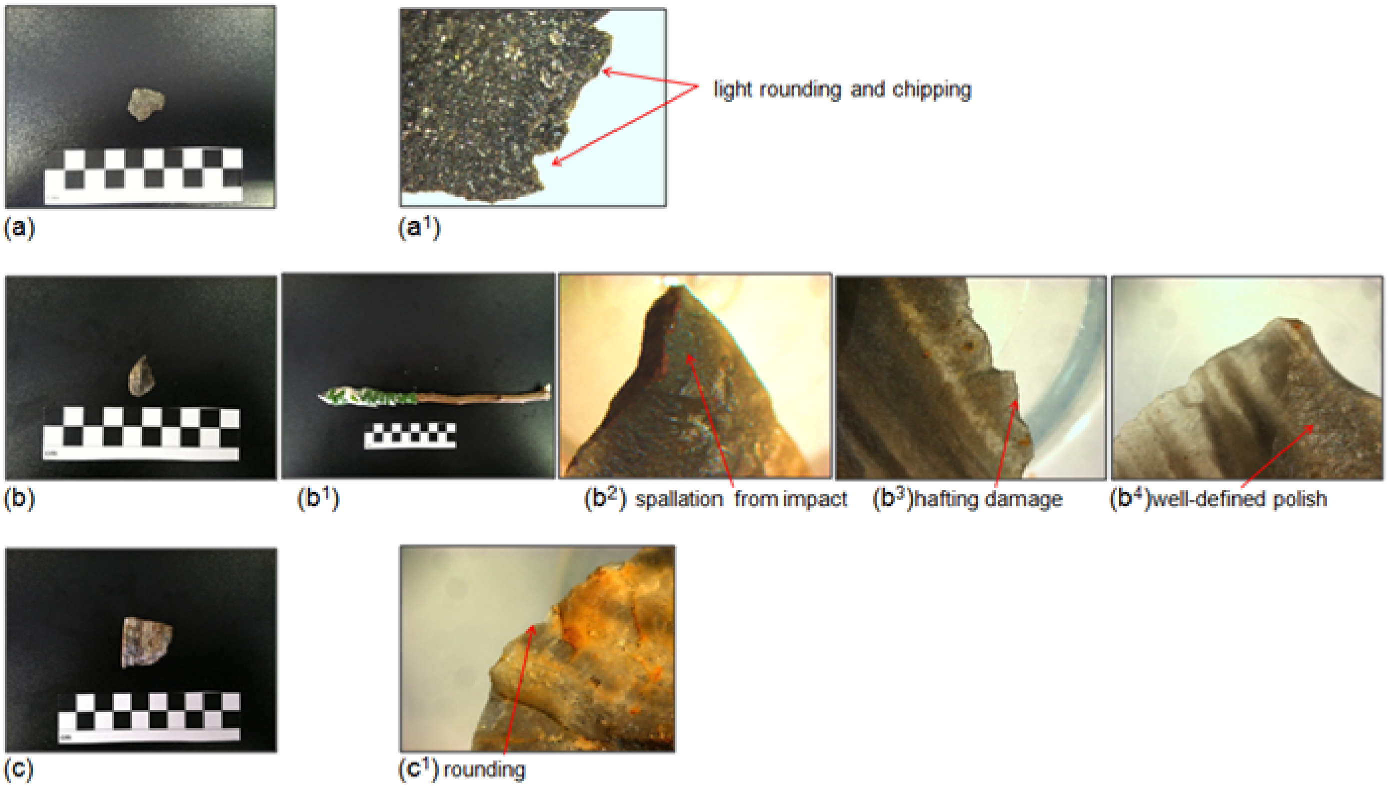
13	scrape	fresh sheep bone	4-5	pronounced rounding, striae perpendicular and parallel to edge ventral and dorsal	ventral and dorsal hinge and feather	quartzite	1950, 6-7 cm over 15 minutes	chunk
14	drill	fresh sheep bone	8,1 tip and 2,7	tip snap and abrading on pc’s 2,7 with striae diagonal and clockwise parallel to edge ventral and dorsal	ventral and dorsal clumped, uneven step, hinge and ill-defined feather	quartzite	1500 (rotation <1 cm) over 15 minutes	chunk
15	saw	fresh sheep bone	4-6	heavy rounding, striae perpendicular. and diagonal to edge	dorsal and ventral denticulation, medium-large feather and hinge fracture pc’s 5-6	quartzite	1725, 2-3 cm over 15 minutes	scraper
16	saw	fresh sheep bone	1-4	snap fracture after 10 minutes left edge unusable – pc’s 1-3	faint, ill-defined feather, uneven/ clumped (result of snap)	quartzite	1200, 2-3 cm over 10 minutes	chunk
17	drill	seasoned wood *Podocarpus falcatus*	4-6	heavy rounding of edge, striae perpendicular. and clockwise to edge	dorsal ventral striae and prominent feather on adjacent edges (small, close to tip)	quartzite	1575, clockwise rotations 1 cm, over 15 minutes	chunk
18	slice/ cut	pig hide with flesh	6-8	light rounding on edge, no distinct striae dorsal and ventral	dorsal and ventral close, run together, ill-defined feather	quartzite	1650, 2-3 cm over 15 minutes	chunk
19	scrape	sheep hide with flesh	5-7	very light rounding, faint striae	dorsal and ventral close, uneven ill-defined feather	quartzite	1700, 3-4 cm over 17 minutes	scraper

20	saw	green wood *Grewia occidentalis*	1-4	medium-heavy rounding, striae perpendicular and diagonal to edge	dorsal and ventral close, run-together ill-defined feather	quartzite	1700, 3-4 cm over 17 minutes	chunk
21	saw	seasoned wood *Halleria lucida*	4-6	heavy rounding, striae perpendicular. and parallel to edge, ventral and dorsal	ventral and dorsal uneven denticulation and hinge, small feather	quartzite	1400, 4 cm over 14 minutes	scraper
22	chisel (flaking action for retouch)	stone flake	4-5	heavy rounding, chipping, dorsal and ventral, striae diagonal to edge	dorsal and ventral uneven denticulation, medium feather	quartzite	375, small (<1 cm) (breakage at 5 mins.)	flake
23	scraping (de-barking tree limbs)	green wood *Halleria lucida*	5-7	medium rounding, striae diagonal and parallel to edge dorsal and ventral	dorsal and ventral uneven denticulation, small, ill-defined feather	quartz	1725, 5-6 cm over 15 minutes	chunk
24	scrape	seasoned wood *P. macrophyllus*	7-8,1	heavy rounding, striae perpendicular and diagonal to edge, dorsal and ventral	dorsal and ventral uneven denticulation, crushing, small-medium feather	pseudo-tachylite	1500, 2cm, over 15 minutes	small chunk
25	scrape	green wood *Grewia occidentalis*	5-7	medium rounding and striae diagonal/ perpendicular to edge, dorsal/ ventral	dorsal and ventral close, run together ill-defined feather uneven denticulation	pseudo-tachylite	1800, 2-3 cm over 20 minutes	scraper
26	etching/ graving	seasoned wood *Grewia occidentalis*	7-8, 1 (distal tip and edge)	medium rounding of tip, striae perpendicular to edge, dorsal/ ventral	dorsal and ventral small, clumped feather	quartzite	1300, 2-3 cm over 15 minutes	flake
27	saw	dry bone	5-8	heavy rounding and chipping striae parallel to edge (ridge) and ventral, no dorsal wear	ridge and ventral clumped, uneven feather, step and heavy denticulation	CCS	3676, 4-5 cm, over 5 minutes (damage stopped use)	flake

28	awl	sheep hide	8-1 (distal tip)	heavy rounding tip, clockwise and diagonal striae to tip and adjacent. edges	hinge fracture pc 7-8 within first few jabs, slight chipping in the beginning (dorsal/ ventral)	dolerite	400 rotations clockwise/ counter c.w. (<1 cm) over 15 minutes	flake
29	projectile point (slotted into tree branch, tied with fibre twine)	weighted dead fish to simulate spear fishing	8-1 proximal tip	tip rounding, some shatter and crush from hitting tank and rocks in water	step fracture ventral (at tip and adjacent edge pc 2, well-defined feather dorsal and ventral	CCS	100 throws from 1.5 meters over 20 minutes	flake
30	projectile point (juxtaposed) leather strips for binding (Spear for simulating downing a medium-large animal)	pig hide with fat wrapped around beef with bone in, propped against padded wooden panel	8,1 distal tip	tip rounding, but tip held up	dorsal and ventral (tip) feather where tip made contact with bone	CCS	125 throws from approx. 1.5 m over 30 minutes	retouched flake
31	projectile point slot hafted (sedge and fat)	sheep hide with flesh wrapped around sheep bone	8,1 (tip)	heavy rounding, tip crush (first impact loosened hafting and caused spallation) pc's 1-2		quartzite	1 'projectile launch' only	retouched flake
32	scrape slot hafted (sedge and fat)	scrape animal soft-med (cow hide)	7-8, 8-1	light rounding dorsal and ventral	slight denticulation dorsal and ventral	quartzite	1000, 2-3 cm over 16 minutes	chunk

The meanings of terms used for activities (e.g. cut/slice, grind, etc.) in Table 7.1 are generally understood (see Appendix B); yet the difference between cut/slice and saw may not be clear to some, particularly when considered from the perspective of form equals function. To clarify, sawing is a bilateral motion generally associated with and used to work harder materials (e.g. wood, bone). Cutting/ slicing, however, is generally a unilateral motion in which the (usually) prehended tool is drawn toward the user, and is ‘strongly associated with fleshy tissues and, more generally, with soft materials... and herbaceous plants...’ (Lemorini *et al.* 2006: 925). While a stone tool’s edge is not morphologically equated with that of a traditional saw (e.g. in the western mind/ understanding), a stone tool nevertheless can be (and has been) employed in bilateral motion to saw hard materials.

Figures 7.2-7.5 show some exemplary images of experimental tools before use and their corresponding microscopic photos after use. Before micro-analysis, any hafted tools were removed from their hafts, and the lithics were gently cleaned with soapy water and a soft bristle brush. ‘Plain English’ descriptions are found in image captions to assist with understanding use-wear labels. (Experiment numbers in images correspond to experiment numbers in Table 7.1.)



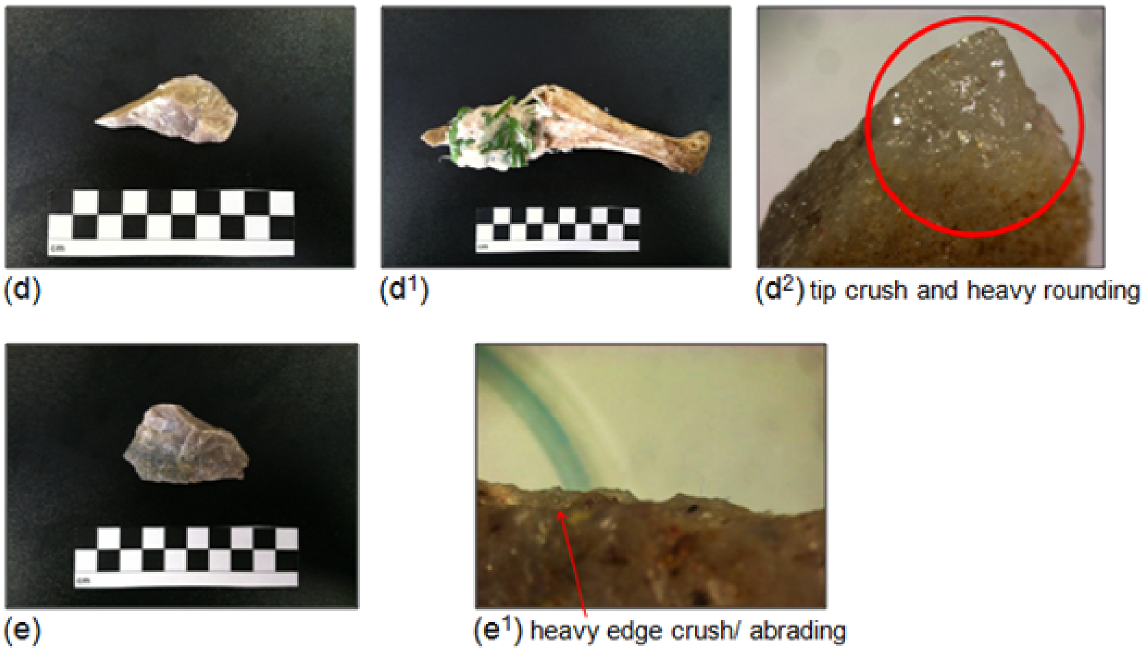
(a) (a^{1})

(b) (b^{1}) (b^{2}) spallation from impact (b^{3})hafting damage (b^{4})well-defined polish

(c) (c^{1}) rounding

See Table 7.1
(a), (a1): exp. 1 - slicing sedge grass; (b), (b$^{1-4}$): exp. 5 – hafted projectile point; (c), (c^{1}): exp. 11 – scraping seasoned wood

Fig. 7.2 Experimental tools: cut/ slice, hafted projectile, scraper (Top right: edge has dulled and piece of material has been removed; middle: stone attached to branch for use, or ‘hafted’, ‘slice’ off tip, chipped edge and shiny area from hafting; bottom: edge has dulled from use)



(d)

(d^1)

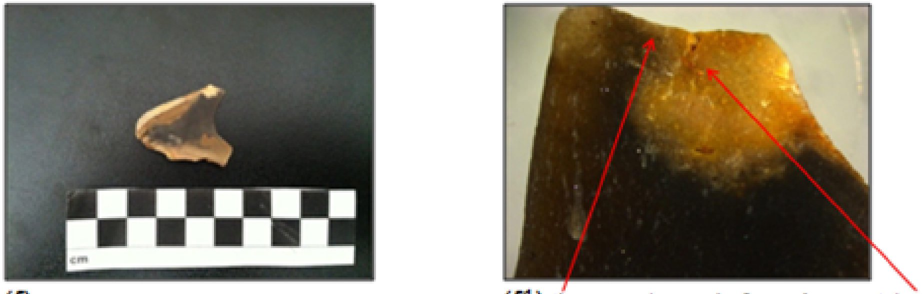
(d^2) tip crush and heavy rounding

(e)

(e^1) heavy edge crush/ abrading

See Table 7.1
(d), (d$^{1-2}$): exp. 12 – juxtaposed hafted drill (on bovine bone); (e), (e^1): exp. 15 – saw fresh sheep bone

Fig. 7.3 Experimental tools: hafted drill and saw (Top middle: stone placed against bone, rather than slotted into bone, then secured (called juxtaposed hafting); top right: tip has been dented, dulled, losing material; bottom right: uneven 'dents' and dulling of edge from use.)



(f) (f^1) tip snap/ crush from impact / striae perpendicular to tip

(g) (g^1) (g^2) spallation from impact

See Table 7.1
(f), (f^1): exp. 29 – replicated spear fishing; (g), (g$^{1\text{-}2}$): exp. 31 - slot hafted projectile point

Fig. 7.4 Experimental tools: fish spear and hafted projectile point (Top right: tip has snapped off from impact, ‘scratchy lines’, or striae/ striations, occurred during impact when piercing struck object; bottom middle: stone piece at left inserted into end of branch (called slot hafting) then secured with animal fat and sedge grass; bottom right: deep groove or loss of material from impact)

(h)

(h^{1})

(h^{2}) denticulation and rounding

See Table 7.1

(h), (h$^{1\text{-}2}$): exp. 32 – slot hafted hide scraper

Fig. 7.5 Experimental tool: hafted scraper

(Middle: stone piece on left inserted into end of branch, slot hafting, then secured with animal fat and sedge grass, making it a ‘composite tool’; branch would be held to assist in scraping motion by adding leveraged force; bottom right: edge is unevenly dulling and losing material, causing ‘teeth-like’ or pointed areas, called denticulates, to appear)

Of the ten tools used to scrape (e.g. transverse motion on animal soft, bone, wood) (Table 7.1), only four pertain to the morphological type category of scrapers – one of which was used as a multi-tool that included scraping. The remaining two morphologically-typed scrapers were used to saw (e.g., wood, bone - not animal or vegetal soft, which would be included in cutting/ slicing). The three formal tools served as two hafted projectiles and a fat grinder.

When knapping, the objective was not to limit or omit any particular morphological type category (although few were secondarily modified); but rather to take what appeared to be usable dislocations (rock removals) and re-create different activities that may have taken place pre-historically, using only materials that would have existed pre-historically.

7.3 Lessons learned from experimentation

While all observable aspects of wear, from the experimental tools that I manufactured and used, were recorded during analysis, the motive behind recording the various attributes of wear was a deliberate and cumulative process. I first wanted to observe the effects that similar use motions had on similar materials (e.g. seasoned versus green wood). I then observed the effects of similar motions on different resistance levels (e.g., soft, medium, hard) of contact materials (e.g., scraping wood versus scraping hide).The last phase of observation included different use motions of different tools on different contact materials.

After Odell and Odell-Vereecken (1980) and Odell (1981, 2004), the patterning of wear traces could be distinguished by edge damage and the categories of abrasion and scarring as seen in Table 7.1. Similar use motions on similar contact materials produce distinguishable wear. For example, scraping activities generally left similar wear traces. Rounding was heavier on edges used on both green and seasoned wood, while lighter when used on animal soft materials (e.g. hide, hide with fat and flesh). Striations, more pronounced on harder materials, were most often perpendicular and diagonal to the working edge. Denticulation quickly began forming on tools used on harder materials (e.g., wood, bone). Terminations (predominantly feather and ill-defined feather) also varied in intensity and corresponded to the resistivity (hardness) of the worked material. Step and hinge fracturing was observed on tool edges used on the hardest materials (e.g. bone).

Drilling activities produced lighter to heavier tip rounding (tip crush) correlating with hardness of materials (e.g., less on softer wood, more on dry and fresh bone). Striations and feather terminations were most often perpendicular and clockwise/ counter-clockwise to the drill ‘tip’. This would be expected due to the pressure exerted on the tool into the material coupled with the short-strokes associated with rotation to produce a hole in the worked material.

Projectile points tend to have tip crushing/ heavier rounding, with lighter rounding, striations and feather/ ill-defined feather terminations running diagonally on the lateral edges adjacent to the tip. This type of wear would be expected for a tool used in simulating the penetration of softer material (e.g., animal hide and flesh) and hitting harder material (e.g., animal bone). Two forces act upon a penetrating projectile: the kinetic force of penetration and the static force exerted by the material (in this case bone) that stopped the movement of the projectile.

Cutting/ slicing and sawing produced similar types of wear distinguishable, however, with microscopic examination. Sawing hard materials (e.g., bone) resulted in heavier edge rounding, chipping and denticulation of the worked edge. Diagonal, perpendicular and parallel striations are observed on stone tools used on harder materials. This can be a result of bilateral use motion, displacement (slipping of the tool during use in a direction other than use motion), and the need for re-introducing the tool to/ into the worked material for continuation of the activity. In softer materials (e.g., green wood), edge damage (e.g., rounding, denticulation, striations, etc.) are not as pronounced.

Duration of use increases the intensity of the wear. Experimental tool replication and use also gives an analyst the opportunity to observe wear in stages, or as it is accruing. This experimental data may be useful as a comparative collection in the functional analyses of the Holkrans E8 artefacts sample.

7.4 Blind test series

Blind testing involves providing a collection of experimental tools to an analyst who has no knowledge of the manufacturing technique or use of the tools used in the test. The analyst is asked to identify various attributes of the tools. For this thesis, I undertook a series of four blind tests. The attributes recorded and calculated for a percentage of accuracy followed *(sensu)* Shea and Odell (1987) and included prehensile mode (hand or haft), action (activity, e.g., cut, scrape, drill, etc.), resistance of material (e.g., soft, medium, hard), and worked (contact) material (e.g., animal, vegetal, wood, bone, etc.).

The protocols were modelled after Odell and Odell-Vereecken (1980), who attempted a similar blind-test scenario using low power microscopy as a response to Keeley and Newcomer's (1979) high power test. However, the protocols and procedures for my blind tests were modified slightly to accommodate a stricter blind-testing series. Specifically: the protocols established by Keeley, Newcomer, Odell and Odell-Vereecken that: 1) all tools for analysis must be handheld and that, 2) all uses must be non-agricultural were both excluded. Tools for my blind tests could be prehended or hafted (if the user elected to) and used on any material that would have existed pre-historically. However, rules concerning reasonable duration of use and standardised definitions for describing wear, and cleaning procedures (mild soapy water, soft-bristle brush and rinsing) were adhered to. Flakes were removed from haft (if applicable) and cleaned before administering of blind tests. No comparative collections of used tools or images of tools or use-wear were permitted for consulting. The test series tools were not provided to me for observation before the blind test.

The majority of blind-test tools were expedient tools (excluding prehensile mode, e.g. hafting) in that most were lithic pieces that were knapped but had no secondary modification. Driver (2006) manufactured and used expedient experimental stone tools of locally available CCS for administering blind tests (of 20 tools each) to (3) unnamed participants – two Great Lakes archaeologists and one lab research assistant . The tools were used for short duration (intervals of 1, 2, 4, 8 and <15 minutes) to determine if short-term use, expedient tools could be correctly identified. The results of the tests showed less than a 50% chance of correctly identifying expedient-use tools. Accuracy diminished further with a decrease in the resistivity level of the contact material (i.e. softer worked materials meant even poorer results).

