THE LATER STONE AGE IN THE SOUTHERN CAPE, SOUTH AFRICA, DURING THE TERMINAL PLEISTOCENE/EARLY HOLOCENE WITH A FOCUS ON KLIPDRIFT CAVE

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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 for any degree or examination in any university.

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Signature of candidate

_______________day of____________________2014 in Johannesburg

ABSTRACT

My analysis of the lithics, shellfish and tortoise recovered from layers dating to between 11.8 and 9.7 ka at Klipdrift Cave (KDC), De Hoop Nature Reserve, southern Cape, provides new information on the Oakhurst technocomplex. A re-analysis of a sample of lithic artefacts from Matjes River Rock Shelter (MRS) indicates many technological similarities, but also unexpected differences, highlighting the need for detailed contextualised studies that could reveal the complexity of the Oakhurst Industry.

The lithic artefacts were analysed following a typo-technological approach. The KDC Oakhurst shares many characteristics typical of this technocomplex from the southern Cape, for example in the dominance of quartzite, irregular and unstandardized flakes, the occurrence of irregular cores and typical large side and end scrapers. It differs from most coastal Oakhurst sites in the more intensive exploitation of quartz, and the presence of a morphological blade component, especially in the lowermost layers.

Shellfish remains were identified to species level in terms of minimum number of individuals (MNI) and weight. The two main species are *Dinoplax gigas*, dominating in the lower part of the sequence, between 11.8 and 11.1 ka and *Turbo sarmaticus* that is more numerous thereafter. These species provide the highest energy yield in terms of kilojoules, estimated at 667 511 kilojoules for both species combined. The species composition at KDC reflects changing environmental conditions that may relate to the effect of the Younger Dryas event, changing from a sheltered sandy bay to a habitat with more exposed rocks and less sand after 11.1 ka. *T. sarmaticus* opercula, *Cymbula oculus* shells and tortoise medio-lateral humeri were measured to investigate whether human predation pressure could have affected their size. Although the sizes of *T. sarmaticus* opercula show some decrease through time suggesting human predation pressure on these molluscs, there is also a possibility that environmental factors may have affected *Turbo* growth. The tortoise sizes at KDC, and some other Oakhurst sites, are similar to that of the Middle Stone Age (MSA) but the KDC data are

inconclusive on whether intensive harvesting had an effect on average tortoise size.

In memory of my father

Ndikira Ryano

1937–2002

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All errors and omissions in this thesis remain my responsibility.

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1. INTRODUCTION AND RESEARCH AIMS

1.1 Introduction

Klipdrift Cave (KDC), (34^{o}27.0963'S 20 ^{o}43.4582'E), located on the coast in the De Hoop Nature Reserve, southern Cape, South Africa, contains archaeological deposits dated to between 11.8 and 9.7 ka (see Chapter 3). KDC is a newly discovered site, and its suite of archaeological data, collected using best practice excavation methods, offers an opportunity to expand our understanding of the lithic technology, shellfish subsistence patterns and climate for this time. The central region of the cave contains several superimposed shell middens of varying density. The deposits here consist of features such as hearths, stone and bone artefacts, fish bones, macro- and micro-fauna, marine shellfish, and tortoise remains. Other cultural items include ostrich eggshell beads and red ochre, which relate to the symbolic repertoire of the cave's inhabitants.

The assemblage at KDC dates to the last part of the late Pleistocene and the Holocene boundary and it forms part of the Later Stone Age (LSA). The upper boundary for the transition to the LSA of southern Africa is c. 40 ka (Villa *et al*. 2012) but there is no single trajectory towards the typical variability of this period (Mitchell 2013). Age estimations from sites in the southern Cape with typical LSA tools, such as Nelson Bay Cave (NBC) and Boomplaas Cave (BPA), indicate that the LSA here spans the period from c. 22 ka to a few centuries ago (Deacon & Deacon 1999). The LSA in the southern Cape consists, in chronological order, of the Robberg, Oakhurst, Wilton and post-Wilton lithic industries (Lombard *et al*. 2012). The subject of this thesis is the Oakhurst Industry (Sampson 1974) from KDC that occurs between c. 12 and 10 ka. The Oakhurst Industry is non-microlithic and bladelet poor (Deacon 1982; Wadley 1993). The Oakhurst technocomplex is an unstandardised flake industry characterised by irregular or quadrilateral flakes struck from irregular cores from rocks that often occur in large nodules such as quartzite (Deacon 1982; Wadley 1993). Formal tools are mainly large to medium scrapers (Deacon 1982; Wadley 1993; Deacon & Deacon 1999;

Lombard *et al*. 2012).There are few temporal trends in the Oakhurst of the southern Cape, but larger side scrapers on D-shaped flakes tend to occur earlier. Elongated end-scrapers, sometimes with steep adze-like retouch, characterise the latter phase of the Oakhurst technocomplex, which occurs from c. 10 ka (Deacon 1982; Wadley 1993; Lombard *et al*. 2012). The Deacons originally suggested the term "Albany" for Oakhurst type assemblages occurring in the eastern and southern Cape (Deacon 1976; Deacon 1982; Deacon & Deacon 1999). However, in this thesis the term "Oakhurst" is used (after Lombard *et al*. 2012), as this combines all non-microlithic occurrences with the characteristics described above. Other sites in the southern Cape with Oakhurst stone artefacts are MRS, NBC, BPA, Kangkara Cave and Melkhoutboom (Deacon 1976, 1979; Deacon 1982; Döckel 1998). Oakhurst assemblages in the southern Cape coast contain significant amounts of shellfish and, together with artefacts such as fish-gorges, indicate successful coastal adaptation by humans. Marine resources, in contrast to the preceding Robberg period, played an important role in subsistence behaviour of the LSA people (Deacon 1978, 1982). Oakhurst populations also hunted mainly large-to-medium game, for example, eland, warthog and bushbuck (Klein 1972a) and sea birds (Mitchell 2013). The new data from KDC provides the opportunity to investigate anew trends and patterns from this period in the southern Cape. The focus in this thesis is on the lithic artefacts, shellfish and tortoise remains, particularly limb bones.

1.2 Research Aims

The rationale for this study lies partly in the fact that, in the past decade, South African archaeological research focused mainly on the Iron Age, historical archaeology and on modern human origins in the MSA and to a lesser extent on the LSA (Mitchell 2005). It has been more than 15 years since the publication of detailed research on the technology and subsistence patterns associated with the Oakhurst in the southern Cape. Furthermore, new paleoenvironmental and paleoclimatic reconstructions for the Last Glacial Maximum (LGM) and subsequent periods (e.g. Chase & Meadows 2007) may be used to re-examine cultural patterns from this perspective (Mitchell 2002a, 2005). Some late expressions of the Robberg technocomplex fall within the time range of the KDC occurrence for example at BPA in the southern Cape (until c. 12 ka) (Deacon 1982). In contrast to the Oakhurst, Robberg industries are microlithic, recognised by bladelet production, *outils écaillées* (scaled pieces), unretouched bladelets and bladelet cores. It is therefore of interest to ascertain in this thesis whether the KDC assemblage shows any relationship to the Robberg Industry. My research aims in this thesis are therefore as follows:

i. To investigate lithic technological behaviour at KDC during the terminal Pleistocene and the Holocene boundary. To achieve this aim, lithic artefacts from KDC were analysed by combining conventional typological approaches with the *chaîne opératoire* principles;

ii. To compare the lithic technology from KDC with another southern Cape Oakhurst site. To this end, the MRS lithics of the Oakhurst technocomplex were studied and a sample re-analysed using the methodology applied to the KDC lithic artefacts;

iii. To reconstruct shellfish exploitation patterns of the people who occupied KDC. Shellfish data from the various occupational horizons were analysed and compared to discern whether there was a change over time in species composition;

iv. To investigate the degree to which shellfish remains at KDC reflect sea surface temperatures and changing habitats during the Oakhurst period; and

v. To establish the relationship between the sizes of *T. sarmaticus* opercula and *C. oculus* shells and tortoise humeri medio-lateral diameter and the impact of human predation pressure.

1.3 Hypotheses

This research focused on investigating the following hypotheses:

i. The lithic assemblage from KDC is typical of the Oakhurst Industry as described for other sites in the southern Cape. The KDC assemblage dates to between c. 11.8 and 9.7 ka and therefore would contain the typological elements typical of the earlier phase of the Oakhurst, including irregular cores and large side and end scrapers;

ii. The KDC and MRS occurrences are similar in terms of raw material exploitation, typology and technology and belong to the same techno-complex, the Oakhurst;

iii. The shellfish species composition at KDC changed through time, and resembles exploitation patterns at other Oakhurst sites in the southern Cape. At NBC and MRS, the species that were most intensively exploited include *Donax serra*, *Perna perna* and *Choromytilus meridionalis*. At these sites there is change through time in the shellfish subsistence patterns, and similar changes occur at KDC;

iv. Shellfish species composition is often used as an indicator of sea surface temperature (Klein 1972b; Thackeray 1988; Döckel 1998; Galimberti 2010; Sealy & Galimberti 2011) and therefore it is postulated that the shellfish species at KDC provides an indication of sea surface temperature, and indirectly of habitat, during the Oakhurst period in this area of the southern Cape coast; and

v. The relative sizes of *T. sarmaticus* opercula, *C. oculus* shells and tortoise medio-lateral humeri from KDC provide an estimate of the extent and intensity of harvesting.

1.4 Thesis structure

This thesis is organised into eight chapters, starting with this introductory chapter. Chapter 2 presents an historical overview of the LSA of South Africa, and in particular the southern Cape. The history of the Oakhurst industrial terminology is traced to the late 1920s with research reports from Goodwin and van Riet Lowe setting up a classification framework and later researchers such as the Deacons bringing in refinements in the classification scheme. Recent elaborations of the scheme are those suggested by Lombard *et al*. (2012). In this chapter, the history of shellfish subsistence studies in South Africa is also summarised.

In Chapter 3, I give details of the excavations at KDC and MRS (the latter site most recently investigated by Döckel 1998) and environments, including the geological formation of the southern Cape. KDC occurs in the De Hoop Nature Reserve while MRS is on the Plettenberg Peninsula and there are some variations in present day physical environments.

In Chapter 4, I describe the methodology, methods and techniques, adopted for the analysis of the lithic, shellfish and tortoise remains. The lithic analytical approach combines typological and technological (the French *chaîne operatoire*) techniques. This approach serves to reconstruct technological behaviour of the Oakhurst people at KDC and MRS and correlate the results with previous studies. The shellfish analysis approaches include species identification, quantification of the MNI, shell weights, measurements, and dietary reconstruction in terms of shell weight, and kilojoules estimated based on average weight of each species per available MNI. Analysis technique of tortoise remains involved measurement of the medio-lateral diameter of the distal humeri.

In Chapter 5, the results of the lithic analyses for KDC and MRS are presented and discussed in relation to other sites of the Oakhurst Industry in the southern Cape. The assemblages are analysed in terms of the relative quantities of artefact classes, raw material composition, techniques and methods of production. Cores and core products are, for example, important in reconstructing methods and techniques of flake production. Formal tools inform on the motives of the lithic knappers to modify flaked stone to produce desired working edges for various purposes.

The results of the shellfish and tortoise analyses are presented in Chapter 6. Here, the dietary contribution of the main shellfish species is estimated and kilojoules of *D. gigas* and *T. sarmaticus* are calculated. The sizes of the *T. sarmaticus* opercula and *C. oculus* shells are compared with specimens from LSA and MSA sites and reasons offered for observed size differences. I also present the results of the analysis of the humeri medio-lateral diameter measurements of tortoises and its implications in this chapter.

In Chapter 7, the results from all the data sets are discussed in a wider theoretical perspective. The palaeoenvironments of the late Pleistocene and early Holocene are discussed, and how these may have influenced technology and subsistence adaptations. How the stone tool technology of the Oakhurst relates to stylistic variability, systems of stability and change, social-ecological and behavioural ecological models, is discussed.

In the final chapter, Chapter 8, I summarise the results of the research carried out for this thesis, and the implications of the results in furthering our understanding the Oakhurst period is outlined.

2. THE OAKHURST INDUSTRY WITH SPECIFIC REFERENCE TO THE SOUTHERN CAPE COASTAL SITES

2.1 Introduction

In this chapter, I review the development of the past and current theoretical and thematic understanding of the LSA in southern Africa, and specifically the Oakhurst Industry. The systematic scheme of lithic classification in South Africa was developed in the late 1920s by Astley John Hilary Goodwin, the first professional archaeologist in South Africa, and Clarence van Riet Lowe, a civil engineer who became interested in archaeology during his engineering projects in the Free State (Thackeray 1981: 11; Parkington 1984: 91; Deacon 1990). In this scheme, Goodwin (1926) devised a local terminology, dividing South Africa's Stone Age into two stages, Earlier Stone Age (ESA) and LSA.

Major industries in the ESA then included the Stellenbosch, Fauresmith, and Victoria West (Goodwin & van Riet Lowe 1929: 9-94). The LSA was used to refer to a group of lithic artefacts that were characteristically different from the ESA. In general, the major characteristics of the LSA were seen as "the flat striking platforms, fine longitudinal parallel flaking, and even, steep secondary trimming" (Goodwin 1926; Goodwin & van Riet Lowe 1929: 150). As the LSA was the final stage of the Stone Age, and it was then relatively well studied, it became a "better known field" and was associated then with near modern-to-modern humans (e.g. Bushmen) in South Africa (Goodwin & van Riet Lowe 1929: 147).

Goodwin and van Riet Lowe (1929) divided the LSA into two industries, the Smithfield and Wilton. The term Smithfield was first used in 1925 to describe the collections made by the late Dr. Kannemeyer near the town of Smithfield (Goodwin & van Riet Lowe 1929) in the Orange Free State. The term Wilton was first applied during the early 1920s (Hewitt 1921) to describe lithic material from the Wilton Rock Shelter near Grahamstown in the Eastern Cape, and later used in honour of Hewitt's work there (Goodwin 1926: 787; Goodwin & van Riet Lowe 1929: 149; Thackeray 1981: 14).

The innovations then associated with the LSA included rock art and rock engravings, deliberate burial of the dead, microlithic artefacts, organic artefacts such as strings, bows and arrows, bored stones used as digging weights, grooved stones, and use of mastic to make handles on stones. Others included decorative items such as ostrich eggshell and shellfish beads, eggshell flasks and tortoise bowls, polished bone tools (e.g. eyed needles), fishing equipment, and, in the last 2000 years, earthenware pottery (Deacon 1984a: 221–222, 1984b; Deacon & Deacon 1999: 109).

A few years later, Goodwin and van Riet Lowe (1929) introduced a middle division in the lithic assemblages, the MSA. The creation of the MSA division was necessary because of the mounting evidence of lithic artefacts that were dissimilar from ESA or LSA *fossiles directeurs* (Deacon 1990). The MSA with its variations was mainly characterised by the facetting of the butt of flakes or flake tools and convergent flaking i.e. flake and prepared core technology (Goodwin & van Riet Lower 1929: 97). Goodwin and van Riet Lowe (1929: 98) thought that the typical implement of the MSA, though with variations, was a point, a description now known to capture only part of variability in the MSA (Wurz 2014).The scheme of Earlier, Middle, and LSA survives, albeit with modifications, to describe the archaeological temporal divisions in most of sub-Saharan Africa.

2.2.1 The Later Stone Age of the Goodwin and van Riet Lowe era

Subdivisions within the LSA, as in the other major stages, were referred to as industries or phases based on geographical area, stone tool types and differences in patination (Deacon 1990). The Smithfield Industry was subdivided into Smithfield A, B, and C. The three phases suggested "convergent evolution" of the Smithfield Industry (Goodwin & van Riet Lowe 1929: 150). Concavo-convex scrapers and large circular scrapers were restricted to the Smithfield A phase. Other artefacts appearing in this phase were duckbill end scrapers, side scrapers, trimmed points, bored stones and grooved stones (Goodwin & van Riet Lowe 1929: 172). The Smithfield B at the type-site (Avalon, near the Orange River) was characterised by the high frequency of duckbill end scrapers. Other artefacts included thumbnail scrapers, notched scrapers, trimmed points, stone borers, bored stone, stone rings, grooved stone, ostrich eggshell beads, pottery and glass objects but concavo-convex and large circular scrapers were absent (Goodwin & van Riet Lowe 1929: 179). The stone artefacts of Smithfield B were smaller in size (average duckbill end scraper length 30 mm, width 15 mm and thickness 4 mm), lacked patina and were more finely worked than in the Smithfield A (Goodwin & van Riet Lowe 1929: 179). In the Smithfield C phase, the most abundant stone tool was the microlithic thumbnail scraper and lithics from this phase were smaller than scrapers in the Smithfield A and B. Other Smithfield C artefacts and features were notched scrapers, pottery, bone points and rock art (Goodwin & van Riet Lowe 1929: 183).

The Wilton Industry, as defined by Goodwin (Goodwin & van Riet Lowe 1929: 258), was characterised by the presence of crescents, small end scrapers, thumbnail scrapers, horseshoe scrapers, small cores, eggshell beads, bone points, spatulas, pigment and paintings, firesticks as well as San ("*Bush-Hottentot*") type skeletons. Smithfield C was referred to as a "crescentless Wilton" (Goodwin & van Riet Lowe 1929: 150) because it was, like the Wilton, microlithic in character but lacked segments. Clark (1959:211; see also Willcox 1956; Sampson 1972, 1974; Deacon 1974) proposed that Smithfield C be included in the Wilton.

In the years after Goodwin and van Riet Lowe's (1929) co-authored monograph, there were more phases or variations added to the Smithfield Industry from outside the type site region. These variations included Smithfield N for northern Natal (characterised by hollow or notched scrapers), Smithfield P for Pondoland (Goodwin 1930; van Riet Lowe 1936), and the Umgazana variant of Smithfield A from a coastal cave in Pondoland (with artefacts such as large circular scrapers, strangulated and hollow scrapers made on hornfels) (Chubb *et al*. 1934; van Riet Lowe 1936). Others were the Umlaas variant on the coast of Natal, which was characterised by flat bipolar cores made on hornfels (Schoute-Vanneck & Walsh 1961), and the Coastal Smithfield on the southern and eastern Cape coasts (Schoefield 1936; van Riet Lowe 1946) that consisted of small scrapers and *outils écaillés* or scaled pieces (van Riet Lowe 1946).

Goodwin and van Riet Lowe's theoretical perspective on the origin and spread of LSA industries, the Smithfield and Wilton, was based on immigration of people from outside South Africa, the Capsian makers of North Africa. Clarence van Riet Lowe (Goodwin & van Riet Lowe 1929) thought Smithfield A was a local development from either MSA or Fauresmith makers who immigrated a while before. The Wilton people migrated from North Africa to South Africa and diverged into the central zone influencing Smithfield development there and to the east coast where Wilton was probably well developed, but a possible third channel could have been through the Western Desert (Goodwin & van Riet Lowe 1929: 150). Before its arrival to South Africa, the Wilton was considered to have first been established in Zimbabwe (then Southern Rhodesia).

The resultant effect of the invasion hypothesis was that it was convenient not to explain the reasons for the development of the LSA technology in the region, as north-south migrants brought it (Deacon 1982). In the beginning of their monograph Goodwin & van Riet Lowe (1929: 3) considered sub-Saharan Africa as something of a cultural backwater, a place where no invention could be expected and the Sahara Desert was seen as a potential barrier for the south-north migration but not the opposite direction (see also Willoughby 2007). In the same vein, Mason (1962: 301) thought that Smithfield makers in the interior descended from the Sangoan people from the modern Democratic Republic of Congo who may have physically resembled the Bushmen. The Capsian hypothesis was later perspicaciously challenged by Clark (1959: 215) who argued that both the Smithfield and Wilton industries were local developments in southern Africa; and that the Smithfield was essentially a "South African culture with a long history…"

Most of the occurrences used to discern the different Smithfield industries were surface collections and the chronological gap or overlap between the industries and/or phases was based on differences in patination, size and shape of tools. Sampson (1972: 173) commented that the Smithfield collections made by the late Dr. Kannemeyer, along stream banks, were mixed up and thus their geological or chronological succession could not have been determined. Because of the lack of radiometric dating at the time and the presence of very few undisturbed deposits to show succession, Goodwin and van Riet Lowe (1929) thought Smithfield B and C and Wilton industries were contemporaneous but separated geographically (Thackeray 1981: Figure 4). The Oakhurst Shelter played an important role in the initial ordering of the LSA industries. Goodwin (1938a) reported Oakhurst Shelter material in the southern Cape and demonstrated that Smithfield B was above Smithfield C, then the Wilton and at the top Developed Wilton with pottery. He suggested that the succession at Oakhurst Shelter was similar to the nearby Glentyre Shelter. Although this succession at Oakhurst Shelter was challenged at first (Fagan 1960), later re-analysis of the collections (Schrire 1962) vindicated Goodwin's stratigraphic succession of the industries at this shelter.

Problems with Goodwin and van Riet Lowe's model were outlined by Inskeep (1967) and later by Deacon (1982). These included the association of the LSA with modern Bushman and the unclear hypothesis on the origins of industries. A Eurocentric-biased approach to the study of African prehistory (see Willoughby 2007) coupled with the lack of radiometric dating might have influenced the interpretations raised by early writers such as Goodwin and van Riet Lowe (1929) with regard to the origin and development of the LSA industries.

2.2.2 Sampson's era

At the Burg Wartenstein symposium held in Austria from July 14 to August 9, 1965 (Bishop & Clark 1967) it was proposed to use the hierarchical terms Industrial Complex, Industry, Phase, and Archaeological horizon instead of the seemingly loosely defined ESA, MSA, and LSA stage terms. In attempting to conform to the recommendations made at the symposium, Sampson (1972, 1974) proposed a classification scheme for southern Africa. In his critique of the Goodwin and van Riet Lowe (1929) approach, Sampson (1972: 180) concluded that "... all the terms could and indeed should be abandoned..." Sampson used his Orange River data assembled in several reports (Sampson 1967a, 1967b, 1967c, 1970) to refine a classification of the LSA in his synthesis of the results (Sampson 1972). He based his synthesis on the material from six rock shelters and two open sites within the Orange River Scheme area and two shelters and one cave outside the main area. He proposed six phases of the LSA but no single site provided the entire sequence of all six phases.

Sampson's (1972) Phase 1 included convex scrapers, several types of side scrapers, frontal scrapers and other tools and this phase resembled van Riet Lowe's Smithfield A. Phase 2 appeared to have the same range of tools found in Phase 1 but in addition it contained *outils écaillés,* backed blades, backed crescents, and curved backed blades (Sampson 1972: 190). Phase 3 showed a dwindling of the artefact types that occur in Phase 1 while microlithic artefacts such as small convex scrapers, crescents, and points become dominant. Phase three compared with the Goodwin's Wilton (Sampson 1972: 214). Sampson's other phase is the Phase 3–4 transition which reflected more use of lydianite raw material than in the previous phases.

In Phase 4 (Sampson 1972: 197, 199), earlier termed the "evolved Wilton" (Sampson 1972: 214), end scrapers that showed an increase in size were dominant and backed crescents were rare or absent. Phase 5, "evolved Wilton with pottery" in the early terminology (Sampson 1972: 214), marked the first appearance of pottery and rare metal objects in the area but with no important changes in the lithic tools. Shale palettes with ground edges appeared for the first time in Phase 5 (Sampson 1972: 199). "Evolved Wilton" (Phase 4) and "evolved Wilton with pottery" (Phase 5) are equivalent to Goodwin's (1938b) Developed Wilton and Developed Wilton with pottery respectively (Sampson 1972: 257, 1974: 300, 302).

The final stage in the phase sequence at the Orange River Scheme area is Phase 6 (Goodwin's Smithfield B & C) which showed a decrease in size and the disappearance of backed artefacts, replaced by an increase in bone point fragments. A new pottery style, glass beads, and European items such as ceramics, button, metal fragments, clothing, metal fragments, hooks and eyes occur (Sampson 1972: 202).

Sampson's Orange River Scheme work suggested that Smithfield A (Phase 1) and B (Phase 6) were widely separated in time where the former was dated to c. 8–7 ka while the latter appears only around 1700 AD in the area (Sampson 1972: 212). This meant that both phases could not be described using the same terminology, Smithfield, and different terms had to be devised. Sampson further suggested that van Riet Lowe's Smithfield B and C belonged to the same industry, his Phase 6.

Subsequent to his Orange River Scheme Memoir (Sampson 1972), C. G. Sampson (1974) constructed a regional framework of the southern African Stone Age record. In this synthesis, Sampson revised what he called the "orthodox framework" of the LSA into four main complexes: the Oakhurst Complex, the Wilton Complex, the Smithfield Complex of the South African Interior, and the Coastal Complex (Sampson 1974: 9, Table 1).

The Oakhurst Complex (Sampson 1974: 258-291), named after the Oakhurst Shelter excavated by Goodwin (1938a) in the southern Cape as mentioned above, was characterised by the production of broad un-facetted platform flakes from large single or multiple platform cores. The Oakhurst Complex was divided into the Oakhurst, the Lockshoek and the Pomongwan industries. The Oakhurst Industry (Sampson 1974: 258) definition was then based on the southern Cape coast sites including the type-site (Oakhurst Shelter), MRS (Louw 1960), Glentyre Shelter (Fagan 1960), Melkhoutboom Cave (Deacon 1969) and NBC. The Oakhurst Industry (Sampson 1974) was dated to between 12 and 9 ka and represented an arrival of a new population to the Cape coast on whose area of origin Sampson (1974) did not want to speculate. The only dated sites from the southern and Eastern Cape were MRS (11.3 & 10.5 ka; Louw 1960: 20) and Melkhoutboom Cave (10.5 ka; Sampson 1974: 276).

The Lockshoek Industry was represented at Nqamakwe Cave layer C (Laidler 1934), Zeekoegat 13 (Sampson 1967c), and the Wonderwerk Cave in the Northern Cape (Malan & Wells 1943), Rufus in the Transvaal (Mason 1962), Bushman Rock Shelter (Louw 1969), and Umgazana (Chubb *et al*. 1934). The Lockshoek Industry had little worked bone unlike the Oakhurst (with the exception of Umgazana). The Pomongwan Industry, which contained subcircular scrapers, was named after the Pomongwe Cave studied by Cooke *et al*. (1966) and was represented at Pomongwe and Tshangula sites in Zimbabwe.

Sampson's model was not generally accepted as a working scheme for the LSA (Deacon 1976; Thackeray 1981; Humphreys & Thackeray 1983) mainly because no single site in his Orange River Scheme area showed the stratigraphic succession of all the phases he proposed. He described his work as "little more than guesswork propped up by fragments and hints" (Sampson 1974: 439). His interpretation of variation between and within occurrences was purely cultural and did not put into consideration raw material differences and subsistence strategies (Thackeray 1981: 22). Deacon (1982: 16) criticized the Sampson model as based on "post hoc accommodative arguments" that relied on migration/diffusion or environmental change in explaining technological change.

In general the difficulties in characterising occurrences during both the Goodwin and van Riet Lowe era and Sampson's resulted from "the lack of precise definition and quantitative analyses" (Thackeray 1981: 18) and the rarity of dated sites. In spite of the dissatisfaction with the Goodwin and Van Riet Lowe's scheme at the Burg Wartenstein conference in 1965 and the Sampson synthesis, the main stages for the Stone Age chronological framework by Goodwin and van Riet Lowe (1929) continued to be in use.

2.2.3 The Deacons' era

The results of the re-excavation of the Wilton Large Rock Shelter by the Deacons, Hilary and Janette, in 1966/7 (Deacon 1969, 1972) ushered in a new methodological and theoretical approach into the LSA. Janette Deacon was able to show that there was change through time in the Wilton layers and that the artefacts were not similar as Hewitt (1921) had described for the Wilton site. The gradual changes through time were explained both in the relative frequencies of the formal tools and in the size and shape of the scrapers (Deacon 1972). She offered an ontological model of change of the Wilton Industry evolving from birth, maturity to its decline (death).

Hilary Deacon (1972, 1976), on the other hand, suggested a shift in the norms of artefact manufacture coincident with the shift in the hunting pattern as reflected by the faunal record (e.g. Klein 1972a, 1972b, 1974). Using a linguistic and environmental model, Hilary Deacon (1976) suggested a three-stage sequence in the late Pleistocene industries (i.e. LSA) at Melkhoutboom Cave and NBC. The three industries were Robberg, Albany and Wilton where each represented a period of adaptation (as reflected by faunal and floral remains) and relative stability in the lithic artefact record of each stage.

In her analysis of the data from three sites: NBC, BPA and Kangkara Cave, Janette Deacon (1982: 396, Table 69) further substantiated and expanded the terminology proposed by Hilary Deacon (1976) to southern African LSA studies. She divided the LSA into four main groups: 1) the late Pleistocene microlithic assemblages, 2) terminal Pleistocene/early Holocene non-microlithic assemblages, 3) Holocene microlithic occurrences, and 4) the late Holocene assemblages associated with pottery. Assemblages with somewhat similar stone flaking techniques, the size and shape of formal tools and unretouched flakes were grouped into a loose temporal framework from 40 ka to a few hundred years ago. Contemporary assemblages that showed regional variations were placed into regional-specific industries, identified by local terminologies (Deacon 1982: 395).

The late Pleistocene microlithic occurrences were bracketed between 40 and 12 ka (Deacon 1982: 397), and included samples from Border Cave in KwaZulu (c. 38 ka, Beaumont 1978), Rose Cottage Cave (RCC) (Beaumont 1981), BPA, NBC, Kangkara Cave and Melkhoutboom Cave in the southern and eastern Cape (Deacon 1976; Deacon 1978), and Elands Bay Cave (EBC) in the Western Cape. Other sites were Byneskranskop 1 (BNK 1) in the southwestern Cape (Schweitzer & Wilson 1982), Shongweni in Natal (Davies 1975) and Sehonghong in Lesotho (Carter 1978). Other occurrences assigned to this group were from the Tshangula Industry (25–12 ka; Cooke 1963, 1971) in Zimbabwe and the non-microlithic assemblage in Namibia (40–10 ka; Wendt 1976).

The late Pleistocene microlithic assemblages except those from Border Cave and Heuningneskrans showed systematic production of bladelets, few of them retouched, from standardised single platform cores and bipolar cores that have been so reduced through flaking that they are termed *pieces esquillées* or scaled pieces. Quartz or fine-grained rocks were the preferred raw materials. Scrapers are short but relatively thick and there are rare large scrapers similar to Goodwin and van Riet Lowe's (1929) Smithfield A (Deacon 1982: 399) in some sites such as NBC. The term Robberg describes these microlithic industries in the southern Cape (Deacon 1982; see also Klein 1974), Western Cape (Parkington 1984), RCC (Wadley 1996) and Sehonghong in Lesotho (Wadley 1993). The Robberg Industry nows falls between c. 22 and 12 ka (Deacon & Deacon 1999) in the southern Cape.