Shea and Odell (1987), commenting on a blind test by Newcomer *et al.* (1986), explained that the tools being analysed were used for less than ten minutes, to make the analysts' job easier. However, previously confirmed, (e.g. Moss 1987; Bamforth 1988; Hurcombe 1988), tools used for such short duration, in this case less than 10 minutes, would not be sufficient for certain wear traces to develop (with particular emphasis on polish). Shea and Odell (1987) ask what, then, is to be done with ethnographic accounts (e.g. Hayden 1977) of expedient tools, used for short durations? For the sake of avoiding a debate over what precisely constitutes enough time, reasonable duration is defined in this thesis as the time necessary to use a chosen tool to complete a chosen task (e.g. de-barking a tree limb, stripping meat from a bone, etc.). This definition seemed prudent as an expedient pre-historic tool may have been utilised only once for one specific task.

A number of stone tools were manufactured by WITS ARCL III 2013 Holkrans field school participants (students and supervisory assistants) from raw materials obtained on site. (N.B.: These tools should not be confused with those I manufactured and used in my experiments, section 7.2). The tools were then used to perform activities unknown to me. The equipment used for analysis was the same Nikon SMZ 745t that I used for experimental and artefact lithic analyses. Microscopic observations were recorded on data sheets (replicated in Table 7.2) using the same format employed for experimental tools and artefact sample analyses. Plain English interpretations of the blind-test use-wear codes were then handwritten for easier comparison between my interpretations of data and the plain English test key answers compiled by the scorers.

A. Esterhuysen served as proctor, and selected and provided the tools at the appropriate times for each of the first three series of analysis (A, B and C). Each series was to consist of 10 tools, for a total of 30. However, Bag B-4 was empty when the B (or second series) was presented to me. Esterhuysen later arbitrarily selected 8 tools from among the 29 analysed in the first three series, re-bagged and re-labelled them ('D'), and administered a fourth double-blind test for intra-analyst comparison. The four-part series was then scored for overall accuracy by Esterhuysen, N. Sherwood and T. Lambert.[1] Accuracy percentages were determined by Esterhuysen and Professor K. Sadr, based on Shea and Odell (1987) and Odell and Odell-Vereecken (1980). The scored results of the four-part blind test series are shown in Table 7.3.

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[1] Esterhuysen is assoc. professor of archaeology at WITS. Sherwood is a WITS PhD candidate specialising in raw materials and Stone Age tool manufacture. T. Lambert, trained in use-wear under Odell, is a post-graduate student at WITS, specialising in use-wear and ESA lithics.

Raw materials are generally not recorded and scored, unless the blind test is specifically designed for the identification of raw materials. Recording the stone tool materials was for my own personal instruction and for providing more complete information to the comparative collection of experimental tools. Similarly, the presence or absence of retouch was recorded for identifying secondarily modified and unmodified pieces with the view of having more complete information in the comparative collections. Raw materials for both experimental and blind test tools come from Holkrans, and the tools in both experimental and blind test assemblages currently comprise the only analysed comparative collections we have for Holkrans.

Table 7.2 Four-part blind test series A-D

v = ventral, d = dorsal; AS = animal soft, VS = vegetal soft; morphological type (from Deacon 1984b) for comparison and relevant to (Ch. 8). Additional information on 'used as/ to' motions see Appendix B; also Tringham *et al.* (1974); Odell & Odell-Vereecken (1980).

Blind Test N^{O}	Used as / to (action)	Worked (contact) Material	PC of wear	Abrasion (type, location)	Scarring (location, distribution, size, termination)	Raw Material	Retouch	Morpho-logical type
First Part: A								
A1	cut	AS hit hard (e.g. bone)	1-3, 7-8	heavy rounding v/ d and ridge unrelated to edge, striations perpendicular to edge	tip broken, v/ d, uneven bend fracturing	CCS	n/a	chunk
A2	cut	VS	5-8	light rounding, bright polish	small, clumped, ill-defined feathers, v/ d	CCS	n/a	chunk
A3	scrape	medium (e.g. wood)	8-1 distal tip	heavy rounding, bright polish, striations diagonal to edge (no denticulation)	v/ d run-together small feather terminations	CCS	n/a	flake fragment
A4	cut	VS	6-8	light rounding, bright polish, striations parallel to edge	v/ d medium, uneven denticulation	CCS	n/a	flake
A5	scrape	VS	5-8	bright polish, v/ d	run-together, small feathers	CCS	n/a	flake
A6	file	hard dirt	8-1 (distal tip)	heavy rounding, bright polish, striations perpendicular to edge, tip snap in use	v/ d uneven, clumped feathers	CCS	n/a	flake fragment
A7	scrape	medium (e.g. green wood)	5-7	heavy rounding, bright polish (from fresh wood?), striations diagonal to edge, v/ d	v/ d medium, clumped denticulation	dolerite	n/a	flake fragment
A8	cut/ scrape	hard	1-4	heavy rounding, bright polish, striations diagonal to edge v/ d	v/ d small – medium uneven denticulation	basalt	n/a	flake

A9	scrape	hard	6-7	heavy rounding, matte polish, striations diagonal to edge, v/ d	v/ d medium run-together denticulation	basalt	n/a	flake
A10	projectile	AS hit hard (1H)	1-2	heavy rounding, bright polish, striae diagonal to edge, v/ d, tip snap	v/ d small – medium clumped feather	quartzite	n/a	flake
Second Part: B								
B1	bore/ drill	medium (e.g. wood)	8-1 (tip)	heavy rounding, bright polish, striae parallel to edge, v/ d	v/ d small-medium, uneven feathers with bend fracture (tip)	quartzite	n/a	chunk
B2	grind	AS	5-8	light rounding, bright polish used edge	v/ d small, run-together ill-defined feathers	quartzite	n/a	flake
B3	scrape	medium (e.g. wood)	1-4	heavy rounding, matte polish, striations diagonal to edge	small, uneven and run-together feathers	quartzite	n/a	flake
B4	MISSING FROM BAG							
B5	scrape	medium (e.g. soft wood)	1-4, 5-7, >1 used edge	light rounding, matte polish, striations diagonal to edge	v/ d uneven, ill-defined feathers	quartzite	n/a	flake
B6	scrape	AS hit med-hard	7-8	heavy rounding, bright polish, striae diagonal to edge, uneven denticulation	v/ d medium run-together ill-defined feathers	quartzite	n/a	flake
B7	scrape	AS hit hard	6-7, 7-8	heavy rounding, bright polish, striae diagonal to edge, denticulation	v/ d, run-together ill-defined feathers	quartz	n/a	flake
B8	NOT USED					quartz	n/a	flake
B9	scrape	AS (with hard inclusions)	5-8	heavy rounding, bright polish, striae diagonal to edge, small denticulates		pseudo-tachylite	n/a	flake
B10	grave/ file	medium (e.g. wood)	4-5	h.rounding, matte polish, striae perpend. to edge	v/ d clumped denticulates	quartzite	n/a	flake

Third Part: C								
C1	drill	Hard (e.g. bone)	8-1 (distal tip)	heavy rounding, bright polish, striations parallel to edge (clockwise/ c.c.w.), tip crush		pseudo-tachylite	n/a	chunk
C2	scrape	AS	5-8	h.rounding, bright polish, striae perpendicular to edge, v/ d	v/ d, small-medium, uneven, ill-defined feathers	quartzite	n/a	flake
C3	grave	medium (e.g. wood)	5-8	h.rounding, matte polish, striae diagonal to edge, v/ d	v/ d, medium, clumped denticulates	pseudo-tachylite	n/a	flake
C4	drill	hard (bone)	8-1 (tip)	h.rounding, bright polish, striae parallel to edge (clockwise/ c.c.w.), v/ d, tip crush	v/ d, small, uneven feathers	quartzite	n/a	flake
C5	drill	hard (bone)	8-1 (tip)	h.rounding, bright polish, striae parallel to edge (clockwise/ c.c.w.), v/ d, tip crush	v/ d, small, run-together feathers	quartzite	n/a	flake
C6	chisel	hard (e.g. stone)	8-1 (tip)	medium rounding, matte polish, striae diagonal to edge, v/ d	v/ d, small, uneven feathers from tip and lateral edge rounding	quartzite	n/a	flake
C7	RETOUCHED BUT NOT USED					quartzite	yes	flake
C8	NOT USED					quartzite	n/a	chunk
C9	scrape	AS/ hafted	5-7	heavy rounding, bright polish, striae diagonal to edge (dorsal only)	ventral, medium run-together hinges	pseudo-tachylite	n/a	flake
C10	scrape	AS/ hafted	5-8	light rounding, matte polish, striae diagonal to edge, ridge and surface unrelated to edge	uneven small, ill-defined feathers	quartzite	n/a	flake

Fourth Part: D (double-blind test/ intra-analyst variability)								
D1	cut	VS	8-1 (tip), lateral edges	light rounding, matter polish, striae diagonal / perpendicular to edge	v/ d small-medium ill-defined feathers	CCS	n/a	flake
D2	?	-	-	-	-	quartzite	n/a	flake
D3	RETOUCHED BUT NOT USED					quartz	yes	flake
D4	scrape	AS hit hard (e.g. bone)	6-8	heavy rounding, bright polish, striae diagonal to edge, v/ d	v/ d small, ill-defined feathers (and small uneven denticulates)	quartzite	n/a	flake
D5	NOT USED					quartzite	n/a	flake
D6	RETOUCHED BUT NOT USED					quartzite	yes	flake
D7	scrape	AS	1, 6-8	light rounding, striations diagonal / perpendicular to edge, v/ d hinges	v/ d small-medium close, uneven ill-defined feathers	quartzite	n/a	flake fragment
D8	engrave	medium (e.g. wood)	8-1 (tip); hafted	heavy rounding, bright polish (tip), striations diagonal to edge	v/ d large, uneven step fractures	pseudo-tachylite	n/a	flake fragment

The blind test series results summary (Table 7.3) follows similar formatting to Shea and Odell (1987). PC wear indicates the polar co-ordinates upon which wear is located. (This was unfortunately omitted when the scoring key was being compiled.) Prehensile mode refers to whether the tool was hafted or held in the hand. Action is the interpreted activity (e.g. 'used as / to' in Table 7.1) observed by the analyst during the blind test. Resistivity indicates only the softness or hardness of the contact material (with varying degrees). Worked material refers to that on which the tool was used, and is placed in general categories (animal, vegetal, wood, bone, etc.). Specifics are given if known. The error column indicates the correct answer for incorrect interpretations (in parentheses) in any of the test categories.

Table 7.3 Four-part blind test series results summary

PC = polar co-ordinates of wear; meaning of category terms on previous page (p. 211)

Blind test N^{O}	PC	Prehensile mode	Action (Used as/ to)	Resistivity	Worked (contact) material	Error (should be)
First Part: A (n = 10)						
A1	1-3,7-8	hand	cut	soft	animal	
A2	5-8	hand	cut	soft	vegetal	
A3	8,1	hand	scrape	medium	wood	
A4	6-8	hand	cut	soft	vegetal	
A5	5-8	hand	scrape	soft	vegetal	
A6	8,1	hand	(file)	hard	(hard dirt)	engrave pottery
A7	5-7	hand	scrape	medium	green wood	
A8	5-8	hand	(cut/scrape)	hard	bone	cut
A9	6-7	hand	scrape	hard	bone	
A10	1,2	not indicated	projectile	soft/ hard	animal	
Second Part: B (n = 9*)						
B1	8,1	hand	bore	medium	wood	
B2	5-8	hand	grind	soft	animal	
B3	1-4	hand	scrape	medium	wood	
B4*	MISSING FROM BLIND TEST SERIES ASSEMBLAGE (BAG EMPTY)					
B5	1-4, 5-7,	hand/ vary	scraping	medium	wood	
B6	7,,8	hand	scraping	soft-hard	animal hit bone	
B7	6-7, 7-8	hand	scraping	soft-hard	animal hit bone	
B8	NOT USED					
B9	5-8	hand	scraping	soft-hard	animal hit bone	
B10	4-5	hand	graving	medium	wood	

(Continued p. 213)

Blind test N^O	PC	Prehensile mode	Action (Used as/ to)	Resistivity	Worked (contact) material	Error (should be)
Third Part: C (n = 10)						
C1	8,1	hand	drill	hard	bone	
C2	5-8	hand	(scraping)	soft	animal	awl
C3	5-8	hand	graving	medium	wood	
C4	8-1	hand	drill	hard	bone	
C5	8,1	hand	drill	hard	bone	
C6	8,1	hand	(chisel)	hard	stone	used to retouch
C7	RETOUCHED BUT NOT USED					
C8	NOT USED	not indicated				
C9	5-7	hafted	scrape	soft	animal	
C10	5-8	hafted	scrape	soft	animal	
Fourth Part: D (n = 8)						
D1	8,1	hand	(cut)	soft	vegetal	scrape
D2	8,1	hafted	?	-	-	file branch tip
D3	(retouched but unused)					awl, hide
D4	6-8	hand	scrape	soft-hard	animal hit bone	
D5	NOT USED					
D6	RETOUCHED BUT UNUSED					
D7	6-8,1	hand	scrape	soft	animal	
D8	8,1	hafted	(engrave)	(medium)	(wood)	scrape hide

Overall Accuracy: total number correct followed by mean percentage for Series A -- D (n = 37)				
PC	**Prehensile Mode**	**Action (used as/ to)**	**Resistivity**	**Worked Material**
(not in score key)	34/37 91.89%	30/37 81.08%	34/37 91.89%	33/37 89.19%

Images of selected tools analysed during the blind tests are shown in Figure 7.6. (Alpha-numeric codes in images correspond to same alpha-numeric codes in Table 7.2.)

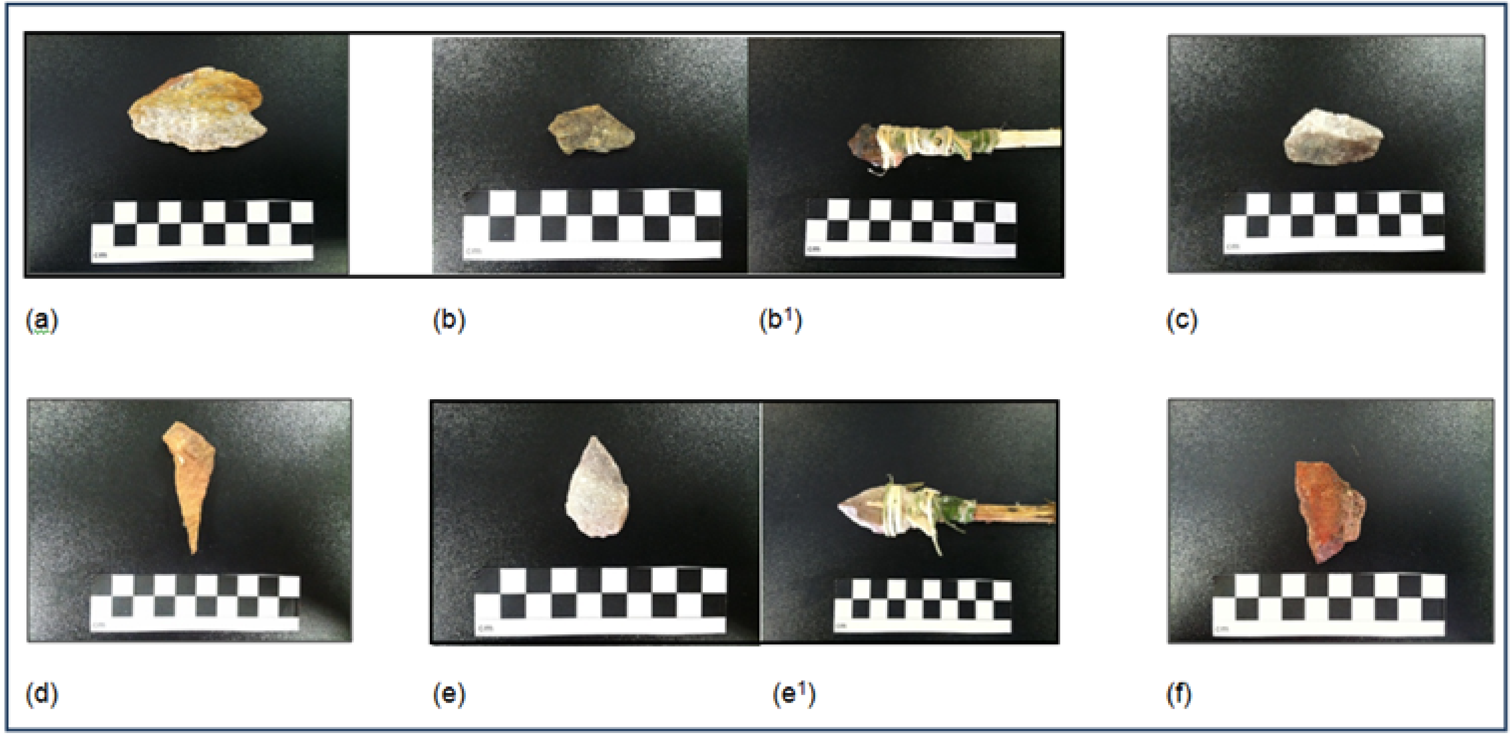


Fig. 7.6 Selected stone tools administered in blind-test series [See Table 7.3.] (a) *blind test piece B9* scrape meat off bone; (b) and (b^1) *blind test piece C9* hafted, scrape animal soft; (c) *blind test piece B8* not used; (d) *blind test piece C5* – drill fresh sheep bone; (e)and (e^1) *blind test piece C8* hafted but not used; (f) *blind test piece* B2 grinding animal soft (sheep fat). Images show different 'prehensile modes': left to right, top to bottom: (a), (c), (d) and (f) were 'prehended' or held in the hand while using; (b) was 'slot hafted' (b^1), stone inserted into branch then secured; (e) was 'juxtaposed hafted' (e^1), stone was placed against, not inserted into, branch then secured.

7.4.1 Lessons learned from blind testing

Lessons learned from this study’s series of blind tests are similar to those I have experienced in previous blind testing. The task of correctly identifying the information in attribute testing categories (e.g. prehensile mode, use motion / activity, resistivity of material and worked material) became easier when analysing a larger number of pieces (e.g., 30) than when facing a small collection of items for analysis (e.g. only 8, done the following day). In essence, as the number of tools analysed increases, one begins building an intra-test comparative collection. Nuances of the same use on the same or similar materials can be observed or distinguished as different, if applicable.

7.4.1.1 Wear and activity

Manufacturing of stone tools leaves damage which can be confused with use-wear. It usually manifests crushing at the point at which the manufacturer’s object of impact contacted the edge, leaving uncrushed and unscarred areas between negative impact and pressure points. Use-wear on the other hand, is usually smaller and less regularly spaced, it is often concentrated on projecting parts of the edge and, if it occurs on a retouched edge, it tends to nick, crush, or abrade those parts of the larger scars that occur between impact and pressure points (Odell and Odell-Vereecken 1980).

Cutting/ slicing usually produces scarring on both surfaces of an edge, alternating from side to side and developing with use into denticulation of the lateral margin. In scraping, the scarring occurs on a relatively wide area, although this depends on the nature of the contact between tool and worked material. Striations, if present, are perpendicular to the edge, on the surface opposite the scarring. Projections are again the first and most extensively worn. Boring/ drilling, is motion involving downward pressure and lateral twisting. The downward pressure can usually be ascertained from roughening of the tip and scarring that emanates from the tip. Twisting often results in removals from the lateral edges that lead to the point. Characteristics of wear on stone projectile points often includes impact damage resulting in removals of all sizes that usually have sharply-defined terminations. When striae are observed, they are typically parallel or diagonal to the long axis of the piece. Hafting frequently produces damage of either an abrasive or dislocatory (scarring) sort, or both.

7.4.1.2 Wear and contact material

Soft includes animal (e.g., meat, skin and fat) and soft vegetal (e.g., tubers, rhizomes, stalks, and leaves). Scarring is usually small with feather terminations that are most often medium on interior borders (i.e., one can see the terminations, but they are not deeply cut into the stone Soft medium, (e.g. soft woods like coniferous trees) have a relatively deep penetration into the material, scarring is often fairly large (i.e., visible to the naked eye), particularly on edges with relatively low edge angles. It also tends to have ill-defined feather terminations that may be barely visible under magnification. Hard medium (e.g. wood such as Real Yellowwood, *Podocarpus latifolius,*) materials leave scarring that is typically hinged and medium-to-large in size. Striations and polish are often present. Hard (e.g., bone, antler, stone) most often have scarring with stepped fractures, medium-to-large in size, which frequently undercut the lateral margin, causing significant damage. Striations and polish appear, but can be removed after formation by the extensive scarring. Implements used on hard materials for a moderately long time usually incur significant edge rounding.

7.5 Blind tests summary

Results of the blind tests confirm a number of points regarding the use of low power microscopy: 1) activity and resistivity of worked material can be identified with a relatively high percentage of accuracy; 2) exact worked material is difficult to identify (e.g., sheep hide versus cow hide), but general categorisation of contact material (e.g., animal, vegetal, wood, bone, etc.) can be accurately identified with a high percentage of accuracy; 3) prehensile mode damage and wear from use can be distinguished and identified; 4) intentional secondary modification can be identified and distinguished from use-wear; 5) The behaviours of different raw materials can be distinguished and noted during use (e.g., a quartz drill versus a CCS drill). These five points of distinction were equally observed during and confirmed by experimental tool manufacture and use (Section 7.2).

7.6 Chapter summary

Experimental work using raw materials from the Holkrans rock shelter site in order to replicate tools and activities that would have likely occurred at the site during occupation periods confirm the observations and interpretations at which I arrived when analysing the artefact assemblage sample. Blind testing served to confirm my abilities as analyst and provided the challenge of correctly interpreting the nuances of similar tools used in similar ways on similar materials.

While various analytical methods (e.g., high power, residue analysis, etc.) could have been used, the low power microscopic approach has provided the greatest amount of information on a larger number of lithics, affording a broader understanding of the Holkrans lithic assemblage.

CHAPTER 8

The Holkrans assemblage samples: Use-wear application and results

8.1 Introduction

Detailed examination and discussion of Holkrans rock shelter (Ch.4) provided the background for this chapter. The selected methodological approach (Ch. 5), determined suitability of the artefacts for analysis using the chosen approach (Ch.6), and the experimental work and blind test analyses (Ch. 7) provided a solid foundation for analysing and interpreting the stone tools from Holkrans. Sampling strategies are discussed in detail in Chapter 6 (section 6.3).

I turn now to the presentation of three use-wear analyses in the following order: a) stratified statistical random sampling of the pre-contact/ pre-ceramic assemblage (section 8.2, lower E-8 component; see Ch. 4, sections 4.4.2-4.4.4); b) stratified statistical random sampling of the early contact/ ceramic assemblage (section 8.3, middle E-8 component); and, following a comparison of the aforementioned two components (section 8.4), c) the arbitrarily selected sample (section 8.5, comprised of pieces from both pre-contact/ pre-ceramic and early contact/ ceramic E-8 components).

8.2 The pre-contact/ pre-ceramic component

Of the 141 pieces selected and analysed, forty-nine were determined to have been utilised. The observed wear (Table 8.1) on specific tools used for specific activities corresponds to the wear on tools used for similar activities in my experimental work and blind-test series. The functional uses of the artefacts do not appear to strongly correspond to their morphological type categories.

Table 8.1 E-8 Pre-contact/ pre-ceramic period utilised lithics (n = 49)
PC = polar co-ordinates of wear; AS = animal soft, VS = vegetal soft; v = ventral, d = dorsal; MRP = miscellaneous retouched piece; morpho-type (Deacon 1984b) shown for comparison with function ('used as/ to'); for additional information see Ch. 7, Table 7.1 and Appendix B.

Artefact N^0	Used as/ to	Worked material	PC	Abrasion (type, location)	Scarring (location, distribution, termination, size)	Raw material	Secondary modific-ation	Morpho-logical type
A1.10.1	point	med-hard (e.g. hard wood)	1-3	heavy rounding, striations parallel to edge	v/ d, clumped, step and hinge, small	quartz	v/ d	flake
A1.10.2	cut/ scrape	soft-med. (e.g. soft wood)	1-4 4-5 6-8	rounding, spine or ridge, and surface unrelated to edge	spine/ ridge, surface unrelated to edge, uneven, ill-defined feather terminations, medium	CCS	n/a	flake
A1.10.3	punch/ scrape	AS or VS	1-5, 6-8	heavy rounding, striae parallel to edge, ridge; d	v/d, uneven, hinges, medium	CCS	n/a	flake
A1.11.2	point	AS to soft-med.	1-3 4-5 6-8	v/d, striations diagonal to edge	v/d, clumped and uneven, step, small	CCS	d	flake
A1.13.1	scraper	AS	1-4 4-8	light rounding, striae perpendicular to edge, spine and surface unrelated to edge	ridge/ spine, run-together, ill-defined feather terminations, medium	quartz	d	blade distal portion
A2.10.1	scraper	AS	4-5	heavy rounding, striations perpendicular to edge, v/ d	v/ d, uneven, step, small	CCS	n/a	flake siret
A2.11.p	point	AS / 1 hard (bone)	8	heavy rounding, striations diagonal to edge, v/ d	v/ d, close, break / snap fracture, small	CCS	d	flake proximal fragment
A2.12.3	gouge/ ream	med-hard to hard	1-4 6-8	heavy rounding, striations parallel to edge, v/ d	v/ d, uneven, clumped, comminution	quartzite	n/a	linear flake
A2.13.1	scrape/ pick	soft medium	1-6 6-8	light rounding, v/ d	v/ d, close, ill-defined feather terminations, small-medium	quartz	v/ d	flake
A2.13.2	cut/ slice	AS or VS	1-3 3-8	2-7 light rounding,1 & 8 heavy rounding, v/d	v/ d, uneven, ill-defined feather terminations, small-medium	quartz	n/a	flake
A2.13.3	core		1-8	v/d, non-edge surface	v/ d, non-surface edge, clumped , feather, step	banded CCS	v/ d, non edge	radial core
(cont.)								

A3.12.1	cut/ ream/ scrape	1- 2 med. (e.g. wood)	1-4 4-5 5-8	light rounding, striae parallel, perpendicular and diagonal to edge, h. rounding v/ d	small-med. ill-defined feather, clumped/ run together, hinge v/ d	mudstone	d	side struck flake
A3.12.2	uncertain					quartz		bipolar debris
A3.12.3	core?			heavy rounding v/ d	v/ d small-medium ill-defined feather and hinge	quartz		bipolar core
A3.13.1	uncertain	uncertain	1-4 4-5 5-8	heavy rounding surface unrelated to edge	small-medium feather, clumped/ uneven	quartz	non-edge	flake
A3.13.5	projectile	AS	1-4 4-5 5-8	light rounding 1-5, heavier rounding 6-8, ridge	v/ d, surface unrelated to edge, snap and hinge fractures	pseudotachylite	d	bladelet
A4.10.2	scrape	AS	1-5 5-7 7-8	light rounding (small chip), striae parallel and perpendicular to edge, v/ d and non-edge surface	ridge, clumped and close together, small ill-defined feather terminations	quartz	d	bipolar flake debris
A4.12.2	cut/ scrape	soft to med. (e.g. soft wood)	1-4 4-5 6-8	d and non-edge surface, light rounding, striae diagonal/ perpendicular to edge	ridge, small, ill-defined feather terminations, close and clumped	CCS	d	bladelet lame à crête
B3.10.1	awl/ scrape	AS	1-3 4-8 scrape	heavy rounding 1-3, light rounding 4-8, striae diagonal /perpendicular to edge	ridge and surface unrelated to edge small, ill-defined feather , uneven and clumped	quartz	v/d 4-8, none 1-3	flake
B3.13.1	scrape	medium (e.g. wood)	6-8	heavy rounding, surface unrelated to edge and ridge	small feather terminations, clumped, none-edge and ridge	quartzite	n/a	spall
B4.13.1	scrape/ pick	VS and soil	1-4 5-8	heavy rounding and striations perpendicular to edge, ridge and non-edge surface	small-medium feather and hinge, clumped and uneven, non-edge surface and ridge	quartz	v/ d	flake
C2.11.1	pick, dig (possibly drill)	1-hard (e.g. bone)	1-4 4-5 6-8	heavy rounding, striations perpendicular and parallel to edge, dorsal, ventral and ridge	small to medium feather and comminution, close / running together, dorsal, ventral and ridge	quartzite	n/a	scraper
(cont.)								

C2.11.6	scrape	soft-med. (e.g. softer wood)	1-4 5-8	heavy rounding, striations parallel to edge, v/ d	small, ill-defined feather, clumped, close, v// d and ridge	quartzite	n/a	chunk
C3.10.1	pick/ dig, drill	soft -med. (e.g. soft wood)	1-4 5-6 7-8	heavy rounding pc's 1-4, v/ d and non-edge surface	ridge and non-edge surface, close, ill-defined feather	quartzite	n/a	chunk
C3.11.1	pick / dig, drill	soft –med. (e.g. soft wood)	1-4 5-8	heavy rounding, ridge non-edge surface	ridge and non-edge surface, medium comminution	quartzite	n/a	flake
C3.11.2	pick/ scrape	1-medium (e.g. softer wood)	1-3 4-7 7-8	light rounding 1-3, heavy rounding 4-8, striae diagonal to edge, v/d, ridge	v/ d and ridge, small-medium, close break and comminution	quartzite	v/ d	flake
C3.11.4	scrape	AS / attached to bone	1-4 5-6 6-8	heavy rounding 5-8, striae diagonal to edge, ridge and non-edge surface	ridge and non-edge surface, small ill-defined feather	quartz	v/ d	flake
C3.11.5	scrape	AS to 1-medium	1-3 4-5 6-8	6-8 heavy rounding, striae diagonal to edge, d and ridge/ non-edge surface	d, ridge/ non-edge surface, clumped, ill-defined feather	'other' not yet defined	v/ d	thumbnail scraper
C3.13.1	projectile	AS	1-4 4-5 5-8	pc wear 1-4, 5-8, heavy rounding, impact crush, striae diagonal to edges v/ d	v/ d, non-edge surface small, close feather	CCS	v/ d	bladelet
C3.13.2	scrape	AS	1-4 5-8	scrape wear, rounding distal tip (8,1) light rounding 1-7	ridge/ surface unrelated to edge, medium, close, uneven feather	'other'	5-8 v, ridge	bladelet
C3.13.3	pick / scrape	AS	1-3 6-8 (pick)	striations diagonal/ perpendicular to edge, tip and lateral adjacent edges	v/ d and tip, small-medium, close feather	CCS	d, 1-3, 6-8	flake
C3.13.4	point	AS hit hide, flesh, bone	1-4 4-8	striations diagonal (tip and edge)	v/ d small, close ill-defined feather	CCS	d, all round	side struck flake
C4.10.1	point	-	1-4 4-8	-	v/ d close, uneven small ill-defined feather	quartz	v/ d	flake
C4.10.2	scrape	AS to 1-medium	1-4 5-8	rounding 1-8 striae on edge perpendicular /diagonal	v/ d small, ill-defined feather, close / uneven	quartzite	n/a	flake

C4.12.2	scrape	1 medium (e.g. wood)	8-1 1-5	heavy rounding tip, striations perpendicular to distal edge	v/ d, medium feather and hinge, uneven at tip	CCS	n/a	flake
D1.12.1	awl/ ream/ gouge	AS	1-4 5-7 7-8	heavy rounding tip	small uneven ill-defined feather at tip, step at 5-7	quartzite	n/a	flake
D1.12.2	punch/ ream	AS	1-3 3-5 6-8	heavy rounding tip	v/d , small, close ill-defined feather	quartz	n/a	flake
D2.12.1	punch	AS	1-2 3-5 5-8	light rounding 1-2, 7-8, tip, striations clockwise to edge	v/ d, small, uneven feather	CCS	v/ d	flake
D2.12.2	scrape	AS	1-4 4-5 5-8	heavy rounding 1-5 tip, edge adjacent, striae diagonal/ perpendicular to edge	v/ d close, uneven medium ill-defined feather, hinge 4-5	CCS	d	scraper
D2.13.2	cut/slice/ scrape	AS or VS	1-4 5-8	d, light rounding tip/ edge	d, small-medium uneven feather	quartzite	n/a	linear flake
D2.13.3	rub/ burnish	uncertain	1-3 5-8	light rounding v/ d	v/ d, close ill-defined feather and comminution	CCS	v/ d	MRP
D2.13.4	cut/ slice	AS or VS	1-4, 4-5, 5-8	light rounding 4-5 (cutting edge), v/ d	v/ d small, close feathers	CCS	v/ d	flake siret
D3.10.2	saw	hard (e.g., hard wood or bone)	1-4 4-8	heavy rounding 1-4 (saw edge), striae v/ d parallel and diagonal to edge	v/ d medium, clumped uneven comminution	CCS	d	flake
D3.12.1	projectile	AS hit hard (e.g. bone)	1-4, 5-7	v/ d diagonal striae to edge, 1-4 haft, 5-7 projectile	v/ d small, uneven ill-defined feather	CCS	d	blade
D3.12.4	cut/ slice	AS or VS	1-4, 4-5, 5-8	light rounding, striae parallel to edge, v/ d	v/ d small, close feather	CCS	n/a	flake
D3.13.3	cut/ slice, scrape	AS or VS	1-3 4-5 5-8	light rounding, striae parallel to edge 1-3, diagonal to edge 5-8, v/ d	v/ d, small to medium run together feather	CCS	v/ d	flake
(cont.)								

D3.13.4	scrape	1 medium (e.g. soft wood)	1-4 4-6 6-8	heavy rounding, v/ d, striae parallel, perpendicular and diagonal to edge	v/ d, close uneven, medium feather and bend 1-4	quartz	v/ d	flake or chunk
D4.11.5	grind	med-hard (e.g. bone)	1-4 5-8	very heavy rounding, v/ d, striae perpendicular to edge	v/ d, medium-large, close, uneven ill-defined feather	hematite	n/a	flake or spall
D4.13.1	bore/ drill	medium (e.g. wood)	1-4 5-8	heavy rounding v/ d	v/ d small-medium close crush	quartzite	n/a	flake fragment

Two of three morphologically-typed scrapers correspond to functional scraping activities (Table 8.1). One has both ventral and dorsal secondary modification; the other has dorsal only secondary modification. There are twenty-one additional pieces among pre-contact/ pre-ceramic lithics that were used primarily to scrape, some with additional secondary uses (e.g. picking with a pointed scraping edge). Their morphological types and counts are: flakes 14, blade 1, bladelet 2, bipolar debris 1, spall 1, and chunk 2. Of these, eight have secondary modification on both ventral and dorsal surfaces. Six have secondary modification on the dorsal surface only. All utilised pre-contact/ pre-ceramic (lower component, Ch. 4) pieces with morpho-type and functional use are shown in Table 8.2. Twenty-seven pieces have what appear to be material dislocations that can be discerned with magnification. The dislocations could be the result of anthropogenic or other forces (e.g. PDSM [post-depositional surface modification] from trampling, bioturbation, etc.)(see Ch. 5 and Appendix A). Many look as if made with purpose (i.e. regular patterning). From previous experience, and not wishing to speculate, the most that can be objectively stated about these dislocations is that I have observed them with magnification and noted them in the use-wear inventories, but am unable to qualify them.

Table 8.2 Summary: morphology / functional use (n = 49)

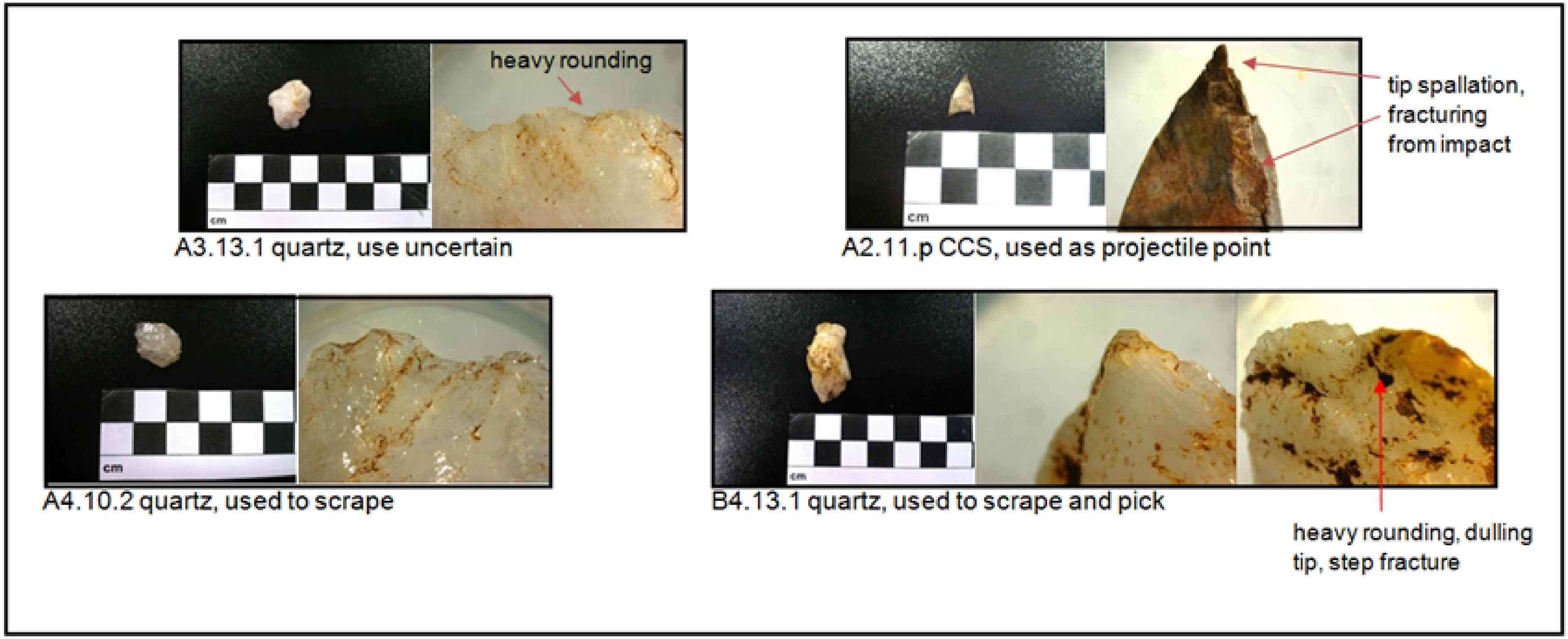
v = ventral, d = dorsal; MRP = miscellaneous retouched piece

Artefact N^{0} (Table 8.1)	Functional Use	Morphology	Non-use material dislocation
A1.10.1	projectile point	Flake	v/ d
A1.10.2	scrape/ cut	Flake	
A1.10.3	pick/punch	Flake	
A1.11.2	projectile point	Flake	d
A2.10.1	scrape	Flake	
A211.p	projectile point	Flake	d
A2.12.3	dig/pick	Flake	d
A2.13.1	scrape/ pick	Flake	v/ d
A2.13.2	scrape/ pick	Flake	
A3.12.1	scrape/ ream	Flake	d
A3.13.1	uncertain	Flake	non-edge
B3.10.1	scrape/ awl	Flake	
B4.13.1	scrape/ pick	Flake	v/ d
C3.11.1	dig/ drill	Flake	
C3.11.2	scrape/ pick	Flake	v/ d
C3.11.4	scrape	Flake	v/ d
C3.13.3	scrape/ pick	Flake	d
C3.13.4	projectile point	Flake	extensive, d
C4.10.1	point	Flake	v/ d
C4.10.2	scrape	Flake	
C4.12.2	scrape	Flake	
D1.12.1	awl/ ream	Flake	
D1.12.2	awl/ ream	Flake	
D2.12.1	pre-form / punch	Flake	v/ d
D2.13.2	scrape/cut/slice	Flake	
D2.13.4	cut/ slice	Flake	v/ d
D3.10.2	saw	Flake	d
D3.12.4	cut/ slice	Flake	
D3.13.3	scrape/cut/slice	Flake	v/ d
A1.13.1	scrape	Blade	d
D3.12.1	projectile	Blade	d
A3.13.5	projectile	Bladelet	d
A4.12.2	scrape/ cut	Bladelet	d
C3.13.1	projectile	Bladelet	v/ d
C3.13.2	scrape	Bladelet	v/ ridge
A4.10.2	scrape	Bipolar debris	
A3.12.2	uncertain	Bipolar debris	
A3.12.3	core?	Core	
A2.13.3	radial core	Core	v/ d, non-edge
C2.11.6	scrape	Chunk	
C3.10.1	drill, dig	Chunk	
D3.13.4	scrape	Chunk	v/d
D4.13.1	drill/ bore	Chunk	
B3.13.1	scrape	Spall	
D4.11.5	grind	Spall	
D2.13.3	rub/ burnish	MRP	
C2.11.1	dig/ possible drill	Scraper	
C3.11.5	scrape	Scraper	v/ d
D2.12.2	scrape	Scraper	d

The following are noted for comparison with the early contact/ ceramic component:

- Morpho-typed flakes (n = 29) represent at least (9) distinct functional activities. Fourteen flakes (> 48% of utilised pieces) show wear indicative of scraping, most of which also show wear from additional activities (e.g. pick, cut/ slice). Polar co-ordinates of wear (Table 8.1) show that more than one edge of most prehended (held in hand) pieces was used. From previous experience and the experimental work (Ch. 7), I learned that it is quite natural, depending on the activity (e.g. scraping) and the lithic item, to turn a piece when an edge begins to dull or to reduce the dulling of an edge, resulting in use traces observed on more than one edge.
- Blades (n = 2) represent two functional uses/ activities (projectile, scrape);
- Bladelets (n = 4) represent three functional uses (projectile, scrape, cut);
- Chunks (n = 4) represent three functional uses (scrape, drill, dig); and
- Spalls (n = 2) represent two functional uses (scrape, grind).

Figures 8.1, 8.2 show microscopic images with exemplary wear, accompanied by their macroscopic image, of selected pieces presented in Tables 8.1 and 8.2. (Artefact numbers in images correspond to artefact numbers in Tables.) Line drawings are not conventionally presented with microscopic images. A more recent development in the presentation of microscopic images is the placement of geometric shapes, pointers and lines along and around areas purportedly containing traces. The practice is by no means convention, and I have found that, in various cases, the actual location of otherwise identifiable traces are obscured by indications of where one should be seeing them (e.g. Wadley and Langejans 2014: 25-27).



A3.13.1 quartz, use uncertain

A2.11.p CCS, used as projectile point

A4.10.2 quartz, used to scrape

B4.13.1 quartz, used to scrape and pick

Fig. 8.1 Utilised artefact examples (Note: top left, ‘denting’ and dulling left from use; bottom left, uneven edge has flattened or dulled from use; top right formerly complete tip has lost pieces of material that look like ‘dents’ as a result of impact; bottom right, the edge has rounded or dulled, material has been removed, ‘fractured’, and looks like a step down.