The terminal Pleistocene/early Holocene non-microlithic occurrences, the subject of this thesis, post-date the late Pleistocene microlithic assemblages, and occurred roughly from 12 to 8 ka (Deacon 1982: 396, Table 69). Bladelet cores are rare or absent in these layers while large to medium scrapers are dominant. Cores are informal with multiple or irregular platforms and resultant flakes are quadrilateral or irregular in shape (Deacon 1982: 402). In earlier layers (12–10 ka), the Goodwin and van Riet Lowe's (1929) Smithfield A scraper types (concavo-convex and large circular scrapers) and large side scrapers are common. In the more recent layers (10–8 ka) elongated end scrapers similar to Goodwin and van Riet Lowe's Smithfield B are abundant. These scrapers are "made on relatively thick flakes with scraper retouch on the convex working edge, sometimes almost adze-like, retouch down one or both sides" (Deacon 1982: 403). The latter type of scrapers has been termed woodlot scrapers in Lesotho (Mitchell 2000). Regional terminologies for the terminal Pleistocene/early Holocene non-microlithic industries included the Albany in the south and south-eastern Cape (Klein 1974, Deacon 1976; Deacon 1978), Oakhurst in the Western Cape (Parkington 1984) and RCC (Wadley 2000), the Lockshoek Industry in the Karoo and Free State (Sampson 1974), and the Kuruman Industry in the Northern Cape (Humphreys & Thackeray 1983).

The Holocene microlithic occurrences, dating from 8-2 ka, have a wider range of formal tools than appear in the two previous groups of assemblages with a microlithic flaking technique for the production of bladelets re-established (Deacon 1982). Despite having a wider a range of formal tools these industries are dominated by small convex scrapers with average mean length <20 mm. Other formal tools include adzes, segments, backed bladelets, backed points, large segments, petitis tranchets, borers, microliths with serrated edges, tanged arrowheads or points, grooved stones, sinkers, bored stones and reamers (Deacon 1982: 408). There is greater variability in these ocurrences during the last two thousand years than earlier in the mid-Holocene (Deacon 1982: 409). 'Wilton' is a label used for these assemblages.

Deacon (1982: 436) grouped other industries into the late Holocene assemblages with pottery and domestic animals such as sheep and cattle. These technocomplexes occur within the last two millennia in southern Africa (Deacon 1982: 447). In addition to pottery abundance, there are, in many cases, bones of domesticated animals such as sheep, goats, and/or cattle. Pottery making and domestic animals were added to the already existing stone tool making traditions. Regional variants of the late Holocene assemblages with pottery included the

Smithfield Complex, Ceramic Wilton, and Strandloper Complex as defined by Sampson (1974).

2.2.4 The post-Deacon era

The Deacon (1982) schema of divisions for LSA was generally accepted (e.g. Wadley 1993). However, while Deacon (1982: 396, Table 69) grouped stone industries dated between 40 and 12 ka under one label, 'late Pleistocene microlithic assemblages', Wadley (1993: 260) discusses the complexity associated with this period in terms of various labels. These are 1) the early microlithic industries called the early LSA, 2) evidence for the MSA surviving until 26–20 ka, 3) evidence for a MSA/LSA transition and 4) nonmicrolithic, bladelet-poor industries dating between 12 and 8 ka. Deacon's 'terminal Pleistocene/early Holocene non-microlithic assemblages' (Oakhurst) are discussed by Wadley (1993: 260) as having rare, or lacking, bladelet cores.

Bladelet cores in the terminal Pleistocene/early Holocene industries are largely replaced by informal multiplatform cores; quadrilateral or irregularly shaped flakes, which are often side-struck (i.e. width greater than length); medium to large sized scrapers, ranging from "convex end scrapers to circular forms that Goodwin and van Riet Lowe (1929) called concavo-convex" (Wadley 1993: 270, 271). Other scrapers include "large scrapers on D-shaped flakes and naturally backed knives" and elongated end scrapers on thick flakes, often having steep retouch or adze-like damage "down one or both sides adjacent to the scraper retouch" (Wadley 1993: 271). Large flake production is associated with the use of stone occurring in large blocks such as quartzite, hornfels, sandstone and dolerite. Quartzite is dominant in the southern Cape sites such as MRS, NBC, BPA, and Kangkara Cave while hornfels is numerous in Lockshoek sites in the interior part of the country (Wadley 1993: 271).

Despite the acceptance of the Deacons terminology, it still seemed that there was imprecision in the scheme and the terminology remained dependent on the intuition of the analyst as discussed by Underhill (2011). This apparent lack of a cohesive terminology in Stone Age studies prompted Lombard and colleagues (2012) to suggest a unified scheme for South African and Lesotho Stone Age (SALSA) occurrences.

The proposed scheme retains the use of the broad terms ESA, MSA and LSA (Lombard *et al*. 2012: Table 1) referring to different periods in the Stone Age. The terminology is built on the anthropological premise that archaeological horizons reflect activity patterns of different prehistoric people and thus occurrences may not necessarily be "replicas of each other" although they may show economic, chronological and/or regional overlap (Lombard *et al*. 2012: 124) that may be due to contact. The conceptual framework includes technocomplexes or industrial complexes. A technocomplex is a group of industries sharing broadly similar characteristics but differing in others. An industry may show changes through time, which are called phases. Lombard *et al*.'s (2012) proposed updated sequence has six technocomplexes for the LSA (Table 2.1) of South Africa and Lesotho dating from 40 ka to <2 ka. These technocomplexes are associated with Marine Isotope Stages (MIS) 3–1.

Table 2.1 South African and Lesotho Later Stone Age sequence (after Lombard *et al.* 2012: 125)

Technocomplex	Regional names	Associated MIS
Ceramic final LSA <2 ka	Ceramic post-Wilton, Late Holocene with pottery	MIS 1
Final LSA 0.1-4 ka	Post-classic Wilton, Holocene microlithic (Smithfield, Kabeljous, Wilton)	MIS 1
Wilton 4-8 ka	Holocene microlithic (Springbokoog)	MIS 1
Oakhurst 7-12 ka	Terminal Pleistocene/Early Holocene non-microlithic (Albany, Lockshoek, Kuruman)	MIS 1
Robberg 12-18 ka	Late Pleistocene microlithic	MIS 2
Early LSA 18-40 ka	(informal designation) Late Pleistocene microlithic	MIS 2 to 3

The updated sequence incorporates the terms used earlier (e.g. Sampson 1974; Deacon 1982) such as Robberg, Oakhurst, Albany, Lockshoek, Kuruman, and the Wilton. In this updated sequence some technocomplexes as before, for example the Robberg, have no regional phases. The Oakhurst technocomplex, on the other hand, encompasses industries such as the Albany, Lockshoek, and the Kuruman. Two new terms have replaced existing ones. The term post-classic Wilton as used by Deacon (1982: Table 69) is replaced by 'final LSA' in the updated sequence (Lombard *et al*. 2012). Ceramic final LSA replaces ceramic post-classic Wilton (Lombard *et al*. 2012).

As it stands, the updated sequence may create an impression that the geopolitical regions we call South Africa and Lesotho were isolated in prehistory from the immediate neighbors of southern Africa. However, this is simply a reflection of the state of research and focus of the project. The ideal is to update this sequence with new data, and data from other areas in southern Africa (Lombard *et al*. 2012: 125).

2.2.5 The Oakhurst Industry in the southern Cape

Oakhurst-type sites (Figure 2.1) date between 12 and 7 ka in the southern Cape, South Africa (Lombard *et al*. 2012). The term 'Albany' was suggested by Hilary and Janette Deacon to describe assemblages that, on stratigraphic grounds, preceded the Wilton layers in the southern Cape (Klein 1974: 258). It was derived from the Albany District in the southeast Cape where better known occurrences of this nature occurred (Klein 1974). The term Albany replaced the seemingly ambiguous term 'Pre-Wilton' used by Deacon (1969) and Klein (1972a, b) (Klein 1974). Lombard *et al*. (2012) use the term Oakhurst for the technocomplex dated between 12 and 7 ka (Table 2.1).

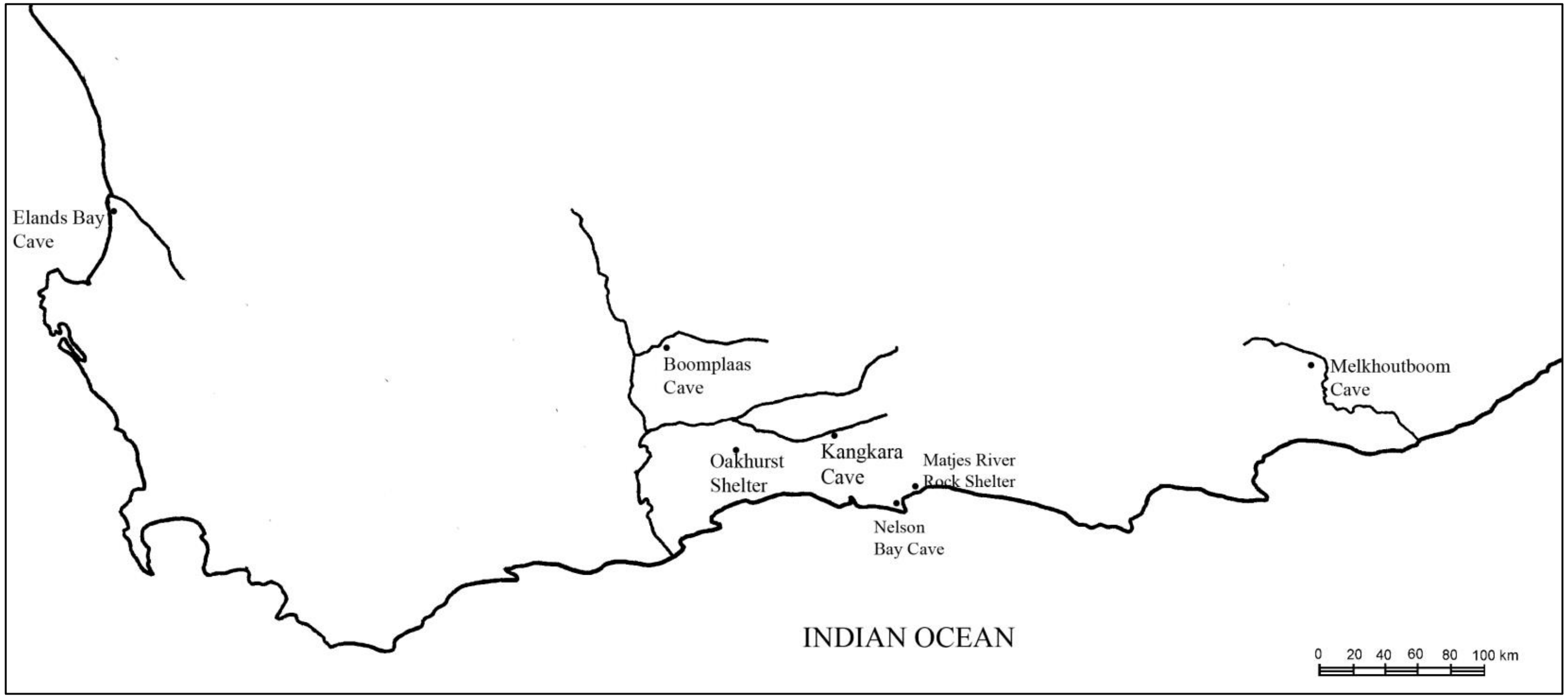

Figure 2.1 South and southwestern Cape: some of the Oakhurst sites mentioned in the text

The term Oakhurst seems to be the most used description and is thus applied to refer to the lithic industry at KDC. However, the term Albany may be used here interchangeably with 'Oakhurst'. There are very few sites with calibrated dates (e.g. NBC, BPA and MRS, see Chapter 3). The dates show that Oakhurst occurrences occur between 12 and 7 ka (Lombard *et al*. 2012).

The Oakhurst Industry in the southern Cape is characterised by rare bladelet cores, irregular or informal multiplatform cores, large quadrilateral or irregular flakes and often sidestruck. The raw materials selected for flake production are quartzite and hornfels in some sites (Deacon 1982; Döckel 1998). Formal tools are few but large convex end scrapers, circular scrapers (Goodwin & Van Riet Lowe's concavo-convex scrapers), large side scrapers on D-shaped flakes, and naturally backed knives, occur (Louw 1960; Wadley 1993). Later Oakhurst phases are characterised by elongated end scrapers ('frontal' scrapers in Sampson's 1972 terminology), often made on thick flakes. Some of these also show retouch on the sides of the piece or the piece has natural steep sides and some of the side retouch is adze-like (Deacon 1982: 165, 183, 193). Other stone tools are ground stone palettes, upper and lower grindstones, anvils, and bored stones especially at MRS found in association with naturally backed knives (Louw 1960).Oakhurst layers are also associated with polished bone points, bone and ostrich eggshell beads, tortoise shell bowls or containers, ochre and fish gorges (Deacon 1976, 1979; Wadley 1993; Deacon & Deacon 1999).

2.3 Shellfishing during the Oakhurst Industry

This thesis is partly about shellfish subsistence at KDC and how it compares to other Oakhurst sites in the southern Cape, particularly MRS and NBC. The exploitation of marine invertebrates for subsistence or manufacture of tools and ornamental objects traces to the MSA in South Africa (e.g. Marean *et al*. 2007; Jerardino & Marean 2010). It is possible however that many older sites that contain shellfish remains were destroyed by the Marine Isotope 5e sea level transgression (Marean *et al.* 2007).

The regression of the ocean during the Last Glacial Maximum (LGM) may have caused the coast to be very far from caves that contain Stone Age evidence in the modern archaeological map of the southern Cape. The evidence of shellfishing re-appears here again at the end of the Robberg period (e.g., at NBC) and shellfish become abundant during the Oakhurst Industry suggesting that in the preceding Robberg Industry the coast was still relatively far. At inland sites such as BPA (Deacon 1982: 215), shellfish remains are rare even during the Oakhurst and did not serve as subsistence items. There are rare remains of the estuarine shell *Nassarius kraussianus* in the BRL member at BPA probably used for ornamental purposes although *Nassarius* beads are absent (Deacon 1976).

Below, I show that the history of shellfish research dates to the fifteenth century with cursory references to shellfishing along the coast of South Africa. This would later become a fully-fledged archaeological research focus with questions of ecology, subsistence and climate addressed.

2.3.1 History of Shellfish research

Coastal shell middens are among the first archaeological remains to be recognised by European 'explorers' along the coast of South Africa as they were so clearly visible (Döckel 1998). Myths and speculations about the physical type of the people responsible for these shell collections dominated early observations and research (Avery 1976). The first written descriptions of shell middens come from the mariners who stayed after Bartolomeu Dias's voyage to the Cape (see Axelson 1987). In 1620, Augustin de Beaulieu gave a perhaps Eurocentric view of the coastal people by describing them as starved "savages" living on shellfish and decaying meat (see Raven-Hart 1967: 100). Mandelslo, who visited the Cape in 1639, described two groups of people he encountered: a people who consumed shellfish and fish especially when their cattle were depleted (Strandlopers) and the 'Watermans' who possessed no livestock but seasonally exploited the coast (Raven-Hart 1967: 150). Jan Van Rieebeck's journal shows that by 1652 shell middens were still accumulating on the coast through the actions of the indigenous population (Thom 1952, 1954). Other accounts of the coastal dwellers come from the late eighteenth and early nineteenth centuries (Raper & Boucher 1988).

A new wave of exploration related to shellfishing by indigenous people was encouraged when the British occupied the Cape in 1796 (Döckel 1998: 6) probably to gain a better understanding of the ways of life of coastal dwellers (e.g., Avery 1976). Other observers (e.g., Barrow 1801: 67 cited in Döckel 1998: 6) were of the opinion that natural agents accumulated shells (fore example, sea birds, which brought shells into the caves in which they nested). Later, Gregory (1858 cited in Döckel 1998) gave an ethnographic account that shell mounds were created by human agency, as there were people still shellfishing at this time. Gooch (1882: 154) reported an abundance of shellfish along the coast (e.g., *Haliotis* and mussel shells at Simon's town in False Bay) although the age of these middens was not known.

Excavation of the MRS in the southern Cape by Dreyer (1933) and others (Hoffman 1958) revealed that some shell middens were as old as 10 ka or more (see Louw 1960). Layer D dated between 11.2 and 10.5 ka (Louw 1960: 20). Although Clark (1959: 188) thought these dates were too old for this layer, its antiquity was confirmed by later research (e.g. Döckel 1998; Sealy *et al*. 2006). Hoffman (1958) reported *D. serra* from layer D (the Oakhurst layer) of the MRS but a detailed study was not presented. A detailed investigation from the later excavations by Döckel (1998) shows several shellfish species in addition to *D. serra* in the Oakhurst layers. These include *P. perna, C. meridionalis, Patella* species, *Diloma* (formerly *Oxystele*) *sinensis, T. sarmaticus, Haliotis midae, Burnupena* species, and *D. gigas* (Döckel 1998; see also Chapter 6).

NBC was excavated during the 1960s and 1970s by R. R. Inskeep (Deacon 1982: 75) where shellfish remains, along with other finds, were recovered. Shellfish remains from this site were preliminarily analysed by G. Rice and an extensive report was compiled by Klein (1972b). At NBC, the introduction of shellfish is noted in layer BSL, the upper Robberg layer, followed by the gradual increase of shellfish over time (Deacon 1978: 89; Klein 1972b). Species identified include *P.*

perna, *C. meridionalis*, *D. serra*, *Burnupena* species, *T. sarmaticus*, *Oxystele* spp., *Scutellastra argenvillei*, *S. barbara*, *S. longicosta*, *S. tabularis*, *C. cochlear*, *Haliotis midae*, *Crepidula porcellana* and unidentified species of chitons (Klein 1972b).

As shellfish research progressed in the twentieth century, ecological interpretations were offered (Hewitt 1920; Goodwin 1952) especially on the seasonal occupation of the sites. These seasonal-ecological models, inspired by ethnographic works (e.g. Lee 1965; Lee & De Vore 1968), were especially developed based on the Western Cape late Holocene assemblages (4/3–0.5 ka at De Hangen & EBC) (Parkington 1972, 1976, 1977, 1981). The seasonal mobility model is based on the idea that there are different ecozones that can be occupied at different times of the year as seasonal environmental conditions dictate. The model was developed for the Western Cape coast because there seemed to be different resource zones across space that may have influenced seasonal mobility of prehistoric people (Parkington 1972, 1981). The study area, between the Berg and Olifants Rivers and to the hinterland, was divided into four ecological zones: the coast, the coastal plain, the Cape Folded Belt, and the Doorn Karoo, which offer a variety of different resources (Parkington 1972, 1981). For example, the coastline offers a range of resources (mainly marine: fish, molluscs, rock lobsters, seals, birds and seaweeds) (Parkington 1972: 227) not available further inland.

It is postulated that hunter-gatherers knew the seasons of availability of certain resources although sometimes they may have chosen not to utilise some of the resources. *C. meridionalis,* which is dominant in the late Holocene EBC assemblages, becomes toxic when affected by red tides during summer and at this time people would exploit resources in the hinterland (Parkington 1972, 1981). Shellfish is an alternative source of food during winter when inland resources are scarce. However, it was not clear whether some communities were confined to the coast and others to the hinterland (Parkington 1972: 233). Sealy's (1986) isotope analysis of human skeletal material suggests that the dietary signal she detected does not support a coastal/inland visiting model as proposed by Parkington (1972, 1981). Sealy (1986) argued that some groups were confined to the coast while others were inland with each exploiting available resources. In recent years, Galimberti (2010: 236) shows that there was seasonal exploitation for Pinnacle Point MSA shellfish in the southern Cape. Exploitation of *T. sarmaticus* was in winter, spring or autumn while *D. serra* was collected in spring/autumn as indicated by temperature signals of each species.

Other interpretations focused on climate change as the reason for species replacement or the co-existence of warm and cold-water indicators (e.g. Klein 1972b; Voigt 1975; Thackeray 1988; Döckel 1998). The replacement of one species by another has been noted at NBC (Klein 1972b) and MRS (Döckel 1998). *P. perna* replaces *C. meridionalis* at about 10 ka at NBC and c. 9.5 ka at MRS. *C. meridionalis* presently occurs mainly in the colder waters of the west coast and whenever they are found in southern Cape archaeological sites inferences of colder sea surface temperatures are made (Deacon 1978: 106; Klein 1972b; Döckel 1998; see Chapter 6). The presence of low proportions of *C. meridionalis*, along with the abundant *P. perna*, at Klasies River in the southern Cape during MSA also indicated temperatures lower than the present (Thackeray 1988: 31).

Shellfish remains have also been used as proxy for human population sizes in prehistory. For example, the reduced size of some shellfish species in LSA sites suggests higher human population numbers compared to the MSA (Klein *et al*. 2004; Steele & Klein 2005-06; Klein 2008; Avery *et al*. 2008; Klein & Steele 2013). As will be shown in Chapter 6, the LSA shellfish remains are comparatively smaller than those from MSA sites, and this has strengthened the argument of intensive exploitation due to higher human populations during the latter part of the Stone Age as argued by Klein and colleagues.

Another important but controversial theme with regards to shellfish studies is the contribution of shellfish to the daily diet of prehistoric people. Avery (1976: 106, Table 5) estimated the amount of fresh meat yielded in grams for different shellfish species. Buchanan (1985, 1986 &1987) later expanded this initiative and attempted to reconstruct calories (in kilojoules) obtained from shellfish species. The relevant question in this line of argument is how important shellfish were in the diet of prehistoric people (Buchanan 1986: 222; Döckel 1998: 16). This question may be difficult to answer using the shellfish data alone and analysts (e.g. Buchanan 1986; Clark & Kandel 2013) use both terrestrial and shellfish data to project the total kilojoules obtained by prehistoric hunter-gatherers in an occupation layer.

2.4 Summary

The development of the LSA terminology and theory traces to the works of the first professional or amateur archaeologists who devoted much of their time to archaeology in South Africa (e.g. Goodwin & van Riet Lowe 1929). These researchers avoided the use of the European Paleolithic terms although “superior” technological influences from the north to the southern African Stone Age record were still invoked. Terminologies were modified over time and sometimes influenced by global archaeological trends and expansion in local research and knowledge but the broad categories, ESA, MSA and LSA, proposed by Goodwin and van Riet Lowe (1929) survive until today.

The proposed major scheme of classification by Sampson (1972, 1974), which followed that of Goodwin and van Riet Lowe (1929) was short lived as Deacon (1982) further refined the LSA culture-stratigraphy. Even until the 21st century the lack of conciseness and precision in the terminology used for the Stone Ages is still expressed (Underhill 2011). This has led to a suggestion of a scheme applied for the Stone Age of South Africa and Lesotho (Lombard *et al*. 2012) based on sites with chronometric dates. In this work, ‘Oakhurst’ is used as a general term.

Shellfishing was an important component of the economies of the coastal dwellers in South Africa and evidence traces back to the MSA (Henshilwood *et al*. 2001; Marean *et al*. 2007; Avery *et al*. 2008; Langejans *et al*. 2012) with a hiatus in the southern Cape during the LGM due to the regression of sea levels. The extent of the contribution of shellfish to the diet may have been relatively insignificant compared to terrestrially derived diets, such as animals and plants (Clark & Kandel 2013), but as further discussed in Chapter 6, it may have provided essential nutrients.

3. THE RESEARCH AREA AND ENVIRONMENTS

3.1 Introduction

In this chapter, I describe the KDC and MRS sites and summarise information about environmental conditions of the southern Cape region, South Africa. KDC is one focus of an ongoing research project while MRS was excavated several times between the early 1930s and the 1990s.

3.2 The setting of Klipdrift Cave

KDC is situated in the De Hoop Nature Reserve on Portion 20 of farm 516, Swellendam District in the southern Cape, South Africa (Figure 3.1).

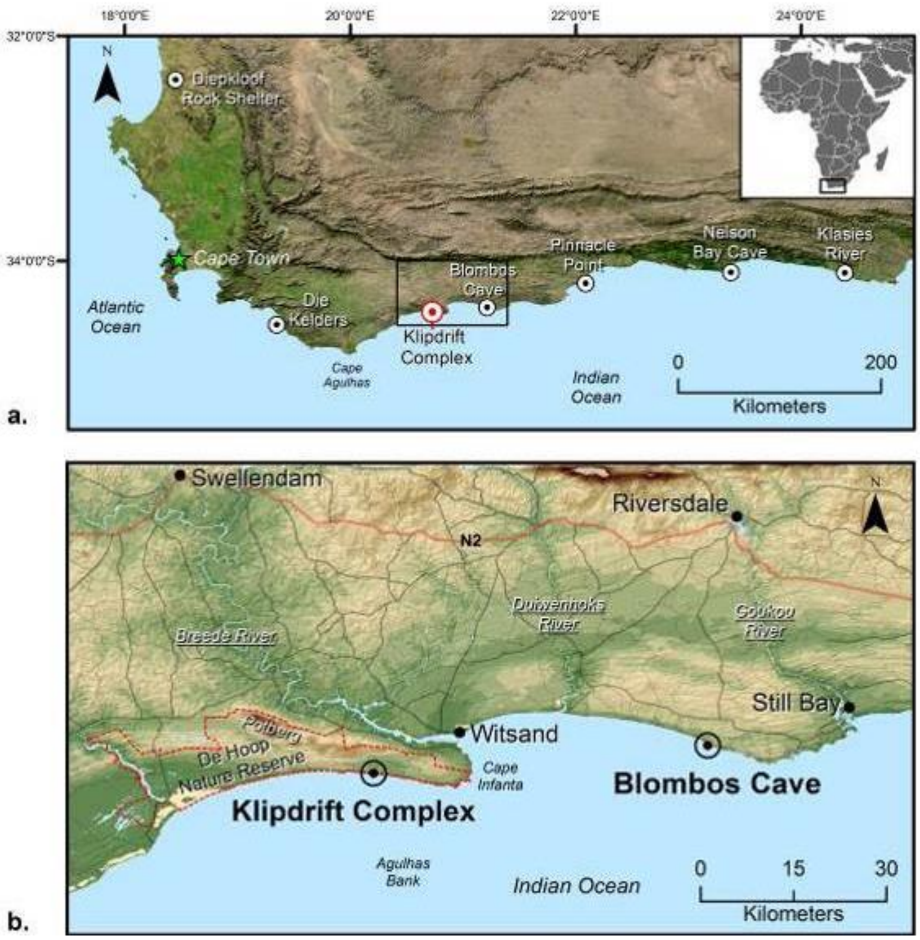

Figure 3.1 Location of Klipdrift Complex (after Henshilwood *et al*. 2014: Figure 2)

De Hoop Nature Reserve is a naturally protected area, managed by Cape Nature, of about 34 000 ha in size (http://www.capenature.co.za/reserves/de-hoop-nature-reserve/). KDC forms part of the Klipdrift Complex, which consists of a western section, here referred to as KDC, and the eastern section, Klipdrift Shelter (KDS) (Figure 3.2) (Henshilwood *et al*. 2014).

Figure 3.2 Klipdrift Complex: Klipdrift Cave is the western section and Klipdrift Shelter is to the east (courtesy of Henshilwood *et al*. 2014: Figure 1)

The Klipdrift Complex is a single wave cut platform with a quartzite promontory in the centre located in a steep quartzite cliff (34°27.0963'S; 20°43.4582'E) approximately 10 m from the Indian Ocean and about 17 m above the current sea level. Just below the site is a quartzite cobble beach and the general area is characterised by a rocky shoreline with few sandy beaches in the vicinity. The Klipdriftsfonteinspruit stream lies about 200 m east of the cave complex. The complex has been undercut on the seaward edge by raised sea levels during the mid-Holocene. Originally, the talus in front of these caves extended to the south east for about 100 m, at a slope of about 30°. Remnants of this deposit are visible in the cliff face to the east of the site (Henshilwood *et al*. 2014).

3.3 Physiography of the southern Cape

The southern Cape is a region from Cape Agulhas in the west to Cape Padrone in the east (Figure 3.3) and from the coast in the south to the remote edge of the Cape Folded Mountain Belt (Deacon 1982: 25). The whole area covers about 650 km from west to east and approximately 100 km from north to south (Deacon 1982: 25).

Figure 3.3 The southern Cape extents from west (Cape Agulhas) to east (Cape Padrone) along the coast and some towns mentioned in Chapter 3 (edited after d-maps.com)

The physiography of the southern Cape divides into the coast and adjacent coastal lowlands, the Cape Fold Belt Mountains, and the Great Karoo Basin, which lies between the Fold Belt and the South African Plateau (Deacon 1982: 25; Henshilwood 1995, 2008). The Cape Fold Belt (CFB) formed as series of resistant quartz sandstone folded mountains rising to 2 km in high relief. It is separated from the coastal plain by several narrow, rugged mountain slopes. These mountain slopes occur parallel to the coast for about 800 km from Cape Hangklip in the west to Plettenberg Bay in the east (Compton 2011: 508), where MRS occurs (see Section 3.9).

Both KDC and MRS are on the coast in the southern Cape. The coastline of the southern Cape has a “series of westward-facing half-heart bays formed by the presence of resistant arms of the Cape Folded Mountains which extend into the sea as capes” (Deacon 1982: 25). The return Agulhas Current cleans the capes and deposit sand on the sand beaches between the capes (Deacon 1982: 25). The coastal lowland, about 20 km wide in the west but narrowing to a few km in the east, is 600 m above sea level and consists of a gently undulating plain overlying the basement rocks of the Table Mountain Group.

The southern coastal plain (SCP) (Figure 3.4) is a narrow plain from George to the east and extends westward to Cape Hangklip (Compton 2011). The CFB bounds the SCP in the east between Gorge and Port Elizabeth and forms rocky cliffs on the eastern shores of False Bay. To the north of the SCP, continuous, parallel belts of the CFB separate this region from the Klein Karoo and the Great Karoo (Compton 2011: 508; Figure 3.4). Folded mountains further separate the SCP from the western coastal plain (WCP) around Cape Hangklip (Figure 3.4).

Figure 3.4 The southern coastal plain and adjacent areas: extents of the SCP are shown by the dashed line (source: Compton 2011: Figure 2).

Several short and longer rivers, which drain the Cape Folded Mountains, dissect the coastal lowland (Deacon 1982: 26). Rivers close to KDC are Breede, Gourits (Figure 3.4), Goukou and Duiwenhoks (Noah 2010) while Bitou and Keurbooms Rivers occur near MRS in the Plettenberg Bay.

3.4 Geology

The southern African rock formation dates back to 3.6 billion years starting with the early crustal development, the fragmentation of Gondwana land and the formation of the most recent rocks (Tankard *et al.* 1982). From the Early Ordovician (c. 500 Ma) to the Early Carboniferous (c. 300 Ma) (Thamm & Johnson 2006), the Cape Supergroup was deposited on the Cape granites. The Cape Supergroup divides, from the oldest to the youngest, into the Table Mountain, the Bokkeveld and Witteberg Groups comprising clastic shallow-marine, deltaic and near-shore fluvial deposits (Tankard *et al*. 1982; Thamm & Johnson 2006). The Cape Supergroup is well represented in the southern Cape, forming the basis for the current geomorphology (Holmes *et al.* 2007). The break up of Gondwana during the Mesozoic Era gave rise to the southern Cape coast between c. 180 and 135 Ma (Partridge & Maud 1987).

The Table Mountain Group, deposited under shallow marine and fluvial environments around 450 Ma, is lithologically sandstone-dominated. The overlying group, the Bokkeveld Group (419–382 Ma), deposited during the Early (c. 419–393 Ma) to the Middle Devonian (c. 393–382 Ma), is a composition of fossiliferous shale and sandstone coarse sediments which may be attributed to basin ward progradation activities. The youngest formation of the Cape Supergroup, the Witteberg Group which is Late Devonian to Early Carboniferous in age (c. 382–359 Ma), is composed of sandstone and mudrock sediments deposited under shallow-marine, paralic and deltaic environments (Thamm & Johnson 2006).