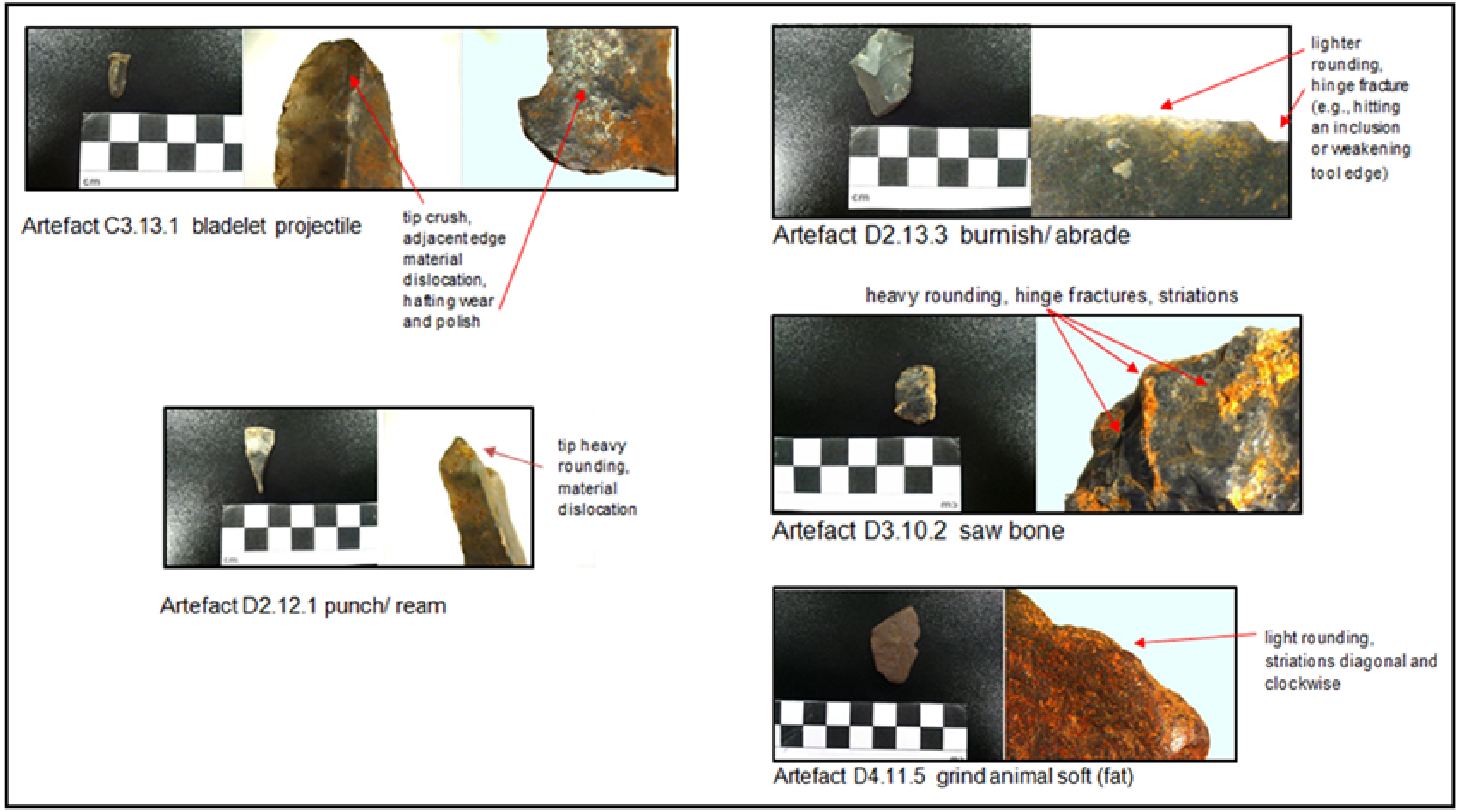


Fig. 8.2 Utilised artefact examples (Note: top left, crush or dull 'slicing off' of material and grooves from hafting; bottom left, portion of tip 'sliced off', tip flattened; top right chip of edge, dulling; middle right, fracture or portions of material removed and dulling of edge; bottom right, smoother dulling of edge, edge becoming irregular)

8.2.1 Pre-contact/ pre-ceramic component summary

Of the utilised pieces (Table 8.1): 14 (28.6%) are of quartz and were predominantly used to scrape; 11 (22.5%) are of quartzite, also used to scrape, but used more often for wear-intensive activities (e.g. bore, drill, gouge); 19 are of CCS (38.8%), used as points/ projectiles, to cut/slice, and in complimentary activities (e.g. scrape/ pick). Little may be suggested for the remaining pieces, due to such low frequencies: 1 (2%) is of pseudotachylite, 1 (2%) is of mudstone, 1 (2%) is of hematite and 2 (4.1%) are of 'other' (not yet identified). The pre-contact/ pre-ceramic utilised assemblage sample contains no dolerite, shale or basalt (see Ch. 4, section 4.6 for detailed discussion of Holkrans raw materials).

Of interest, it was previously believed that the closest source of chert was more than 50 km from the shelter. However, a chert outcrop was located just over 5 km from the shelter during a 2013 field school survey, making what appears to be a preferred material more accessible to inhabitants of a site where quartzite is abundant.

Statistical analysis of the pre-contact/ pre-ceramic period morphology versus function may not reveal much on its own; though a comparative analysis of pre-contact/ pre-ceramic and early contact/ ceramic components (section 8.4) should provide more information, such as changes or continuity between the two periods (e.g. activities, raw material choices).

8.3 The early-contact/ ceramic component

Of the 185 pieces selected and analysed, forty-five were determined to have been utilised. As in the pre-contact/ pre-ceramic component, the functional uses of the artefacts (Table 8.3) do not appear to strongly correspond to their morphological type categories.

Table 8.3 E-8 Early contact/ ceramic period utilised lithics (n = 45)

PC = polar co-ordinates of wear; AS = animal soft, VS = vegetal soft; v = ventral, d = dorsal; MRP = miscellaneous retouched piece; bp = bipolar morpho-type (Deacon 1984b) shown for comparison with function ('used as/ to'); for additional information see Ch. 7, Table 7.1 and Appendix B.

Artefact N^0	Used as/ to	Worked material	PC	Abrasion (type, location)	Scarring (location, distribution, termination, size)	Raw material	Secondary modific-ation	Morpho-logical type
A1.5.1	point hafted	AS	1-4 4-5 5-8	heavy rounding 1-4, light rounding 5-8, striae diagonal to edge, v/ d	v/ d small, close ill-defined feather, hafting scar 4-5	quartzite	d	blade
A1.5.3	projectile	uncertain	1-4 4-8	heavy rounding 1-4, light rounding 5-8, crushing v/ d, edge striae parallel/ diagonal	v/d, small uneven feather	CCS	d	bladelet
A1.6.1	uncertain (point?)	uncertain	1-3 4-5, 6-8	striations perpendicular to edge	tip, small bend fracture	CCS	n/a	flake chip
A1.6.3	scrape	AS	1-3 4-5 6-8	heavy rounding 1-4, striae perpendicular to edge 1-4, diagonal to edge 5-8, v/ d	v/ d close, ill-defined feather, 1-4 and 5-8	CCS	v/ d	MRP on bipolar flake
A1.6.4	cut/slice, scrape	AS or VS	1-3 4, 5-8	light rounding 1-3, edge striae parallel/ perpendicular 1-3, prehension 5-6, v/ d	v/ d small, close feather	CCS	v/d	spall
A1.7.2	punch, scrape	AS	1-5 6-8	light rounding, edge striae parallel 1-5 (scrape), diagonal 6-8 (punch), v/ d	v/ d small, uneven feather	CCS	d	scraper
A1.8.1	point	AS and hit hard (e.g. bone)	1-5 6-8	heavy rounding, v/ d, impact crush, tip and lateral snap	v/ d small-medium ill-defined, clumped feather	CCS	d	chunk or flake fragment
A1.8.3	point	AS and hit hard (bone)	1-5 5-8	light rounding, striae diagonal to edge, v/ d, edge crush	v/ d, small ill-defined close feather	CCS	d	chunk / bp debris
A2.5.3	punch/ gouge	AS (e.g. hide)	1-4 8-1 (tip)	heavy rounding tip and lateral adjacent 1-4, tip, v/ d	tip, v/ d small, ill-defined feather	dolerite	n/a	flake
A2.6.1	projectile	AS	1-5 5-8	heavy rounding, v/ d, tip, edge striae diagonal 1-5, perpendicular 5-8	v/ d small close and clumped feather	CCS	d	bladelet

A3.5.2	chop/ cut	AS or VS	1-2 2-3, 4-8	light 2-3, striae perpendicular to edge, v/ d	v/ d small, close feather	CCS	d	flake proximal fragment
A3.6.2	pick/ dig	AS or soft soil	1-5 5-8, 8-1	heavy rounding tip, striae perpendicular / edge, tip, v/ d	v/ d small, uneven ill-defined feather	CCS	v/ d	scraper
A3.6.3	scrape	medium (e.g. wood)	1-2 2, 4-8	light rounding 2, striations parallel to edge, v/ d	v/ d small, close feather	CCS	v/ d	scraper
A3.8.2	scrape	medium (e.g. wood)	tip 1-4, 5-8	heavy rounding tip, adjacent 1-4, v/ d	v/ d small, uneven, close ill-defined feather	quartzite	n/a	flake fragment
A4.5.1	point	AS and gentle hit to hard (e.g. bone)	1-4 5-8	heavy tip rounding, striations diagonal to edge v/ d, (impact)	v/ d small, close ill-defined feather, edge abrasion, hafting wear mesial to proximal	quartz	v/ d	chunk, bipolar debris
A4.5.2	cut/ chop	soft-medium (e.g. soft wood)	1-5. 5-8	heavy rounding all PC, v/ d striae perpendicular to edge	v/ d small-med uneven feathers	CCS	v	bladelet
A4.7.1	scrape	AS and soft-med (e.g. soft wood)	4-6 7-8	heavy rounding, striae parallel/ perpendicular to edge v/ d	v/ d, small uneven ill-defined feather	iron stone	v/ d	flake / MRP
B1.5.1	point	AS hit hard (e.g. bone), with impact	1-4 4-5 5-8	heavy rounding 1-4, 5-8, hafting 4-5, edge striae, crush diagonal 1-4, 5-8, v/ d	v/ d, small-medium close uneven feather	CCS	v	flake
B1.5.4	point	AS hit hard (e.g. bone)	1-4 4-5, 5-8	heavy rounding all PC edges striae diagonal to edge, v/ d	v/ d small-medium clumped feather	CCS	v/d	bipolar core
B1.6.1	scrape	AS or VS	1-7 7-8	light rounding, edge striae v/ d parallel / perpendicular	v/ d, small, uneven feather	CCS	v/ d	scraper
B2.5.1	punch/ gouge	AS and med. (e.g. wood)	1-3 4-6, 7-8	heavy rounding tip, striae diagonal to adjacent edge	v/ d, medium uneven comminution	quartzite	n/a	flake / MRP
B2.5.2	punch/ gouge	AS	1-3 3-5, 5-8	heavy rounding, clockwise striae 5-8, tip striae diagonal	v/ d, small, uneven comminution	CCS	n/a	chunk
B2.5.4	scrape	AS and med. (e.g. wood)	1-4 5-8, 8-1	light rounding, v/ d striae perpendicular to edge	v/ d small, close/ uneven ill-defined feather	CCS	n/a	linear flake

B2.5.7	heavy cut/ saw	hard (hard wood, bone)	1-5 6-8	heavy rounding, striations parallel to edge, v/ d	v/ d medium close comminution	CCS	v/ d	flake
B2.6.1	point	AS	1-6 7-8	light rounding1-6, heavy rounding 7-8, striae diagonal to edge, v/ d	v/ d, small uneven feather	CCS	v	flake
B3.5.1	shave/ whittle	medium (e.g. wood)	1-5 6-7, 8-1	heavy rounding v/ d	v/ d small, close ill-defined feather	CCS	v/ d	bipolar core / chunk
B3.6.1	cut, gouge, plane	medium (e.g. wood)	1-4 4-5, 5-8	heavy rounding tip, ridge, striae v/ d diagonal/ perpendicular to tip, ridge	v/ d, small-medium close feather and comminution	dolerite	v/ d	flake
B3.7.3	scrape	AS	1-4 6-8	heavy rounding, striations perpendicular to edge, v/ d	v/ d small, uneven ill-defined feather	pseudo-tachylite	n/a	linear flake
B4.5.1	point	AS hit hard (e.g. bone)	1-5 6-8 tip	heavy rounding, striae diagonal to edge, snap fracture tip, v/ d, non-edge	v/ d, non-edge surface, small, close/ uneven feather and snap tip	CCS	v/ d	chunk
B4.5.3	scrape, saw	scrape AS, saw hard (e.g. bone)	8-1 1-4 5-7	heavy rounding, striations perpendicular to edge, v/ d	v/ d medium uneven, clumped hinge, bend at tip, small feather 5-7	CCS	v/ d	scraper
B4.5.6	cut, scrape	AS	8-1 1-4, 5-7	light rounding, perpendicular striae on non-edge surface	v/ d small, close feather	CCS	d	flake
B4.7.2	projectile	AS hit hard (e.g. bone)	1-4 4-5, 5-8	light rounding 1-4, bend 4-5, light rounding 5-8, diagonal edge striae 1-4, 5-8, v/ d	v/ d small uneven feather 1-4, 5-8, bend fracture 4-5 (large)	pseudo-tachylite	d	bladelet
B4.7.3	carve, whittle	hard (bone?)	8-1	heavy rounding, tip striae perpendicular/ diagonal v/ d	v/ d small-medium close ill-defined feather	CCS	v/ d	flake fragment
B4.8.2	scrape	med-hard (e.g. hard wood, bone)	1-4 4-5 5-8	prehension 1-4, 5-8, scrape 4-5, heavy rounding 4-5, edge striae perpendicular/ diagonal, v/ d 4-5	4-5 v/ d small, uneven ill-defined feather	pseudo-tachylite	d	flake
C1.6.1	cut/ slice, scrape	AS or VS	1-6 7-8	light rounding, striae parallel/ diagonal to edge, v/ d	v/ d small, close uneven feather	CCS	v/ d	linear flake

C1.6.2	dig, punch	AS or soft soil	5-8	heavy rounding tip, striae parallel/ clockwise to tip, v/ d	v/ d small, uneven ill-defined feather	shale	v/ d	MRP
C1.6.3	plane, saw	medium to hard	6-8	heavy rounding, edge striae parallel, v/ d, gash (crush)	v/ d uneven small-medium bend fractures	CCS	v/ d	flake
C2.5.2	gouge/ ream, scrape	medium (e.g. wood)	1 2 3-8	heavy rounding 1, light rounding 2, striations diagonal to edge, v/ d	v/ d large, close bend 1, v/ d small, uneven ill-defined feather 2	CCS	v	scraper
C3.6.1	point	AS hit hard (e.g. bone)	1-4 4-5, 5-8	heavy rounding, edge striae diagonal, v/ d, impact crush	v/ d small-med. snap1-4, feather 4-5, bend 5-8	CCS	v/ d	flake siret
C4.8.4	point	AS	1-4 5-8	heavy rounding v/ d	v/ d small-medium close ill-defined feather	quartz	d	blade fragment
D1.7.1	gouge/ ream, scrape	soft-med. (e.g. soft wood)	4-5 6-8	heavy rounding, edge striae clockwise 4-5, diagonal 6-8, v/ d	v/ d small, close feather 4-5, small, uneven ill-defined feather 6-8	shale	d	blade
D2.5.2	cut/ slice	AS or VS	1-4 5-8	striate parallel to edge, v/ d	v/ d small, close feather	CCS	n/a	flake fragment
D2.6.2	scrape	AS to soft-med.	1-4 5-8	light rounding, edge striae perpendicular, v/ d	v/ d, uneven small-med. ill-defined feather	CCS	d	scraper
D3.8.1	pick / dig	AS, VS or soft soil	1-4 5-8	light rounding v/ d (hafting mesial)	v/d small ill-defined feather	shale	d	linear flake
D4.5.3	projectile hafted	AS hit hard (e.g. bone)	1-4 4-5 5-8	heavy rounding, non-hafted PC, edge striae diagonal, hafted edge striae parallel, v/ d	v/ d small, clumped feather, edge crush 1-4, 5-8, small v/ d hinge fractures, close 4-5	CCS	d	bladelet

Comminution is the reduction of particle sizes from one (e.g. larger) size to another (e.g. smaller) caused by abrasion, grinding, frictional heat, etc.

Six of seven morphologically-typed scrapers correspond to functional scraping activities. Three of these six were also used for secondary activities. There are ten additional pieces among the early contact/ ceramic lithics that were used primarily to scrape, some with additional secondary uses (e.g. cut/ slice with a sharp edge): flakes 6, bladelet 1, spall 1, and MRP 2. Of additional interest, four of five chunks and one of two bipolar cores were used as projectiles. All utilised early contact/ ceramic (middle site component, Ch. 4) pieces with morpho-type and functional use are shown in Table 8.4

Thirty-seven pieces have what appears to be non-use, non-other wear material dislocations (removals) that can be discerned with magnification (previously explained on p. 231). Eighteen of these pieces show dislocations on both ventral and dorsal surfaces. Fifteen pieces have removals on the dorsal surface only; and four pieces have removals on the ventral surface only.

The following are noted for comparison with the pre-contact period:

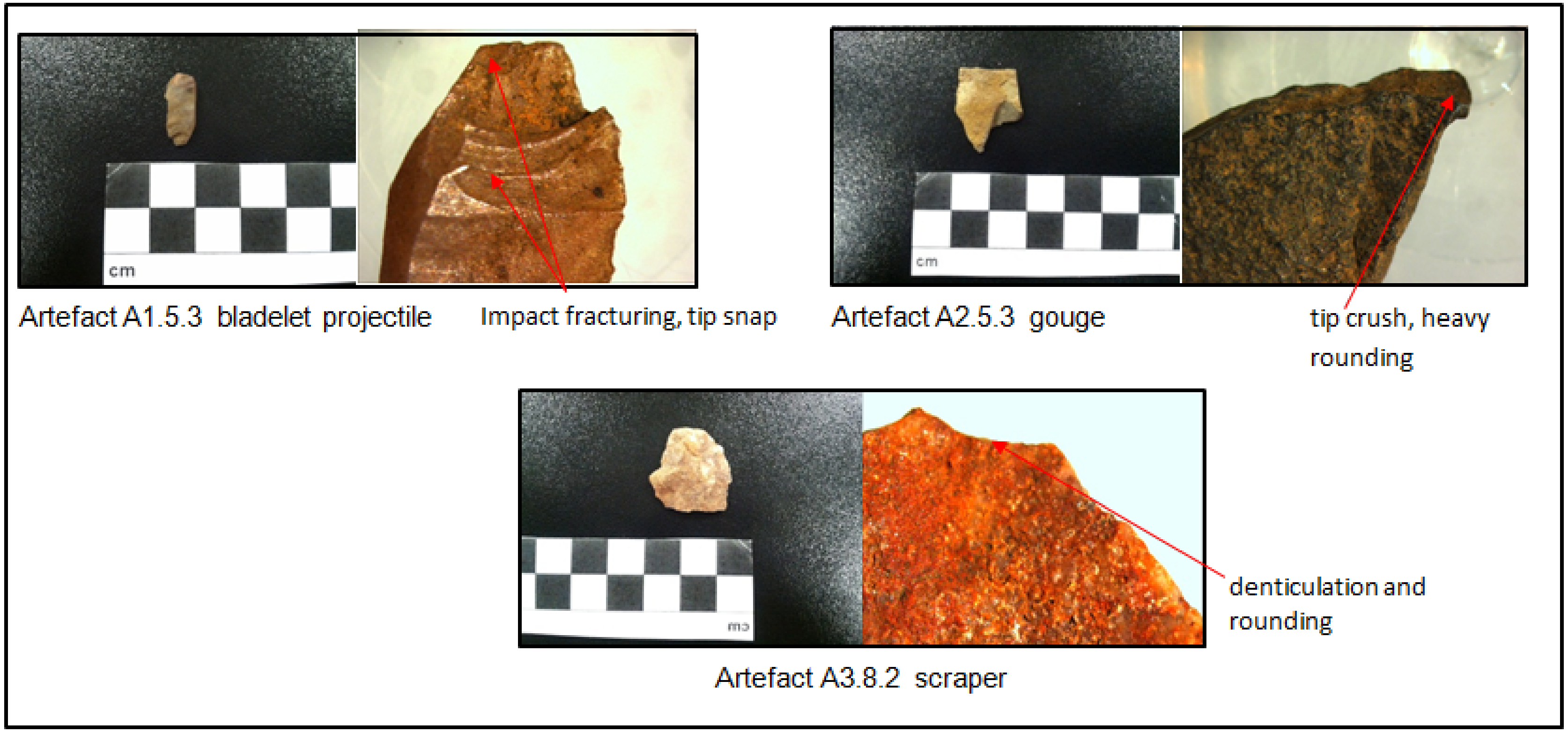
- Morpho-typed flakes (n = 18) represent at least (7) distinct functional activities. Six flakes show wear indicative of scraping, two of which also show wear from additional activities (e.g. cut/ slice).
- Blades (n = 3) represent at least two functional uses/ activities (projectile, one of which was hafted, and scraping with secondary activity);
- Bladelets (n = 5) represent three functional uses (projectile, one of which was hafted; cut, chop);
- Bipolar cores (n = 2) represent at least two functional uses (projectile, shave/ whittle);
- Chunks (n = 5) represent at least two functional uses (projectile, punch/ gouge); and
- MRPs (n = 4) represent at least three different functional uses (scrape, punch/ gouge, dig).

Table 8.4 Summary: morphology/ functional use (n = 45)

v = ventral, d = dorsal, MRP = miscellaneous retouched piece

Artefact N^0 (Table 8.3)	Functional Use	Morphology	Non-use material dislocation
A1.6.1	projectile (?)	Flake	
A2.5.3	punch/ gouge	Flake	
A3.5.2	chop/ cut	Flake	d
A3.8.2	scrape	Flake	
B1.5.1	projectile	Flake	v
B2.5.4	scrape	Flake	
B2.5.7	heavy cut/ saw	Flake	v/ d
B2.6.1	projectile	Flake	v
B3.6.1	cut, gouge, plane	Flake	v/ d
B3.7.3	scrape	Flake	
B4.5.6	end scrape/ cut	Flake	d
B4.7.3	whittle/ carve	Flake	v/ d
B4.8.2	scrape	Flake	d
C1.6.1	scrape, cut/ slice	Flake	v/ d
C1.6.3	saw/ plane	Flake	v/ d
C3.6.1	tanged projectile	Flake	v/ d
D2.5.2	cut/ slice	Flake	
D3.8.1	dig/ pick	Flake	d
A1.5.1	hafted projectile	Blade	d
C4.8.4	projectile	Blade	d
D1.7.1	scrape, gouge/ream	Blade	d
A1.5.3	projectile	Bladelet	d
A2.6.1	projectile	Bladelet	d
A4.5.2	cut, chop	Bladelet	v
B4.7.2	projectile	Bladelet	d
D4.5.3	hafted projectile	Bladelet	d
B1.5.4	projectile	Bipolar core	v/ d
B3.5.1	shave/ whittle	Bipolar core	v/ d
A1.8.1	projectile	Chunk	d
A1.8.3	projectile	Chunk	d
A4.5.1	projectile	Chunk	v/ d
B2.5.2	punch/ gouge	Chunk	
B4.5.1	projectile	Chunk	v/ d
A1.6.4	scrape, cut/ slice	Spall	v/ d
A1.6.3	scrape	MRP	v/ d
A4.7.1	scrape	MRP	v/ d
B2.5.1	punch/ gouge	MRP	
C1.6.2	dig/ punch	MRP	v/ d
A1.7.2	scrape, punch	Scraper	
A3.6.2	dig / pick	Scraper	
A3.6.3	scrape	Scraper	
B1.6.1	scrape	Scraper	
B4.5.3	scrape, cut/ slice	Scraper	
C2.5.2	scrape, gouge/ ream	Scraper	
D2.6.2	scrape	Scraper	

Figures 8.3 – 8.6 show microscopic images with exemplary wear, accompanied by their macroscopic image, of selected pieces presented in Tables 8.3 and 8.4. (Artefact labels in images correspond to Tables.)



Artefact A1.5.3 bladelet projectile

Impact fracturing, tip snap

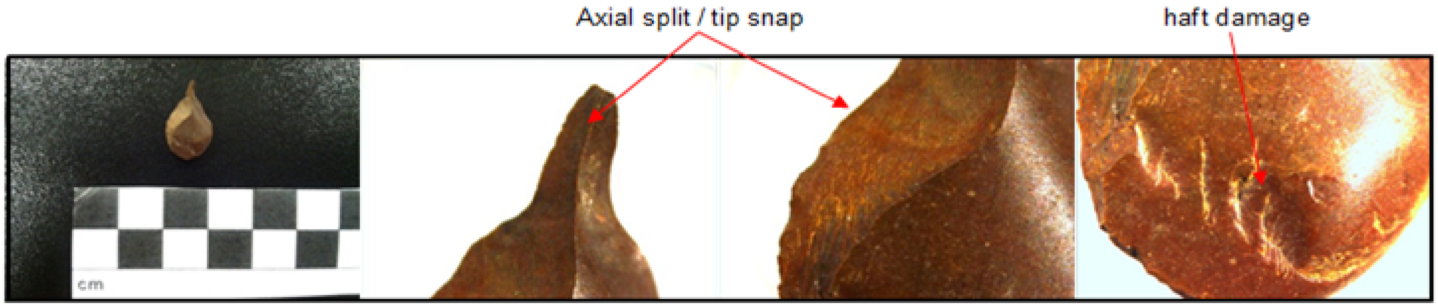
Artefact A2.5.3 gouge

tip crush, heavy rounding

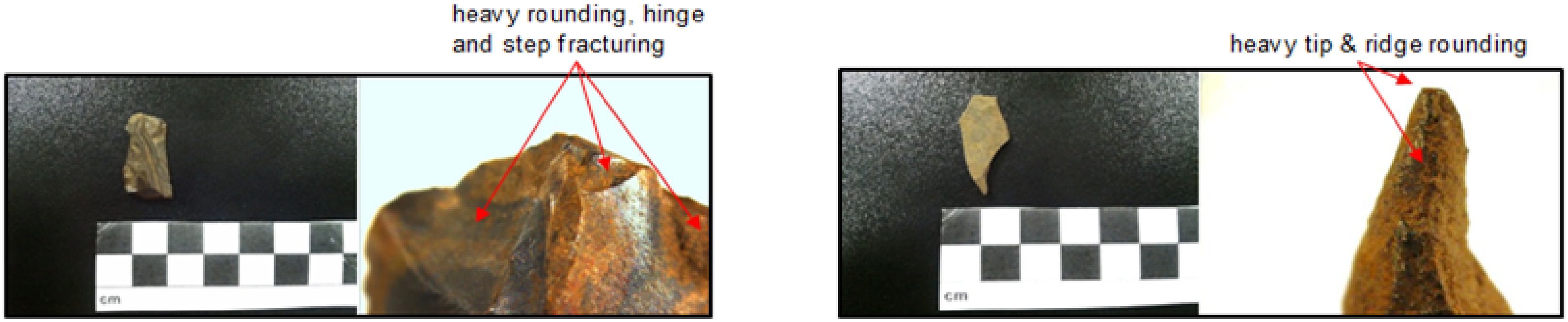
denticulation and rounding

Artefact A3.8.2 scraper

Fig. 8.3: Utilised early contact/ ceramic component artefact examples (Top left shows clear fracture, removal of tip material in 'steps' as a result of impact; top right shows the flattening, crushing and dulling from gouging; bottom shows the dislocation of material with 'teeth', pointed areas formed from scraping)



Artefact D1.8.p projectile point – split at tip and adjacent edge, hafting damage



Artefact B4.5.6 multi-purpose / end scraper

Artefact B4.6 drill

Fig. 8.4: Utilised early contact/ ceramic component artefact examples (Top middle images show split and snapping off of tip, which appear ‘sliced’; top right shows ‘dents’ caused from hafting; bottom left, fracturing from scraping force; bottom right, loss of material, dulling from drilling)

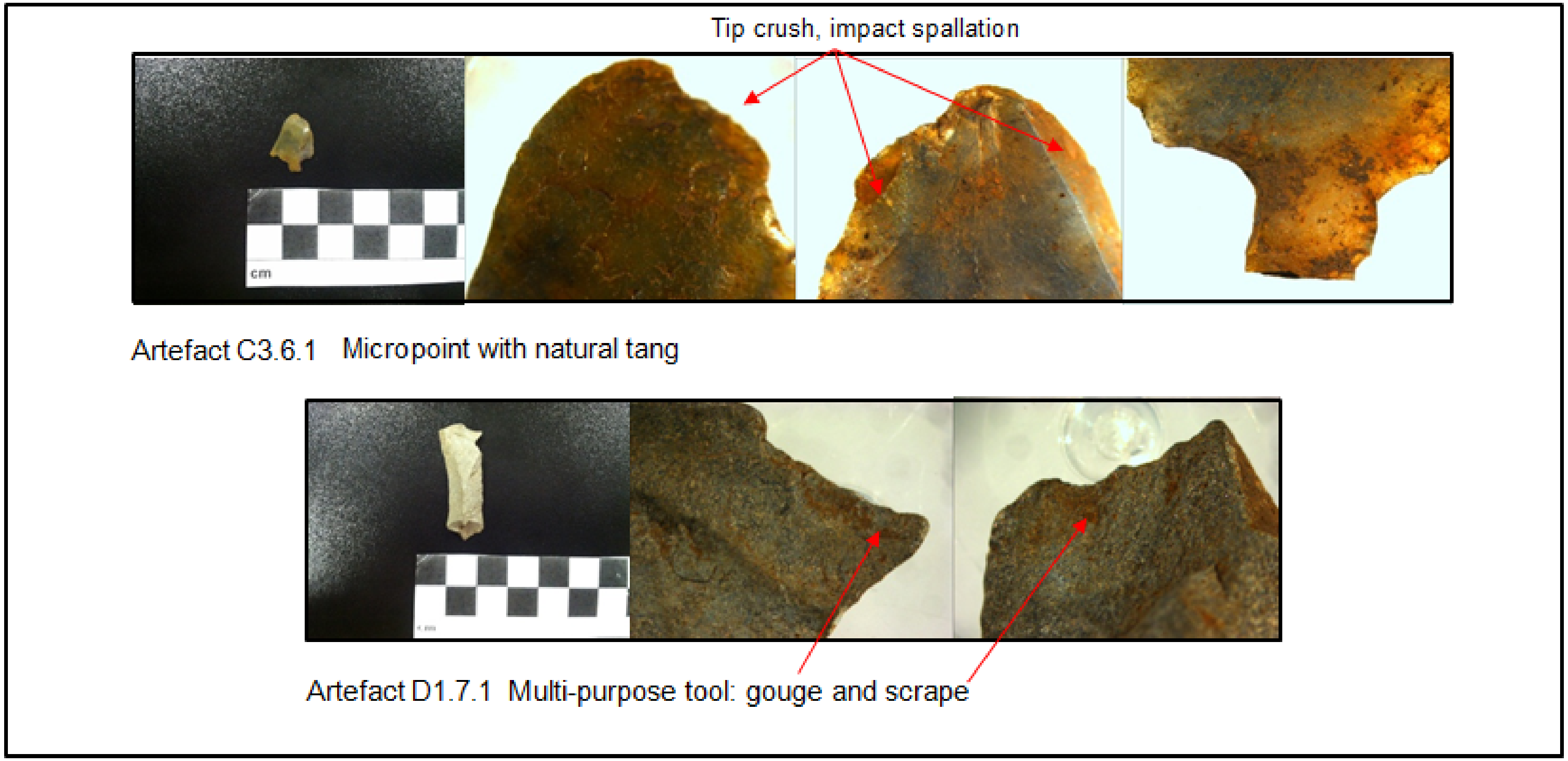
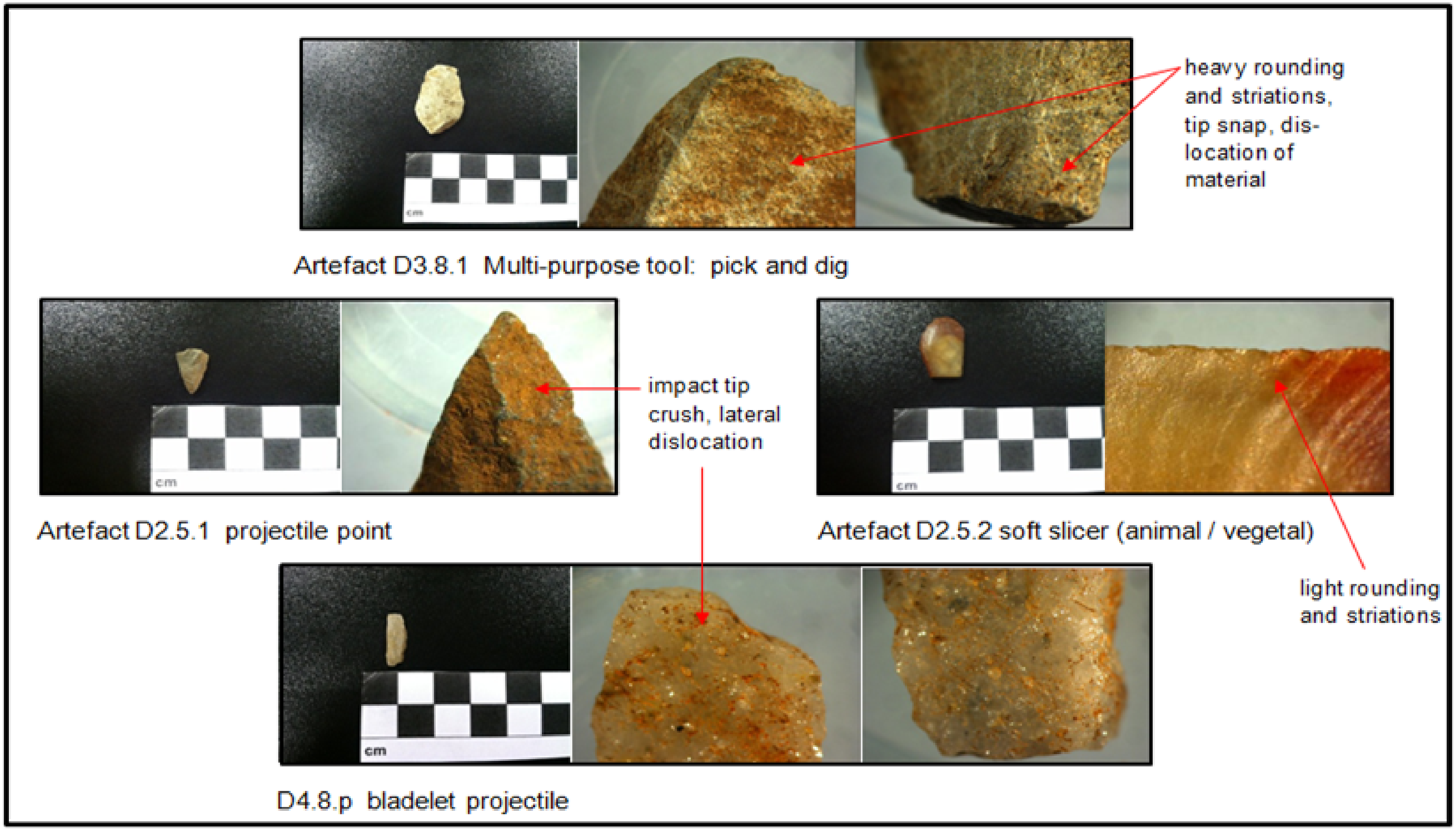


Fig. 8.5: Utilised early contact/ ceramic component artefact examples (Note the flattened, crushing of tip and material dislocations, fracturing where small fragments of material were removed or appear sliced off, top middle two images; bottom middle image shows the sharper point used to gouge; bottom right shows the rounding and material dislocation from end scraping.)



heavy rounding and striations, tip snap, dis-location of material

Artefact D3.8.1 Multi-purpose tool: pick and dig

impact tip crush, lateral dislocation

Artefact D2.5.1 projectile point

Artefact D2.5.2 soft slicer (animal / vegetal)

light rounding and striations

D4.8.p bladelet projectile

Fig. 8.6: Utilised early contact/ ceramic component artefact examples (Note: tip ‘snapped off’ top right; ‘scratchy lines’, or striae/ striations, accumulated during use; middle and bottom ,‘flattened tips’, middle right, rounding at edge, groove-like vertical lines downward from edge.)

8.3.1 Early-contact/ ceramic component summary

Of the (45) utilised pieces (Table 8.3): 2 (4.4%) are of quartz and were both used as points; 3 (6.7%) are of quartzite, one used as a hafted projectile, one as a gouge, one use to scrape; 31 are of CCS (68.9%), 10 of which were used as points/ projectiles (one certainly hafted) and 1 uncertain, but appears to have been used as a point; 11 were used to primarily scrape, some with complimentary activities (e.g. cut/ slice); and the remaining 10 CCS pieces were used in activities requiring sharp edges (e.g. chop, cut, carve, plane). CCS does not appear to have been used for activities requiring heavy load-bearing pressure (e.g. boring/ drilling, digging).

The remaining nine utilised pieces comprise: 3 (6.7%) of pseudotachylite, 1 projectile and 2 used to scrape; 3 (6.7%) of shale, 1 used to scrape with secondary activities, 2 used to dig; 2 (4.4%) of dolerite, primarily used to gouge, but with secondary activities (e.g. punch); and 1 (2.2%) of iron stone, used to scrape.

8.4 Comparison of lower and middle site component assemblages

The purpose of this section is to compare the stratified, statistically random sampled pre-contact/ pre-ceramic and early contact/ ceramic assemblages, as they are, according to optimum sampling strategy (Ch. 6, section 6.3), representative of the population. The arbitrarily selected pieces are discussed in Section 8.5.

The following comparison elaborates on the Holkrans raw materials discussion in Chapter 4. Table 8.5 presents the frequencies of raw materials for utilised pieces.

Table 8.5 Raw materials of utilised pieces

Value in each column = number of utilised pieces made of the corresponding material

Raw Material	Pre-contact/ pre-ceramic (n = 49)	Early contact/ ceramic (n = 45)
Quartz	14	2
Quartzite	11	3
CCS	19	31
Pseudotachylite	1	3
Shale	/	3
Dolerite	/	2
Mudstone	1	/
Iron stone	/	1
Hematite	1	/
Other (unknown/ undefined)	2	/

The decrease between periods in quartz and quartzite, and the increase in CCS appears notable, suggesting an increasing preference for finer-grained materials post-contact (and contrary to the tenets of the morphological model developed and tested in Chapters 2-4). Statistical analyses of the morpho-typed Holkrans E-8 stone assemblage (Ch. 4, section 4.6) showed no significant difference between the pre-contact/ pre-ceramic and early contact/ ceramic periods. Analysing different attributes of utilised pieces (e.g. raw materials and activities) may provide a different interpretation. For statistical analysis (Table 8.6), the raw materials have been pooled (Ch.4, section 4.6) into the following categories: quartz, quartzite, CCS, and all other (pseudo-tachylite, shale, dolerite, mudstone, iron stone, hematite and other) – due to low values or no presence.

The result of the chi-square test shows that there is a significant difference in raw material changes of functionally analysed utilised lithic items between the pre-contact/ pre-ceramic and early contact/ ceramic phases ($0.00057 < p < 0.05$). The observed decreases in quartz and quartzite, and the observed increase in CCS between the two phases appear to be the primary factors influencing significant change.

Table 8.6 Statistical comparison of raw materials and utilised pieces

Raw materials and utilised pieces

Observed	pre-contact	early contact	total	*Expected*	pre-contact	early contact
Quartz	14	2	16	Quartz	8.3404	7.6596
Quartzite	11	3	14	Quartzite	7.2979	6.7021
CCS	19	31	50	CCS	26.0638	23.9362
All other	5	9	14	All other	7.2979	6.7021
	49	45	94		49	45

$\chi 2$ test:	*Count*	*Rows*	*Cols*	*df*
	94	4	2	3
			Alpha	*0.05*
		chi-sq	*p-value*	*significant*
		17.4557	0.00057	YES

While various scholars (e.g. Sampson 1974; Humphreys and Thackeray 1983; H.J. Deacon 1992; Beaumont *et al.* 1995; Mitchell 2002; also see Ch. 2, p. 54) maintain that a shift from fine to coarse-grained raw materials occurred in many post-contact/ ceramic sequences, Holkrans functional analysis reveals that finer-grained CCS was a (likely preferred) material that significantly increased in use in the early contact/ ceramic phase (see Ch. 1, section 1.5.2, see also Ch. 3, section 3.4).

Tables 8.7, 8.8 show the functions and chi-square test respectively for the two components. Pieces used to scrape and pieces utilised as projectiles are presented as distinct, non-pooled data categories (rationale: 1) significant changes in scraping activities are often associated with behavioural changes due to post-contact interaction; and 2) projectiles are used in a unique manner, dissimilar to all other activities). Activities with similar objectives (e.g. the removal of material) and similar ways of achieving these objectives have been combined (see McDonald [2014] for statistical pooling of data). Miscellaneous represents pieces and activities for which there is low (potentially non-representative) frequency in one time component and no presence in the other (e.g. rub, grind, burnish, uncertain).

Table 8.7 Utilised items function comparison

Items categorised according to primary function, although many pieces were used for secondary/ complimentary activities (see Appendix B for further information).

Function	Pre-contact/ pre-ceramic	Early contact/ ceramic
Bore	10	9
Cut	3	10
Point	8	15
Scrape	22	11
Miscellaneous	6	0
Total	49	45

Table 8.8 Statistical analysis of utilised items and functions

Functions (N.B.: point , scrape are distinct non-pooled activity data sets)

Observed	pre-contact	early contact	total	*Expected*	pre-contact	early contact
bore	10	9	19	bore	9.9042	9.0957
cut	3	10	13	cut	6.7766	6.2234
point	8	15	23	point	11.9893	11.0106
scrape	22	11	33	scrape	17.2021	15.7978
misc.	6	0	6	misc.	3.1277	2.8723
	49	45	94		49	45

χ2 test:	*Count*	*Rows*	*Cols*	*df*
	94	5	2	4
			Alpha	*0.05*
		chi-sq	*p-value*	*significant*
		15.4768	0.0038	yes

There is a statistically significant difference between the utilised pre-contact/ pre-ceramic and early contact/ ceramic lithic components ($0.0038 < p < 0.05$) as a whole. Yet, the results should be considered with caution. Larger values for utilised tools in each functional category would provide more reliable and reassuring results. Of note: there is no statistically significant difference between pre-contact/ pre-ceramic and early-contact/ ceramic pieces utilised to scrape ($X^2 = 2.2752$, $0.13 > p < 0.05$) or pieces used as projectiles ($X^2 = 3.2643$, $0.07 > p < 0.05$). Table 8.9 shows adjusted residuals for cells in Table 8.8.

Table 8.9 pre- contact/ ceramic and early contact/ ceramic adjusted residuals (≥ 1.96 or ≤ -1.96 significant values at 0.05 level of significance); PC = pre-contact/ pre-ceramic, C = early contact/ ceramic.