Another major geological deposition took place during the Cenozoic c. 60 Ma and, in the southern Cape; these sediments are clustered as the Bredasdorp Group (Malan 1989; Roberts *et al.* 2006). The present-day southern Cape coast is formed by alternation of straight, hard rock cliffs of the Cape Supergroup quartzites with sandy bays in the vicinity (Holmes *et al.* 2007) but sediments of the Bredasdorp Group are also part of the geology around Plettenberg Bay.

The Bredasdorp Group, composed of limestones, calcarenites, calcirudites, conglomerates, coquinites and calcareous sandstones (Malan 1989), is found between Plettenberg Bay and Hermanus (Roberts *et al.* 2006). Deposited due to sea-level fluctuations during the late Cenozoic, the Bredasdorp Group is divided into the De Hoopvlei, Wankoe, Klein Brak, Waenhuiskrans and Strandveld Formations (Roberts *et al.* 2006; Table 3.1).

Table 3.1 Geological sequence of the Bredasdorp Group sediments (source: Roberts *et al*. 2006: 615)

Formation	Description	Age
Strandveld Formation	Dune sand	Holocene
Waenhuiskrans Formation	Semi-consolidated aeoliniate with calcrete lenses	Mid-Late Pleistocene
Klein Brak Formation	Quartzose sand with pebbles	Early Pleistocene
Wankoe Formation	Calcarenite with Aeolian cross-bedding and calcrete lenses	Early Pliocene
De Hoopvlei Formation	Calcarenite, calcirudites, coquinite, conglomerate and sandstone	Miocene

This description of the Bredarsdorp Formations starts from the oldest occurrence and proceed to the youngest while the table above (Table 3.1) reverses this order. The De Hoopvlei Formation occurs intermittently between Bredasdorp to Mossel Bay and is conformably covered by the Wankoe Formation (Malan 1991; Roberts *et al.* 2006). The sandstone sediments of the De Hoopvlei Formation, deposited in a regressive shallow-marine environment, are conformable, or deposited in a continuous sequence, and horizontally stratified (Roberts *et al.* 2006).

The Wankoe Formation unconformably underlies unconsolidated aeolian sands of the Klein Brak Formation. Named after the type area, the Wankoe valley, this formation is the most extensive in the Bredasdorp Group, covering 250 km along the coastline, from Hermanus in the west to Mossel Bay in the east (Roberts *et al.* 2006). The Klein Brak Formation originates from cemented and uncemented sand, gravel, coquina and peat deposited under estuarine, foreshore and lagoon environments (Malan 1990; Roberts *et al.* 2006). The age of the Klein Brak Formation is Eemian (c. 100 ka) (Malan 1990) and unconformably overlain by the Middle Pleistocene aeolinites of the Waenhuiskrans Formation at Arniston, a village 23 km southeast of Bredasdorp (Roberts *et al.* 2006).

The middle to late Pleistocene Waenhuiskrans Formation comprises weathered aeolian sands at Knysna and three major dune cordons, indicative of Pleistocene sea-level changes, occur at Wilderness west of Sedgefield (Roberts *et al.* 2006). The most recent phase of the Bredasdorp Group is represented by unconsolidated, calcareous sands of the Holocene and is known as the Strandveld Formation. The Waenhuiskrans Formation occurs intermittently along the coast running from Hermanus in the west to Plettenberg Bay in the east (Roberts *et al.* 2006) where the Strandveld Forestry Reserve, southeast of Hermanus, forms the type area (Malan 1990).

3.5 Present climate

The southern Cape currently has a warm temperate climate with rainfall throughout the year, receiving both winter and summer precipitation (Tyson 1986;

Deacon & Lancaster 1988; Chase & Meadows 2007; Compton 2011) but maximum rainfall occurs in spring and autumn (Deacon & Lancaster 1988: 110). The climate of southern Africa is influenced by a wide range of atmospheric and oceanic circulation systems (Tyson 1986; see also Chapter 7). Rainfall along the southern and western coasts, for example, "results from temperate frontal systems embedded in the westerlies" (Chase & Meadows 2007:104). The southern Cape atmospheric circulation systems that influence weather include pressure, cold fronts, coastal winds, westerlies, and oceanic circulation. These factors are prone to day-to-day changes occurring at a particular latitudinal position and by topographic features (Tyson & Preston-Whyte 2000).

Topographic features such as bays, the coastal platform, rivers, the Outeniqua and Tsitsikamma mountain ranges, parts of the Cape Fold Belt, and the intermontane valleys such as the Langkloof, influence the amount of rainfall received from area to area (Deacon & Lancaster 1988). This is because mountains enhance, while valleys diminish precipitation (Tyson 1986). Thus, the SCP climate and vegetation is physically separated from the interior of Africa by the Cape Folded Belt (Compton 2011: 508). Due to a variety of relief features from the coast to the CFB, precipitation varies from 500–600 mm on the coast to 1000–1200 mm in the mountains (Deacon & Lancaster 1988: 110). Precipitation is slightly higher between February–March and September–October as recorded at Plettenberg–Keurbooms region (Döckel 1998). The average annual temperature at De Hoop Nature Reserve is 15–17.5^{o} C while mean annual rainfall varies from 454 mm at Gansbaai to 400 mm at Gourits River (Wills *et al*. 1996).

3.6 The Indian and Atlantic Ocean current systems

The southern African shoreline, from Namibia to Mozambique, is a long (4350 km) and exposed coast with few large bays and lagoons but without large offshore islands (Kilburn & Rippey 1982: 21). Two major ocean currents influence the southern African coastal littoral. These are the cold Benguela Current from north and the warm south-flowing Agulhas Current (Branch & Branch 1981: 14; Kilburn & Rippey 1982: 21; Figure 3.5) but these two current systems tend to interact with other currents from the Antarctic Ocean (Tyson & Preston-Whyte 2000).

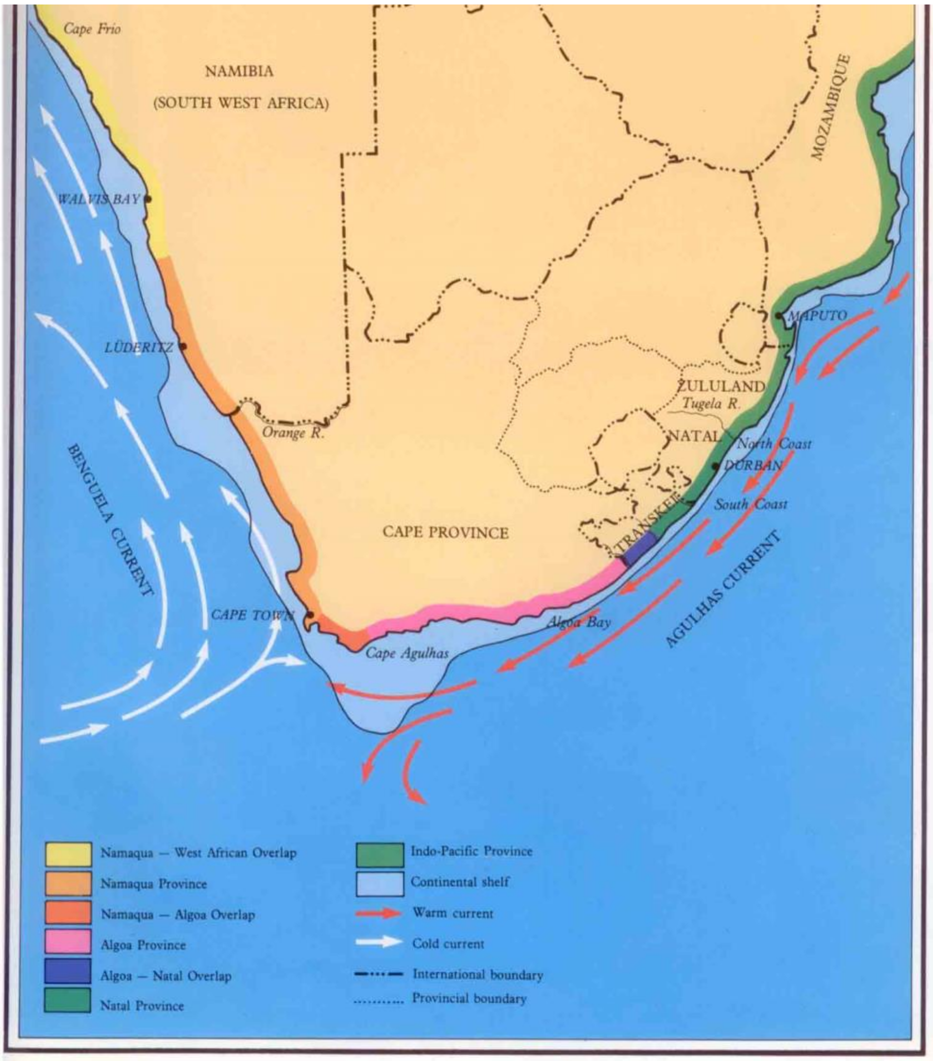

Figure 3.5 Benguela and Agulhas currents, marine provinces and continental shelf (source: Kilburn & Rippey 1982: 23)

The Agulhas Current originates off the East African coast, bringing warm water from the tropics, and moves south on the edge of the continental shelf (Figure 3.5) and later converges with the Antarctic Circumpolar Current before swinging back as the return Agulhas Current (Branch & Branch 1981: 15; Kilburn & Rippey 1982: 21; Tyson & Preston-Whyte 2000: 220). Much of the water to the Agulhas

Current is supplied by a large circulation gyre in the south-west Indian Ocean, extending to around 60^o E. The South Equatorial Current in the South Indian Ocean, the Mozambique and the East Madagascar currents contribute small amounts of water to the Agulhas Current (Tyson & Preston-Whyte 2000: 220). The temperature of the Agulhas Current is between 20 and 28^o C and shows a cool progression towards the west because of the upwelling of cold water and of the local counter-currents of cooler water (Kilburn & Rippey 1982: 21). The cold Benguela Current is, according to Reid's (1989) dynamic topography, between the African coast and Walvis Ridge (see also Figure 3.5). It is an offshore, wide, slow and northward drift of water pushed by the South Atlantic Anticyclone and the Benguela upwelling system. Much of the cold waters entering the Benguela Current is produced by the Benguela upwelling system but the two phenomena are inherently different (Tyson & Preston-Whyte 2000: 221).

The Agulhas and Benguela currents meet at the tip of South Africa's Cape Peninsula (Branch & Branch 1981: 13). At this point there is also interaction between these currents and the Antarctic Circumpolar Current creating considerable variation in sea surface temperature and heat fluxes and moisture from the surface of the sea to the atmosphere (Tyson & Preston-Whyte 2000: 222). These two main currents acting on the southern Cape and Western Cape coasts create different sea surface temperature conditions, which influence the geographical spread of marine life including shellfish (Branch & Branch 1981; Kilburn & Rippey 1982). Warm water species dominate the south coast while cold water indicators are numerous on the west coast (Branch & Branch 1981; Kilburn & Rippey 1982). The meeting point of the current systems where there is considerable variation in sea surface temperature (Tyson & Preston-Whyte 2000) may be inhabited by both warm and cold water loving species (Branch & Branch 1981; Kilburn & Rippey 1982). Localised variations in sea surface temperature caused by warm or cold water and local counter currents (Kilburn & Rippey 1982) may also create subtle differences from the generalised warm-cold water patterns.

3.7 Present vegetation patterns in the southern Cape

The southern Cape is part of the Cape Floristic Kingdom in terms of vegetation types. The Cape Region has five vegetation biomes: fynbos (limestone or sandstone fynbos or grassland mosaic), Renoster shrubland, Afromantane Forest, Thickets, and Karroid Shrubland (Cowling & Holmes 1992: 24; Rutherford *et al*. 2006; Compton 2011: 509; Figure 3.6). Endemic vegetation species comprise 60% of all floras (Cowling & Holmes 1992; Rutherford *et al*. 2006). Karroid and Renosterveld shrubland mainly occur in the interior part of the southern Cape, associated with low rainfalls and soils with higher pH (Cowling & Holmes 1992: 55).

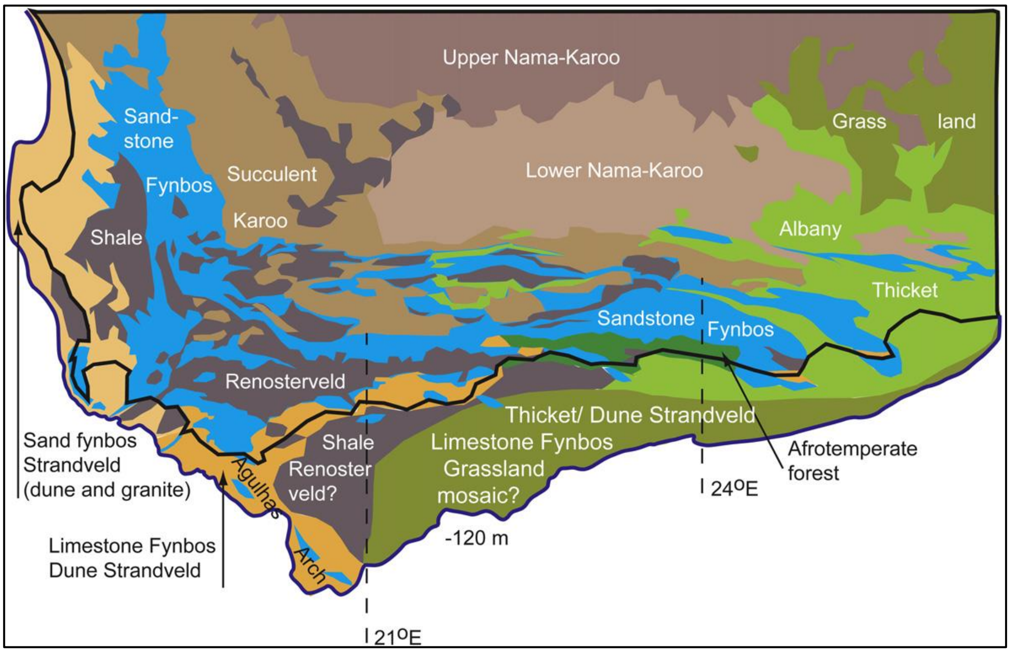

Figure 3.6 Major vegetation biomes in the southern Cape coast. Sandstone fynbos dominates nutrient poor Quartzose of the Cape Fold Belt. Renosterveld is dominant in the nutrient rich bedrock soils on the interior coastal plain. Afromantane forests occur along the narrow coastal plain between George and Plettenberg Bay (source: Compton 2011: Figure 3)

The term fynbos derives from the Dutch 'fijn-bosch', pronounced '*feinbos*'and it means fine bush, with a Dutch connotation for 'kindling' – as opposed to fire-wood (Rebelo *et al*. 2006: 69). Fynbos is sclerophyllous, heath-like and fire prone shrubland that contain grass, herbaceous annuals and browse which may have supported large range of game during the Pleistocene (Wills *et al*. 1996; Rebelo *et al*. 2006; Compton 2011: 509). Cowling and Holmes (1992: 35) consider restioids as a central feature of fynbos but other important features include ericaceae and proteoids. Additional attributes are sedges; non-ericaceous ericoids; ericoid Asteraceae; stoeboids (shrubs in crowded minute leaves in fascicles); leaf spinescence; Penaeaceae; and Bruniaceae (Cowling & Holmes 1992: 35; Rebelo *et al*. 2006). Fynbos occurs in areas with relatively higher rainfall, on clay-rich substrates (Cowling & Holmes 1992: 56; Rebelo *et al*. 2006). Fynbos is prone to fires, both natural (lightning and rock falls ignited) or anthropogenic, and fire has an ecological significance to this vegetation because they stimulate the reproduction of the majority of the species (Rebelo *et al*. 2006; Seydack *et al*. 2007; Keeley *et al*. 2012: 182). However, fynbos shrubs are intolerant of shading by alien trees like the northern hemisphere conifers and Australia acacias hakeas (Keeley *et al*. 2012). Most fynbos species die under severe shading while few that survive fail to flower (Keeley *et al*. 2012: 182).

Renosterveld literally means rhinoceros vegetation (Rebelo *et al*. 2006). Renosterveld vegetation is dominant in the interior of the SCP on nutrient rich shale bedrock soils (Rebelo *et al*. 2006; Compton 2011; Figure 3.6). The vegetation shows a dominance of shrubby members of the Asteraceae, especially *Elytropappus rhinocerotis*, often occurring on granitic and shale soils in valley and the lower slopes of mountain fynbos (Rebelo *et al*. 2006; Keeley *et al*. 2012: 170). Renosterveld is shrubby vegetation and in the southern Cape it has small-leaves and is confined to the semi-arid and sub-humid coastal forelands/interior SCP (Cowling *et al*. 1986; Compton 2011). Renosterveld vegetation mainly occurs in nutrient-poor clay substrates of the Bokkeveld, Witterberg and Uitenhage Groups (Cowling *et al*. 1986: 366). This vegetation decreases as the rainfall gradient increases (>600 mm) and is replaced by the fynbos on clay-rich soils (Keeley *et al*. 2012: 171).

The difference between Renosterveld and fynbos is in the near absence of Proteaceae and Restionaceae in the former. Renosterveld sporadically shows taller broadleaf shrubs, with forest and thicket affinities (Keeley *et al*. 2012: 186). Renosterveld, like fynbos, is prone to fires but has longer fire intervals (20–30 years) in the southern Cape than the latter (Seydack *et al*. 2007; Keeley *et al*. 2012: 187).

The Karroid shrubland, the most fire-resistant vegetation type in the southern Cape, is xeric and succulent, dominated by leaf succulents of the Mesembryanthemaceae and Crassulaeae. There are also components of the stem-succulent Euophorbiaceae and the evergreen shrubs of the Asteraceae (Keeley *et al*. 2012: 171). It is characterised by groups of tall shrubs occurring in a matrix of non-ericaceous low shrubs. The Karroid shrublands have distinctively patchy canopy covers and low and fragmented fuel loads (Seydack *et al*. 2007: 82).

The Afromantane forests, c. 250 km long, are on the narrow coastal strip between Mossel Bay and Humansdorp. They form a broken forest belt between the coastal plateau and the lower slopes of the Outeniqua-Tsitsikamma Mountains, extending into the mountain kloofs and as far as to the seaward plateau escarpment (von Breitenbach 1974: 7).

The SCP comprises limestone fynbos, grassland mosaics and thicket/dune strandveld (Compton 2011). This type of fynbos occurs on the coast on limestones and is characterised by distinctive communities such as proteoids fynbos, asteraceous fynbos and dune thicket (Cowling & Holmes 1992). The De Hoop Nature Reserve, where KDC occurs, is a limestone fynbos area, referred to as De Hoop limestone fynbos (Rebelo *et al*. 2006: 172). In the De Hoop Nature Reserve, the fynbos vegetation occurs in four forms: proteas, ericas, restios, and geophytes (Rebelo *et al*. 2006; Wills *et al*. 1996). These occur largely in nutrient poor soils. In terms of species richness of the limestone endemics of the lowland fynbos biome, the De Hoop Nature Reserve is considered as a 'hotspot' because it contains more species than other areas (Wills *et al*. 1996). Two fynbos species dominate the limestone areas: *Leucadendron meridianum* and *Protea obtusifolia*

(Wills *et al*. 1996: 57). The De Hoop limestone fynbos is distributed in the "broad swathe on the coastal forelands from Struisbaai and Bredasdorp to Infanta at the Breede River Mouth" at an altitude of 20–240 m (Rebelo *et al*. 2006: 172). It occurs on shallow, alkaline to neutral sand and bedrock, Glenrosa and Mispah forms on limestone of the Bredasdorp Formation (Rebelo *et al*. 2006: 172).

3.8 The Klipdrift Cave excavations

Prof. Christopher Henshilwood, Dr Karen van Niekerk, and a research team from the Universities of the Witwatersrand and Bergen excavated KDC in two seasons between 2010 and 2011. The excavation was terminated in 2011 after $3m^2$ had been excacated when it was realised the age of the deposits did not fit in with the aims of their project, namely excavating MSA deposits. The size of the excavation is limited compared to most LSA cave excavations in the southern Cape such as NBC and MRS. Controlled and accurate excavations of the site, however, resulted in the recovery of a substantial amount of material. These include lithics, shellfish, terrestrial animal bones, fish bones, ostrich eggshell fragments and beads (Henshilwood *et al*. 2014). For this thesis, I study lithic artefacts, shellfish and tortoise bones.

The surface area for excavation was divided into square metre units and each unit sub-divided into 50 cm quadrants named a–d. Hence, each square metre was designed to have four quadrants or units. Prior to excavation the surface was scanned using a Trimble VX Total Station which allows digital recording of individual 3D location of archaeological artefacts and other features with a high precision (1/1000 of cm) and accuracy (± 2 mm). Throughout the excavation, the total station was used to plot individual archaeological finds and features such as hearths (Henshilwood *et al*. 2014).

The local 3D coordinate system (square metre grid) was applied based on a numerical coordinate system. This includes an X-baseline (horizontal) with value 50 and Y-baseline (vertical) with value 100. The grid was aligned to "Cave North" i.e. according to the north-south axis of the cave, where the cave mouth is the south. An alphanumerical system was also used starting from A1 and values increased in the southeastern direction. Thus, any square metre of excavation can be referred to in two ways, one by its numerical coordinate system (e.g., 51, 105) or by its alphanumerical value (e.g., L11). Figure 3.7 shows that the excavated area may be designated as L11, L12, L13, M11, M12, and M13 by the alphanumerical system. Because each square metre was subdivided into 50 cm quadrants, quadrants/units are named for example as M11a, M11b, M11c, and M11d (Henshilwood *et al*. 2014).

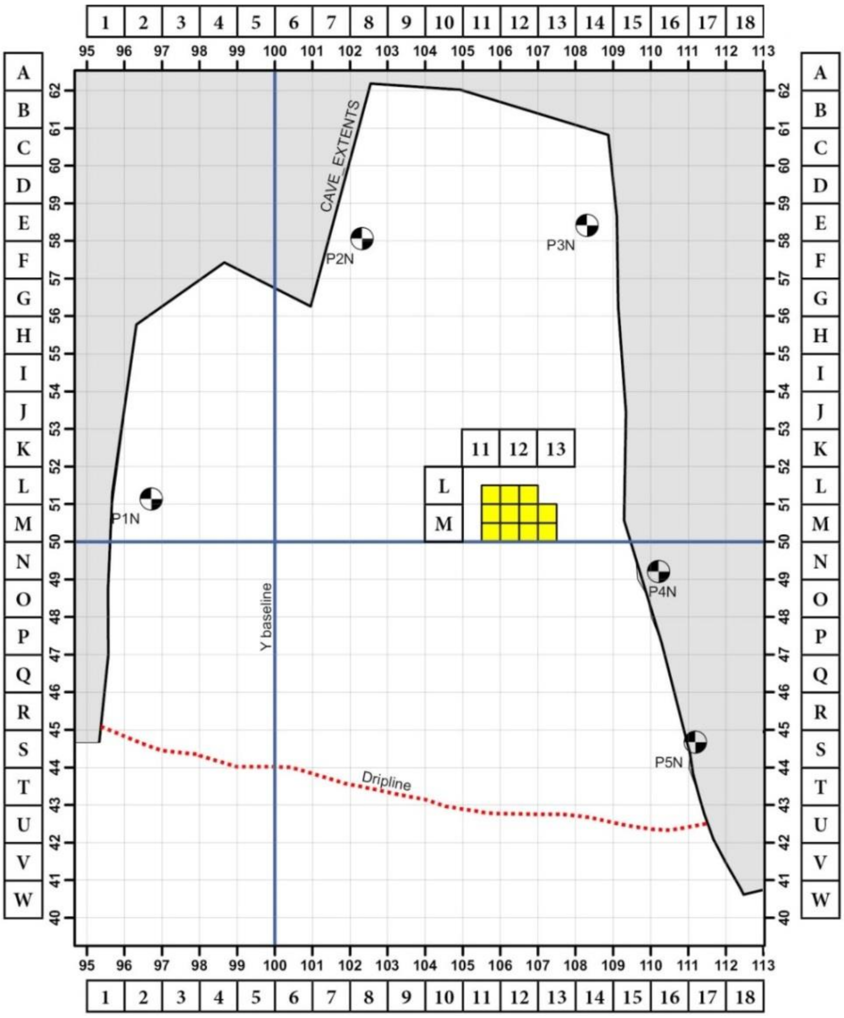

Figure 3.7 Klipdrift Cave: site plan showing both the numerical Trimble coordinate system (e.g., 50, 100) and the alphanumerical coordinate system (e.g., L11). Yellow areas show the excavated quadrants, the circles indicate the position of the prisms (datum points) and blue lines show the X and Y baselines (Source: Unpublished report on Klipdrift coordinate system 2011). Here the alphanumerical coordinate system is used to name excavated quadrants in Section 3.8.1.

3.8.1 Klipdrift Cave stratigraphy

Nine distinct lithological and cultural layers were identified based on texture, composition, colour, thickness, cultural materials and available features (Figure 3.8).

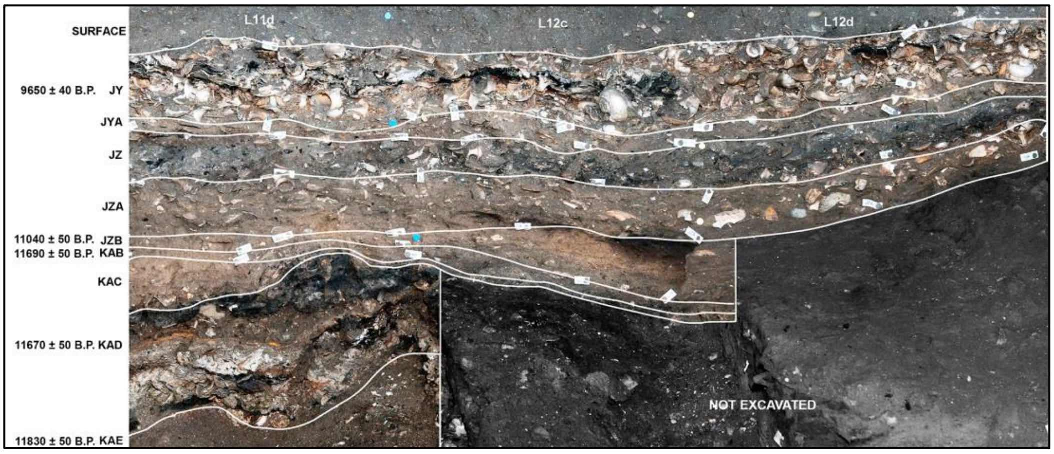

Figure 3.8 Part of the Klipdrift Cave natural stratigraphic profile and associated Accelerator Mass Spectrometry dates (courtesy of Dr. Karen van Niekerk)

The KDC layers are named, from the top, JY, JYA, JZ (including a unit with substantial amount of charcoal referred to as JZ(h)), JZB, KAB, KAC, KAD (also includes a unit with high amount of charcoal and ash, referred to as KAD(h1)), and KAE. Layer KBA occurs just below KAE but it was not excavated. KAA is a surface layer and the finds from this layer are not analysed in this thesis.

Layer JY (excavated units are L11d, L12c and L12d) is approximately 13 cm thick although it is thinner in places (Figure 3.8). JY is an irregular layer that truncates from north to south (mouth) of the cave. Sediments are loose in unit L12c but compact in units L11d and L12d. The layer has yellow to brown medium and coarse-grained sands. JY shows an abundance of *T. sarmaticus* but other species such as *D. gigas* are also present as discussed in detail in Chapter 6.

Layer JYA (excavated units include L11d, L12c and L12d) is a thin layer, 1–6 cm thick, that occurs just below JY. It also truncates from north to south and shows a clear transition from the layers above and below it. Sediments are dark-brown medium and coarse-grained sands with charcoal specks. Although it is a relatively thin layer, it contains more shellfish especially *T. sarmaticus* but other species such as *D. gigas* and *C. oculus* are also present.

Layer JZ (2–9 cm thick; units: L11d, L12c, L12d, M11b, M12a, M12b and M13a) has weakly cemented, soft and moist sediments, brown, grey and black in colour consisting of fine to medium grained sands. Due to the slanting of the surface of the cave some parts of this layer are in contact with the surface layer, KAA in units M11b, M12a, M12b and M13a but overlying layer JZA. There are large pieces of charcoal especially in unit L11d (see Figure 3.8). A large hearth feature in layer JZ was named JZ(h1) because it contains substantial amount of charcoal and ash and it was considered a separate layer during excavation. This hearth feature is deeper than the rest of the units in layer JZ. In this thesis cultural materials from JZ and JZ(h) are combined and referred to as layer JZ.

Layer JZA (2–12 cm thick: excavated units include L11d, L12c, L12d, M11b, M12a, M12b and M13a) is composed of fine to coarse-grained brown sands. In addition to sand, it consists of silt dark brown soil especially in unit M12b and the layer has a loamy matrix, which is grey to brown in colour in unit M12a. Sediments are moist and the layer still slopes north south except at the bottom. In some units (e.g. M11b, M12a) layer JZA is in contact with KAA instead of JZ at the top. Roof spalls occur in some units such as L12d. There is dense accumulation of *T. sarm*aticus shell fragments but other shellfish types such as *D. gigas* and *C. oculus* are also present.

Layer JZB (units: L11d, L12c, M11b, M12a, M12b and M13a) is 1 to 15 cm thick and slopes from north to east of the cave. It consists of loose and soft to firm sediments including brown silt and fine sand. In unit M12b, the transition from the layers above and below is diffuse and designation was arbitrary. Hearth features occur in units M12a and M12b. The shells of *D. gigas* become more numerous while those of *T. sarmaticus* decrease.

Layer KAB (1–9 cm thick; units excavated are: L11d, L12c, M11b, M11d, M12a, M12b, M12c, M12d, M13a and M13c) has an even surface on top of the layer but this layer disappears in unit M11d. Layer KAB consists of grey to brown fine and medium grained sand and sticky and firm dark clay soil. Sediments are soft but stiff and firm in some units of this layer and also charcoal specks are distributed in some units and this makes the layer darker especially in unit M12c. Layer transition in unit M12b was diffuse and decision was arbitrarily made. Roof spalls occur especially in units L11d and M12b. Haematite and shale ochre are part of the matrix in some units. *D. gigas* are dominant in this layer.

Layer KAC (excavated units are M11b, M11d, M12a, M12b, M12c, M12d, & M13c) has an uneven thickness that varies from three to six centimetres and slopes from north/south-west to south. It is composed of weakly cemented and soft red-brown fine to coarse-grained sands with isolated charcoal specks and bone flecks. Bone preservation here is excellent. Sediments are sticky and moist in some units and transition from the overlying layer is diffuse. This layer underlies the surface layer (KAA) at unit M11d. Roof spalls are abundant in this layer. In addition to the dominant marine shellfish, *D. gigas* and others, there are remains of land snails especially in unit M13c.

Layer KAD (excavated units are M11b, M11d, M12a, M12b, M12c, M12d, M13a & M13c) has an uneven thickness, between 2 and 18 cm, and thickest at the northeast part of unit M13a. It consists of soft and compact sediments, grey fine sand and black coarse sand, large flecks of white powder probably of decomposed bones in unit M12d, charcoal flecks, and large pieces of calcite roof spalls. In unit M11b, the demarcation between the layers above and below was not clear and decision was arbitrary. There is a large hearth feature in unit L11d of this layer, named KADh1 and separated from layer KAD although it appeared to be part of it. Substantial amount of haematite occurred at the centre of the hearth feature. Cultural materials from layer KADh1 are analysed together with those from KAD and treated as layer KAD. There are abundant *D. gigas* shells in layer KAD and those from unit L11d are apparently burnt.

Layer KAE (excavated units are M11b, M11d, M12a, M12b, M12c, M12d, M13a & M13c) is the lowermost excavated layer that overlies an unexcavated layer named KBA. Layer KAE also has an uneven thickness, between10 and18 cm. Layer KAE sediments range from clay to sand and loose, soft to compact in some units. Sediments are pink, yellow, and grey, brown to black in colour. There are flecks of charcoal and ash especially at unit M12b and some *D. gigas* shells are burnt. Layer transition at top of layer, units M12a and M13a, is diffuse but clear at the contact with the unexcavated KBA layer. Large water worn pebbles are part of the matrix in some units at KAE and small insect burrows (±1 cm) occur at the base of KAE in unit M13c.

3.8.2 Klipdrift Cave Accelerator Mass Spectrometry radiocarbon dates

Charcoal samples from five layers were submitted for Accelerator Mass Spectrometry (AMS) radiocarbon dating to the Beta Analytic Radiocarbon Dating Laboratory in Miami, Florida, United States and the results are presented in Table 3.2 and Figure 3.8.

Table 3.2 Klipdrift Cave: Accelerator Mass Spectrometry chronology of charcoal samples

Layer	Unit	Beta	Sample	Date B.P.	2 Sigma calibration
JY	L11d	347865	Charcoal	9650 ± 40	11070–11190
JZB	M11b	347868	Charcoal	11040 ± 50	12760–13090
KAB	L11d	347866	Charcoal	11690 ± 50	13420–13670
KADh1	L11d	347867	Charcoal	11670 ± 50	13400–13640
KAE	M11b	347869	Charcoal	11830 ± 50	13590–13790

The topmost layer, JY, is dated to 9650 ± 40 BP (cal BP 11 070–11 190) (Beta-347865). Samples from layers JYA, JZ, and JZA were not dated but a sample from the underlying layer, JZB, provided a date of 11 040 ± 50 BP (cal BP 12 760–13 090) (Beta-347868). The undated layers (JYA, JZ, & JZA) thus encompass a period of c. 1400 years between JY and JZB.

The KAB sample is dated to 11 690 ± 50 BP (cal BP 13 420–13 670) (Beta-347866); while KADh1 (a hearth feature in KAD) charcoal sample gave a date which is contemporaneous to KAB, 11 670 ± 50 BP (cal BP 13 400–13640) (Beta-347867). The charcoal sample from the lowermost excavated layer, KAE, is dated to 11 830 ± 50 BP (cal BP 13 590–13 790) (Beta-347869).

These AMS dates suggest that the cultural horizon and stratigraphy of the excavated area at KDC may be divided into two main phases of occupation. The lower phase would include layers KAE to JZB while the upper phase includes layers JZA to JY. This pattern is supported by the shellfish composition as discussed in Chapter 6. However, the dates can also suggest multiple short visits between c.11.8 and 9.7 ka (Table 3.2) where humans expediently made and used stone artefacts (Chapter 5) and exploited both marine shellfish (Chapter 6) and terrestrial resources. The KAE date is contemporaneous with the beginning of the Oakhurst Industry at NBC dated to 11 950 ± 150 BP, with a 2 sigma calibration of 13 430–14 130 BP (Faith 2013: 195; Table 3.3). The lowermost member of the Oakhurst Industry at MRS is younger by a few hundred years than at KDC and NBC (Table 3.3). Table 3.3 shows that KDC falls in the early part of the Oakhurst Industry while MRS occurs in the latter phase, from c. 10 ka.

Table 3.3 Radiocarbon dates of the southern Cape Oakhurst Industry

Site name	Layer	^{14}C BP	Calibration	Reference
MRS	TSM-L	7400 ± 30		Döckel 1998: 39
		7685 ± 30		
		7920 ± 100		
	LSL-U	7900 ± 340		
		9610 ± 170		
		9890 ± 70	9060, 9048, 9031 BC	
		10 055 ± 30		
	LSL-L	10 120 ± 40		
		10 155 ± 30		
		9790 ± 90		
		10 215 ± 25		
	LSL-C	10 660 ± 280		
NBC	J	8990 ± 80	9885 - 10 280	Deacon 1982: 82; Faith 2013: 195
	BSBJ	10 256 ± 210	11 309 - 12 564	
		10 540 ± 110	12 096 - 12 651	
	CS	10 150 ± 90	11 388 - 12 105	Deacon 1982: 83; Faith 2013: 195
		10 180 ± 85	11 397 - 12 144	
		11 505 ± 110	13 143 - 13 622	
	GSL	11 080 ± 260	12 425 - 13 467	
		11 950 ± 110	13 430 - 14 140	
BPA	BRL	9100 ± 135	9866 - 10 595	
		10 425 ± 125	11 954 - 12 613	
Kangkara Cave	YBL	9260 ± 90		Deacon 1982: 94
	BBD/BHL	12 330 ± 130		
		12 550 ± 110		
Melkhoutboom	MBS	7660 ± 80		Deacon 1976: 25
	RF	10 500 ± 190		
Oakhurst Shelter		8950 ± 90		Schrire 1962

3.9 Matjes River Rock Shelter

MRS is a high overhang, 45 m above current sea level, facing east on a cliff at the mouth of the Matjes River (Dreyer 1933; Döckel 1998). The Matjes River drains the coastal margin and enters the sea near the MRS. The shelter is situated on a formerly private land approximately 10 km from the town of Plettenberg Bay (Figure 3.9) in the southern Cape (Döckel 1998: 1; see also Figure 2.1).

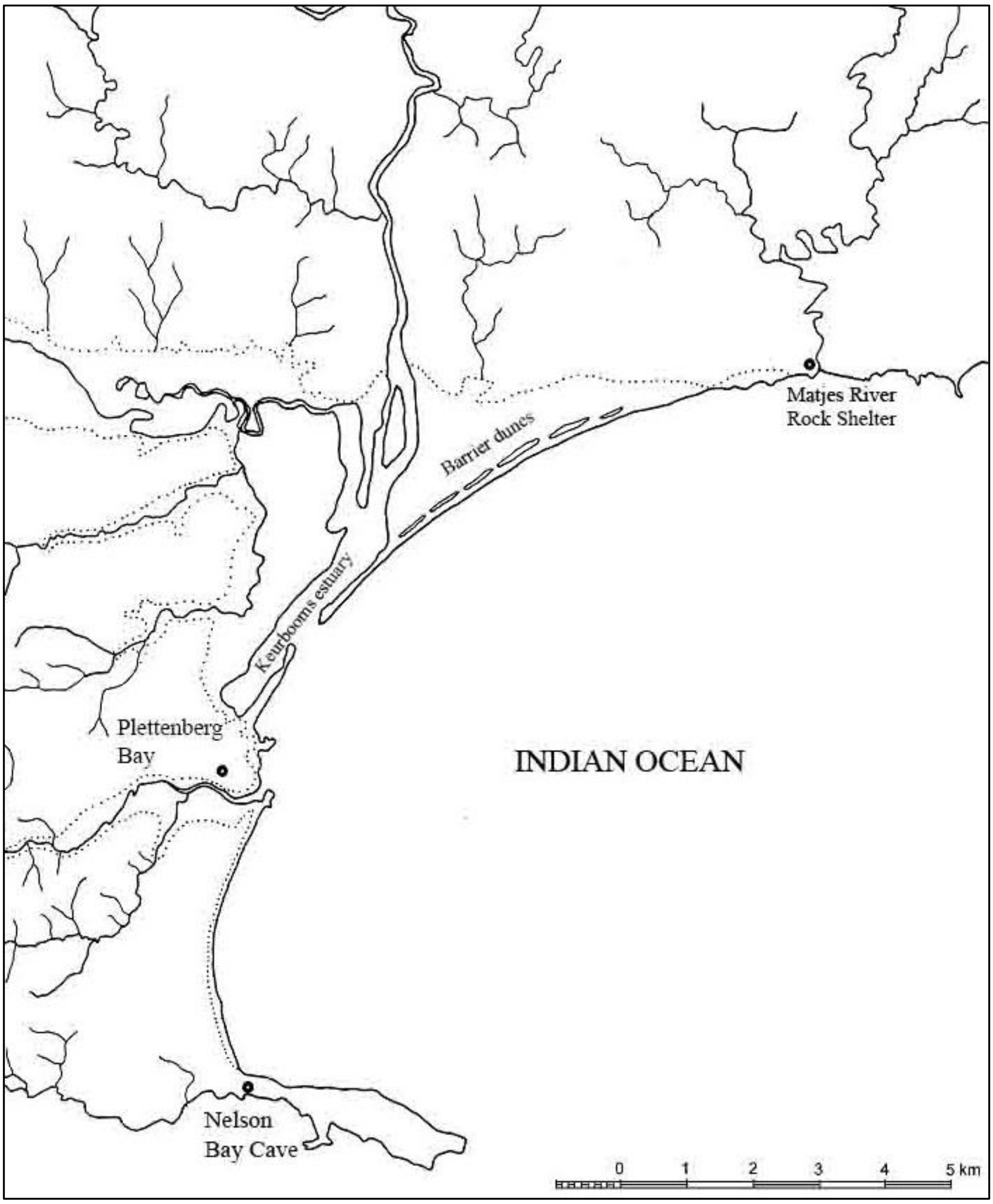

Figure 3.9 The Plettenberg Bay Peninsula: Matjes River Rock Shelter with the broadly contemporaneous Nelson Bay Cave (modified from Döckel 1998: Figure 3)

Plettenberg Bay is located in the eastern part of the SCP. The coastal platform here shows a stepped feature as it rises from c. 200 m near the coast to 400 m at the foothills of the mountains. The drainage is deeply incised into both softer Cretaceous fills and harder rocks of the Cape Supergroup. In addition to the

Matjes River, there are other river systems such as Piesangs, Bitou and Keurbooms (Döckel 1998: 18). The Keurbooms estuary (Figure 3.9) in Plettenberg Bay forms as the Bitou and Keurbooms Rivers meet on the coast (Döckel 1998: 19).

At Plettenberg Bay, rainfall is evenly distributed throughout the year but tends to be higher in February–March and September–October. The mean annual long-term rainfall record at Plettenberg Bay is 1115 mm and effective rainfall is enhanced by low surface evaporation (Döckel 1998: 20). Temperatures also show little inter-annual variation at Plettenberg Bay and frost does not occur. February is usually the hottest month with a mean daily maximum temperature of 24.3^{o} C but breezes relieve the hot weather (Döckel 1998: 20). July is the coldest month with daily maximum temperature being 17.6^{o} C but can drop to 11^{o} C at night (Döckel 1998: 20). There are more sandy shores than at KDC including rocky coasts, mountains and plains nearby. The surrounding vegetation unlike at KDC is a combination of fynbos and a lush forest (Döckel 1998: 18).

MRS is a shelter rather than a cave because the roof is the overhang of the cliff. The shelter is 55 m long and between c. 1.1 and 7 m wide (Döckel 1998: 25). The MRS together with a 5 km strip of land to the east is now under the management of the National Parks Board forming an extension of the Tsitsikamma National Park (Döckel 1998: 1). The cliff protects the site from the strong westerly winds common along this coast (Döckel 1998).

3.9.1 History of research at Matjes River Rock Shelter

The first pilot excavation of MRS was carried out in 1928 by Thomas Fredrick Dreyer (1888–1954), then Chair of Zoology and Geology at Grey University College (now the University of the Free State). This excavation continued in the following year. It seems that research was aimed at searching for burials and the significance of the site was to be judged by the presence of skeletal remains that would give an indication of the prehistoric human groups/races around the area (Louw 1960; Döckel 1998).

The site was organised into five “sites” of excavation, S, S.1, S.2, S.3, and S.5 in addition to a small passage named S.4 (Louw 1960: 16) although it is not clear what equipment was used and how excavation was carried out. The layers were named from top to bottom (Dreyer 1933; Louw 1960) and had varying thicknesses. Dreyer named the layers as MR., A; MR., B; MR., C.; MR., D and MR., E while Louw (1960) simply named them as A to E. Layer A was c. 1.2 m, B (c. 2.4 m), C (c. 1.2 m) while Layer D, the Oakhurst layer, was c. 4.9 m at its thickest point (Louw 1960: Figure 4). Layer E was a base of the deposit and sterile in contents. Dreyer (1933:197) suggested that larger implements from M.R., C. were indicative of Smithfield A but there were also microlithic artefacts such as crescents comparable to the Wilton Industry. This was probably caused by intermixing of the material from both layers C and D during excavation or thereafter. For layer D, Dreyer mentioned end-scrapers being more common but side-scrapers and lance-heads of the Mossel Bay Industry appeared at the contact with layer E. Because the total number of artefacts from layer E was small, Dreyer thought it better not to make a distinction between these artefacts and those from layer D.

In 1952 another excavation project was undertaken by Abraham Carl Hoffman and A. J. D. Meiring (Hoffman 1958). Hoffman was then curator of the National Museum, Bloemfontein (Döckel 1998). The motivations for this research are not obvious (Döckel 1998). Hoffman (1958: 342) mentioned that their excavations revealed four clearly demarcated layers: A (Bushman layer), B (Pre-Bushman layer), C (Wilton layer), and D (Proto-Bushman layer) while layer E was not part of their stratigraphy. In his assessment of the lithic artefacts from layer D, Hoffman suggested that Dreyer’s conclusion of the Mossel Bay Industry was based on only a few selected artefacts. Hoffman (1958: 347) saw these implements as largely comparable to “… a late Fauresmith or an early Smithfield, because the most dominant tool is a side-flake, concavo-convex in shape.” Some of the tools from this layer included: end scrapers (on long flakes), circular scrapers, and points (not Mossel Bay type) (Hoffman 1958: 347). Perhaps the distinction from layer D to E as mentioned by Dreyer (1933) was blurred.

The collections from Dreyer and Hofmann excavations were later studied by Louw (1960), a museum officer at the time (Döckel 1998). Louw (1960: 17-18), like Dreyer (1933), divided the stratigraphy into five instead of four layers: A, B, C, D, and E but noted that the underlying layer was a "completely sterile deposit of fallen rock". Louw (1960: 73) mentioned that only a few artefacts have been recovered from this layer, adding that the two points in the list were merely end-struck flakes from quartzite pebbles. Louw (1960) therefore disregarded Dreyer's (1933) tentative classification of artefacts from layer E into the Mossel Bay Industry and treated them as belonging to the Oakhurst Industry, then Smithfield A.

Louw (1960: 18, 87) described layer D as a long occupation sequence, almost 5 m in depth, and sub-divided it into lower and upper phases. The lower phase was characterised as Smithfield A while the upper phase was also Smithfield A, but included end scrapers on MSA points. These end scrapers, which were made on points of which the striking platforms were facetted, created an impression that the Smithfield Industry was a direct development of the MSA at this site (Louw 1960). However, Louw (1960) opined that Oakhurst people people brought and recycled these points. He added that numerous points with facetted butts were available near the shelter but unlike the ones re-used in layer D at the shelter, they showed more patina and were not retouched to form scraper edges. A contentious opinion that Louw (1960) raised was that layer D occupants were so lazy that they readily collected discards from MSA people to recycle. MSA-like artefacts have also been recovered in Oakhurst contexts at RCC in the Eastern Free State that eroded from the donga almost half a kilometre up slope around the cave (Wadley 2000: 20). Erosional activities and stratigraphic disturbance could as well explain the imposition of MSA artefacts at MRS but this remains to be established.

At MRS, humans remains were recovered from layer D to layer B (Louw 1960) and although the total number of skeletons recovered from the site is unknown, it is estimated that there are between 40 and 120 individuals (L'Abbé *et al*. 2008: 61). A minimum of three skeletons are associated with layer D, which contains the Oakhurst Industry (L'Abbé *et al*. 2008: 61), and one of these skeletons was dated to 9.7 ka (Sealy *et al*. 2006), a period contemporaneous to KDC's top layer (JY). Skulls were encrusted in ochre and so fragile that "Glyptol cement had to be applied before they could be removed" (Louw 1960: 33). The skeletons were initially named the Matjes River race (Dreyer 1933) or Proto-Bushman (Hoffman 1958) and Louw (1960) inferred the size of the people as bigger in stature with larger skulls than those from layer C. Later re-analysis indicated that the physical characteristics of an individual from layer D (termed NMB 1342 or MR 1) displayed Khoesan facial features (Stynder *et al*. 2006). These physical features are similar to the 'Albany Man' cranium (UCT 378) from EBC, also dating to the Oakhurst period/late Pleistocene/early Holocene (Stynder *et al*. 2006) in the Western Cape.

Sampson (1972, 1974) re-analysed the MRS collection and divided layer D into the upper and lower phases. The lower phase was composed of flakes with plain platforms, a high frequency of side-struck flakes with large butts, and miscellaneous utilised flakes and side scrapers made on quartzite (Sampson 1974: 268). Sampson's upper phase contained frontal scrapers, side scrapers and rare weathered Mossel Bay points. The basic technology shows an emphasis in the production of quartzite blades from single platform cores and it does not appear that the artefacts from this phase were brought from outside (Sampson 1974: 269) as Louw (1960) had suggested.

Döckel (1998) started a new program of excavation in 1993. Earlier excavations are said to have been carried out using sub-standard archaeological procedure and that the reports "…do not provide the details that make it possible to relate what can be seen in the field to the reported finds" (Döckel 1998:3). The excavation by Döckel (1998) was carried out between 1993 and 1994 under the direction of the late Prof. Hilary Deacon. This time there were two objectives for the excavation: 1) the establishment of the stratigraphic profile of the shelter because contexts for the finds from earlier excavations were improperly recorded, and 2) to suggest better ways for the rehabilitation of the seemingly neglected national monument

(Döckel 1998: 2, 3, 34). The Döckel's main excavation was in the deepest part of the shelter, named the "Apex" by earlier excavators, which is the junction between Dreyer's cutting and Hoffman's cross cutting (Döckel 1998: 3). When compared to the previous excavations, Döckel's excavation was limited (Döckel 1998: 34) and only reached half of Dreyer's (1933) excavation that was 11 m deep (Döckel 1998).

Before Döckel's excavation started, a baseline was established along the length of the shelter and a secondary grid was laid out at the "Apex" (Döckel 1998: 34). Excavation was conducted in quarter metre grids/squares. Excavation on the Apex was restricted to squares: AG7, AF7, AG8, AF8, AG9 and AF9 (Figure 3.10). Squares B3 and B4 (Figure 3.10) fall into the Wilton Industry and are not reported here.

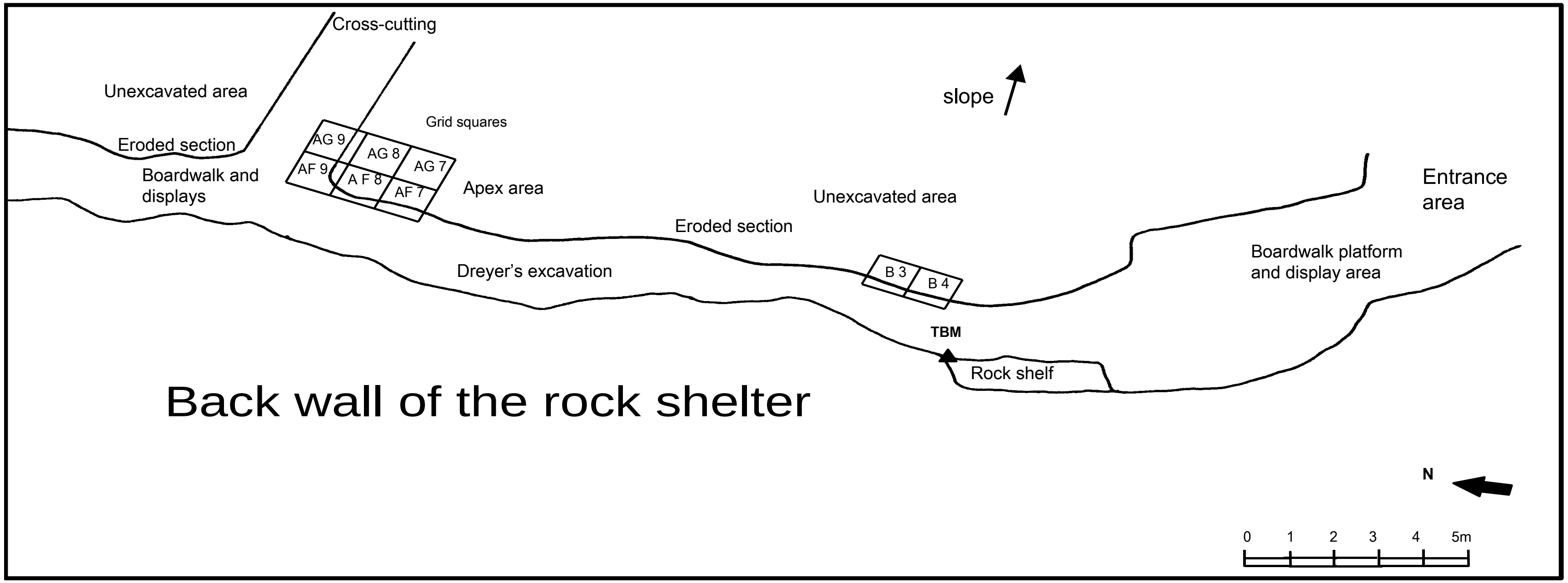

Figure 3.10 Surface plan of the Matjes River Rock Shelter (adapted from Döckel 1998: Figure 8)

Döckel (1998) excavated stepwise vertically and the area of excavation narrowed with depth. Smaller scale cuttings were made at other points in the shelter to trace the layers mentioned from earlier reports but which were not represented in the Apex section (Döckel 1998: 34). Trowels and brushes were used for excavation and material sieved using 20 mm, 10 mm and 3 mm sieves (Döckel 1998).

3.9.2 Stratigraphy of the Matjes River Rock Shelter

It is Döckel's (1998) finds that are reported in this thesis (see Chapters 5 & 6) and thus the stratigraphic information presented here is that in her report (Döckel 1998). The upper member of the Apex in Figure 3.11 is TSM-W and falls under the Wilton Industry.

The uppermost Oakhurst member, TSM-L is 1037 mm thick and includes units SL10 to BAF9. It consists of loosely compacted shell, ash features and humic brown soil (Döckel 1998: 36). Member LSL-U is a prominently thick shell bed, 2280 mm, and includes units AF29 to SL33. The soils are still humic brown, with ashes and shell lenses (Döckel 1998: 37) as is the member above. Member LSL-L is 810 mm thick and covers units CSL1 to BCL29. The deposits are more or less the same as the members above but roof clasts occur in units SL43, SAF11 and BCL29 (Döckel 1998: 38) of this member. Döckel's lowest member, LSL-C, is 940 mm thick and encompasses units CRL1 to CRL4. Roof clasts form the major deposits in this member with thin partings of dark humic brown soils. This member is culturally sterile and Döckel (1998: 38) thinks it may be close to bedrock.

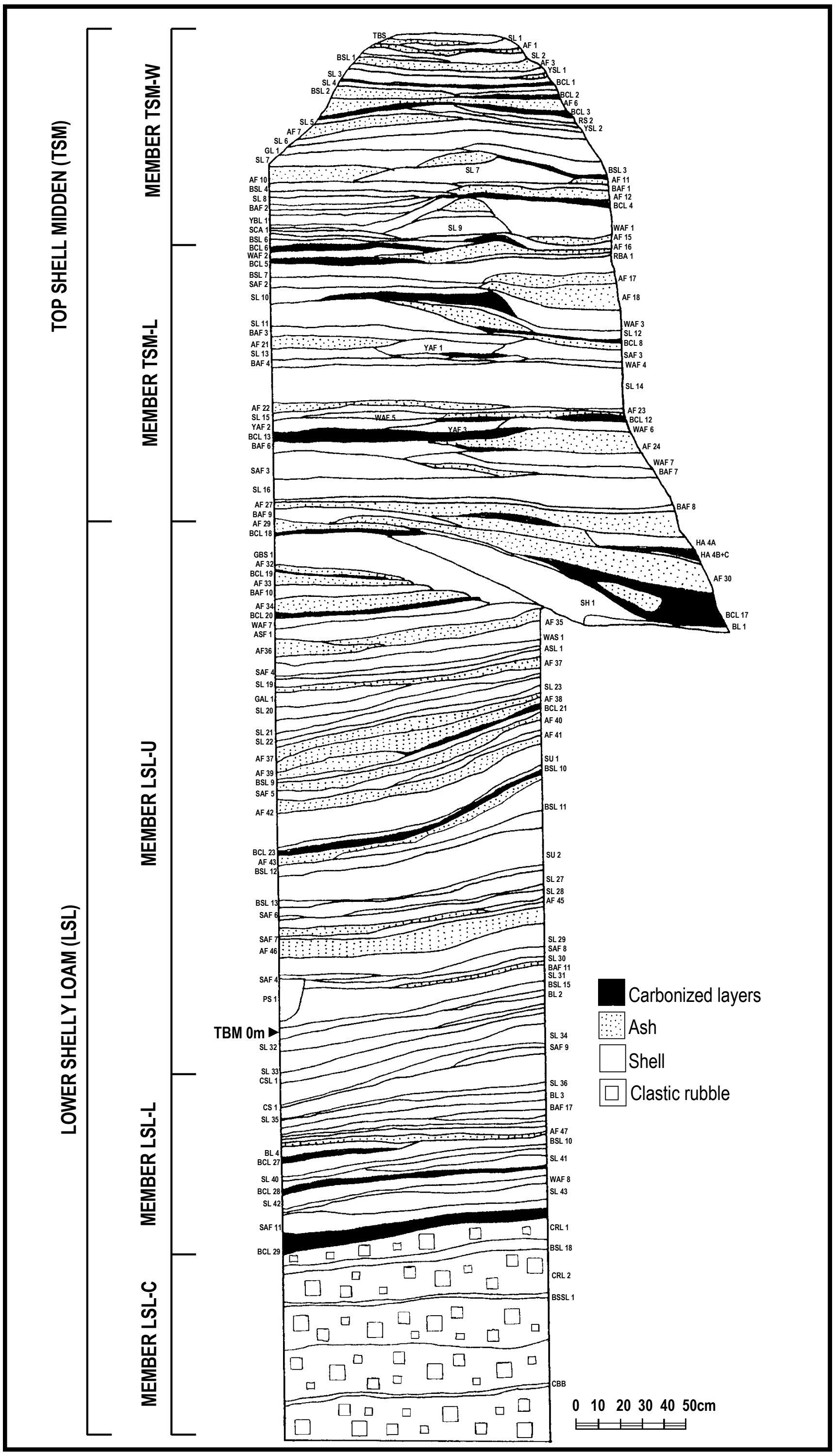

Figure 3.11 Matjes River Rock Shelter: stratigraphy of the Apex section. Member TSM-W belongs to the Wilton Industry and the others fall into the Oakhurst Industry reported in this thesis (adapted from Döckel 1998: Figure 9)

3.9.3 Dating the Matjes River Rock Shelter

Shellfish and charcoal samples from Döckel's (1998) excavation were radiocarbon dated at the Quaternary Dating Research facility, EMATEK, CSIR in Pretoria by J.C. Vogel (Döckel 1998: 38). Only the ages related to the Oakhurst Industry are reported in this thesis (Table 3.4).

Table 3.4 Matjes River: radiocarbon dates for the Oakhurst members (source: Döckel 1998: 39, Table 3)

<table>
<tr><th>Member</th><th>Unit</th><th>Reference</th><th>Sample</th><th>Date BP</th><th colspan="3">Calibrated BC</th></tr>
<tr><td rowspan="3">TSM-L</td><td>AF17</td><td>Pta-6823</td><td>Charcoal</td><td>7400 ± 30</td><td colspan="3" rowspan="5">Nil</td></tr>
<tr><td>AF17</td><td>Pta-6831</td><td>P. perna</td><td>7685 ± 30</td></tr>
<tr><td>SL16</td><td>Pta-6688</td><td>Charcoal</td><td>7920 ± 100</td></tr>
<tr><td rowspan="4">LSL-U</td><td>BCL17</td><td>Pta-6687</td><td>Charcoal</td><td>7900 ± 340</td></tr>
<tr><td>BSL11</td><td>Pta-6686</td><td>Charcoal</td><td>9610 ± 170</td></tr>
<tr><td>SL31</td><td>Pta-6936</td><td>Charcoal</td><td>9890 ± 70</td><td>9060</td><td>9048</td><td>9031</td></tr>
<tr><td>SL31</td><td>Pta-6925</td><td>D. serra</td><td>10055 ± 30</td><td colspan="3">Nil</td></tr>
<tr><td rowspan="4">LSL-L</td><td>SL35</td><td>Pta-6838</td><td>Charcoal</td><td>10120 ± 40</td><td>9047</td><td>9018</td><td>8950</td></tr>
<tr><td>SL35</td><td>Pta-6848</td><td>D. serra</td><td>10155 ± 30</td><td colspan="3" rowspan="4">Nil</td></tr>
<tr><td>SL41&SL42</td><td>Pta-6937</td><td>Charcoal</td><td>9790 ± 90</td></tr>
<tr><td>SL41&SL42</td><td>Pta-6951</td><td>D. serra</td><td>10215 ± 25</td></tr>
<tr><td>LSL-C</td><td>CSL5</td><td>Pta-6702</td><td>Charcoal</td><td>10660 ± 280</td></tr>
</table>

The Oakhurst sequence at MRS dates between 7400 ± 30 (Pta-6823) and 10660 ± 280 BP (Pta-6702) (Table 3.4). The dates from shell samples are older than those from charcoal samples in the same units, probably because of the marine reservoir effect and isotopic fractionation. A correction of -300 years has been applied (Döckel 1998: 39). The dates suggest a rate of accumulation of the deposit of about 2.1 m per 1000 years (Döckel 1998).

When compared to the KDC data (Table 3.2) the uppermost sequence of the Oakhurst Industry at MRS (Table 3.4) is much younger and the base of KDC is almost 1000 years older than MRS. The MRS Oakhurst may be much younger especially when as the base of the sequence, member LSL-C, is sterile and may not have been occupied. Other sites such as BPA, Kangkara Cave and Melkhoutboom Cave are also somewhat younger compared to KDC and NBC (see Table 3.3).

3.10 Summary

In this chapter, I discuss the settings of KDC and MRS. Both sites are located along the southern Cape coast of South Africa and present evidence of activities of terminal Pleistocene and early Holocene LSA people that produced artefacts typical of the Oakhurst Industry. The deposition at KDC was in a cave context whereas MRS represents occupation under an overhang. KDC is 17 m above current sea level while MRS's elevation is somewhat higher at 45 m above sea level. MRS is adjacent to the mouth of a river and occurs near a productive estuarine environment. There is also a small river at KDC, the Klipdriftfonteinspruit, about 200m east of the site but no estuary. Currently, the shore at MRS is mainly sandy with some rocky areas whereas at KDC fewer sandy beaches occur. Rainfall is higher at MRS than at KDC. Limestone fynbos is the dominant vegetation type for the southern coastal plain with grassland mosaic and thicket dune strandveld (Compton 2011). At MRS, in addition to the fynbos vegetation, there is a heavy Afromantane forest component, mountains and plains.