Function	*Tool Function* Pearson's (standardised residual) Adjusted residual	
	PC	C
bore	0.05 -0.05	-2.27 [2.27]
cut	-1.45 [-2.27]	1.52 [2.27]
point/ projectile	-1.15 -1.92	1.2 1.9
scrape	1.16 [2.07]	-1.21 [-2.10]
misc.	1.62 [2.42]	-1.7 [-2.43]
No brackets = not statistically significant [ ] = lower or higher than expected values		

With crosstabs larger than 2 x 2 dimension, Residual Analysis will sometimes show interesting results along the lines of particular sub-categories that 'buck the trend' of the overall association between the variables. Alternatively, much higher values for residuals, whether + or -, may be taken as indicating those cells which make a particularly strong contribution to the relationship depicted in the table (E. Komulainen, Prof. Behavioural Sciences, University of Helsinki; pers. obs. 2014).

8.5 Arbitrarily selected pieces

As a heuristic exercise, and to augment the analyses of the statistically random samples, I selected twenty additional lithic pieces (Table 8.10), representing pre-contact/ pre-ceramic and early contact/ ceramic period components, based on various visual attributes (e.g. colour, raw material, unusual shape or interesting manufacture, such as tanged or barbed points). No preference was given to either time component. While not representative in a strict statistical sense, the items may provide some meaningful information (e.g. on technology, trade). It is also beneficial from an analyst's perspective to examine interesting or unusual pieces, as the analysis adds to his/ her knowledge base.

Table 8.10 Use-wear data for arbitrarily selected pieces (n = 20)

PC = polar co-ordinates of wear; AS = animal soft, VS = vegetal soft; v = ventral, d = dorsal; MRP = miscellaneous retouched piece; PDSM = post-depositional surface modification; morpho-type (Deacon 1984b) shown for comparison with function ('used as/ to'); for additional information see Ch. 7, Table 7.1 and Appendix B. PP = pre-contact/ pre-ceramic, EC = early contact/ ceramic.

Artefact N^0	Used as/ to	Worked material	PC	Abrasion (type, location)	Scarring (location, distribution, termination, size)	Raw material	Secondary modific-ation	Morpho-logical type
C2.12^1 PP	projectile point	AS hit hard (e.g. bone)	8,1 (tip) 2, 7 4-5	heavy rounding, tip crush 8-1, striae diagonal to lateral edges 2,7, spallation 7, hafting 4-5, v/ d	v/ d uneven, clumped small-med. bend, hinge 8-1 (tip), small-med. hinge 7, clumped hinges 4-5 (medium)	CCS	v/ d and edges all PC	flake/ MRP
A3.9$_p$ PP	projectile point	AS hit medium (e.g. wood)	8-1 (tip) 6-8, tang (hafted)	heavy rounding 8,1, 1-3, 6-8, striae perpendicular and diagonal to edge v/ d	v/ d tip crush (snap fracture) (impact stress) 1-3, 6-8, denticulation, small feather, hinge, perpendicular hafting striae (polish?)	CCS	v/ d and PC related adjacent edges	point
B1.8^{f7} EC	hafted projectile	AS hit medium	8,1 (tip) 6-8, tang (hafted prehensile mode	heavy rounding 8,1, 1-3, 6-8, striae perpendicular and diagonal to edge v/ d, Possible organic residue present	v/ d tip crush (snap fracture) (impact stress) 1-3, 6-8, denticulation, small feather, hinge, perpendicular hafting striae (polish?)	pseudo-tachylite	v/ d	point
B2.6$_p$ EC	projectile point	not used		tip and intricate edge flaking in near mint-condition		CCS	d/ v	point
J6.A1.6^1 EC	possible projectile	not used		distal section above barbs missing (snap fracture)	fracture likely due to handling	quartz		point fragment
E8.A1.8^1 EC	possible core	not used		irregular flaking scars, v, regular flaking scars, d	no apparent purposeful flaking; likely PDSM	basalt		core?

A1.7 EC	scrape	AS	8,1 (tip) 2-4, 6-7	heavy rounding tip and adjacent edges, striae perpendicular to edge, v/ d	v/ d uneven, clumped denticulation and hinge edges immediately adjacent to tip	basalt	v/ d	flake
A2.7^0 EC	MRP		not used	PDSM		dolerite	n/a	MRP
A1.5^1 EC			not used	PDSM probably sub-surface soil movements, contact with other artefacts	chipping and bright spots result of PDSM	dolerite	n/a	flake fragment
B3.12$_p$ PP	projectile point	AS hit hard (e.g. bone)	8,1 (tip) 2-3, 5-7 4-5 (hafting)	heavy rounding tip and adjacent PC, striations diagonal to tip and on adjacent edges, v/ d	v/ d large snap (tip), small uneven ill-defined feather adjacent edges, hafting wear uneven ill-defined feather	quartz	v/ d	flake/ MRP
D3.11^1 PP	scrape	AS	1-2 3-4 4-8	heavy rounding all PC, v/ d	v/ d uneven, small-med. snap (tip), uneven denticulation 3,4; comminution 4-8	quartz	v/ d	flake fragment
D3.10$_b$ PP	hafted, projectile	AS	8,1 tip 2-4, 4-7 4-5 (hafting)	heavy rounding v/ d (tip), heavy rounding, striae diagonal to tip, adjacent edges 2-4, 4-7	v/ d uneven med-large snap and hinge (tip), close, uneven small denticulation, small clumped hinges 4-5	Quartz	v/ d	bladelet
A3.5^1 EC		not used	8,1	tip snap, no wear		CCS	n/a	flake fragment
A4.12 PP	scrape	1 medium (e.g., soft wood)	1-4 prehension 5-8 scrape	heavy rounding 5-8, striae perpendicular/ diagonal to edge, v/ d	ventral and dorsal close, small-medium denticulation and hinge	quartzite	n/a	flake fragment
D2.13^1 PP	hafted projectile	AS	8,1 (tip), 1-3, 4-6 (haft) 6-8	heavy rounding tip,1-3, 6-8, light rounding 4-6 striae diagonal to tip, 1-3, 4-6, perpendicular to edge 4-6, v/ d	v/ d large snap (tip), close ill-defined feather 1-3, med. uneven hinge 4-6 (haft), small, close ill-defined feather 6-8	quartz	n/a	flake fragment

B2.7[1] EC		not used				basalt	dorsal	flake fragment
D4.5[1] EC		not used unusual, natural ‘tear drop’ flake				quartzite	n/a	flake fragment
C4.8[1] EC	scrape, and punch/ gouge	AS (medium soft, e.g. hide)	8, 1 (tip) punch 1-2, 2-3 scrape 4-8 prehension	heavy rounding tip, striae perpendicular to tip/ adjacent edges, heavy rounding and striae perpendicular/ diagonal to edge, v/ d	v/ d large tip snap and dulling, uneven medium denticulation 2-3; no observable prehensile wear or wear at 1-2	shale	n/a	flake fragment
A4.6[1] EC	hafted projectile	AS hit hard (e.g. bone) all non-hafting PC	8,1 (tip) 1-4 / 6-8 4-5 (hafting)	heavy rounding tip, adjacent edges, striae diagonal to edge 8,1 (tip), adjacent edges 1-4/ 6-8, striae perpendicular to edge 4-5 – hafting, v/ d	ventral and dorsal large snap fracture – tip, medium-large denticulation and feather pc’s 1-4/6-8, large hinge pc’s 4-5	dolerite	v/ d	flake fragment
A4.13 EC		not used				quartzite	n/a	bipolar flake

All utilised (n = 11) arbitrarily selected pieces with morpho-type and functional use are shown in Table 8.11, sub-divided into pre-contact/ pre-ceramic and early contact/ ceramic components.

Table 8.11 Morphology versus functional use (n = 11)

MRP = miscellaneous retouched piece; morphological types after Deacon (1984b)

Pre-contact/ pre-ceramic			Early contact/ ceramic		
Artefact N^0	Morpho-type	Used As/ To	Artefact N^0	Morpho-type	Used As/ To
A3.9$_p$	point	hafted projectile	A1.7	flake	scrape
A4.12	flake fragment	scrape	A4.6^1	flake fragment	hafted projectile
B3.12$_p$	flake / MRP	projectile	B1.8^{f7}	point	hafted projectile
C2.12^1	flake / MRP	projectile	C4.8^1	flake fragment	scrape, punch/ gouge
D2.13^1	flake fragment	hafted projectile			
D3.10$_b$	bladelet	hafted projectile			
D3.11^1	flake fragment	scrape			

Although only eleven of twenty pieces were used, the exercise supported my findings in the two statistically sampled components. The eight flakes/ flake fragments were used in several ways: (4) as projectiles, (2) to scrape, and (1) to scrape with secondary/ complimentary activities. The two points and the bladelet were used as projectiles. Figures 8.7-8.10 show arbitrarily selected pieces with exemplary wear.

Artefact B.2.6$_p$ shown was not used. However, the craftsmanship and intricate retouch of this microlith, which is among the smallest that have been published in southern Africa (see Bradfield and Sadr 2011), deserves mention. One plausible explanation for the origin and purpose of the microlith is *hxaro*. Of interest, however, is artefact A3.9$_p$ in the same Figure 8.8, which is approximately the same size as B.2.6, and has similar, but not as extensive intricate retouch. It shows clear traces of hafting wear, spallation, rounding, and impact (dislocatory) damage.

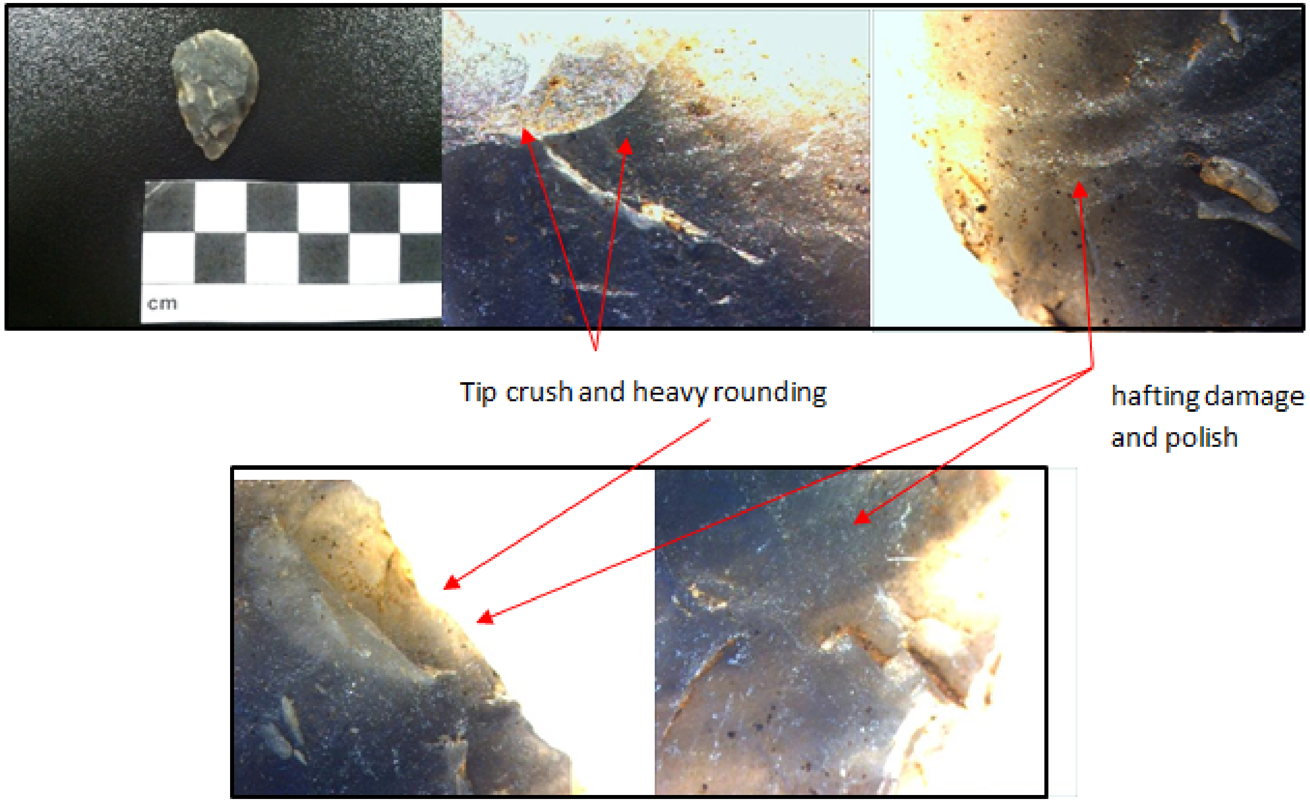
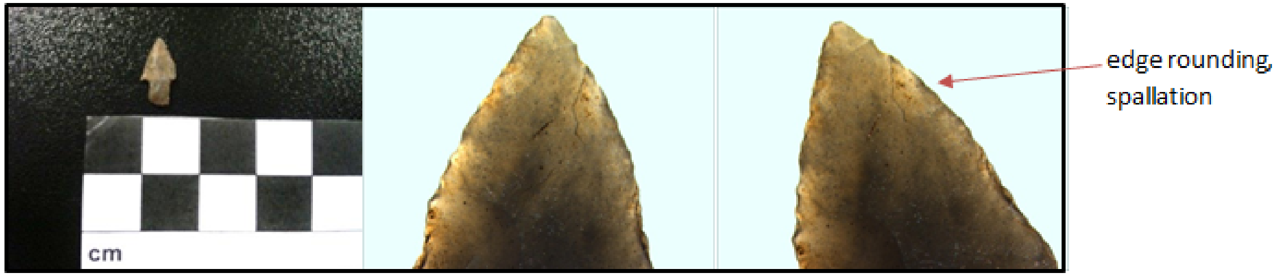
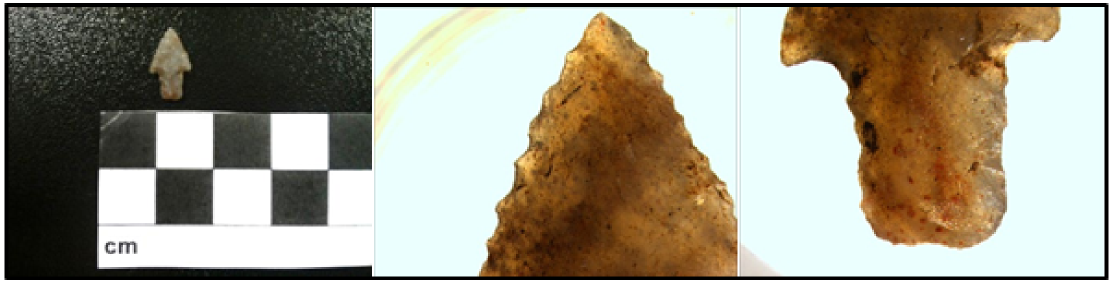


Fig. 8.7 Artefact C2.12[1] CCS projectile point with impact damage and hafting wear
(Note the dislocations leaving steps and rounding, top middle; the hafting groove and bright/ shiny areas top right; the dislocation groove with bright, shiny areas, and the striations and glistening areas bottom left and right.)

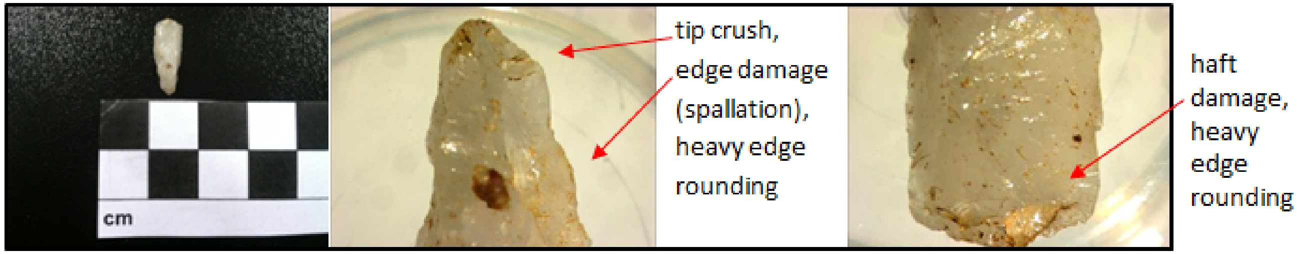


Artefact A3.9$_p$ CCS Microlith point with edge damage, striae, hafting damage and polish (pre-ceramic)

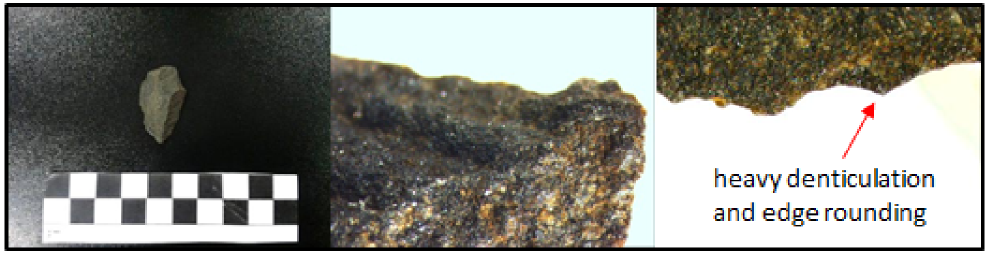


Artefact B2.6$_p$ CCS Unused, denticulate retouch microlith point (ceramic)

Fig. 8.8 Microliths A3.9$_p$ and B2.6$_p$ (not utilised) (Top, note dulling of edge and ‘dent’ near top; bottom, note intricate ‘teeth-like’ work)

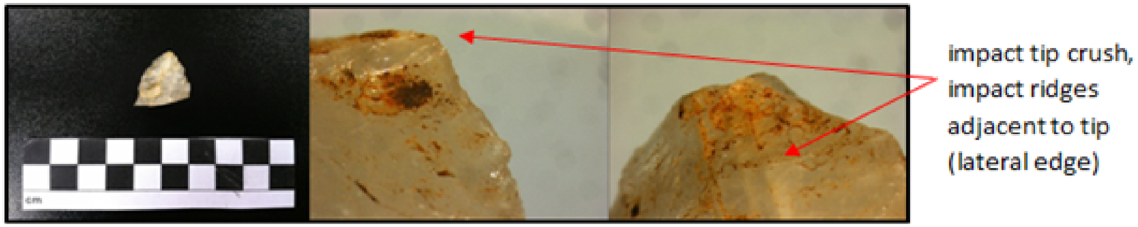


Artefact D3.10$_b$ Quartz bladelet projectile (pre-ceramic)

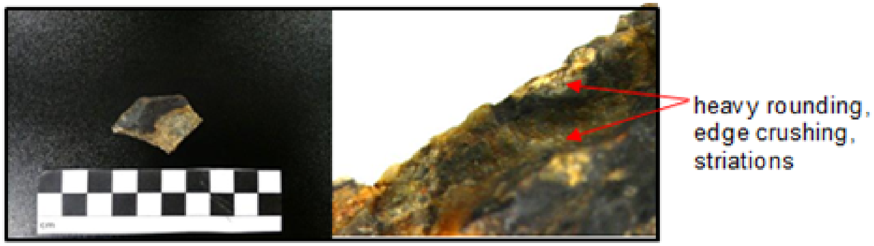


Artefact A1.7 Basalt scraper (ceramic)

Fig. 8.9 Artefacts D3.10$_b$ and A1.7 (Top, 'slice' off tip and along edge, with dulling; bottom, material removal and 'teeth' or pointed areas resulting from scraping)



Artefact B3.12$_{p}$ Quartz projectile point (pre-ceramic)



Artefact A4.12 Quartzite scraper (pre-ceramic)

Fig. 8.10 Artefacts B3.12$_{p}$ and A4.12 (Top middle: ‘slice’ off tip, or ‘crush’; top right, grooves which appear as vertical lines coming down from top, left from impact; bottom: material removal and edge dulling from scraping)

8.5.1 The Holkrans Arrowheads

Briefly introduced in Chapter 4 (section 4.6.1), this section is devoted to the stone arrowheads recovered from Holkrans. Artefact B2.6, shown in Figure 8.8, was recovered from Unit E-8. Artefact A3.9 (also in Fig. 8.8) was recovered from Unit F. The inclusion of arrowheads from other Holkrans excavations units (see Ch.4, Fig. 4.4) assists in confirming a time frame for early contact at the site and addresses the broader topic of stone arrowheads in South Africa.

Numerous stone arrowheads from over forty sites have been documented and have a currently known distribution that extends west to east from the Seacow Valley to the Thukela Basin, and north to south from the Vaal River to the Drakensberg Mountains (Bradfield and Sadr 2011: 81-82). Among the Holkrans arrowheads, one of four bifacially worked, tanged and bilaterally barbed arrowheads is made of quartz (Fig. 8.11a) and is missing its tip. The other three are made of chert. Bradfield and Sadr (2011: 84) note: 'The degree of standardisation in shape, size and retouch suggests that all four tanged examples could have been made by the same hand'. Measurements are shown in Table 8.12. Arrowhead images are shown in Figure 8.11.

Table 8.12 Holkrans arrowhead measurements

Arrowhead	Length mm	Width mm
J6.A1.6 (Fig. 8.11a)	--------	6.51
F7.B1.8 (Fig. 8.11b)	12.7	6.22
F7.A3.9 (Fig. 8.11c)	14.82	7.36
F7.C2.12 (Fig. 8.11d)	26.43	17.65
E8. B2.6 (Fig. 8.11e)	13.22	7.62

Alpha-numeric codes refer (in order) to excavation unit, quadrant and spit level.