The excavations at MRS are extensive and were mostly conducted in a rough manner, by various researchers. Excavations at KDC are small and carefully controlled by a single team (Henshilwood *et al*. 2014). MRS has a relatively long sequence spanning from 10 to 7.4 ka but younger than at KDC where deposition started at c. 11.8 ka. Human skeletons of about 120 individuals have been recovered from MRS, some of them from layer D dated to c.10 ka. KDC did not yield human skeletal material but investigation is still ongoing.

4. METHODOLOGY

4.1 Introduction

Three datasets, lithics, marine shellfish, and tortoise remains, were analysed to address technological and subsistence behaviours; and to explore the palaeoclimate and environment of the KDC surroundings. Lithic artefacts from MRS, also in the southern Cape, are compared with the lithics from KDC. In this chapter, I discuss the methods and approaches used to analyse these datasets.

4.2 Lithic analytical approaches

Lithic artefacts are important records of human workmanship during prehistoric times because they carry "...unalterable traces of the physical actions applied" to them (Pelegrin 2005: 23) by the knappers. Since the beginnings of archaeology as a discipline (antiquarianism), lithic artefacts have aroused curiosity from their collectors. As archaeology matured, different approaches of analysing lithic data were developed. The lithic knapping process creates different types of blanks and cores, some of which may be retouched into various tool forms and some may be utilised without further modification.

The main approach until four decades ago was to classify such artefacts typologically based on shape attributes (Dunnell 1986; Odell 1981). In the past few decades, this has been complemented by a technological behavioural approach (Sellet 1993; Odell 2003). Below, the typological approach, and how it is used to describe Oakhurst occurrences, is discussed. The technological approach and its relevance to the occurrences analysed here are discussed thereafter.

4.2.1 The typological approach

The typological classification of lithic artefacts has been the traditional approach (Dunnell 1986) to organise and compare different sites and assemblages or traditions of lithic knappers in space and time. Typological descriptions classify artefacts based on the shape of the piece or its morphological attributes (Odell 1981). For example, if a piece has steep retouch on its convex edge, it is most likely called a scraper (Deacon & Deacon 1999: 112). The pioneers of this approach in South Africa (Goodwin 1926; Goodwin & van Riet Lowe 1929) categorised stone tools into broad types, and implements with similar typological and size parameters were associated into groupings considered as industries within a temporal and geographical framework (Goodwin & van Riet Lowe 1929: 6; see also Chapter 2).

Stone tools were used as *fossiles directeurs* to construct geo-temporal frameworks due to the lack of chronometric dating at the time (Deacon 1990). As discussed in Chapter 2, Goodwin and van Riet Lowe (1929) subdivided the LSA into Smithfield A, B and C, and Wilton industries. The type artefacts of the Smithfield A Industry included concavo-convex and large circular scrapers (Goodwin & van Riet Lowe 1929: 172). The Smithfield B industry was defined as consisting of duckbill end scrapers, thumbnail scrapers, and side scrapers and the Smithfield C Industry was characterised by thumbnail scrapers (Goodwin & van Riet Lowe 1929: 183).

Typological attribute analysis, supported by metrical measurements of stone implements, became the dominant approach in South African lithic studies. For example, Deacon (1972) applied a typological approach for the LSA small convex scraper class of the Wilton type-site assemblage with functional implications. The small convex scrapers are interpreted as implements that were used for scraping small leather hides (Deacon & Deacon 1980, 1999). Most of the names or terminologies given to implements that had certain shapes remain in use today because they are useful descriptions. For example, Oakhurst tools are defined on their size and position of retouch (e.g. large side scrapers, circular scrapers).

The shape, size, and frequency of tools and raw material types of dated assemblages have continued to be broad defining features of the Stone Age phases in South Africa until today (e.g. Deacon & Deacon 1999; Lombard *et al*. 2012). The latest synthesis of the LSA for South Africa and Lesotho, for example, divides the LSA into six main industrial or techno complexes. These are based on sites with tightly constrained chronological assessments (Chapter 2): early LSA (40–18 ka), Robberg (18–12 ka), Oakhurst (12–7 ka), Wilton (8–4 ka), final LSA (4–0.1 ka), and ceramic final LSA (<2 ka) (Lombard *et al*. 2012: 125). Some minor differences to this approach (e.g., in form of transitional industries at EBC) have been noted (Orton 2006) but these differences have not affected the scheme (Lombard *et al*. 2012).

In this thesis, the typological classification scheme for LSA, as discussed below, is adopted in combination with a technological approach. The typological classification of lithic artefacts is useful because it allows efficient management of data for descriptive purposes (Odell 1981: 321; Humphreys & Thackeray 1983; Deacon 1982; Andrefsky 2005: 61) and it allows comparisons of the results from this analysis with the existing body of data of the Oakhurst layers.

4.2.2 The analysis of Oakhurst Assemblages

Janette Deacon (1969: 42-50, 1972, 1978, 1982: 513–579) proposed a typological scheme for the LSA. Most lithic analysts working on southern African LSA lithic material (Deacon 1976; Schweitzer & Wilson 1982; Thackeray 1981; Humphreys & Thackeray 1983; Wadley 1986: 98, 2000; Manhire 1987; Opperman 1987; Carter *et al*. 1988; Mitchell 1988, 1993; Barham 1989; Döckel 1998; Orton 2004: 23) adopted it. Here, I discuss only the approaches relevant to the Oakhurst technocomplex.

In her analysis of NBC, BPA, and Kangkara Cave lithics, Deacon (1982) uses four broad classes of lithic artefacts, namely manuports, waste, utilised, and formal tools (Table 4.1). Orton (2004: 26) criticized some of Deacons terms as lacking discreteness and prone to diverse interpretations and Barham (1989: 131) earlier noted that the results of the classification process might vary according to the analyst’s abilities and experience. Thackeray (1981: 47) also commented that the classification approach may be “…very intuitive and another archaeologist could easily classify the same assemblage differently by using different combinations of attributes as being diagnostic.” Different archaeologists working on the same locality may thus employ different terms.

Table 4.1 presents the terminology used in a number of Oakhurst studies. This table shows that there are minor terminological differences in broad classes of artefacts but the meaning or implication of the class of artefacts remains more or less the same, and the opportunity for misunderstanding is rather minimal. Each of Deacon’s four classes is discussed below, as many of the same concepts will be used in this thesis.

Table 4.1 Main lithic artefact classes used in southern African Oakhurst studies

Thackeray 1981	**Schweitzer & Wilson 1982**	**Barham 1989**	**Döckel 1998**
(Wonderwerk) Non-retouched Utilised Retouched	(BNK 1) Unmodified Utilised-modified Retouched	(Siphiso, Nyonyane & Sibebe) Unretouched Utilised Retouched Manuports	(MRS) Waste Utilised Retouched Manuports
Deacon 1982	**Wadley 1986**	**Mitchell 1993**	**Orton 2004**
(NBC, BPA & Kangkara) Waste Utilised Formal tools Manuports	(Jubilee Shelter) Waste Utilised Formal tools	(Ntloana Tsoana & Ha Makotoko) Unmodified Utilised Formally retouched	(EBC) *Débitage* Edge-damaged Formal tools Cores

4.2.2.1 Manuports

Manuports are raw material brought to the site, which can include cobbles, pebbles, or other rocks, ochre, and micaceous sandstone (Deacon 1982: 516). A few other analysts (Barham 1989; Döckel 1998) use this category in their analysis. Barham (1989) simply defines this as material brought to the site, suggesting that the origin is outside the geological cave/site formation. Mitchell (1993) does not use the term manuport but mentions a class of small smoothly polished opaline pebbles brought to the site of Ha Makotoko probably as gastroliths (small stones occurring inside gastrointestinal tracts of some animals, for example ostriches, and that serve digestive functions; Tylor 1993). Small pebbles that look like gastroliths also occur at RCC Oakhurst layers, many of them in association with adzes and spokeshaves (Wadley 2000: 26). Such small polished stones (gastroliths), perhaps introduced in association with fish or birds brought to the site by humans for consumption (Mitchell 1993; Wadley 2000), may not be classified as manuports.

4.2.2.2 Waste

Waste refers to knapped material, as indicated by the presence of negative scars, which are not utilised or retouched (Deacon 1982: 517). This category, also adopted by Wadley (1986: 98) and Döckel (1998: 66), includes cores, chunks, core by-products, chips, and unretouched flakes with no visible utilisation damage (Deacon 1982: 517). Barham (1989), Mitchell (1993), and Orton (2004) avoid this term. Barham (1989: 140) and Orton (2004: 32) mention that 'waste' as a category is ambiguous, and prefer the terms unretouched and *débitage* respectively.

A term such as *débitage* (Orton 2004: 32), however, is not free from ambiguity because it may be used in more than one sense. Orton (2004: 28) defines *débitage* as all stone artefacts other than cores and tools and with no visible edge damage. In the original French sense, *débitage* refers to a process or operation of fracturing raw material to produce blanks (Inizan *et al*. 1999: 59) but may also mean pieces resulting from that process (Inizan *et al*. 1999: 32). Deacon (1976: 55) uses waste and *débitage* interchangeably to mean discarded pieces lacking in any modification. Willoughby (2007: 13) sees the term 'waste' (also garbage) as an English equivalent for the French term *débitage*. Other terms used for the 'waste' class include 'non-retouched' (Thackeray 1981) and 'unmodified (Schweitzer and Wilson 1982, Mitchell 1993; see also Table 4.1). In this thesis the general term 'waste' is not used, but the artefacts are classified into the sub categories of this class, further described below.

i. Cores

Deacon (1982: 517) classifies cores into irregular, radial, prepared, blade, bladelet, and flat bladelet cores. Other analysts adopted her classification scheme of cores (Barham 1989: 149; Döckel 1998: 66). Orton's (2004: 28) classification of cores differs somewhat from this and in addition to Deacon's core types includes single platform and single platform bladelet cores. Conard *et al*. (2004) propose core taxonomy based on reduction methods applicable to all stages of the Stone Age in South Africa. This taxonomy includes classes of cores such as initial, inclined, parallel, platform, multidirectional, bipolar, indeterminate, broken cores and other cores.

As Deacon's radial, prepared and flat bladelet cores have not been observed in this study, the core types described in this thesis are partly based on her thesis (Deacon 1982) and Conard *et al*.'s (2004) core taxonomy. Core types in this thesis include core fragments, irregular, unidirectional, bipolar, bladelet and platform cores. A description of each core type is discussed further in Appendix A.

ii. Chunks

Chunks are pieces of stone with one or two negative flake scars (Deacon 1982: 517; see also Thackeray 1981: 58; Döckel 1998: 66). These pieces result from material breaking up during the knapping process and the maximum dimension is suggested to be >10 mm (Deacon 1976: 57; Thackeray 1981: 58; Humphreys & Thackeray 1983: 299; Orton 2004: 29). Barham (1989: 145), on the other hand, classifies chunks into a) small (maximum dimension of ≤10 mm), and b) large (>10 mm) chunks. In this thesis chunks are classified in the same way as Deacon (1982) but only include pieces >20 mm (see Appendix A).

iii. Core by-products

Deacon (1982: 517) classifies core by-products into core-reduced pieces (see also Barham 1989: 147–8) and core rejuvenation flakes. Core-reduced pieces are cores that have been so flaked that they are no longer possible to flake and are usually

<25 mm (Deacon 1982: 523). Core rejuvenation flakes are pieces whose removal results from maintenance of a core for further flaking (Barham 1989: 147). In this thesis core rejuvenation flakes are referred to as ‘core management’ flakes (Appendix A).

iv. Chips or pieces <10 mm

Chips are pieces of flake or chunk origin that may be less or equal to 10 mm in maximum dimension (Deacon 1982: 517; Thackeray 1981: 58; Humphreys & Thackeray 1983: 299; Barham 1989: 145; Orton 2004: 29). According to Barham (1989: 145), chips are debris of flaking, which may constitute “small broken flakes” and “complete flakes”, too small to have any functional significance. The technological origin of the chips, whether from bipolar or non-bipolar flaking, cannot readily be determined (Barham 1989: 145). This artefact class is subsumed under ‘pieces <20 mm’ in this thesis (see Appendix A).

v. Unretouched flakes with no visible utilisation

Deacon (1982: 517) uses the terms “unretouched flakes with no utilization visible to the naked eye” to make a distinction between retouched or utilised flakes. She classifies unretouched flakes into irregular, quadrilateral and convergent flakes, and blades and bladelets. Wadley (2000) uses the term ‘flake’ for this subcategory. Other analysts (Thackeray 1981: 59; Humphreys and Thackeray 1983: 300; Barham 1989: 145) use the term ‘flake’ without qualifiers for this category of Deacon (1982). Here the terms flakes and blades are equivalent to Deacon’s unretouched flakes with no visible utilisation. Some analysts (Deacon 1982; Barham 1989; Wadley 2000) further subdivide flakes according to the breakage condition (e.g. broken or complete flake) and the type of the platform (e.g. plain or facetted). In this thesis, flakes/blades are classified according to technological criteria (Appendix A).

4.2.2.3 Utilised

This category (Deacon 1982) includes unflaked stones but that were utilised, as well as cores/chunks and flakes with utilisation damage (Deacon 1982: 527). All analysts mentioned in Table 4.1 above use the term utilised while Orton (2004) prefers the term ‘edge-damaged’ to emphasize that causes of damage are uncertain and may not necessarily result from human utilisation. Other writers (Thackeray 1981: 59; Humphreys & Thackeray 1983: 300; Barham 1989: 151) also agree with this point. I use the term ‘retouched’ to refer to pieces with miscellaneous retouch and these artefacts are included in the class of formal tools.

4.2.2.4 Formal tools

Formal tools constitute implements with deliberate modification through retouch to shape the working edge (Deacon 1982: 541). Barham (1989) and Orton (2004) adopt this term while Thackeray (1981: 61), Humphreys and Thackeray (1983: 305) and Döckel (1998: 67) use the term retouched and Mitchell (1993) prefers ‘formally retouched’ for the same artefact class. The terms ‘formal tools’ are used here (Appendix A) and include those artefacts with ‘miscellaneous retouch that may have resulted from utilisation without retouch.

As discussed in Chapter 2, the dominant tool type in the Oakhurst layers is the scraper. A scraper is a piece with “steep retouch around a convex edge” (Deacon & Deacon 1999: 112). Oakhurst scrapers differ from preceding and succeeding LSA industries in terms of size (Deacon 1982, 1984; Deacon & Deacon 1999) as they are generally large. Table 4.2 lists the types of tools that occur in selected Oakhurst sites and representative examples described below.

Table 4.2 Tool types of Oakhurst sites in South Africa and Lesotho sites

Site name	Formal stone tools	Reference
NBC	Large scrapers, medium scrapers, side scrapers, adze-like side retouch on some scrapers	Deacon 1982: 165; Deacon 1978: 95
Kangkara Cave	Large scrapers	Deacon 1982
BPA	large scrapers, rare backed microliths	Deacon 1982
Melkhoutboom Cave	Very few large scrapers	Deacon 1976
MRS	Large scrapers	Döckel 1998
BNK 1	Few large scrapers, adzes, microblades	Schweitzer & Wilson 1982
Oakhurst Shelter	End, circular, and serrated scrapers	Schrire 1962; Goodwin 1938a
Wilton	Large scrapers, rare segments	Deacon 1972
EBC	Albany-like large scrapers; D-shaped scrapers	Orton 2006: 12
Ha Makotoko	Large scrapers; End-scrapers with lateral adze-like retouch, locally termed 'Woodlot' scrapers, adzes	Mitchell 1993, 2000
Sehonghong	Woodlot scrapers	Mitchell 1993, 2000
Liphofung	Woodlot scrapers	Kaplan & Mitchell 2012: 15
Ntloana Tsoana	Woodlot scrapers, broad-short scrapers, backed point, adzes	Mitchell 1993, 2000
Jubilee Shelter	Large D-shaped scrapers (>30 mm) and concavo-convex scrapers; naturally backed knives (NBK), adzes, spokeshaves, awls, borers	Wadley 1986: 102, 208, 1987: 50
RCC	Side & end-scrapers (duckbilled), adzes/spokeshaves	Wadley 1997, 2000
Wonderwerk Cave	Kuruman industry: large side-scrapers; few adzes	Thackeray 1981; Humphreys & Thackeray 1983
The Havens Cave	Scrapers	Binneman 1997

4.2.3 Definitions of scrapers and other tools in the Oakhurst Industries

4.2.3.1 Concavo-convex scrapers

The concavo-convex scraper (Figure 4.1) as described by Goodwin and van Riet Lowe (1929: 159, Plate XXVI) is made on a flake with a negative “bulb on the dorsal face and a positive bulb on the ventral face”. The trimming is on the side edge between the proximal and dorsal ends to form a bevelled edge. This tool type was typical of the Smithfield A, and are numerous in earlier Oakhurst layers (Deacon 1982: 403; Wadley 1993: 270).

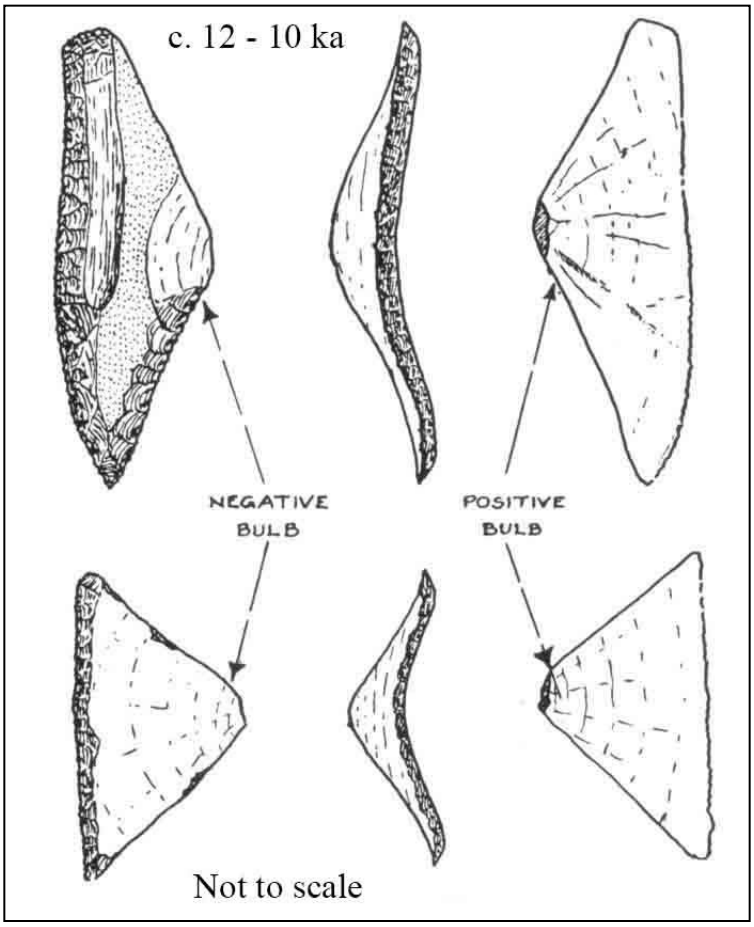

Figure 4.1 Concavo-convex scrapers from Oakhurst layers, Smithfield, Orange Free State (Goodwin & van Riet Lowe 1929: Plate XXVL, Figure 2)

4.2.3.2 Side scrapers

Side scrapers occur on D-shaped flakes (Wadley 1993: 271) and are sometimes referred to as D-shaped scrapers (e.g. Deacon 1982: 10; Wadley 1993: 271; Orton 2006: 12; Figure 4.2). Like the concavo-convex scrapers, they occur mainly in the earlier Oakhurst layers. Side scrapers have convex retouched edges and retouch angles of $<45^o$ (Wadley 2000). A type of sidescraper is referred to as a 'knife' and these knives show straight cutting edges and retouch angles of $<45^o$ (Wadley 2000; see also Figure 4.2).

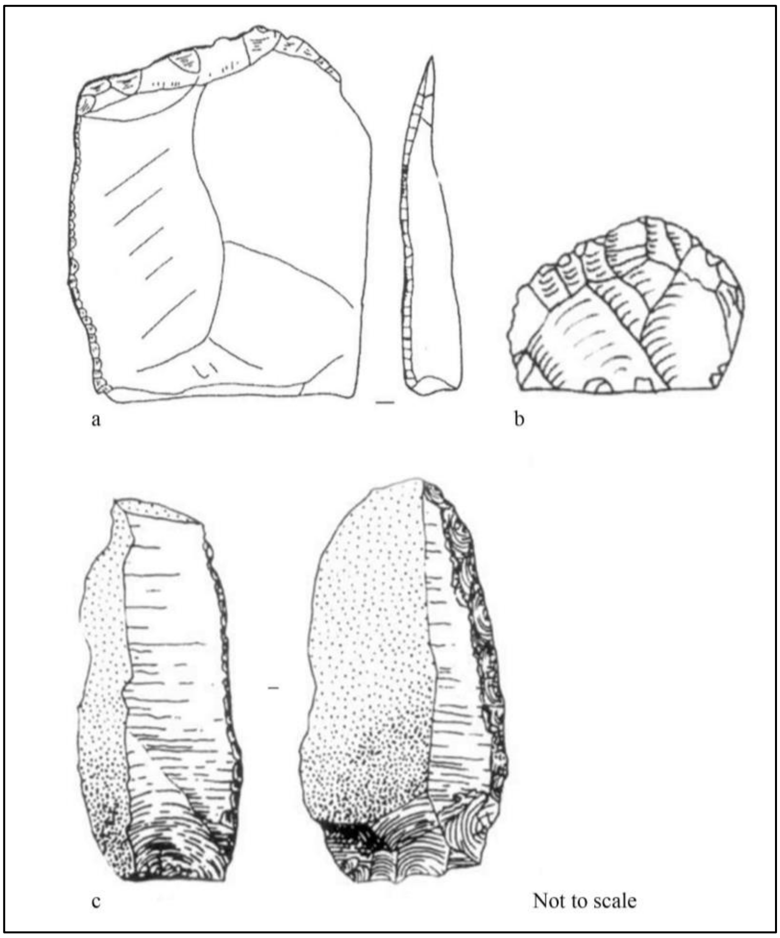

Figure 4.2 Side or D-shaped scrapers (a–b) and knives (c). a) Liphofung layer 6, Lesotho (Kaplan & Mitchell 2012: Figure 9, no. 15), b) Elands Bay Cave (Orton 2006: Figure, no. E), c) Rose Cottage Cave layer Ja (Wadley 2000: Figure 5, nos. 16 & 17)

4.2.3.3 Circular scrapers

Retouch on the circular scraper (Figure 4.3) occurs in a circular arc from the one end of the platform to the other (Goodwin & Van Riet Lowe 1929: 159). Large circular scrapers with a diameter of c. 60 mm are typical of the Smithfield A (Deacon 1982: 403) now referred to as the Oakhurst Industry.

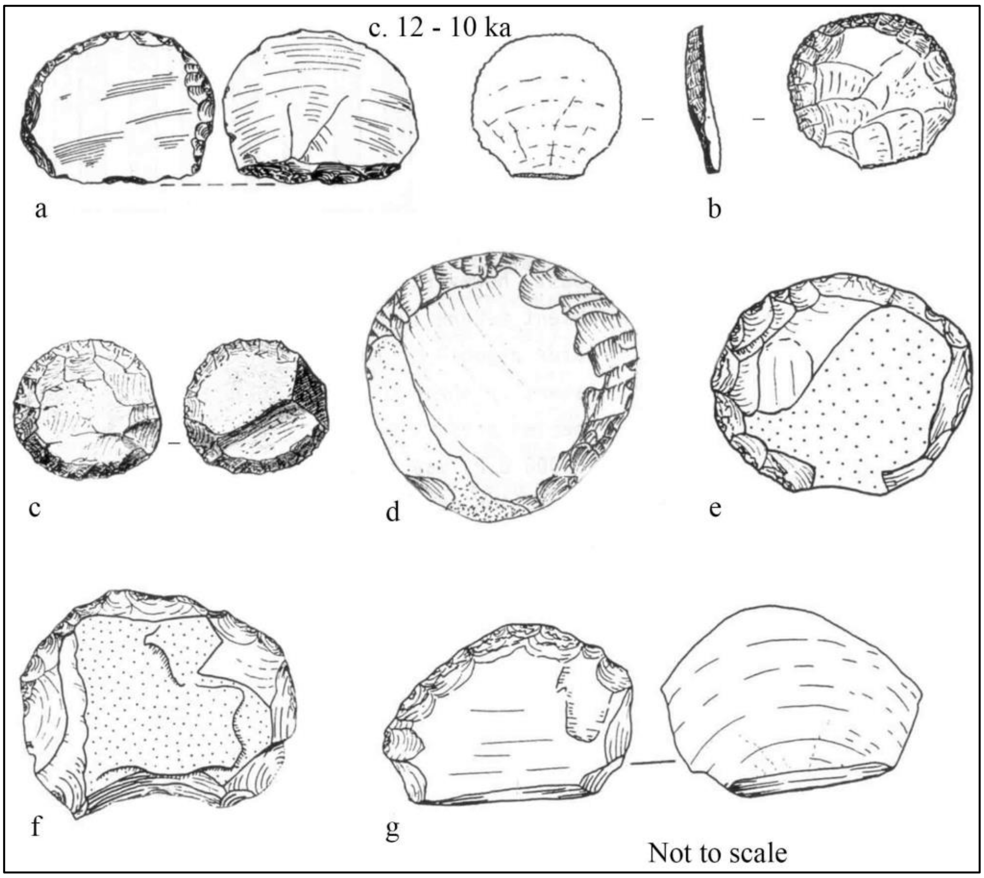

Figure 4.3 Circular scrapers from Oakhurst occurrences. a) Smithfield, Orange Free State (Clark 1958: 145, Figure 1, no. 5), b) Smithfield, Orange Free State (Goodwin & van Riet Lowe 1929: Plate XXVI, Figure 1), c) Smithfield, Orange Free State (Goodwin & van Riet Lowe 1929: Plate XL, nos. 10 & 11), d) Zeekoegat 13, lower level (Deacon 1982: 405, Figure 157, no. 13), e) Jubilee Shelter (Wadley 1986: 260, Figure 18, no. 1), f–g) Jubilee Shelter (Wadley 1986: 258, Figure 17, nos. 1 & 5)

4.2.3.4 Duckbill end scrapers

The duckbill end scrapers (Figure 4.4) are rectangular pieces known as duckbill due to shape (Goodwin & van Riet Lowe 1929: 157). A typical duckbill end-scraper is retouched by trimming several steep, small flakes from the dorsal or ventral side of a flake to form a bevelled arc appearance (Goodwin & van Riet Lowe 1929: 157). The striking platform of the blank is often untouched and flat, plain or cortical. Other duckbill end scrapers may also have been trimmed on their sides or from the proximal part (Goodwin & van Riet Lowe 1929: Plate XXV).

These formal tool types occur mostly in the latter part of the Oakhurst occurrences, between 10 and 8 ka (Deacon 1982: 403).

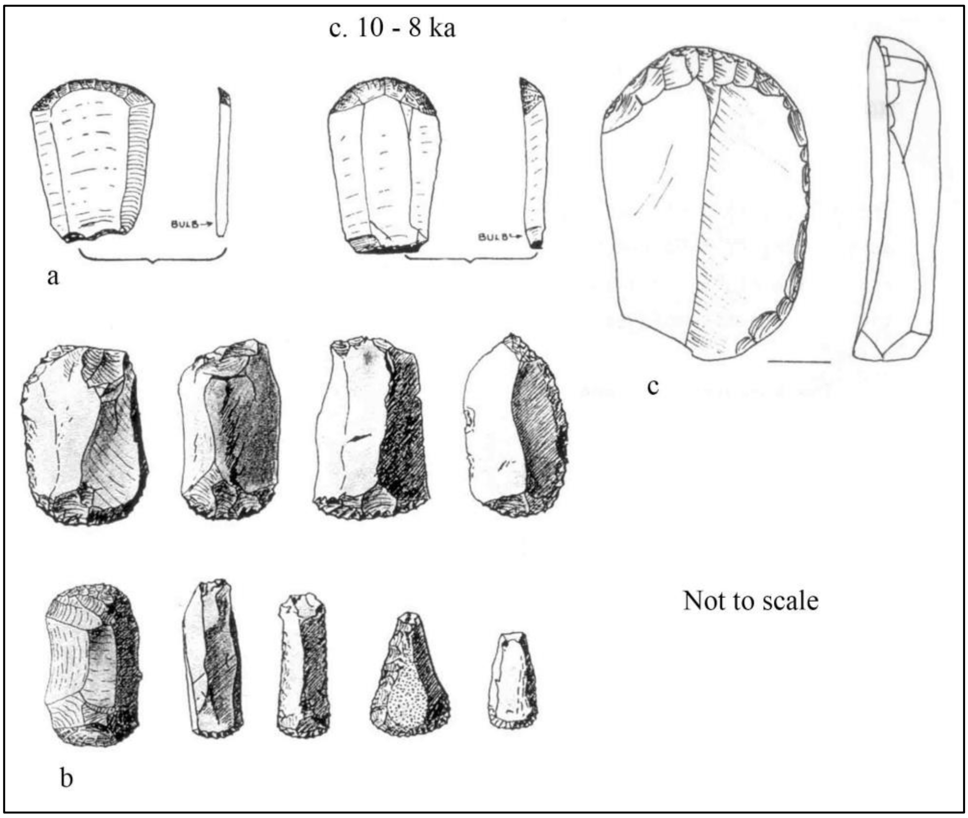

Figure 4.4 Duckbill end scrapers. a) Smithfield, Orange Free State (Goodwin and van Riet Lowe 1929: Plate XXV, Fig. 1), b) Smithfield, Orange Free State (Goodwin and van Riet Lowe 1929: Plate XL, nos. 1 – 9), c) Nelson Bay Cave (Deacon 1982: 405, Figure 157 no. 2)

4.2.3.5 Woodlot scrapers

Woodlot scrapers (Figure 4.5) are a sub-category of duckbill end scrapers that occur, as mentioned above, in the later Oakhurst layers. This term describes this type of end scrapers that occur in Lesotho. These scrapers have adze-like lateral retouch and marginal trimming and are more standardised in size, position of retouch, blank form, and choice of raw material (Mitchell 2000: 156) than scrapers occurring in the earlier Oakhurst layers in this area.