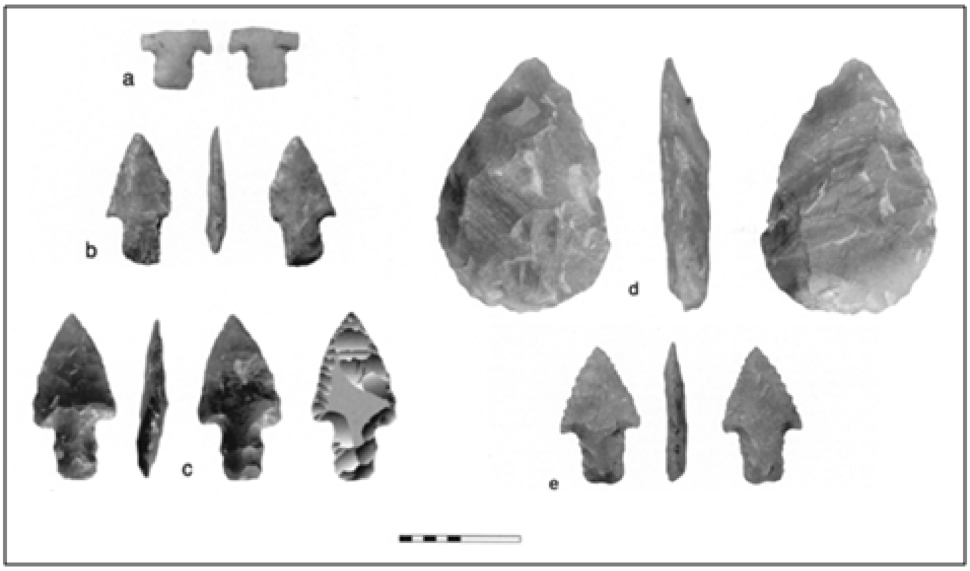


Fig. 8.11 Arrowheads from Holkrans: (a) J6.A1.6; (b) F7.B1.8; (c) F7.A3.9; (d) F7.C2.12; (e) E8.B2.6. Scale bar is 10 mm. (image Bradfield and Sadr 2011, modified); (c) and (e) also shown in Fig. 8.8.

The largest, oldest and only non-tanged, non-barbed Holkrans arrowhead comes from the pre-contact/ pre-ceramic LSA component, approximately 2000 years ago. The tanged arrowheads come from the base of the early contact/ ceramic (middle) component, which is just beneath a level with a weighted mean date (following Aitken 1990: 111-113) for three ^{14}C dates of 200 ± 23 BP, calibrated between AD 1665 and AD 1954 (using two standard deviations and the Southern Hemisphere INTCAL 1998 curve [Stuiver *et al.* 1998]) (Bradfield and Sadr 2011).

Taylor's (1979: 23) (see also Ch. 4, section 4.9) 2627 CD 4 site, approximately 10 km northeast of Holkrans, represents the earliest known dates from a pre-colonial agro-pastoralist site in the Vredefort Dome, with a weighted mean date of 337 ± 26 BP, calibrated to AD 1510-1654 (using the aforementioned calibration curve). The stratigraphic location of the tanged arrowheads suggests that they pertain to the early contact/

ceramic component at Holkrans, making Taylor's earlier dates a more probable time frame (Bradfield and Sadr 2011).

A probable terminal date, according to Bradfield and Sadr (2011), is between the 1820's, when Mzilikazi was in the area during the Difeqane (Rassmussen 1978) and the 1830s when the first Europeans arrived in the area (Bakker *et al.* 2004: 55).

Addressing the broader issue of stone arrowheads in southern Africa: Bradfield and Sadr (2011: 80) note that 'no micro-wear studies have been conducted to establish whether the southern African stone arrowheads were in fact used as projectile points'. Wadley (2009: 94) writes that blood residue on a stemmed arrowhead from Rose Cottage has been interpreted as evidence of hunting or butchering. Williamson (2000: 56), however, explains that other arrowheads from the area have traces of plant residue. Close and Sampson (1998), whose study of the Seacow Valley is discussed in Chapter 2 (pp. 57-58), concluded that stone arrowheads were not used in hunting, due to the large discard pattern they observed; or if used in hunting, they were not used with poison. Some studies have been done on MSA materials, such as backed pieces (e.g. Lombard and Pargeter 2008; d'Errico *et al*. 2012), but the paucity of use-wear analysis of LSA assemblages includes stone arrowheads.

I have a reasonable amount of experience in the analysis of stone arrowheads. They are often prolific in North American lithic assemblages (and significantly vary in size, shape, stylistic attributes and raw materials). I devoted a significant amount of time in 2010 and 2011 to the analysis of North and Central American stone arrowheads, primarily ranging in age from approximately 11 000 years ago to within the last century. In 2013 and 2014, I conducted microscopic use-wear analysis on the Holkrans stone arrowheads (results in this chapter) and can confirm that stone arrowheads were used as projectiles – at least at Holkrans. Artefact A3.9, for example, carries hafting and impact/ ‘entry’ damage, and distinguishable polish. (See Ch. 5 and Appendix A for aids in distinguishing use-wear from ‘false wear’ caused by other processes and forces.)

8.6 Chapter summary

This chapter served to more fully explore many of the topics and data presented in Chapter 4. While the results of statistical analysis on the morphologically-typed assemblage show no significant differences between the pre-contact/ pre-ceramic and early-contact/ ceramic periods, there are statistically significant differences, taken with caution, in the results of functional analysis between the two site components. There is no significant frequency change in lithic items used as points/ projectiles between to the two time components. There also appears to be no significant change in the frequency of pieces used to scrape (Chi-square test), or a minimal change (adjusted residuals). Correspondence between morphological type categories and actual use is low.

Additional evidence was provided to support a contact period at Holkrans within the last 500 years, probably between the early16th and 17th centuries (explained in detail Ch. 9, section 9.2). The results of use-wear analysis on stone arrowheads confirm their use as projectiles.

The following chapter discusses and concludes this study, placing the intra-thesis topics in perspective, addressing Holkrans in terms of my hypotheses (Ch. 1, section 1.6.1) and explaining what was learned about the nature and impact of contact on the hunter-gatherers at Holkrans as reflected in the lithic assemblage components.

CHAPTER 9

Discussion and conclusion

9.1 Introduction

The results of the lithic use-wear analysis of the Holkrans pre-contact/ pre-ceramic (lower) and early-contact/ ceramic (middle) components presented in Chapter 8 have shown: morphological types correspond poorly to actual function; a wide variety of activities were performed using stone tools in both time periods; significant changes in the functional use of some stone items occurred in the early-contact/ ceramic period; raw materials of utilised pieces changed significantly in the early-contact/ ceramic period; and, of significant interest, stone arrowheads were confirmed to have been used as projectiles in both time periods.

This chapter first briefly discusses the meaning of these results in relation to the nature and impact of contact on Holkrans hunter-gatherers with food-producers. The limitations of the applied methods are then discussed and recommendations for future research are made. The chapter concludes with a summary of the thesis.

This study has been but a single step forward. Time will tell if the results and conclusions herein are borne out by future research.

9.2 Contact

Contact is believed to have occurred within the last 500 years. A more specific time frame is probably sometime between the early 16th and 17th centuries. Several lines of archaeological evidence support this time frame. First, there are numerous stone-walled structures in the Holkrans vicinity and in the larger area (Ch. 4, Fig. 4.9 and Ch. 8). The structure at site 2627 CD 4 (Fig. 4.9 MOVT), 10 km northeast of Holkrans (Ch. 8) has a weighted mean date calibrated between AD 1510 and 1654. Secondly, the stratigraphic position of the Holkrans tanged arrowheads analysed (Ch. 8) is just beneath a level with a weighted mean date calibrated between AD 1665 and AD 1954. Third, this level corresponds to the base of the ceramic phase at Holkrans, suggesting that the nearby site 2627 CD 4 weighted mean date calibrated between AD 1510 and 1654 is a more probable time frame (see Taylor 1979; Bradfield and Sadr 2011).

Raw materials change significantly from the lower, pre-contact/ pre-ceramic component to the middle, early-contact/ ceramic component (Ch. 4, Table 4.4; Ch. 8, Table 8.6). Quartz and quartzite decrease in both presence and use, and CCS significantly increases. Certain categories of lithic tool functions (Ch. 8, Tables 8.7-8.9) also appreciably change across the pre-contact/ contact horizon (e.g. items used for boring, cutting and miscellaneous pieces). There is no significant change in items used as points/ projectiles or items used to scrape. However, a variety of raw materials and tool types are present in both components. Additionally, the greatest concentrations and frequencies of bone and stone (Ch. 4, Table 4.2) occur in the early contact/ ceramic component, with pottery sherd frequencies steadily increasing through the terminal (upper) component.

9.2.1 The settlement strategy of Holkrans hunter-gatherers

Wadley (1987: 76) writes, ‘The more varied the artefacts and their raw materials, the more likely it is that an assemblage will belong to a well-established home base where a wide variety of processing and manufacturing tasks take place’. This statement holds true for Holkrans. The material record of the site (Ch.4, sections 4.5-4.6) and the abundant resources in the immediate vicinity (Ch. 4, section 4.2) suggest a non-logistical settlement pattern (Ch.1, section 1.5.3). Holkrans should be considered a residential, ‘mapped on’ (Ch. 1, section 1.5.3) site, or as Wadley (1987: 76) terms, ‘a well-established home base’.

Of note, particularly given the high number of stone-walled structures in the area is the stone retaining wall a few metres from the shelter dripline and dated to the LSA (Ch. 4, section 4.4.4); although no direct correlation of the wall to these structures is intended. One has to be on site to appreciate the skill invested in this feature. It does not appear to have been erected for defensive purposes; and it is not needed for accessing the shelter. It supports a relatively flat to gently sloping terraced area outside of the shelter. It would currently be speculative to suggest a use for the terraced area. It is nevertheless plausible that the retaining wall and terraced section may be in some way associated with the nature of relations between Holkrans hunter-gatherers and food producers.

9.2.2 The nature and impact of contact

According to my hypotheses (Ch. 1, Table 1.1), the nature of early contact and interaction between Holkrans hunter-gatherers and food-producers reflects an extended ‘pioneer phase’, the first stage of contact in my developed frontier theory (after Alexander 1977, 1984). It appears this pioneer phase may have lasted several hundred years for the hunter-gatherers.

In the pioneer phase, ‘outsiders’ were exploring new territory (the Vredefort Dome), exploiting the wilderness, seeking land, pasture, wild or exotic products, perhaps seeking escape routes. The archaeological signature of the food producers would have included transient camps/ settlements, occasional traces of domesticates and of their own material culture. The impact on Holkrans hunter-gatherers would have initially shown minimal or no change to their toolkit and probably involved the exchange of ‘wild products’ (e.g. hunted meat, hides) for something in return.

Although there are few non-indigenous items in the Holkrans material record known to date (Ch. 4, sections 4.5-4.6), hunter-gatherer interaction with food producers, if only infrequent and opportunistic, was highly probable. The landscape in the shelter vicinity and nearby area is marked by numerous stone-walled structures (Ch. 4, Fig. 4.9 and section 4.9). The nearby Vaal River, with abundant aquatic food sources, flanked by fertile soils, and a natural 'refuelling stop' for the numerous animal and bird species indigenous to the area (Ch. 4, Fig. 4.3 and section 4.2), would have been a logical resources procurement location for both hunter-gathers and food-producers.

The second stage in my frontier theory model is the 'substitution phase', during which food producers began to subdue the land and ensure regular access to resources (e.g. pastures, water) – a logical progression from the pioneer phase; but in the Holkrans vicinity, seen mostly from the perspective of the food producers. The archaeological signature of the food producers during 'substitution' included modifying the landscape, establishing settlements and investing in features (e.g. stone-walled structures). If the hunter-gatherers had joined the food producers in the progression toward substitution, evidence of further-developed relations would be noted in the material record, such as a peak in production of specialised tools (e.g. items used for hunting, butchering, hide preparation) or 'hyperactive phase' (Sadr 2004) to meet the demands of the new relationship (e.g. client-patron, trade partners), and probably a greater frequency of non-indigenous material items. Social organisation might have changed and eventual changes in the mDNA of the population might be noted.

It appears, however, that while the food-producers were progressing from the pioneer phase and through the substitution phase, the Holkrans hunter-gatherers were experiencing what I refer to as an 'extended pioneer phase'. They maintained an open posture toward the food producers, which was probably manifest as a symbiotic relationship – at least to some extent. There is no evidence of conflict (e.g. war, raiding; an increase in the manufacture of projectile points for offensive/ defensive purposes) during early contact and subsequent interaction. An extended pioneer phase appears to have lasted for the Holkrans hunter-gatherers up to the terminal occupation of the shelter, probably sometime in the early 19th century during the *Difeqane* or with the arrival of colonising Europeans (see Ch. 8, section 8.6). That is, they appear to have maintained a primarily hunter-gatherer lifeway.

The third stage of my frontier model is ‘consolidation’, which occurred in the Holkrans area probably beginning in the 1830’s (Ch.8, section 8.6) with the arrival of the Europeans. Food producers were delineating boundaries of permanent settlements. Conflict may have been experienced by and between all sides (colonisers, food producers and indigenes). Assimilation (by force or by choice) and/ or dispersal were likely consequences for the hunter-gatherers. They may have joined farming communities and intermarried or simply left the area. There is no current, sufficiently supported explanation for what happened to the Holkrans hunter-gatherers after the terminal phase of occupation.

9.3 Recommendations for future research

The contribution of this study has been as much about shedding light on the nature and impact of contact at Holkrans as it has about the importance of understanding the need for the functional analysis of stone tools, particularly when they are used to infer cultural behaviour and group identity. It is clear that answering the question of how stone tools can reflect the changes or continuity in cultural behaviour when different groups meet and interact is, at best, a complicated undertaking. The current study provides a preliminary foundation for such an effort.

It is important to note the shortcomings of this study for the benefit of future researchers. The current study was limited to the excavation unit that has, to date, been completely sorted and catalogued. While it appears to be representative of the site population, a larger number of utilised lithic items, which can only be determined by functional analysis, may provide more meaningful and statistically significant results. This will require the work of several researchers, and then will be limited to the amount of time, support and resources available to them.

9.3.1 Beyond Holkrans

Problems encountered in future functional analysis research may include the physical condition of artefacts and the suitability of artefacts for analysis (*Chapter 6*). The Holkrans assemblage was well preserved and the sampled artefacts were suitable for analysis. It will be important to secure access to suitable artefacts from various southern African LSA sites for analysis if the results of analysis are to become a significantly contributing constituent of the southern African archaeological record.

Specific to lithics, further geo-archaeological studies of particular sites and regions will aid in analysis. Different raw materials respond differently to the lithic manufacturing process, and use traces carry different signatures affected by raw material types, sub-categories within these types, and the overall quality of the material type. More intensive geological and geomorphic studies will not only aid in better understanding the processes that formed the materials chosen for lithic manufacturing, but might also aid in better understanding the discard and post-discard life history of lithics in an assemblage. Currently, experimental archaeology, using materials from a site to replicate tools similar to those in an assemblage followed by the functional analysis of the experimental tools serve as a surrogate in lieu of more detailed geological/ geomorphologic data and for not actually being present at the time the artefacts were being manufactured and used.

Nevertheless, the value of experimental archaeology for its own sake cannot be overstated, as it builds comparative collections that will certainly be useful at some point when analysing artefacts. Using the appropriate materials (e.g., raw stone materials from a specific site or vicinity that correspond to those in an artefact assemblage) and performing similar activities for which the artefacts were used (which may be determined from use-wear) will serve to confirm that particular materials were used for particular activities. It also builds within the experimenter an appreciation for what the original manufacturers and users experienced, which will aid in the interpretation of the artefacts. Any experimental programme should, apart from including the appropriate materials and activities as mentioned above, include those items found in this thesis: the paper recording of data, example photographs, before and after use, and both prehended and hafted uses of lithic items. If the research question involves distinguishing multiple variables of a particular activity using a particular tool, a number of repeated applications, using several and similar replicated tools will need to be considered.

With respect to my own research, I believe it would be advantageous and time well spent to undertake functional analyses on various Kasteelberg assemblages – to better understand the 'mind of Smith' behind the Smith morphological model constructed and used in this study. The results of analysis may shed some light on the currently debated issue of neighbouring hunter-gatherers and pastoralists on the Kasteelberg.

9.4 Summary of thesis

Chapter 1 presented the study problem of determining the nature and impact of contact on Holkrans hunter-gatherers with food producers, which required the exploration of frontier theory, from which I ultimately derived my hypotheses on what the possible outcomes might look like, and what archaeological signatures they would leave on the hunter-gatherers and food producers, and on the landscape. Chapter 2 provided background information on the LSA, needed for the development of a morphological model that I wished to apply to selected comparative sites and to Holkrans, for the sake of objectivity in my approach, and to serve as one part of a dual-strand analysis.

The model was applied to the comparative sites in Chapter 3, and while proving to lack applicability and utility, due to the flaws in my construct, it nevertheless provided insightful information on the comparative sites, as well as increased my understanding of the model, how it was flawed, and how it could be applicable and useful in different circumstances. The final application of the model was discussed in Chapter 4, which presented Holkrans in greater detail, and provided background for further discussion in subsequent chapters.

Chapter 5 provided the background to and explanation of various use-wear methods and the rationale for the method I chose for analysing the Holkrans lithic assemblage. Chapter 6 included a discussion of the suitability of the assemblage for analysis and the appropriateness of my chosen approach.

Chapter 7 presented my preparation for analysis by performing experimental work and undergoing a series of blind tests to confirm my abilities as an analyst. Chapter 8 was the core of this study, in which the results of functional analysis provided the information on which my conclusions are based. Chapter 9 provided a discussion of the findings of the study, proposed a probable time frame for contact and terminal occupation, as well as an explanation of the nature and impact of contact on Holkrans hunter-gatherers, presented recommendations for future research and concluded the study.

APPENDIX A

(PERTAINS TO CHAPTER 5)

A1.1 Introduction

Andrefsky (1998: 23) writes: ‘Many archaeologists have recognized the need to understand the mechanical properties of stone fracture’. Andrefsky adds that, ‘Perhaps the most comprehensive research on stone fracture mechanics was conducted by Cotterell and Kamminga’, and explains that it forms the foundation of his (Andrefsky’s) 1998 work, *Lithics: macroscopic approaches to analysis*. With respect to the foundational work of the aforementioned pioneers, and other researchers who are referenced in this appendix, most of whom write from a morphological and macroscopic approach, I discuss the following topics often employing one of the most current and comprehensive works in my specialty, *Lithic Analysis*, by George Odell (2004), which was written with both macroscopic and microscopic approaches in mind, and is therefore particularly relevant to this thesis.

George H. Odell was one of my mentors and taught me how to both perform and, later, teach lithic use-wear analysis, from high-power, low-power, scanning electron microscopy (SEM) and residue approaches. He was trained in the 1970s by two masters from ‘The Harvard Group’: Raymond Newell, in typological and technological matters, and Ruth Tringham in functional studies. Odell (1977) focused on establishing a clear methodology for microscopic use-wear analysis of lithics. He is regarded as a pioneer in lithic use-wear analysis and was a constant contributor to and architect of this archaeological specialty until his death in October 2011.

A1.2 Basics of fracture mechanics

Types and patterns of wear correspond directly to motion (e.g. scraping, cutting) and the hardness of the material (classified as soft, medium, and hard with sub-classifications anywhere in between, e.g. medium-hard). ‘Hardness’ of the contact material is determined by the size, initiation and termination of the scarring. Size refers to the invasiveness of the scars. Initiation (Herzian, bending or wedging) (Fig. A.1) refers to the fracture mechanics or the dissipation of energy through the material.

Herzian initiation usually occurs close to the edge and does not usually involve thin edges, as the edges would crush or splinter. As contact is made with the brittle solid (e.g. stone) a spherical zone of tension is created around the contact area. A fracture results if tensile stresses are sufficient to break surface molecular bonding. The crack resulting from the fracture slants outward at an angle of approximately 136 degrees, leaving a cone formation. Bending initiations are generally produced at a distance from the applied force and do not leave a bulb of percussion as in the Herzian cone initiation, but rather a small overhang near the point of impact. Wedging initiations occur if impact occurs far from an edge or if the angle of the edge closest to impact is > 90 degrees. For example, this is most often seen in bipolar flaking, where crushing is seen on both proximal and distal ends as the distal end is placed upon an anvil for stability and control (Odell 2004).

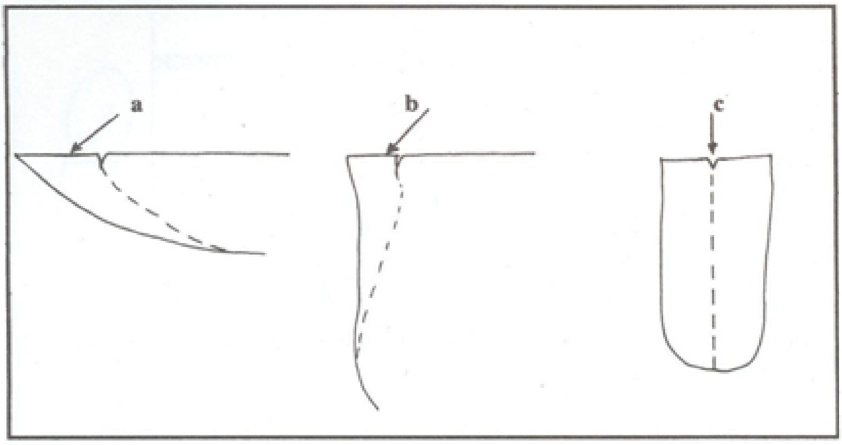


Fig. A.1 a) bending, b) Herzian, c) wedging (Odell 2004)

Terminations refer to how the force of impact exits a material, and is determined by the quality of the raw material, the direction of the application of force, surface features on the material, and internal irregularities in the material (Fig. A.2). *Feather* terminations are the result of a fracture more or less parallel to the outside edge meeting the edge, producing a thin edge all around. *Hinge* fracturing is the result of force being deflected to the outside of the struck object. This can be caused by excessive or misdirected external force, and tends to occur more frequently on flatter surfaces. *Step* terminations result in breaks at the distal end and are cause by the total dissipation of force or the meeting of dissipating energy with an internal irregularity or impurity. Fracturing energy that dissipates by curving away from the near side and exiting the opposite side is called *outrepassé* or plunging (Odell 2004). *Axial* terminations result from the fracture energy dissipating directly through to the opposite end, as seen in bipolar technology (Cotterell and Kamminga, 1987: 699-700).