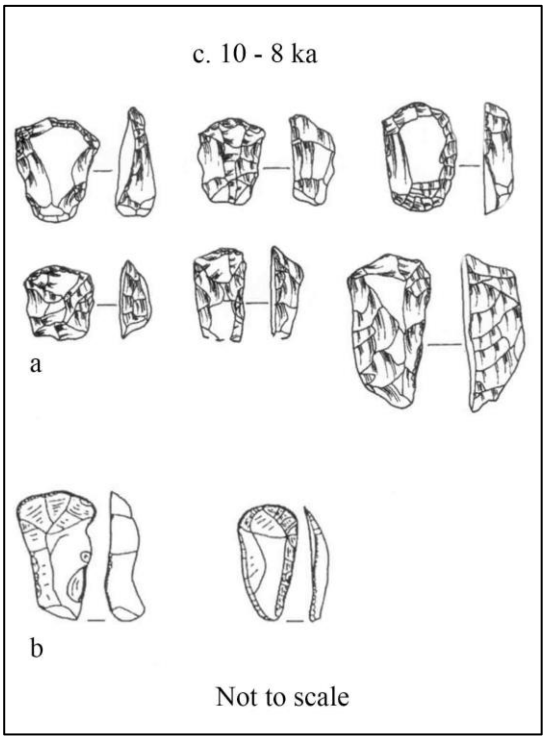

Figure 4.5 Woodlot scrapers. a) Ntloana Tsoana, Lesotho (Mitchell 2000: 157, Fig. 7 nos. 1 – 6), b) Liphofung, Lesotho (Kaplan & Mitchell 2012: 16, Fig. 9 nos. 16 – 17)

4.2.3.6 Adzes

Adzes (Figure 4.6) are tools that have "one or more straight or slightly convex working edges which have been shaped by one set of flake scars and also show secondary step flaking resulting from use at a steep angle and in a chopping motion" (Deacon 1982: 559). The steep step flaking occurs on one or both lateral sides but the shapes can have considerable variations (Thackeray 1981: 65; Humphreys & Thackeray 1983: 304). Adzes are generally larger than scrapers (mean length between 25 and 40 mm) and the southern Cape samples show less variation over time than scrapers (Deacon 1982: 559).

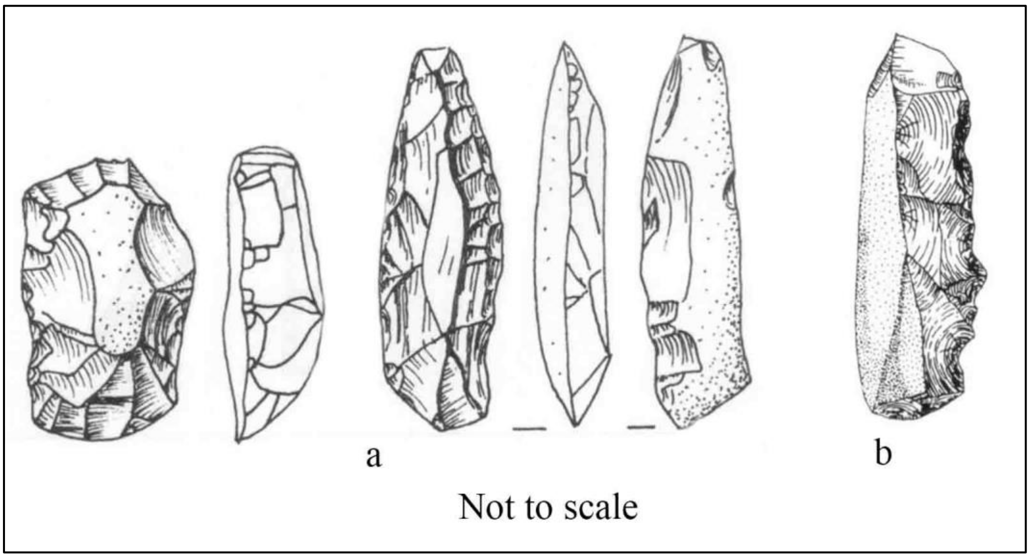

Figure 4.6 Examples of adzes. a) Deacon (1982: 559), b) Rose Cottage Cave, layer H (Wadley 2000: 21, Fig. 4 no. 3)

4.2.3.7 Spokeshaves

Spokeshaves (Figure 4.7) are generally larger than adzes, but have similar shaping scars and step-flaking (Deacon 1982: 561). They differ from adzes in the shape of the working edge, as the edges of spokeshaves are concave and normally have two or more concavities/notches. Spokeshaves occur mostly on hornfels and are geographically more common in the eastern half of southern Africa (e.g., Zambia, Zimbabwe, the eastern Transvaal and Natal, Deacon 1982: 561).

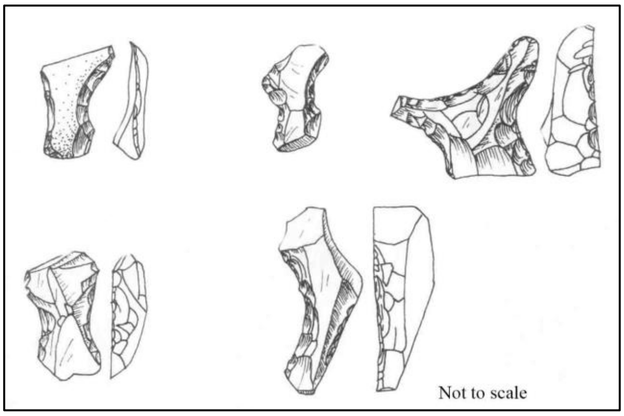

Figure 4.7 Some typical examples of spokeshaves (source: Deacon 1982: 561)

In this thesis, the scrapers are either side or end scrapers, and further described in terms of the blank on which they occur (e.g., core scraper) (Appendix A).

4.2.4 Raw material

Raw material types described for Oakhurst lithic artefacts in the southern and southwestern Cape include quartzite, quartz, silcrete, chalcedony, hornfels and rare sandstone and limestone (Table 4.3). These raw material types reflect the local geological settings of different sites and regions and deliberate choices made by stone knappers possibly influenced by, for example, socio-economic factors (Deacon 1982: 118). At RCC (Wadley 2000), the Oakhurst Industry shows a dominance of locally available small opaline pebbles resulting in the production of shorter flakes than in other Oakhurst occurrences. The dominant rock type for Oakhurst sites in the southern Cape is quartzite.

Table 4.3 Raw material selection in the Oakhurst sites of the southern Cape

NBC (Deacon 1982) Quartzite Quartz Silcrete Chalcedony	**BPA** (Deacon 1982) Quartzite Quartz Silcrete Hornfels	**Kangkara Cave** (Deacon 1982) Quartzite Quartz Silcrete Chalcedony Hornfels	**MRS** (Döckel 1998) Quartzite Chalcedony Quartz
Oakhurst Shelter (Goodwin 1938a) Quartzite Quartz Sandstone	**Melkhoutboom Cave** (Deacon 1976) Quartzite Chalcedony Silcrete	**BNK 1** (Schweitzer & Wilson 1982) Quartzite Quartz Silcrete Limestone	

4.2.5 Studying the lithics from Klipdrift Cave and Matjes River Rock Shelter: combining typological and technological approaches

The typological approach has been criticised because there could be confusion between form and function of artefacts (Odell 1981, 2003) and unverifiable descriptive terms are sometimes used (Odell 2003: 103). In contrast, the technological approach provides solutions to these restrictions to some extent (Soressi & Geneste 2011). The technological approach considers the holistic lithic knapping process from raw material procurement to artefact discard (Sellet 1993). This approach is termed as 'behavioral chain analysis' in American archaeology (e.g., Schiffer 1972, 1976) while in French archaeology it is known as '*chaîne opératoire'* or 'operational chain/sequence' or 'core reduction sequence' (Sellet 1993; Bar-Yosef & Van Peer 2009).

The term '*chaîne opératoire'* or 'operational chain' originates in ethnography (Carvalho *et al*. 2008; Bar-Yosef & van Peer 2009). Working in the field of anthropology directly related to extant human cultures, ethnology, Leroi-Gourhan perceived and proposed that technology was a "science of human activities" (Soressi & Geneste 2011: 335) and society would be better understood by studying its techniques. The application of *chaîne opératoire* to archaeology dates to the 1970s (Carvalho *et al*. 2008) when French archaeologists such as J. Tixier, M.-L. Inizan, H. Roche and others promoted it as a technological approach to studying prehistoric societies through, for example, stone artefacts (Soressi & Geneste 2011). When it became a fully-fledged analytical approach in lithic studies, it involved a series of stages such as raw material procurement strategies, blank production, tool manufacture, use, maintenance and discard (Sellet 1993; Inizan *et al*. 1999; Soressi & Geneste 2011).

The ideal in this approach is to identify how mental operations (*savoir-faire idéatoire*) interacted with technical gestures (*connaissance*) in the production of stone artefacts (Perlès 1987 cited in Sellet 1993; Pelegrin 2005). The '*chaîne opératoire'* approach does not necessarily provide a problem free alternative to the typological approach (Bar-Yosef & Van Peer 2009) but I use it here in addition to the typological approach. Deacon and Deacon (1999: 112) remark that most analyses of the South African Stone Age occurrences in any event address the principles of the technological approach. By explicitly using the *chaîne opératoire* approach in this thesis, it provides an opportunity for more extensive discussion of all steps of the procedure. Below, I describe the analytical framework applied in this.

4.2.5.1 Assemblage composition

The first step in my analysis is to describe the assemblage composition. As mentioned above, I follow the basic scheme of Deacon (1982), but avoid the terms waste and utilised. The assemblage is described using the terms chunks, pieces >20 mm, ochre, hammerstones/anvil, grindstone, hearthstones and formal tools. The category 'pieces <20 mm' instead of chips (<10 mm) is used to facilitate comparison with all Stone Age sites in South Africa (cf. Conard *et al*. 2004) and sites from other parts of the world. It is international practice to express proportions of the major artefact classes such as flakes, blades and tools in relation to the artefacts <20 mm (e.g. Villa *et al*. 2005). Mitchell and Steinberg (1992) and most recent MSA analyses (e.g. Villa *et al*. 2010; Henshilwood *et al*. 2014), for example, also refer to small flaking debris as pieces <20 mm. Therefore, the relative quantities of the major classes of artefacts (cores, flakes, blades, tools) are expressed in relation to pieces >20 mm. To enable comparison with Oakhurst sites that used the (<10 mm) chips class, comparison is undertaken in relation to the total number of artefacts, as done by Deacon (1982). It is unclear whether humans brought small pebbles, in the digestive systems of animals or attached to mussels, found at KDC, or whether they are part of the geological formation of the cave. Hence, unmodified small pebbles, though included in the analysis, cannot readily be considered as manuports in this study. In Appendix A a closer description of the categories used is given.

4.2.5.2 Raw material procurement

The identified raw materials in the KDC lithic assemblage are quartzite, quartz, calcrete, silcrete, hornfels and cryptocrystalline silica (CCS). At MRS quartzite, chalcedony and quartz occur (Döckel 1998: 43; Table 4.3). Sandstone and limestone rocks do not occur at KDC and MRS but occur at Oakhurst Shelter and BNK 1 respectively (Table 4.3).

Raw material selection may influence technological choices made by prehistoric knappers as the abundance and quality of raw material can affect the final type of product. For example, in some cases, high quality raw material may relate to a high frequency of formal tools in the assemblage while the occurrence of low quality raw material relates to a low frequency of formal tools (Andrefsky 1994). The distance from where different raw materials were procured or sourced, determines its classification as local or non-local (Ambrose & Lorenz 1990). Raw materials selected may sometimes, especially along the coast, reflect changes in the environment (Deacon 1982; Wadlye 1993).

4.2.5.3 Method of production

Determining reduction sequences involves recognising and describing reduction methods chosen by lithic knappers during different technical acts. Method of production refers to decisions taken regarding detachment of a flake from an objective piece and this requires an understanding of how the core was treated from the first detachment to the last (Wurz 2000: 44). A method is a "… carefully thought out sequence of interrelated actions" (Inizan *et al*. 1999: 30) which results in production of blanks or shaping of a tool using one or a combination of techniques. Cores and end products bear evidence of the technical processes. Fracture marks on cores and flakes suggest the origin, direction, and order of the act of percussion (Pelegrin 2005).

Lithic analysts have deployed three analytical approaches to reconstruct the methods of production: diacritical analysis (studies of flaking sequences), refitting, and lithic experimental studies (Sellet 1993; Pelegrin 2005; Bar-Yosef & van Peer 2009). Diacritical analysis involves examination of flake scars to reconstruct the order of knapping events or the stages of flake removals (Storck 1983; Young & Bonnichsen 1984; Bradley 1991; Sellet 1993; Odell 2003; Baena *et al*. 2010). Sometimes colours give an indication of older to younger scars on the object (Baena *et al*. 2010: 46). Cores and blanks are the primary source of data in diacritical studies in reconstructing patterns of core reduction (Sellet 1993). The technological reading can be achieved by observation of the order and direction of negative flake scars on extant flakes, cores and retouched tools (Pelegrin 2005: 27).

A complementary approach to diacritical studies is refitting which provides a dynamic view of the use life of a tool. Refitting aids in reconstructing the morphology of the raw material brought or used at the site but can also reveal some specific methods of reduction. Lithic experimental studies also play a role in defining technological criteria (Sellet 1993). Diacritical assessment of lithic artefacts has not been here applied as the coarseness of quartzite and the qualities of quartz preclude determining the direction of removals of the flake scar negatives. Refitting was also not possible.

In recent years very few experimental studies have been undertaken specifically targeting the LSA. Most lithic experiments aimed at reconstructing MSA technical procedures (e.g. Lombard *et al*. 2004; Lombard & Phillipson 2009; Mourre *et al*. 2010). Barham (1987) and Orton (2004) have experimented with bipolar flaking of the LSA. Barham's (1987) replication experiments targeted at investigating the bipolar technique and the conditions under which it occurs. His results indicate that *pièces esquillées*, *outils écailleés*, and core-reduced pieces, which are numerous in LSA industries, are by-products of bipolar flaking. Barham (1987) adds that bipolar flaking is linked to certain raw material, quartz and the scarcity of material. Orton's (2004) experiments found that the use of bipolar technique, on quartz cores, results in relatively few flakes and chunks and abundance of chips (pieces <10 mm in maximum dimension).

Pelegrin (2005: 27) distinguishes two groups of knapping methods: simple methods and elaborated methods. Elaborated methods involve a complex process of decision making and understanding of the techniques. Elaborated methods involve techniques and deliberate intention to manufacture certain types of blanks while simple methods involve splitting of a piece of rock with no predetermined blank shape and involving basic conceptual schemes (Inizan *et al*. 1999; Pelegrin 2005). Elaborated methods include shaping (bifacial shaping, polyhedral and spheroidal shaping, trihedral and quadrangular shaping), predetermined *débitage* methods (Levallois method, the Kombewa method, and blade *débitage* method), and retouching (Inizan *et al*. 1999). Simple methods, on the other hand, entail removal of blanks without much preparation of cores using hard hammer percussion technique (Inizan *et al*. 1999). Blanks/flakes resulting from simple methods lack standardisation in shape and size while cores tend to lack preferential striking platforms (Inizan *et al*. 1999).

To research the method of production followed in the Oakhurst of KDC and MRS, core blanks, types and dimensions, and flake and blade blank characteristics are described using some of Deacon's criteria, in addition to a number of technologically relevant criteria as further elaborated in Appendix A.

4.2.5.4 Techniques of production

The technique refers to the way energy is transferred to cause a particular effect (Chazan 1997: 21; Wurz 2000: 47). Flake/blade platforms carry important information about the techniques or the way energy was applied to cores by prehistoric lithic knappers (e.g. Dibble & Whittaker 1981; Dibble & Pelcin 1995; Wurz 2000; Odell 2003). Studies of platforms are used to make inferences about how flake morphology could be controlled and manipulated (Dibble 1997). Other attributes including lipping of the platform, the platform area or platform condition, the bulb of percussion, and flake breakage condition (Bar-Yosef & Kuhn 1999; Wurz 2000: 47; Andrefsky 2005; Will *et al*. 2013) may be used to infer the technique used.

The use of a hard hammer most often results in a prominent bulb of percussion, a larger platform area, slightly crushed striking platforms (Bar-Yosef & Kuhn 1999; Andrefsky 2005; Will *et al*. 2013), and a high incidence of 'siret' or split breaks (Will *et al*. 2013). It is not straight forward, however, to make a distinction between the impacts made by direct soft hammer percussion, indirect percussion, or pressure flaking (Morrow 1997; Wurz 2000; Odell 2003) because any of these techniques may result in similar impact traces (Morrow 1997: 62). The platform and bulb characteristics used to infer the techniques applied, are discussed in Appendix A.

4.2.5.5 Use, maintenance and discard

The ultimate step in the *chaîne opératoire* approach is to define how artefacts were retouched and how retouched and non-retouched artefacts were used/and maintained before being discarded. One of the goals at this stage is to find out the relationship between tool types such as scrapers and blanks (Sellet 1993), to determine which blanks were chosen for retouch. The following tool types are described for the KDC and MRS Oakhurst: scrapers, notched pieces, denticulate, adze, *piéces esquillée*, and pieces with miscellaneous retouch, simply labelled 'retouched' (see Appendix A).

4.3 Shellfish and tortoise analytical techniques

The study of shellfish remains in archaeological assemblages is important not only in reconstructing ancient diet but also in comparing shellfish composition for different sites and periods and explaining these variations. Shellfish remains serve as climatic indicators (Galimberti 2010; Sealy & Galimberti 2011; Döckel 1998; Thackeray 1988; Klein 1972b; Langejans *et al*. 2013) and as a proxy for prehistoric human population numbers (Klein & Cruz-Uribe 1983; Avery *et al*. 2004; Klein *et al*. 2004; Steele & Klein 2005-06; Klein 2008; Klein & Steele 2013).

Shellfish exploitation by prehistoric coastal human populations was an important strategy of obtaining food for subsistence but it is often considered as marginal compared to terrestrial resources (see Erlandson 1988; Buchanan 1986; Clark & Kandel 2013). Shells have also served a variety of other purposes such as ornaments, medicine or tools (Bigalke 1973; Schweitzer & Wilson 1982; D'Errico *et al*. 2005; Orton 2006: 12, Figure 6).

Archaeological evidence suggests that the oldest shellfish exploitation in South Africa dates to around 164 ka (Marean *et al.* 2007; Jerardino & Marean 2010) at

Pinnacle Point Cave 13B on the south coast although many other older sites along the coast may have been destroyed by rising sea levels (Marean *et al.* 2007). From 110 ka onwards, extensive shellfish exploitation is evident at MSA sites such as Klasies River (Singer & Wymer 1982; Deacon & Geleijnse 1988), Blombos Cave (BBC) (Henshilwood *et al.* 2001; Langejans *et al*. 2012) and KDS (Henshilwood *et al*. 2014). Shell middens are common during the LSA up until historic times (Klein 1972b; Bigalke 1973; Avery 1976; Schweitzer & Wilson 1982; Buchanan *et al.* 1978; Buchanan 1986; Henshilwood 1995, 2008; Jerardino 1995, 1997, 2010a, b; Döckel 1998). A 'megamidden' period is considered to have the highest volume of marine shellfish during the LSA at c. 3–2 ka (Jerardino *et al*. 2008; Jerardino 2010a, b).

The abundance of shell middens along the coast indicates that shellfish became one of the reliable food sources for coastal human populations (Langejans *et al.* 2012). Shellfish continues to be a reliable source of protein even for extant communities along the coast of South Africa (e.g. in the Transkei, Bigalke 1973; Voigt 1975; Lasiak 1991).

4.3.1 Shellfish analysis at Klipdrift Cave

All the shellfish remains retained in the 3 mm sieve, which form 85% of the total excavated volume (0.93 m^3) at KDC, are analysed. Shellfish <2 cm are not considered to be food items (Kyle *et al*. 1997; Buchanan 1986), but rather animals that landed up in the site incidentally, for example attached to bigger shells, and are not included in this analysis. These consist mostly of barnacle fragments and juvenile limpets at KDC. Some analysts (e.g. Langejans *et al*. 2013: 22) consider the smaller shellfish to be good proxy for local sea surface temperatures.

Methods and techniques adopted for analysing marine shellfish from KDC involve species identification, determining the MNI, weighing the shells, and measurements of *T. sarmaticus* opercula and *C. oculus* shells. Both MNI and weight are used as rare species may be underrepresented when only MNI is used (Langejans *et al*. 2013) and further because post-depositional damage can affect the MNI counts (Henshilwood 2008). Klein (1972b) presents his NBC data in MNI values while Döckel (1998) uses both MNI and weight in presenting her counts of MRS shellfish remains. NBC and MRS are particularly relevant as they are in the southern Cape and both have Oakhurst assemblages. Shellfish and tortoise data are used to reconstruct past climatic and environmental conditions, or changes, and these are compared with results from contemporaneous sites of the southern Cape (Chapter 6).

4.3.1.1 Species identification

The KDC shellfish species were identified using descriptions of shellfish (Branch and Branch 1981; Kilburn and Rippey 1982). I also used a comparative collection of modern shells provided by Dr. Karen van Niekerk as an aid in identifying species.

4.3.1.2 Minimum number of individuals and weight

For *T. sarmaticus*, both apices and opercula were counted and the highest value is considered the MNI (see also Langejans *et al*. 2012: 83). Some analysts (e.g. Jerardino & Marean 2010: 413; Langejans *et al*. 2013: 24) use only the opercula to quantify the MNI for *T. sarmaticus* because opercula preserve better than shells. The weight for *T. sarmaticus* species given in this thesis includes the opercula and shell weights (see Langejans *et al*. 2013: 24). The MNI values for other gastropods such as *Burnupena cincta* and *Diloma* spp. and limpets at KDC are calculated by counting the apices. For the giant chiton, *D. gigas*, the MNI is based on the count of the front, middle (the number of middle valves are divided by six), and rear valves. The greatest total for the three categories of values forms the MNI for this group.

The MNI values of bivalves such as *Donax sera*, *Scissodesma spengleri* and *P. perna* available at KDC are calculated by counting the left and right hinges separately (see also Klein 1972b) and the highest value gives the MNI (Jerardino & Marean 2010). Döckel (1998: 51) calculates MNI for bivalves by dividing the total number of hinges by two.

Besides establishing MNI, shellfish remains are also weighed because weights are significant to determine the dietary contribution of each species, particularly if pre- or post-depositional damage has significantly affected the MNI counts (Henshilwood 2008).

4.3.1.3 Dietary contribution

The dietary contribution of shellfish at KDC is reconstructed using average weights (g) of individual shellfish species (Avery 1976; Langejans *et al*. 2012; Table 4.4) to estimate total meat mass. Table 4.4 shows that *D. gigas* is averaged at 45 g per individual while *T. sarmaticus* provides 40 g of fresh meat per individual. The total meat mass for a species would thus be average weight of individual shellfish species (g) multiplied by MNI of that species.

Table 4.4 Estimates of shellfish meat mass (g) per individual species (Avery 1976: Table 5; Langejans *et al*. 2012: Table 3)

Species	mass (g)
Haliotis midae	250
Scutellastra tabularis	50
Dinoplax gigas	45
Haliotis spadicea	40
Scutellastra argenvillei	40
Turbo sarmaticus	40
Cymbula compressa	20
Cymbula granatina	10
Choromytilus meridionalis	10
Cymbula oculus	10
Donax serra	10
Perna perna	10
Scutellastra barbara	10
Aulacomya ater	5
Scutellastra granularis	5
Scutellastra longicosta	5
Burnupena cincta	4
Diloma spp.	4
Scutellastra cochlear	4
Turbo cidaris	4

Another way of reconstructing dietary contribution from shellfish is by estimating kilojoules based on the total weight measurements of shell remains (Buchanan 1986; Langejans *et al*. 2012; Clark & Kandel 2013). In this attempt, limpets such as *Cymbula granatina* and *Scutellastra granularis* provide an estimate of 350 kilojoules for every 100 g of shell weight (Buchanan 1986). Clark and Kandel (2013) estimate dietary contribution of *T. sarmaticus* to be equal to that of limpets and I use the same estimations here. No estimate of kilojoules for *D. gigas* is published. Table 4.4, however, shows that *D. gigas* has 5 grams more fresh meat (mass) compared to *T. sarmaticus*. I therefore assumed here that this giant chiton also provides 350 kilojoules for every 100 g of shell weight like *T. sarmaticus*. These are conservative estimates but provide meaningful projections of kilojoules for dietary reconstruction.

4.3.1.4 Measurement of Turbo opercula and Cymbula oculus shells

I measured the maximum lengths of *T. sarmaticus* opercula and *C. oculus* with a digital calliper to the nearest 0.1 mm and compute measures of central tendency such as means, medians, and standard deviations for each layer in the case of opercula. For *C. oculus*, measurements are lumped together for all layers to compute the descriptive statistics because samples are very few (20 samples in total, Chapter 6). I also measured the back plates of *D. gigas* samples from KDC but, as there are no criteria established to compare measurements of this species in archaeological sites, these results are not presented in this thesis. There were only *P. perna* fragments whose lengths could not be measured using a technique applied by Thackeray (1988; see Chapter 6), and therefore no measurements of this species are presented in this thesis.

4.3.2 Tortoises

Remains of the angulate/bowsprit tortoise (*Chersina angulata*) are abundant in MSA and LSA sites (Klein & Cruz-Uribe 1983; Henshilwood *et al*. 2001; Klein *et al*. 2004; Steele & Klein 2005-06; Avery *et al*. 2008; Klein 2008; Klein & Steele 2013). These are mainly carapace, plastron and limb bones.

Humeri give estimate of tortoise numbers and size (e.g. Henshilwood *et al*. 2001: 435). For the KDC tortoise assemblage, distal humeri are counted and measured but the MNI has not been established. The distal medio-lateral diameters of the humerus are measured to draw comparisons with tortoise remains from other sites along the coast of South Africa. Comparison is made between these measurements and those from MSA and LSA sites, particularly along the south and west coasts of South Africa. The measured specimens are used to compute the mean, median, and standard deviation. It is the median that is considered a better index of size of these animals because they keep growing (Klein & Cruz-Uribe 2000: 191).

4.4 Summary

A combination of typological and technological research techniques are used to analyse KDC and MRS lithic artefacts to reconstruct methods and techniques of flaking employed at these sites. The stages of the *chaîne operatoire* approach are explicitly applied as they provide a guide for reconstructing the technology.

The approaches for analysing shellfish involve species identification, quantification, weight measurements, and metrical analysis for *T. sarmaticus* opercula and *C. occulus* shells. Dietary reconstruction is based on both MNI and shell weights. Tortoise medio-lateral diameters of the humerus are measured for comparative purposes.

5. LITHIC ANALYSIS RESULTS

5.1 Introduction

One of the aims of this thesis was to reconstruct the technological behaviour of the LSA inhabitants of KDC; and to compare with the technology of the Oakhurst collections from MRS. This chapter presents the results of the lithic analyses for KDC and a re-analysis of a sample of the collection from MRS as reported by Willemien Döckel (1998). The assemblage composition is presented first, and thereafter the discussion of the results follows the stages of the *chaîne opératoire*, including raw material procurement, the methods and techniques of blank production, tool manufacture and tool use.

At KDC, a total sample of 13 512 lithic artefacts was classified according to the raw materials and the classes discussed in Chapter 4. These include pieces <20 mm, small pebbles, chunks, flakes and sections thereof, blades and blade sections, cores, hammerstones/anvil, grindstones, ochre, and retouched tools (Table 5.1).

A comparatively small sample (n = 1936; Table 5.2) from Döckel's (1998) collection of the MRS was re-analysed to compare the methods and techniques of manufacture with the KDC assemblage. For the assemblage composition and raw material selection, I compare the KDC data with the results presented in Döckel (1998).

Table 5.1 Klipdrift Cave: frequencies and percentage frequencies of all lithic artifact classes

Layers	JY		JYA		JZ		JZA		JZB		KAB		KAC		KAD		KAE		Total	
Artefact classes	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Pieces <20 mm	54	0.4	174	1.3	599	4.4	789	5.8	444	3.3	815	6	1910	14.1	2906	21.5	1805	13.4	9496	70.3
Chunks	13	0.1	8	0.1	24	0.2	61	0.5	16	0.1	14	0.1	55	0.4	29	0.2	114	0.8	334	2.5
Flakes	29	0.2	51	0.4	122	0.9	397	2.9	225	1.7	211	1.6	262	1.9	349	2.6	271	2	1917	14.2
Blades	2	0.01	1	0.01	11	0.1	51	0.4	30	0.2	27	0.2	39	0.3	109	0.8	149	1.1	419	3.1
Cores	3	0.02	1	0.01	4	0.03	16	0.1	12	0.1	16	0.1	25	0.2	63	0.5	57	0.4	197	1.5
Formal tools	0	0	0	0	2	0.01	5	0.04	2	0.01	4	0.03	5	0.04	13	0.1	7	0.1	38	0.3
Hammerstones	0	0	0	0	1	0.01	0	0	1	0.01	3	0.02	1	0.01	3	0.02	0	0	9	0.1
Grindstones	0	0	0	0	0	0	1	0.01	2	0.01	0	0	0	0	0	0	0	0	3	0.02
Hearthstone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.01	0	0	1	0.01
Ochre fragments	0	0	1	0.01	2	0.01	0	0	1	0.01	4	0.03	11	0.1	87	0.6	12	0.1	118	0.9
Small pebbles	21	0.2	53	0.4	35	0.3	161	1.2	129	1	174	1.3	192	1.4	81	0.6	134	1	980	7.3
Total	122	0.9	289	2.1	800	5.9	1481	11	862	6.4	1268	9.4	2500	18.5	3641	26.9	2549	18.9	13512	100

Table 5.2 Matjes River Rock Shelter: frequencies of re-analysed lithic artefacts from Döckel’s (1998) excavation

Raw material	Artefact type/Member	TSM-L	LSL-U	LSL-L	Total
CCS	Pieces <20 mm	9	0	0	9
	Blade	1	0	0	1
	Flake	5	1	0	6
	Core	1	0	0	1
	Tool	0	0	0	0
Quartz	Pieces <20 mm	2	0	0	2
	Blade	0	0	0	0
	Flake	5	0	0	5
	Core	0	1	0	1
	Tool	0	0	0	0
Quartzite	Pieces <20 mm	142	360	0	502
	Blade	10	15	1	26
	Flake	582	751	24	1357
	chunk	1	0	0	1
	Core	5	5	0	10
	Tool	9	5	0	14
	Upper grindstone	1	0	0	1
Total		773	1138	25	1936

5.2 Assemblage Composition

5.2.1 Klipdrift Cave

Pieces <20 mm make up the bulk of the KDC lithic sample at 70.3% (n = 9496). In keeping with the convention in technological studies, the relative representation of the various artefact classes was calculated, excluding pieces <20 mm, small pebbles, ochre and the hearthstone and is presented in Table 5.3.

Table 5.3 Klipdrift Cave: frequencies and percentage frequencies of main lithic artefact classes (percentages calculated in terms of the grand total, n= 2917)

Layer	JY		JYA		JZ		JZA		JZB		KAB		KAC		KAD		KAE		Total	
Artefact class	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Chunks	13	0.4	8	0.3	24	0.8	61	2.1	16	0.5	14	0.5	55	1.9	29	1	114	3.9	334	11.5
Flakes	29	1	51	1.7	122	4.2	397	13.6	225	7.7	211	7.2	262	9	349	12	271	9.3	1917	65.7
Blades	2	0.1	1	0.03	11	0.4	51	1.7	30	1	27	0.9	39	1.3	109	3.7	149	5.1	419	14.4
Cores	3	0.1	1	0.03	4	0.1	16	0.5	12	0.4	16	0.5	25	0.8	63	2.2	57	2	197	6.8
Formal tools	0	0	0	0	2	0.1	5	0.2	2	0.1	4	0.1	5	0.2	13	0.4	7	0.2	38	1.3
Hammerstones	0	0	0	0	1	0.03	0	0	1	0.03	3	0.1	1	0.03	3	0.1	0	0	9	0.3
Grindstones	0	0	0	0	0	0	1	0.03	2	0.1	0	0	0	0	0	0	0	0	3	0.1
Total	47	1.6	61	2.1	164	5.6	531	18.2	288	9.9	274	9.4	386	13.2	568	19.5	598	20.5	2917	100

Table 5.3 shows that flakes form the dominant group of the main artefact classes at KDC. Flakes are 65.7% (n = 1917) and the next most numerous artefact class is blades, which makes up 14.4% (n = 419) whilst chunks are 11.5% (n = 334). Cores, including core fragments, constitute 6.8% (n = 197) and formal tools are 1.3% (n = 38) (Table 5.3). The formal tools include scrapers, denticulates, an adze, *piece esquillée*, notched pieces and artefacts with miscellaneous retouch, further discussed in Section 5.6. Only about 0.4% (n = 12) of the assemblage consists of hammerstones and grindstones.

Trends in assemblage composition were investigated by calculating the relative proportions of flakes, blades, chunks, cores, and formal tools per layer (Table 5.4; Figure 5.1).

Table 5.4 Klipdrift Cave: frequencies and percentage frequencies of the main lithic artefact classes (percentages calculated based on the layer total)

Layer	JY		JYA		JZ		JZA		JZB		KAB		KAC		KAD		KAE	
Artefact class	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Chunks	13	27.7	8	13.1	24	14.7	61	11.5	16	5.6	14	5.1	55	14.2	29	5.2	114	19.1
Flakes	29	61.7	51	83.6	122	74.8	397	74.9	225	78.9	211	77.6	262	67.9	349	62.0	271	45.3
Blades	2	4.3	1	1.6	11	6.7	51	9.6	30	10.5	27	9.9	39	10.1	109	19.4	149	24.9
Cores	3	6.4	1	1.6	4	2.5	16	3.0	12	4.2	16	5.9	25	6.5	63	11.2	57	9.5
Formal tools	0	0	0	0	2	1.2	5	0.9	2	0.7	4	1.5	5	1.3	13	2.3	7	1.2
Total	47	100	61	100	163	100	530	100	285	100	272	100	386	100	563	100	598	100

In Table 5.4 and Figure 5.1 the dominance of flakes in all the layers is reflected and it can also be seen that there is a clear change in the relative proportions of the artefact classes through time (Figure 5.1).

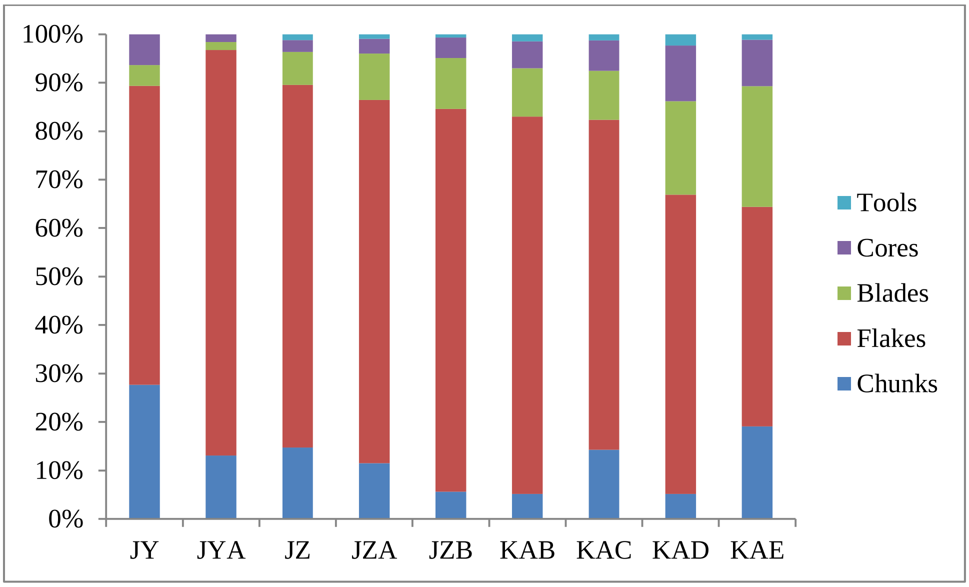

Figure 5.1 Klipdrift Cave: relative proportions of main lithic artefact classes through time

In the lowermost layer, KAE there are relatively fewer flakes than in the other layers. In this layer, flakes form 45.3% (n = 271) while the frequency of flakes increases to 62.0% (n = 349) in KAD, 67.9% (n = 262) in KAC, 77.6% (n = 211) in KAB, 78.9% (n = 225) in JZB then it drops to 74.9% (n = 397) in JZA and 74.8% (n = 122) in JZ (Table 5.4). Although there are relatively fewer artefacts in the uppermost two layers, JYA and JY, the flake dominance is still noticeable at respectively 83.6% (n = 51) and 61.7% (n = 29). Proportionately more blades occur in KAE (24.9%) and KAD (19.4%) than in other layers. Although blades are the next most numerous artefact class in the overall assemblage (Table 5.3) when each layer is considered separately (Table 5.4; Figure 5.1), blades occur less frequently than chunks in layers JZA, JYA, and JY.

The numbers of cores are relatively higher in the lowermost two layers at KDC with 57 (9.5%) cores in KAE and 63 (11.2%) in KAD. The totals of cores drop to below 10% from layers KAC to JY. The formal tools occur in very low frequencies with the highest proportion in KAD (n = 13, 2.3% of the layer total). There are no formal tools in the uppermost two layers, JYA and JY. Layers KAE and KAD thus differ from the other layers in that there are relatively more cores, blades and formal tools in them, but less flakes.

5.2.2 Matjes River Rock Shelter

The percentage frequencies of the lithic artefacts from MRS are reproduced here (Tables 5.5 & 5.6) from Döckel (1998) in order to compare the assemblage composition with that of KDC.

Table 5.5 Matjes River Rock Shelter: frequencies of the lithic artefacts from Oakhurst members (percentage calculated based on grand total). Data abstracted from Döckel (1998: Tables 14, 15 & 18)

Member	TSM-L		LSL-U		LSL-L		LSL-C		Total	
Artefact class	n	%	n	%	n	%	n	%	n	%
Chips	15	0.3	55	1	1	0	0	0	71	1.3
Chunks	107	2	44	0.8	7	0.1	0	0	158	3
Flakes	1656	31	3049	57.1	183	3.4	38	0.7	4926	92.2
Cores	12	0.2	6	0.1	0	0	0	0	18	0.3
CRP*	3	0.1	0	0	0	0	0	0	3	0.1
Utilised	89	1.7	77	1.4	0	0	0	0	166	3.1
Formal tools	0	0	2	0	0	0	0	0	2	0.04
Total	1882	35.2	3233	60.5	191	3.6	38	0.7	5344	100

* core reduced pieces

In Table 5.5 it is evident that flakes are dominant and constitute almost the entire assemblage at MRS, at 92.2% (n = 4926). Chunks and utilised pieces form 3% and 3.1% respectively. Cores are very rare, forming only 0.3% (n = 18) in the Oakhurst units of MRS. Chips (pieces <10 mm) are 1.3% and core reduced pieces (CRP) 0.1%. Döckel (1998) identified only 2 formal tools from Oakhurst members (0.04%; Table 5.5), but see Section 5.6.2 for higher frequencies identified during re-analysis.

The dominance of flakes at MRS is reflected in the overall assemblage and when the relative frequencies are calculated for each individual member (Table 5.6).

Döckel (1998) did not present blades in her analysis but c. 1.4% of the re-analysed artefacts are blades (see Table 5.2 for numbers).

Table 5.6 Matjes River Rock Shelter: frequencies of artefacts per member

Member	TSM-L		LSL-U		LSL-L		LSL-C	
Artefact class	n	%	n	%	n	%	n	%
Chips	15	0.8	55	1.7	1	0.5	0	0
Chunks	107	5.7	44	1.4	7	3.7	0	0
Flakes	1656	88	3049	94.3	183	95.8	38	100
Cores	12	0.6	6	0.2	0	0	0	0
CRP*	3	0.2	0	0	0	0	0	0
Utilised	89	4.7	77	2.4	0	0	0	0
Formal tools	0	0	2	0.1	0	0	0	0
Total	1882	100	3233	100	191	100	38	100

* core reduced pieces

At MRS flakes constitute between 88% in the youngest Oakhurst member, TSM-L, and 100% in the lowermost member, LSL-C (Table 5.6). Chunks are represented from Member LSL-L upwards and represent from 3.7% in this member to 5.7% in the uppermost member. Utilised pieces are at 2.4% (n = 77) in LSL-U and 4.7% (n = 89) in TSM-L while they don't occurr in the oldest two members (Table 5.6). Cores, like utilised pieces, are only present at the uppermost two members, TSM-L (0.6%, n = 12) and LSL-U (0.2%, n = 6). Chips are very rare at MRS and constitute between 0.5% and 1.7% in different members. CRP are restricted to the topmost member, TSM-L, forming 0.3% of total lithic artefacts in this unit. Formal tools were only found in Member LSL-U in the Oakhurst layers (Döckel 1998) and these form 0.1% in this unit.

5.2.3 A comparison of Klipdrift Cave and Matjes River Rock Shelter assemblage compositions

The KDC assemblage composition differs from that of MRS in terms of the relative amount of reported small debris. At KDC the bulk of the assemblage consists of pieces <20 mm (Table 5.1) while at MRS chips are very few (Table 5.5). It is most likely that the discrepancy between the numbers of chips and pieces <20mm can be explained by the inclusion of flake fragments betweeen 10 and 20 mm in the flake class at MRS, whereas these pieces were included in the pieces <20 mm at KDC. My observation of Döckel's (1998) assemblage is that a significant number of what she considered to be flakes would fall into pieces <20 mm class of this study. In the re-analysed sample it was found that 502 out of 4893 quartzite artefacts, which Döckel (1998: Table 14) classified as flakes, are pieces <20 mm (see Table 5.2). This suggests that the differences in assemblage composition are mainly due to differences in approach in categorising lithic artefacts.

At KDC there are substantially more cores than at MRS. Although the number of cores from layer JY to KAC is lower than in KAD and KAE at KDC, it never occurs below 1%. At MRS cores form less than 1% in the two upper members whilst there are no cores in the lower two members. An explanation offered by Döckel (1998: 45) for the rarity of cores at MRS is that primary preparation for flake production may have taken place away from the site. There is a dominance of flakes at both sites. However, KDC differs in that flakes are less dominant in the lower layers where blades form a more notable part of the assemblage. No blades were reported from MRS (Döckel 1998), but they do occur in low numbers (n = 27, c. 1.4% of the re-analysed assemblage), as will be discussed in more detail in Section 5.5.2.2.

5.3 Raw material selection

5.3.1 Klipdrift Cave

The raw materials of the KDC collection include quartzite, quartz, silcrete, calcrete, hornfels, and cryptocrystalline silica (CCS) as shown in Table 5.7.

Table 5.7 Klipdrift Cave: frequencies of raw material selection excluding small pebbles and ochre fragments

Raw material	n	%
Quartzite	8955	72.1
Quartz	3275	26.4
Silcrete	46	0.4
Calcrete	117	0.9
Hornfels	12	0.1

CCS	9	0.1
Total	12414	100

If the relative abundance of the raw materials is considered, excluding small pebbles and ochre fragments (Table 5.7), it is clear that quartzite dominates, comprising 72.1% (n = 8955) of the collection. Quartz constitutes 26.4% (n = 3275) and calcrete is 0.9% (n = 117). Silcrete is 0.4% (n = 46), hornfels 0.1% (n = 12) and CCS 0.1% (n = 9). The sources of the hornfels and CCS are not known, but it appears that quartzite, quartz and calcrete were obtained near the cave, and were thus locally available resources.

Table 5.8 and Figure 5.2 show the frequencies of various artefact classes in different raw materials. The table indicates that 51.8% (n = 6430) of the pieces <20 mm, are in quartzite and 24.1% (n =2992) in quartz.

Table 5.8 Klipdrift Cave: raw material selection in different artefact classes (calculated in relation to the total assemblage excluding small pebbles and ochre fragments; n =12 414)

Raw material	Quartzite		Quartz		Silcrete		Calcrete		Hornfels		CCS		Total	
Artefact classes	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Pieces <20 mm	6430	51.8	2992	24.1	29	0.2	38	0.3	7	0.1	0	0	9496	76.5
Chunks	258	2.1	63	0.5	0	0	8	0.1	5	0.04	0	0	334	2.7
Flakes	1776	14.3	77	0.6	12	0.1	46	0.4	0	0	0	0	1917	15.4
Blades	333	2.7	61	0.5	3	0.02	20	0.2	0	0	2	0.02	419	3.4
Cores	110	0.9	82	0.7	1	0.01	3	0.02	0	0	1	0.01	197	1.6
Tools	35	0.3	0	0	1	0.01	2	0.02	0	0	0	0	38	0.3
Hammerstones	9	0.1	0	0	0	0	0	0	0	0	0	0	9	0.1
Grindstones	3	0.02	0	0	0	0	0	0	0	0	0	0	3	0.02
Hearthstone	1	0.01	0	0	0	0	0	0	0	0	0	0	1	0.01
Total	8955	72.1	3275	26.4	46	0.4	117	0.9	12	0.1	9	0.1	12414	100

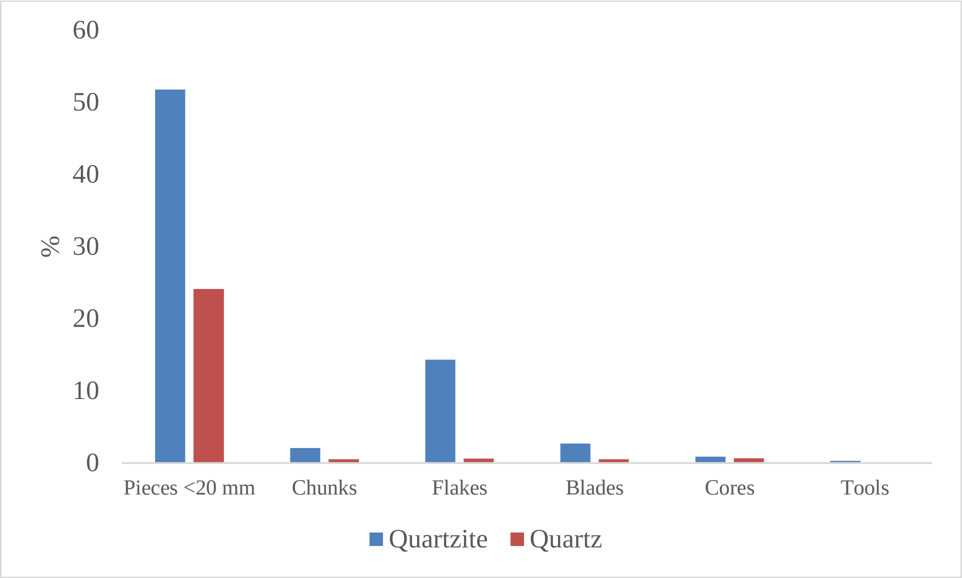

Figure 5.2 Klipdrift Cave: raw material representation by artefact classes for quartzite and quartz

Raw material selection through time also reflects the dominance of quartzite. The way in which raw materials was exploited at KDC (excluding small pebbles and ochre fragments) in each layer is shown in Table 5.9 and Figure 5.3.

Table 5.9 Klipdrift Cave: frequencies of raw material selection through time, excluding small pebbles and ochre (% calculated per layer/column total)

Layers	JY		JYA		JZ		JZA		JZB		KAB		KAC		KAD		KAE		Total	
Raw material	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Quartzite	90	89.1	191	81.3	483	63.3	1078	81.7	575	78.6	868	79.7	1895	82.5	2199	63.3	1576	65.6	8955	72.1
Quartz	11	10.9	42	17.9	271	35.5	232	17.6	146	19.9	203	18.6	391	17.0	1205	34.7	774	32.2	3275	26.4
Silcrete	0	0	1	0.4	1	0.1	1	0.1	5	0.7	1	0.1	2	0.1	16	0.5	19	0.8	46	0.4
Calcrete	0	0	1	0.4	8	1.0	9	0.7	4	0.5	17	1.6	6	0.3	41	1.2	31	1.3	117	0.9
Hornfels	0	0	0	0	0	0	0	0	0	0.0	0	0	0	0.0	12	0.3	0	0.0	12	0.1
CCS	0	0	0	0	0	0	0	0	2	0.3	0	0	2	0.1	2	0.1	3	0.1	9	0.1
Total	101	100	235	100	763	100	1320	100	732	100	1089	100	2296	100	3475	100	2403	100	12414	100

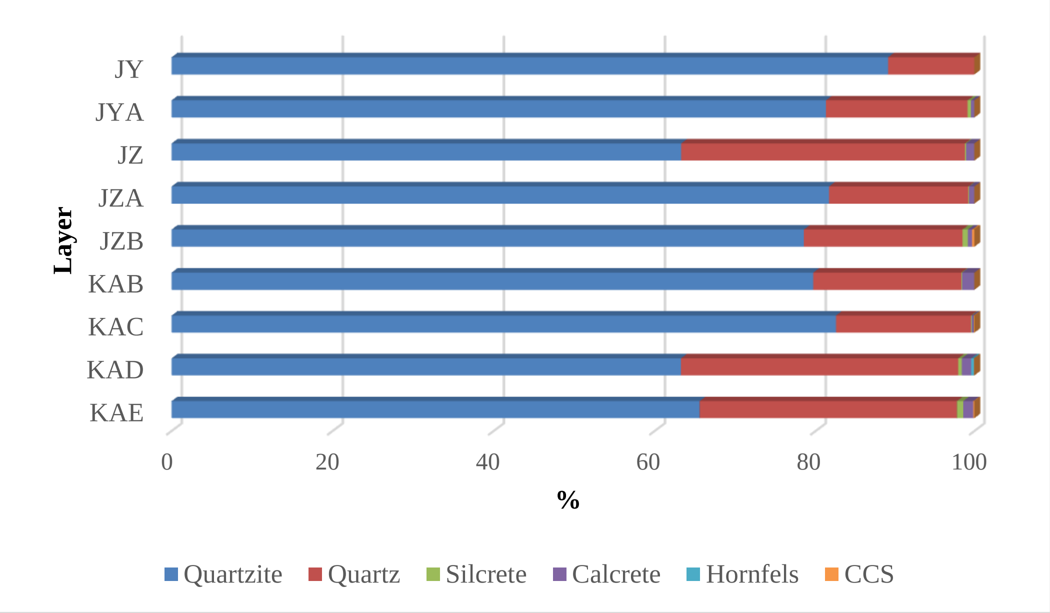

Figure 5.3 Klipdrift Cave: patterns of raw material selection through time (excluding small pebbles and ochre fragments)

Quartzite never occurs below 60% (Table 5.9; Figure 5.3). In layers KAE and KAD, c. 60% of the assemblage is in quartzite whereas in the other layers c.80% is in this raw material (except JY which has >80%). The frequency of quartz is broadly similar in KAE (32.2%, n = 774) and KAD (34.7%, n = 1205), but occurs in lower frequencies in KAC, KAB, JZB and JZA, between 17% and 20%. There is thus a marked decrease of quartz in the middle layers (KAC to JZA) compared to the lowest two layers, KAE and KAD. However, JZ does not conform to the pattern of decrease in quartz (see Figure 5.3). Calcrete forms on average 1% of the raw material usage in KAE, KAD, and JZ while in the remaining layers its presence is <1%. Silcrete, CCS and hornfels are very marginal in the overall total, but these raw materials occur predominatly in the lowermost two layers, KAE and KAD (Figure 5.3).

When the pieces <20 mm are excluded and artefact classes of the two dominant raw materials, quartzite and quartz, are compared (Table 5.10) quartzite constitutes c. 90% and quartz 10% .

Table 5.10 Klipdrift Cave: quartzite and quartz for the main artefact classes (percentage based on the total of pieces >20mm)

Raw material	Quartzite		Quartz	
Artefact classes	n	%	n	%
Chunks	258	9.2	63	2.2
Flakes	1776	63.2	77	2.7
Blades	333	11.9	61	2.2
Cores	110	3.9	82	2.9
Formal tools	35	1.2	0	0
Hammerstones	9	0.3	0	0
Grindstones	3	0.1	0	0
Hearthstone	1	0	0	0
Total	2525	89.9	283	10.1
Total				2808

5.3.2 Matjes River Rock Shelter

Quartzite is almost the only raw material at MRS, and is the material of choice for 98.9% (n = 5118) of the Oakhurst artefacts. Quartz and chalcedony constitute 0.4 (n = 19) and 0.8% (n = 39) respectively (Table 5.11).

Table 5.11 Matjes River Rock Shelter: frequencies of raw material selection at Oakhurst layers (percentages based on member total). Data abstracted from Döckel (1998: 69)

Member	TSM-L		LSL-U		LSL-L		LSL-C		Total	
Raw material	n	%	n	%	n	%	n	%	n	%
Quartzite	1745	97.3	3144	99.7	191	100	38	100	5118	98.9
Quartz	18	1	1	0.03	0	0	0	0	19	0.4
Chalcedony	30	1.7	9	0.3	0	0	0	0	39	0.8
Total	1793	100	3154	100	191	100	38	100	5176	100

Quartzite forms 100% in the oldest two units and is at 99.7% in Member LSL-U and 97.3% in Member TSM-L. Quartz and chalcedony are rare at MRS, and they are restricted to the uppermost two Oakhurst members, LSL-U and TSM-L. In these members quartz comprises 0.03% (n = 1) and1% (n = 18) and chalcedony 0.3% (n = 9) and 1.7% (n = 30) respectively (Table 5.11).

5.3.3 Comparing Klipdrift Cave and Matjes River Rock Shelter raw material selection

The patterns of raw material selection at KDC (Table 5.8) and MRS (Table 5.11) are somewhat different.There is a wider range of raw materials at KDC than at MRS. Quartzite is dominant at both sites but to a lesser degree at KDC where quartz is more significant than at MRS. At KDC quartz comprises slightly over one third of the overall assemblage composition and occurs throughout the sequence. Quartz is almost nonexistent at MRS and only occurs in the upper members. There is change through time in the way raw materials were selected at KDC. For example, quartz usage at this site is more important at the lower two layers, KAE and KAD, and again in layer JZ. Despite the relatively higher proportions of quartz at KDC than at MRS this raw material is not represented in the formal tool category. The lesser occurring raw materials at KDC, hornfels and CCS, are mostly restricted to the lower part of the sequence but they are not represented at MRS.

5.4 Method of production

In Stone Age sites such as KDC, where palimpsests occur, cores provide the most information on reconstructing the method of production, as the opportunity for refitting is rare. In this section, I present the results of the analysed cores from both KDC and MRS.

5.4.1 Klipdrift Cave Cores

At KDC cores constitute 1.5% (n = 197) of the total occurrence (Table 5.1) and 6.8% when pieces <20 mm are excluded (Table 5.3). There are 55 informative cores (Table 5.12) while the remaining142 are core fragments. There are nine hammerstones in the assemblage, two in layer KAD, one in KAC, two in KAB, three in JZB and one in JZ.

Table 5.12 Klipdrift Cave: frequencies of core types by raw material (core fragments excluded)

Raw material	Quartzite		Quartz		Silcrete		CCS		Total	
Core types	n	%	n	%	n	%	n	%	n	%
Irregular	16	29.1	6	10.9	0	0	1	1.8	23	41.8
Unidirectional	8	14.5	2	3.6	1	1.8	0	0	11	20
Bipolar	1	1.8	10	18.2	0	0	0	0	11	20
Bladelet	1	1.8	7	12.7	0	0	0	0	8	14.5
Platform	2	3.6	0	0	0	0	0	0	2	3.6
Total	31	56.4	22	40	1	1.8	1	1.8	55	100

Table 5.13 presents the types of blanks selected for cores at KDC.

Table 5.13 Klipdrift Cave: types of blanks selected as cores

Raw material	Quartzite		Quartz		Silcrete		CCS		Total	
Blank type	n	%	n	%	n	%	n	%	n	%
Angular	21	38.2	18	32.7	1	1.8	0	0	40	72.7
Cobble	8	14.5	0	0	0	0	0	0	8	14.5
Pebble	1	1.8	5	9.1	0	0	1	1.8	7	12.7
Total	30	54.5	23	41.8	1	1.8	1	1.8	55	100

The blanks selected for cores at KDC include angular blocks (72.7%, n = 40), cobbles (14.5%, n = 8), and pebbles (12.7%, n = 7). Angular blocks occur in quartzite (38.2%, n = 21), quartz (32.7%, n = 18), and silcrete (1.8%, n = 1) (Table 5.13). All cobbles are in quartzite while the majority (9.1%, n = 5) of pebble cores occur in quartz.

Most of the cores in the KDC assemblage are irregular (41.8%, n = 23). Unidirectional and bipolar core classes make up 20% each. All bipolar cores except one are in quartz. There are eight (14.5%) bladelet cores and all but one are in quartz. The bladelet cores occur mostly in the lower two layers at KDC, and I discuss the significance of this in Section 5.5.2.1. There are only two (3.6%) platform cores in the KDC lithic assemblage. In Section 5.2.1, I noted that there are substantially more cores and core fragments in layers KAE and KAD than in the other layers in terms of assemblage composition per layer.

This difference becomes more pronounced when the amount of cores in each layer is considered in relation to the total number of cores (Table 5.14). The lower layers (KAE and KAD) each has c. 30% cores whereas layer KAC and upwards contribute <10% cores per layer to the total amount.

Table 5.14 Klipdrift Cave: frequencies of cores per layer (percent based on grand total)

Layer	JY		JYA		JZ		JZA		JZB		KAB		KAC		KAD		KAE		Total	
Core type	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Fragment	1	0.5	1	0.5	2	1.0	13	6.6	10	5.1	12	6.1	19	9.6	51	25.9	33	16.8	142	72.1
Irregular	2	1.0	0	0	2	1.0	2	1.0	1	0.5	0	0	1	0.5	6	3.0	9	4.6	23	11.7
Bipolar	0	0	0	0	0	0	1	0.5	0	0	3	1.5	3	1.5	1	0.5	3	1.5	11	5.6
Unidirectional	0	0	0	0	0	0	0	0	1	0.5	0	0	2	1.0	4	2.0	4	2.0	11	5.6
Bladelet	0	0	0	0	0	0	0	0	0	0	1	0.5	0	0	1	0.5	6	3.0	8	4.1
Platform	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1.0	2	1.0
Total	3	1.5	1	0.5	4	2.0	16	8.1	12	6.1	16	8.1	25	12.7	63	32.0	57	28.9	197	100

The dimensions (length, width and thickness) of all the informative cores at KDC are given in Tables 5.15, 5.16 and 5.17. The mean length, width, and thickness of irregular cores (raw materials combined) are 85 mm, 57.1 mm and 42 mm, and that of unidirectional cores are 72 mm, 58.9 mm and 36.6 mm respectively (Table 5.15).

Table 5.15 Klipdrift Cave: descriptive statics of cores (raw materials combined)

Irregular	Length	Width	Thickness
Mean	85	57.1	42
S.D.	42.3	26.9	19.1
Min	18.6	18.8	16.4
Max	178.3	110.2	94.8
n =	23	23	23
Unidirectional	Length	Width	Thickness
Mean	72	58.9	36.6
S.D.	43.5	32.1	20.7
Min	33.1	23.2	12.9
Max	155.8	124.3	74.8
n =	11	11	11
Bipolar	Length	Width	Thickness
Mean	29.3	19.3	14.3
S.D.	10.7	5.7	4.3
Min	16.2	10.8	8
Max	45.3	27.7	23
n =	11	11	11
Bladelet	Length	Width	Thickness
Mean	24.9	15.9	11.4
S.D.	3.4	4.5	3.2
Min	19.8	11.2	6.3
Max	29.1	24.5	15.5
n =	8	8	8
Platform	Length	Width	Thickness
Mean	31	44	28.2
S.D.	3.3	4.2	1.1
Min	28.6	41	27.4
Max	33.3	47	29
n =	2	2	2

The mean dimensions of irregular and unidirectional cores may have been affected by a number of very large outliers of quartzite cores that occur in layer KAE. These cores are longer than 100 mm each. The mean length of irregular quartzite cores is 103.1 mm, width 68.3 mm and thickness is 48.3mm. The irregular quartzite cores are larger than the same core types in quartz (cf. Tables 5.16 & 5.17). The average length of quartzite unidirectional cores is 83.6 mm (Table 5.16), which is 10 mm longer than the mean length of these cores when all raw materials are combined (see Table 5.15). The mean width and thickness (69.2 mm, 40.9 mm) of quartzite unidirectional cores are similarly larger.

Table 5.16 Klipdrift Cave: descriptive statistics of quartzite cores

Irregular	Length	Width	Thickness
Mean	103.1	68.3	48.3
S.D.	36.6	24.1	18.6
Min	46.9	28.9	21.8
Max	178.3	110.2	94.8
n =	16	16	16
Unidirectional	Length	Width	Thickness
Mean	83.6	69.2	40.9
S.D.	46.0	31.9	22.2
Min	36	34.6	18.9
Max	155.8	124.3	74.8
n =	8	8	8
Bipolar	Length	Width	Thickness
Mean	22.1	21.0	16.5
S.D.	1.4	6.4	6.1
Min	21	15	11
Max	23.6	27.7	23
n =	3	3	3
Bladelet	Length	Width	Thickness
Mean	27.8	24.5	15.5
S.D.	-	-	-
Min	27.8	24.5	15.5
Max	27.8	24.5	15.5
n =	1	1	1

Irregular and unidirectional quartz cores (Table 5.17) are much smaller than that in quartzite (Table 5.16), as can be expected due to the smaller blank size. Irregular quartz cores have mean length of 40.5 mm, width (31.8 mm) and thickness of 26.5 mm (Table 5.17). The average dimensions of unidirectional quartz cores are 35.0 mm, 29.7 mm and 25.5 mm (Table 5.17).

Table 5.17 Klipdrift Cave: summary statistics of quartz cores

Irregular	Length	Width	Thickness
Mean	40.5	31.8	26.5
S.D.	17.7	10.9	12.4
Min	18.6	18.8	16.4
Max	69.8	48.9	47.9
n =	6	6	6
Unidirectional	Length	Width	Thickness
Mean	35.0	29.7	25.5
S.D.	2.6	9.2	17.8
Min	33.1	23.2	12.9
Max	36.8	36.2	38.1
n =	2	2	2
Bipolar	Length	Width	Thickness
Mean	32.0	18.7	13.5
S.D.	11.4	5.7	3.7
Min	16.2	10.8	8
Max	45.3	26.5	18.3
n =	8	8	8
Bladelet	Length	Width	Thickness
Mean	24.5	14.7	10.8
S.D.	3.5	3.0	2.9
Min	19.8	11.2	6.3
Max	29.1	18.4	14.5
n =	7	7	7

The irregular and unidirectional cores in quartzite are similar in size (Table 5.16) at KDC, excluding the possibility that unidirectional cores represent a further stage in reduction. This conclusion is supported by a t-test carried out on the difference of length between irregular and unidirectional cores. The null hypothesis stated that there is no significant difference in length between irregular and unidirectional cores. A significant difference in the two data sets would be indicated when a P-value is <0.05 or <5%. The P-value result here is 0.42, which means a 42% chance that the averages of the irregular and unidirectional cores are the same, thus indicating that there is no significant difference between the two samples. The implication is that there is a minimum degree of planning in the process of flake production.