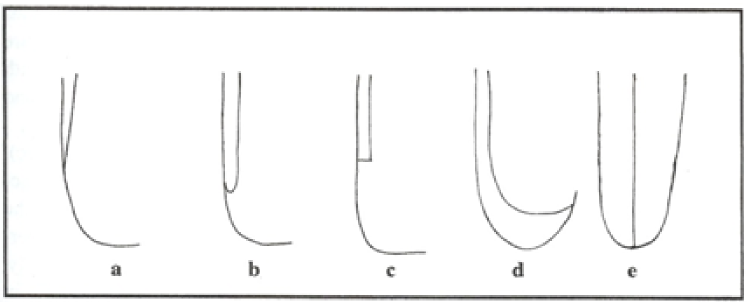


Fig. A.2 a) Feather termination, b) hinge, c) step, d) Outrepassé (plunging), e) axial (Odell 2004)

A1.3 Prehistoric knapping techniques

The question is uncomplicated, as only a few ways exist to remove flakes from cores. Freehand knapping (or manufacturing) necessitates a core large enough to hold onto while striking it with an object (e.g. hammerstone) heavy enough to deliver a blow of desired force (Fig. A.3, see also Patten 1999: 37.)

Indirect Percussion flaking involves using an intermediary striking element (e.g., soft stone or bone or antler billets) to directly apply the force caused by a striking element hitting the percussor. The benefit of indirect percussive flaking is control, using the intermediary striking device, over the precise location to be worked. *Bipolar* and *Anvil* (or block on block) involves placing the object to be struck on a hard surface. *Pressure flaking* is the most common method of further modifying a flaked item, by which a prehended device (e.g. a bone or antler billet) is used for trimming edges and surfaces of material.

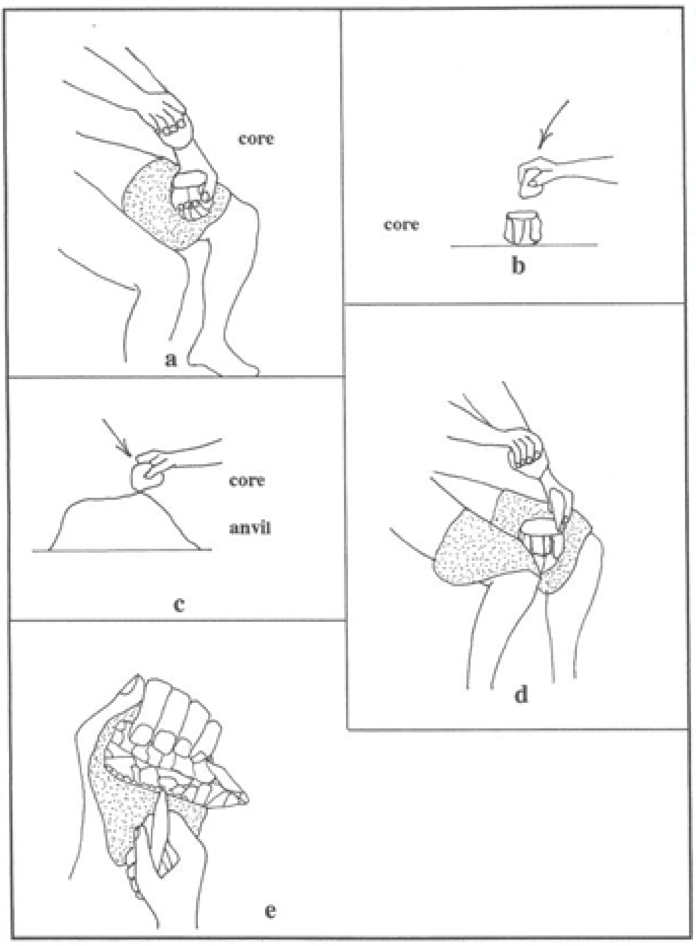


Fig. A.3 a) free-hand percussion, b) bipolar flaking, c) anvil method, d) punch (indirect percussion), e) pressure flaking (Odell 2004)

A1.4 Nature versus human agency: primary and secondary modification

In the early twentieth century a debate arose over whether or not artefacts were, indeed, the products of human agency or the results of natural forces (e.g. rock falls and solifluction- the slow, downhill movement of materials). Barnes (1939) gathered sufficient data to describe certain characteristics of humanly-made flakes, among which the regularity of secondary flaking and acute (< 90 degree) edge angles. Patterson (1983) and Schnurrenberger and Bryan (1985) have since done limited research on the topic of agency. Odell (2004: 63) maintained that cores are a good indicator. Removals from cores, if large, indicate that the removed material was the object of interest, not the core itself.

Secondary modification (intentional retouch) is also indicative of human agency. The chipping or removal of flakes from an edge or surface or the abrasive grinding or polishing of an edge or surface are the two ways in which secondary modification may be achieved. Retouch falls into three basic categories: a) marginal (edge) retouch in which the edge is the focus of modification – pressure being applied perpendicular to the lateral margin, with removals rarely exceeding 5-8 mm; b) burination, the delivering of force to a corner oriented perpendicular to the plane of the piece to produce a sharp point (projection) for etching hard materials (e.g., bone, antler); and c) core reduction – whose primary purpose is the removal of flakes for tools, leaving the core unused or used expediently. However, 'retouch' should be applied to core reduction only in cases where the core is modified in some way that is inconsistent with its primary function – the source of usable flakes (i.e. core tools, such as handaxes).

Intentional modification is important for several reasons: 1) it allows an analyst to include the modified item as part of a humanly-produced assemblage, 2) it may provide clues regarding tool curation, which has implications for interpretation of an archaeological site as a whole, and 3) intentional modification demonstrates that a particular piece received more attention ("cultural input") than similar non-modified pieces. If secondary modification was intentional, one must logically conclude that the modification was purposeful (even if not apparent to us), that the necessary force and modifying technology was within the means of human capabilities, that modification was probably done with instruments available (e.g. antler tine), and the forces of removal were perpendicular to the surface being modified (Odell 2004) (Fig. A.4).

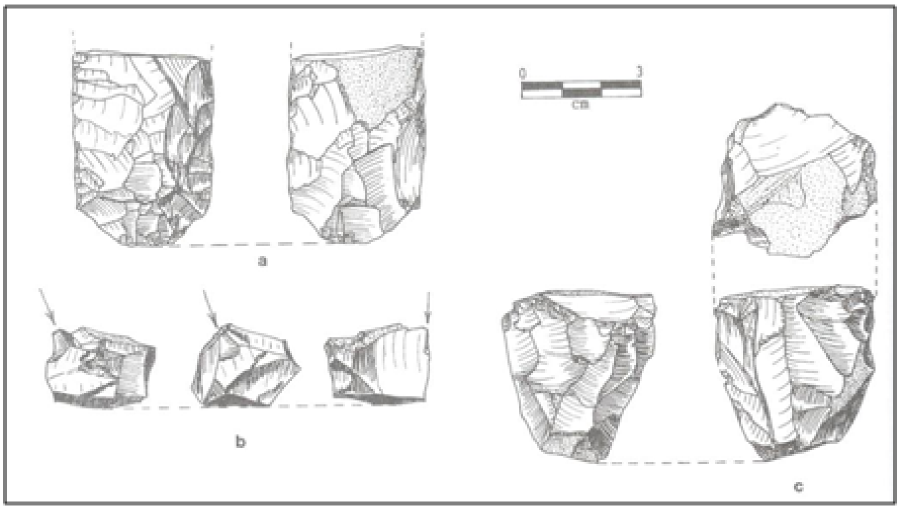


Fig. A.4 Secondary modification: a) biface (in progress), b) burin (or blocky fragment), c) pyramidal (e.g. blade/ bladelet) **flake core** (Odell and Odell-Vereecken 1980)

Nash (1996) performed experiments to replicate natural forces (e.g. cave spalling) by dropping weights from varying heights onto clasts (fragments resulting from the breakdown of larger rocks) of Jasper and tuff. The wear that was exhibited included flake removals of varying sizes, scattered around edges, rather than purposefully placed, leaving random parts of edges untouched (Fig. A.5). Excavation and laboratory damage leave similar types of non-purposeful damage or wear traces.

Fig. A.5 'Retouch' from spalling experiments (Nash 1996)

Trampling experiments yielded similar results. Tringham *et al.* (1974) maintained from experimental work that the effects of trampling on analysis were negligible, as the trampling wear usually occurred on only one side and was randomly dispersed (i.e. as opposed to the purposeful wear seen from human-induced activity). Pryor (1988) agreed that trampling effects did not significantly interfere with analysis, but noted that attention must be paid to soil compaction and disagreed that trampling wear would appear on only one side. Others (e.g. Keeley 1980; McBrearty *et al.* 1998) argued that trampling from humans or animals can cause scarring on edges that would cover genuine use-wear or make the latter indistinguishable. McBrearty pointed out that the soil substrate would necessarily affect the amount of trampling damage. Objects in coarser soils would incur more damage, while objects in finer soils could cause damage to each other through sub-surface movement induced by trampling.

Knudson (1979) studied trampling effects on materials placed around a livestock watering tank. Scarring distribution was random and removals were clustered and of different, irregular sizes (Fig. A.6). Trampling experiments have also shown the same randomness and irregularity in scar distribution and material removals (Flenniken and Haggerty 1979; Pryor 1988; McBrearty *et al.* 1998). Levi-Sala (1986) performed machine tumbling experiments to study the effects of trampling and soil movements on buried lithics. She reported that gravelly sediment can produce edge damage on shifting artefacts, and that this can be misleading if the amount of distribution of damage are the only criteria used for analysis. Her experiments demonstrated that edge damage can occur from non-anthropogenic processes and, as Burroni *et al.* (2002: 1279) explain, these processes include solifluction, soil creep, and bioturbation and freeze-thaw action.

Pargeter (2011) performed trampling experiments to determine damage caused by trampling and during the knapping process. He used two sets of unretouched, experimentally manufactured tools for trampling by cattle and humans. He found that approximately 3% of the tools incurred fracture or impact wear due to trampling.

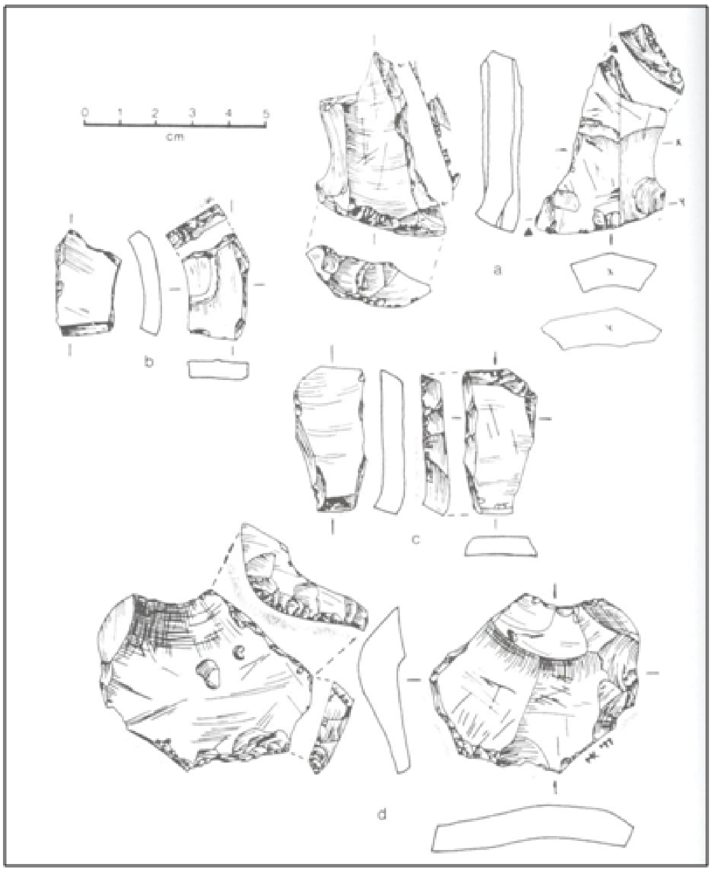


Fig. A.6 ‘Bovifacts’ from around livestock watering tank (Knudson 1979)

Mechanical plough damage experiments (Odell and Cowan 1987), involving 1000 flakes and retouched tools confirm Knudson’s findings of natural forces versus human agency. The results of decades of experimentation confirm that, while nature is certainly capable of producing what look like artefacts, the resulting work is manifest in less purposeful ways, while human modification of stone appears more purposeful and organised, and the primary and secondary removals and modifications are readily apparent as the object of interest, rather than the material object from which removal was taken.

A1.5 Ground and chipped stone

In ground stone analysis, a ground surface must initially be identified. The distinguishing characteristic, whether the surface is ground through use or manufactured, is that it is flat. Microscopically, this means that all protruding parts on the surface in question are ‘on the same plane’ (Odell 2004). When touching the surface, it feels smoother than adjacent areas. Light can reveal striations left from grinding activities. As with general identification of natural versus human agency, striae on human used or manufactured ground stone shows purposeful, repetitive motions – whether grinding in circular motion (e.g. grains) or abrading (e.g. sharpening a tool by grinding in a single direction).

All chipped stone type category items have been secondarily trimmed. The question then becomes how to classify chipped stone tools. The extent of edge retouch, whether a piece exhibits location (of wear), and certain morphological traits (or lack thereof) allow the sub-categorisation of items in a chipped stone assemblage. (Fig. A.7 shows the chipped stone classification system that I use in my analytical work.) Non-edge retouched pieces must show intentional negative flake scars on the dorsal surface. If both ventral and dorsal sides have invasive retouch, it is a biface. If only one side has invasive retouch, it is a uniface.

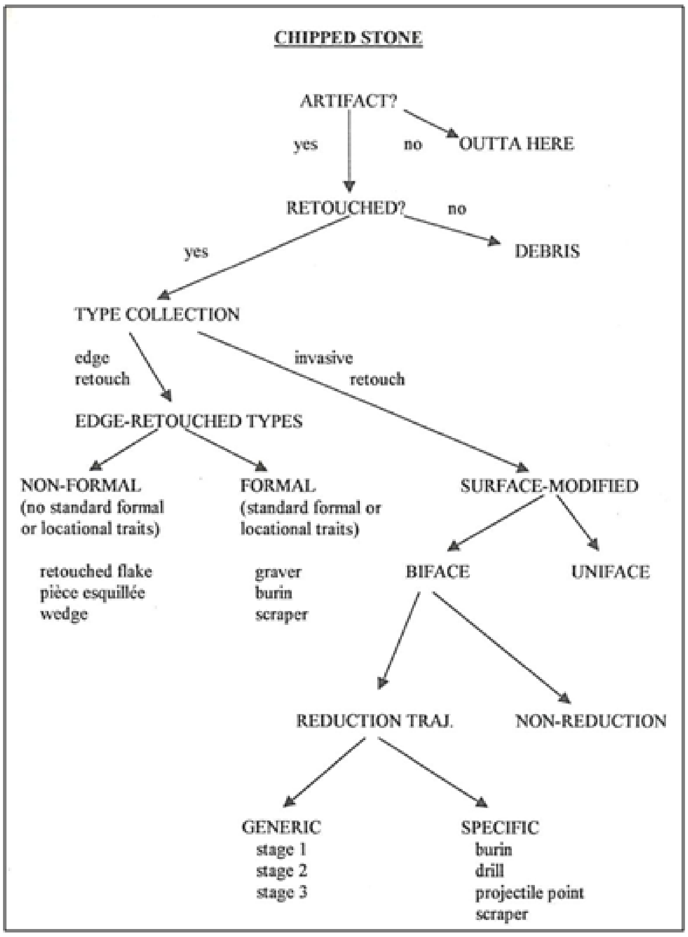


Fig. A.7 Chipped stone classification system (after Odell 1989, 2004)

A1.6 Debitage

According to Odell (2004: 118) edge retouched tools make up only 3-5% of chipped stone assemblages worldwide, leaving 95% of most site materials as debitage (which is the same as debris for discussion purposes in this thesis). He cautions, however, that one must not adopt the position that all un-retouched pieces are merely the result of some ‘higher purpose’ (e.g., the manufacture of exquisite tools, such as intricate projectile points). Unretouched flakes were often chosen for a variety of tasks, and often favoured for specific tasks as the edges were sharper (see Binneman 1982). It is, therefore, probable that some debitage was used at every habitation site.

Debitage analysis can be undertaken by single flake analysis, which is not the focus of this thesis, and by mass analysis for the purpose of determining summary parameters. The latter is usually done by weighing the debitage and/or considering frequencies of debris size. These are the most replicable and have proven to be a good predictor of the lithic reduction stages (Andrefsky 1994; Macgregor 2005). Striking platforms, breadth, length and cortical coverage can also be used in analysis, but are not as easily replicable as debitage weight when comparing parts of an assemblage or one assemblage with another.

In mass analysis, using a simple categorisation of size and weight can provide information on types of lithic activities at a particular site, indicate special-purpose areas, and provide insight into the duration of occupation at a site. For example, ‘cobbles and primary reduction flakes tend to dominate lithic extraction sites (quarries), whereas smaller sharpening and maintenance flakes tend to dominate animal or vegetal process camps located at a distance from lithic resources’ (Odell 2004: 131). Distinguishing chronological boundaries can be done by using size ratios.

A1.7 Appendix A summary

The topics presented and discussed in this appendix are important for understanding use-wear analysis. When undertaking any micro-wear study, one must be familiar with and be able to distinguish wear as a result of use from non-use related damage, the causes of which may be varied and numerous. Primary considerations are recognisable traces and patterns pertaining to an activity (discussed further in Ch. 8) and purposeful modification, which is distinguishable from natural forces, as accidental damage (e.g. trampling, bag-wear) is distinguishable from wear caused by intended use.

APPENDIX B

(PERTAINS TO CHAPTERS 7 and 8)

B1.1 Terms and definitions describing motion/ activity used in functional analysis

The following short list of terms is conventionally used in functional analysis. Plain English descriptions herein of the physics (forces and motions) behind actions that produce wear (damage) on stone tools are compilations intended for the non-microwear specialist and based on Tringham *et al.* (1974), Odell (1977, 1980b) Odell and Odell-Vereecken (1980), and Lemorini *et al.* (2006), as any single source may address only certain aspects of forces and motions, the general and more specific underlying meanings of which are presumed to be understood by specialists in our field. Activities that involve the same functional motion or purpose are combined, as is common practice in use-wear data reporting.

Awl and **Punch** are generally reserved to indicate an activity intended to pierce and remove the contact material, such as punching a hole in hide. Similar to bore/ drill/ gouge/ ream.

Bore/ Drill/ Gouge/ Ream all have as their objective the removal of material. Motions may involve clockwise (c.w.) and counter-clockwise (c.c.w.) rotations, or plunging insertions and twisting/ rotating. It is generally only the matter of the angle at which a tool is used that yields distinctions in wear. As in non-discipline specific English, the words are contextually used in different ways (e.g. one bores or drills holes; one reams or gouges a pipe, etc.). Similar to awl/ punch.

Carve/ Incise is a distinct category having the objectives to and potentially consisting of one or more of the activities described herein (e.g., the decorative line incising of pottery that also results in the removal of material during the process). The angle of use may also leave distinguishing wear. Similar to cut, whittle.

Chop is distinct from cut/ slice as the activity involves a series of repeated, singular, unilateral blows. Similar to carve, whittle.

Cut/ Slice involve the same unilateral motion in which a (usually) prehended (held in hand) instrument is placed on/ in the contact material and drawn toward the user. Generally associated with animal soft (e.g. fleshy tissue) or vegetal soft (herbaceous) materials.

Pick is a separate category, although may arguably be considered unilateral transverse motion, but the overall activity is short, non-scraping/ planning strokes, in a limited location for the removal of small quantities or material. Similar to plane.

Plane/ Shave/ Whittle involve unilateral transverse motion for the reduction of materials, distinct from scraping, which may involve bilateral transverse motion. Similar to carve/ incise.

Points refer to projectile points, arrowheads, microlith points, regardless of prehensile mode (held in hand or hafted/ composite tool).

Rub and **Grind** involve the same transverse motion and have the same general objectives of reducing material particle size and removing air-filled space in materials or the contact space between materials. Like other categories, it may only be the angle of use that distinguishes the activity.

Scrape is generally bilateral transverse motion intended to reduce/ remove material, and is distinct from plane/ shave/ whittle which involve unilateral transverse motion.

Saw is generally bilateral motion in which the instrument (prehended or hafted) is both repeatedly drawn toward and pushed away from the user. Distinct from cut/ slice which is repetitive unilateral motion. Generally associated with medium to harder materials (e.g. wood, bone, stone), and not animal or vegetal soft materials.

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