There are only two examples of platform cores, both in quartzite, and their mean length, width and thickness are 31.0 mm, 44 mm and 28.2 mm (Table 5.15). These do not show any preparation of platform but rather the platforms are natural faces used to conveniently strike off flakes. Bipolar cores are substantially smaller (length 29.3 mm, width 19.3 mm & thickness 14.3 mm) than irregular and unidirectional cores (Table 5.15). Bladelet cores are the smallest with mean length of 24.9 mm, width of 15.9 mm, and thickness of 11.4 mm (Table 5.15). For bipolar and bladelet cores, there is no notable size difference between cores of quartzite and quartz origin.

There is a decrease in size of the irregular cores through time at KDC as demonstrated in Table 5.18 and Figure 5.4. Due to a small sample size, irregular cores were combined into three groups (KAE, KAD & KAC–JY). Irregular cores in KAE, the lowermost layer, have an average length of 101.1 mm and drops to 80.8 mm in KAD and 70.0 mm in layers KAC–JY. The mean width and thickness of irregular cores also decrease through time and so does thickness (Table 5.18). Figure 5.4 further indicates that irregular cores in KAE have a wider range of lengths than in the other layers.

Table 5.18 Klipdrift Cave: dimensions of irregular cores through time

KAC-JY	Length	Width	Thickness
Mean	70.0	48.0	38.6
S.D.	18.1	16.5	11.7
Min	43.4	28.9	21.8
Max	95.2	75	59
n =	8	8	8
KAD	Length	Width	Thickness
Mean	80.8	51.8	41.6
S.D.	31.1	22.9	13.0
Min	33.1	26	18.7
Max	110	82.5	52.9
n =	6	6	6
KAE	Length	Width	Thickness
Mean	101.1	68.6	45.3
S.D.	59.2	34.2	27.5
Min	18.6	18.8	16.4
Max	178.3	110.2	94.8
n =	9	9	9

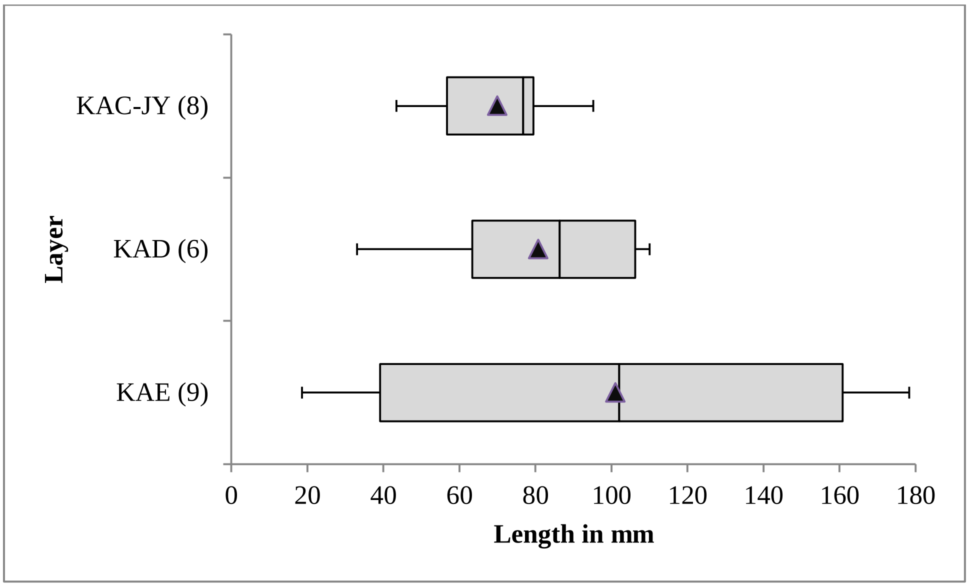

Figure 5.4 Klipdrift Cave: box plots summarising the trend of lengths of irregular cores through time (layers assembled into three groups: KAE, KAD & KAC–JY). Numbers in parentheses indicate sample sizes. The vertical line near the centre of each box plot shows the median, the grey rectangle encloses the middle half of the data (25th and 75th percentiles), the small dark triangle shape shows the mean, and the whiskers show the range of the values

There is a similar trend of decrease in size through time for unidirectional cores as shown in Table 5.19 and the box plots on Figure 5.5.

Table 5.19 Klipdrift Cave: dimensions of unidirectional cores through time

KAC& JZB	Length	Width	Thickness
Mean	43.5	40.2	23.5
S.D.	8.7	9.5	4.2
Minimum	36.8	34.6	18.9
Maximum	53.3	51.2	27.2
n =	3	3	3
KAD	Length	Width	Thickness
Mean	59.7	50.6	34.4
S.D.	29.8	22.4	11.2
Minimum	33.1	35.5	19.4
Maximum	92.8	83.2	46.1
n =	4	4	4
KAE	Length	Width	Thickness
Mean	105.6	81.2	48.6
S.D.	53.5	42.2	30.4
Minimum	36.8	23.2	12.9
Maximum	155.8	124.3	74.8
n =	4	4	4

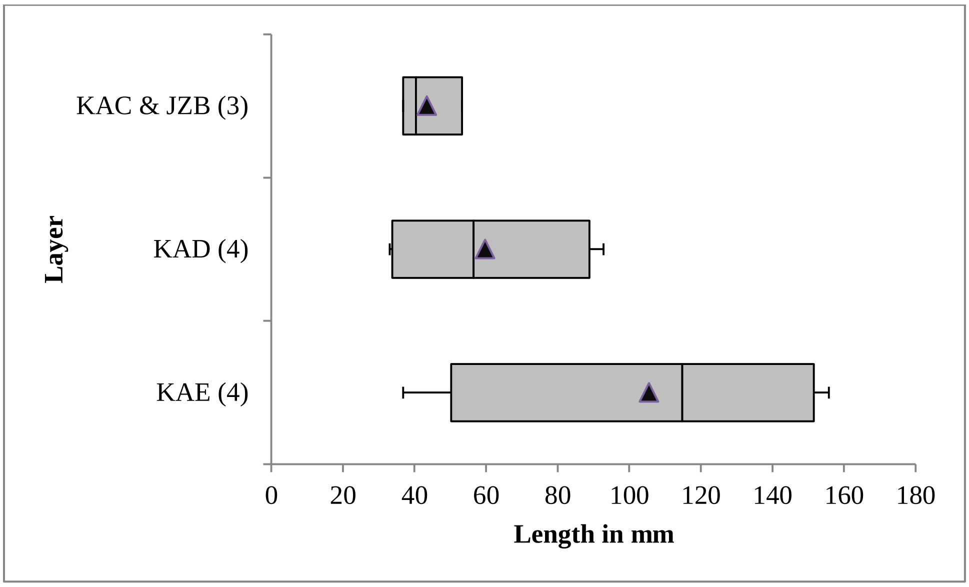

Figure 5.5 Klipdrift Cave: box plots summarising the trend in of lengths of unidirectional cores through time (layers assembled into three groups, KAE, KAD & KAC-JZB). Numbers in parentheses indicate sample sizes. The vertical line near the centre of each box plot shows the median, the grey rectangle encloses the middle half of the data (25th and 75th percentiles), the small dark triangle shape shows the mean, and the whiskers show the range of values.

All the cores at KDC show very little preparation before the production of blanks. They were exploited opportunistically using suitable natural platforms and angles as indicated by the dominance of irregular cores. Sometimes platforms for irregular cores (e.g., Figure 5.6) were prepared by removing a large flake, or an elongated irregular blade. The unidirectional cores were more systematically reduced (see Figure 5.7).

A simple flake production system was followed at KDC in which a few flakes were removed sequentially in a short series from a single platform or multiple, unorganised platforms as in the case of irregular cores. The scars on a few irregular and unidirectional cores show the removal of quadrilateral or irregular flakes, but clear end-product scars are difficult to recognise due to the coarse-grained nature of the quartzite. The products of the flake production system are either flakes or blades. The blades are simply elongated and narrower than flakes but knapped in the same production cycle as the flakes.

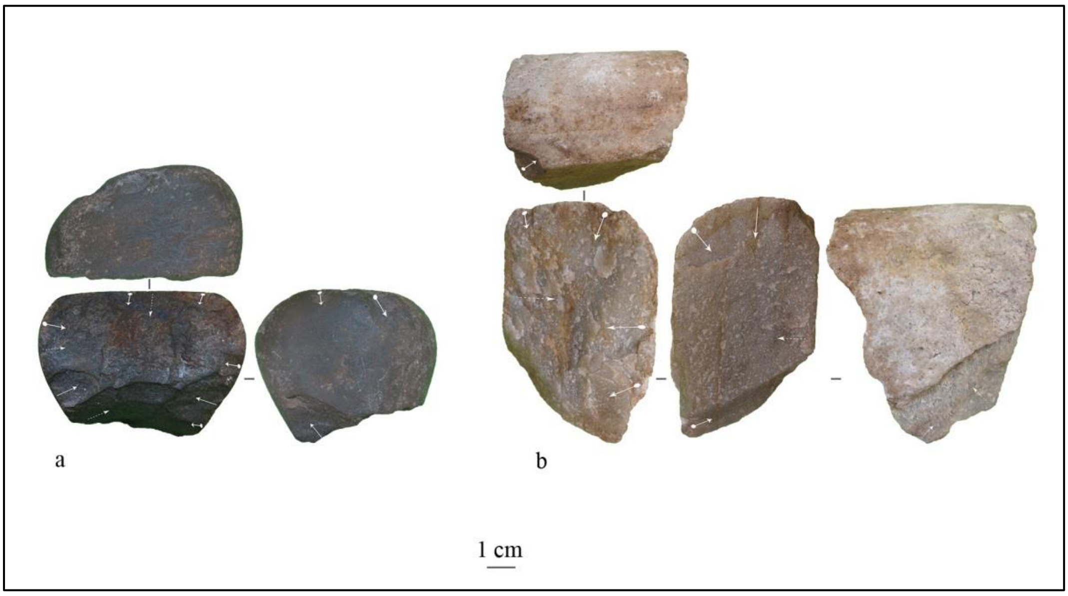

Figure 5.6 Klipdrift Cave: irregular cores in quartzite. a) Layer JZ, b) layer JY

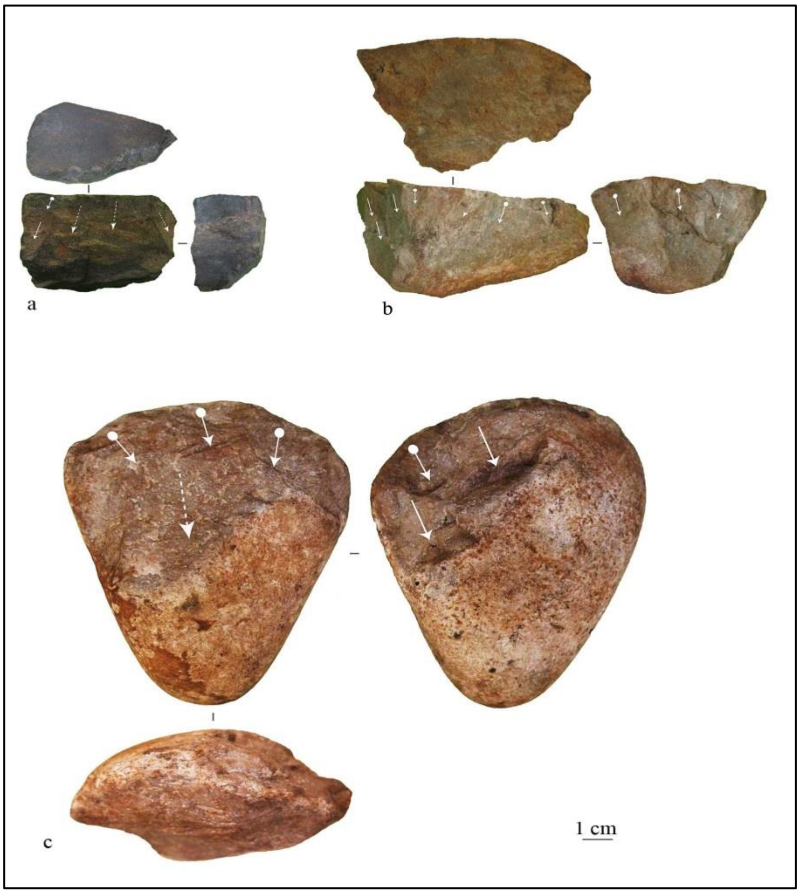

Figure 5.7 Klipdrift Cave: unidirectional cores in quartzite. a) Layer KAC, b) layer KAD c) layer KAE

As mentioned above, bladelet production, though marginal, was mostly restricted to layer KAE at KDC. Six of the eight-bladelet cores occur in KAE, one in KAD and the other in KAB. The bladelet core in KAB (Table 5.14) is a glassy quartz piece, only marginally falling within the class of bladelet cores.

5.4.2 Matjes River Rock Shelter cores

Döckel (1998: 43) indicates that the blanks for the quartzite cores at MRS were cobbles. She reports 18 cores in the Oakhurst sample (14 in quartzite and 4 in chalcedony; Döckel 1998: 69) and these are all described as irregular showing "no trends in the size, shape or number of sequential flake removals" (Döckel 1998: 45). In the re-analysed sample, there were 12 cores, 10 irregular quartzite cores and 2 bipolar cores, in quartz and CCS (Table 5.20).

Table 5.20 Matjes River Rock Shelter: frequencies of re-analysed cores

Raw material	Core type/member	LSL-U	TSM-L	Total
CCS	Bipolar	0	1	1
Quartz	Bipolar	1	0	1
Quartzite	Irregular	5	5	10
Total		6	6	12

All the re-analysed cores at MRS, except one, have cobble cortex indicating that these cores are of cobble origin as Döckel (1998) observed. Irregular cores at MRS have an average length of 95.5 mm, width of 70.3 mm and thickness of 45 mm (Table 5.21). The mean dimensions of bipolar cores at MRS are 25 mm, 22 mm and 15.5 mm (Table 5.21).

Table 5.21 Matjes River: descriptive statistics of re-analysed cores

Irregular	Length	Width	Thickness
Mean	94.5	70.3	45
S.D.	22.4	15.2	15.4
Min	74	49	28
Max	153	101	77
n =	10	10	10

Bipolar	Length	Width	Thickness
Mean	25	22	15.5
S.D.	2.8	0	2.1
Min	23	22	14
Max	27	22	17
n =	2	2	2

Irregular cores at MRS do not show a decrease in size through time from member LSL-U to TSM-L (Table 5.22) in the sample analysed. Irregular cores from the older member, LSL-U are smaller than same core type from the overlying member. All the cores at MRS indicate a simple flake production system and no bladelet production.

Table 5.22 Matjes River Rock Shelter: descriptive statistics of irregular quartzite cores through time

TSM-L	Length	Width	Thickness
Mean	98.2	76.8	54
S.D.	31.4	18.7	17.9
Min	74	49	28
Max	153	101	77
n =	5	5	5
LSL-U	Length	Width	Thickness
Mean	90.8	63.8	36
S.D.	10.6	7.9	3.2
Min	77	51	33
Max	102	69	40
n =	5	5	5

5.4.3 Comparing the method of production at Klipdrift Cave and Matjes River Rock Shelter

The majority of the cores at KDC are from angular blocks while those of MRS are of cobble origin, from a quartzite cobble beach. The irregular quartzite cores at KDC (Table 5.16) are somewhat larger than irregular cores from MRS (Table 5.21), perhaps as the angular blocks may have been larger than beach cobbles. The quartzite cores at KDC become smaller through time whereas those from MRS reflect a minor increase in size (Table 5.22). The MRS bipolar cores are shorter but wider (Table 5.21) than those at KDC (Table 5.15). The differences in size, however, may not be technologically important.

In spite of the different blanks used for cores, the lithic manufacturers from both sites used a simple flake production method, resulting in the production of irregularly shaped and unstandardised flakes. At KDC, in the lowermost layer bladelet production occurred, but no bladelet cores were observed during my re-analysis of the MRS collection, or any reported by Döckel (1998), suggesting the absence of bladelet production during the Oakhurst at MRS.

5.5 Techniques of blank production

5.5.1 Description of platforms and bulbs

Characteristics to infer the techniques of production include attributes of the flake platforms and bulbs of percussion.

5.5.1.1 Klipdrift Cave

Planar (plain & cortical) platforms at KDC constitute the majority of the platforms. Almost 50% of the platforms are plain while 23.2% (n = 194) are cortical, 12% (n = 100) are broken, and 3.6% (n = 30) are classified as very small (Table 5.23). The other platform types such as facetted unspecific, facetted with preparation, dihedral unspecific and shattered occur in very low frequencies. A number of platforms (9.7%, n = 81) at KDC were undiagnostic and were classed as indeterminate (Table 5.23).

Table 5.23 Klipdrift Cave: platform types of flaked products (blades & flakes combined) by raw material

Raw material	Quartzite		Quartz		Silcrete		Calcrete		CCS		Total	
Platform type	n	%	n	%	n	%	n	%	n	%	n	%
Plain	355	42.5	24	2.9	4	0.5	27	3.2	3	0.4	413	49.4
Cortical	189	22.6	2	0.2	2	0.2	0	0	1	0.1	194	23.2
Broken	87	10.4	11	1.3	0	0	2	0.2	0	0	100	12
Facetted	1	0.1	1	0.1	0	0	0	0	0	0	2	0.2

Facetted unspecific	12	1.4	0	0	0	0	0	0	1	0.1	13	1.6
Very small	13	1.6	12	1.4	2	0.2	3	0.4	0	0	30	3.6
Dihedral unspecific	2	0.2	0	0	0	0	0	0	0	0	2	0.2
Shattered	1	0.1	0	0	0	0	0	0	0	0	1	0.1
Indeterminate	63	7.5	10	1.2	1	0.1	5	0.6	2	0.2	81	9.7
Total	723	86.5	60	7.2	9	1.1	37	4.4	7	0.8	836	100

The sizes of the platforms were measured to investigate size trends. Tables 5.24, 5.25, and 5.26 present these descriptive statistics for the different platform types at KDC.

Table 5.24 Klipdrift Cave: descriptive statistics for different platform types (blades and flakes combined)

Plain	Length	Thickness
Mean	14.7	7.1
S.D.	8.8	4.4
Min	2.3	1
Max	72.8	28.4
n =	413	413
Cortical	Pl length	Pl thickness
Mean	17.7	7.6
S.D.	8.5	4.7
Min	4.5	1.3
Max	59.1	28.5
n =	194	194
Very small	Pl length	Pl thickness
Mean	4.6	2.1
S.D.	3.1	1.1
Min	1.7	0.5
Max	14.5	5.9
n =	30	30
Facetted unspecific	Pl length	Pl thickness
Mean	28.1	11.1
S.D.	10.9	4.3
Min	12	3.7
Max	42.4	16.6
n =	13	13
Facetted	Pl length	Pl thickness
Mean	12.6	4.8
S.D.	13.5	5.2
Min	3	1.1
Max	22.1	8.5
n =	2	2
Dihedral unspecific	Pl length	Pl thickness
Mean	28.6	10.3

S.D.	17.3	0.1
Min	16.4	10.2
Max	40.8	10.4
n =	2	2

Facetted unspecific platforms (28.1 mm and 11.1 mm) and dihedral unspecific platforms (28.6 mm and 10.3 mm) are the biggest of all the platform types at KDC. The rare occurrences of facetted and dihedral platforms (Table 5.24) show the lack of specific platform preparation on the core during the reduction process. The main types of platforms, plain and cortical, have more or less similar dimensions. The cortical platforms have a mean length of 17.7 mm and thickness of 7.6 mm while plain platforms are only slightly shorter and thinner (14.7 mm and 7.1 mm) than the former.

The sizes of the two major types of platforms in quartzite were measured to explore how the groups compare (Table 5.25). As seen in Table 5.25 the difference in size between plain and cortical platforms at KDC is very small.

Table 5.25 Klipdrift Cave: summary statistics for quartzite flake/blade platforms

Plain	Length	Thickness
Mean	15.2	7.3
S.D.	8.7	4.4
Min	2.7	1
Max	72.8	28.4
n =	355	355
Cortical	Length	width
Mean	17.8	7.6
S.D.	8.6	4.7
Min	4.5	1.3
Max	59.1	28.5
n =	189	189

At KDC, there are substantially less platform data for the quartz than the quartzite flaked pieces and only two cortical platforms occur. However, given the smaller size of the quartz core blanks compared to quartzite core blanks, the smaller size of the quartz plain platforms (Table 5.26) is unsurprising.

Table 5.26 Klipdrift Cave: summary statistics for quartz flake platforms

Plain	Length	Thickness
Mean	8.6	5.8
S.D.	4.5	4.2
Min	2.3	1.5
Max	19.1	18.4
n =	24	24
Cortical	Length	Thickness
Mean	11.9	9.6
S.D.	0.8	1.2
Min	11.3	8.7
Max	12.4	10.4
n =	2	2

The bulb characteristics may also give an indication of the knapping technique, as discussed in Chapter 4, and these are presented in Table 5.27.

Table 5.27 Klipdrift Cave: attributes of bulbs of percussion on flaked products by raw material

Raw material	Quartzite		Quartz		Calcrete		CCS		Silcrete		Total	
Bulb type	n	%	n	%	n	%	n	%	n	%	n	%
Prominent	120	14.4	2	0.2	3	0.4	2	0.2	4	0.5	131	15.7
Weak	76	9.1	0	0	4	0.5	1	0.1	1	0.1	82	9.8
Negative	1	0.1	0	0	0	0	0	0	0	0	1	0.1
Indeterminate	526	62.9	58	6.9	30	3.6	4	0.5	4	0.5	622	74.4
Total	723	86.5	60	7.2	37	4.4	7	0.8	9	1.1	836	100

At KDC, the majority of bulbs are undiagnostic, at 74.4% (n = 622) while prominent bulbs constitute 15.7% (n = 131) and weak bulbs are at 9.1% (n = 76). Most of the quartzite at KDC is very coarse, and thus preclude straightforward characterisation of the bulbs of percussion. The relatively high frequency of planar platforms that are large and thick and the presence of 12% broken platforms at KDC (Table 5.23) indicate that direct hard hammer percussion was used to detach flakes. This inference is supported by the fact that a substantial number of complete flakes and blades (c. 16%, Table 5.27) have prominent bulbs, which mainly result from the same technique (e.g., Inizan *et al*. 1999). The bipolar technique also occurred at KDC, but this is more evident in the cores than the flake platforms and bulbs.

5.5.1.2 Matjes River Rock Shelter

Table 5.28 shows flake platform attributes for the re-analysed MRS artefacts. In the re-analysed MRS sample, the majority of the platforms are cortical (64.3%, n = 198) while plain platforms form 29.9% (n = 92). Other platform types at MRS are rare (Table 5.28) although this may be due to sampling. This analysis adds to Döckel's (1998: 45) results that, "…the percentage of flakes with platform cortex is 32%" as she did not provide more data on platforms.

Table 5.28 Matjes River Rock Shelter: flake/blade platform types by raw material

Raw material	Quartzite		CCS		Quartz		Total	
Platform types	n	%	n	%	n	%	n	%
Plain	88	28.6	4	1.3	0	0	92	29.9
Cortical	198	64.3	0	0	0	0	198	64.3
Broken	3	1	0	0	0	0	3	1
Facetted	1	0.3	0	0	0	0	1	0.3
Facetted unspecific	3	1	0	0	0	0	3	1
Very small	8	2.6	2	0.6	1	0.3	11	3.6
Total	301	97.7	6	1.9	1	0.3	308	100

Tables 5.29 and 5.30 present descriptive statistics for MRS flake platforms.

Table 5.29 Matjes River Rock Shelter: descriptive statistics of platforms (raw material combined)

Plain	Length	Thickness
Mean	22.5	9.5
S.D.	8.1	4.4
Min	6	2
Max	41	23
n =	92	92
Cortical	Length	Thickness
Mean	27.2	9.7
S.D.	10.5	4.4
Min	6	2
Max	72	36
n =	198	198
Very small	Length	Thickness
Mean	7.5	4.3
S.D.	3	3.7
Min	3	2
Max	12	15
n =	11	11
Facetted unspecific	Length	Thickness
Mean	32.3	15.7

S.D.	5.1	6
Min	28	10
Max	38	22
n =	3	3

Facetted unspecific platforms are alsofew at MRS but they are larger than planar platforms, with a mean length of 32.3 mm and thickness of 15.7 mm. MRS cortical platforms are longer by a few millimetres compared to plain platforms. The mean length of cortical platforms is 27.2 mm and thickness is 9.7 mm. Plain platforms have a mean length of 22.5 mm and average thickness of 9.5 mm. The 'very small' platforms have a mean length of 7.5 mm and thickness of 4.3 mm (Table 5.29).

Flakes of raw materials other than quartzite are rare at MRS and thus, when dimensions of quartzite plain platforms are calculated separately (Table 5.30) there is no difference in size (cf. Tables 5.29 & 5.30). All cortical platforms are in quartzite and measurements of these are in Table 5.29.

Table 5.30 Matjes River Rock Shelter: summary statistics for quartzite plain platforms

Plain	Length	Width
Mean	22.8	9.6
S.D.	7.9	4.4
Min	6	2
Max	41	23
n =	88	88

Döckel (1998) does not present information on bulb conditions in her analysis but the re-analysed flaked pieces indicate that prominent bulbs are in the majority at MRS (Table 5.31).

Table 5.31 Matjes River Rock Shelter: attributes of bulbs of percussion on flaked products

Raw material	Quartzite		CCS		Quartz		Total	
Bulb types	n	%	n	%	n	%	n	%
Prominent	171	55.5	3	1	0	0	174	56.5
Weak	63	20.5	1	0.3	1	0.3	65	21.1
Indeterminate	67	21.8	2	0.6	0	0	69	22.4
Total	301	97.7	6	1.9	1	0.3	308	100

Prominent bulbs at MRS make up 56.5% (n = 174) whilst weak bulbs and indeterminate bulb are around 20% (Table 5.31). The technique of production at MRS was direct percussion using hard hammer as indicated by platform and bulb attributes.

5.5.1.3 Comparing techniques of production at Klipdrift Cave and Matjes River Rock Shelter

Planar platforms are in the majority at both sites. However, the percentage of cortical platforms compared to plain platforms at MRS is higher than at KDC. Conversely, KDC has more plain platforms than cortical ones. These trends are consistent with core blank choices at both sites, where at KDC angular blanks dominate while at MRS cobble blanks are in the majority.

In terms of size, MRS (Table 5.25) platforms are larger than platforms from KDC. The MRS cortical platforms are almost 9 mm longer than cortical platforms from KDC while plain platforms at MRS are at least 7 mm longer than at the former site. The reason for this discrepancy may be in the smaller sample size of MRS, or the fact that KDC assemblage contains more blades. This size difference does not seem significant in technological terms, though, as will be discussed further below.

The dominant flaking technique at both sites was direct hard hammer percussion. This inference derives from the high incidence of planar platforms at both sites and prominent bulbs of percussion. Bipolar percussion is more evident at KDC, as the cores show, than at MRS. The near absence of bipolar flaking at MRS may be because of the rarity of quartz raw material, as bipolar percussion is arguably used more to flake quartz (e.g., Barham 1987) than quartzite.

5.5.2 Description of flakes and blades

5.5.2.1 Klipdrift Cave

Table 5.32 presents the proportions of flakes, blades and sections thereof at KDC. Flake fragments with no diagnostic characteristics are in the majority, almost constituting half (48.5%, n = 1134) of all the flakes and blades at KDC, and by far most of these are in quartzite (Table 5.32). Complete flakes and blades are only slightly above 20% while proximal pieces are 14.2% (n = 331). Medial and distal pieces together comprise c. 10%. A number of *éclat* siret (4.6%) occur at KDC (Table 5.32).

Table 5.32 Klipdrift Cave: Flakes, blades and sections thereof by raw material

Raw material	Quartzite		Quartz		Silcrete		Calcrete		CCS		Total	
Section	n	%	n	%	n	%	n	%	n	%	n	%
Complete	429	18.4	36	1.5	7	0.3	27	1.2	6	0.3	505	21.6
Proximal	294	12.6	24	1.0	2	0.1	10	0.4	1	0.04	331	14.2
Medial	117	5.0	19	0.8	1	0.04	5	0.2	0	0	142	6.1
Distal	87	3.7	16	0.7	0	0	1	0.04	0	0	104	4.5
Éclet siret	107	4.6	1	0.0	0	0	0	0	0	0	108	4.6
Lateral	9	0.4	2	0.1	0	0	1	0.04	0	0	12	0.5
Fragment >20 mm	1067	45.7	40	1.7	5	0.2	21	0.9	1	0.04	1134	48.5
Total	2110	90.3	138	5.9	15	0.6	65	2.8	8	0.3	2336	100

Metrical analysis has been undertaken for flakes and blades separately to determine to which degree the two classes differ (Table 5.33 & 5.34).

Table 5.33 Klipdrift Cave: flake descriptive statistics

Quartzite	Length	Width	Thickness	Pl length	Pl thickness
Mean	38.2	35	12	18	7.9
S.D.	15	14.6	6	9.4	4.7
Min	13.4	2.7	2.3	3	1
Max	105.1	133.2	82.3	72.8	28.5
n =	416	594	709	445	445
Calcrete	Length	Width	Thickness	Pl length	Pl thickness
Mean	29.8	27.7	9.6	16.8	6.6
S.D.	7.5	14.3	4.4	11.3	3.9
Min	20.9	12	3.7	5.2	1.4
Max	46.8	63.1	24.2	48.8	14.4
n =	17	25	25	22	22
Quartz	Length	Width	Thickness	Pl length	Pl thickness
Mean	28.8	20.1	9.2	9.5	5.9
S.D.	11	8.3	4.2	3.8	4.1
Min	14.7	5.4	1.8	4.8	2
Max	53.9	49.7	21	19.1	18.4
n =	15	36	38	17	17
CCS	Length	Width	Thickness	Pl length	Pl thickness
Mean	38.4	28	7.5	12	4
S.D.	16.6	8.9	3	5.3	1.8
Min	24.3	17	2.5	5.3	1.8
Max	60.4	40.5	10.5	18.1	6.2
n =	4	5	5	4	4

Silcrete	Length	Width	Thickness	Pl length	Pl thickness
Mean	22.9	23.6	7	18.2	4.7
S.D.	6.7	4.7	2.5	4	3.1
Min	11.5	17.1	4	13.1	2.8
Max	29.4	30.8	11.7	22.8	11
n =	6	7	7	6	6

The mean length, width and thickness of the quartzite flakes are 38.2 mm, 35.0 mm and 12.0 mm while mean platform length and thickness are 18.0 mm and 8.9 mm. The few CCS flakes have more or less similar dimensions as the quartzite flakes while the calcrete and quartz flakes are smaller than quartzite flakes. Silcrete flakes are the smallest in the KDC lithic collection with mean length of 22.9 mm, width 23.6 mm, and thickness of 7.0 mm and mean platform length and thickness of 18.2 mm and 4.7 mm (Table 5.33).

The mean length of quartzite blades at KDC is 43.1 mm, width 18.3 mm and thickness is 8.8 mm, and the mean length and thickness of the platforms are 10.4 mm and 5.3 mm respectively (Table 5.34).

Table 5.34 Klipdrift Cave: blade descriptive statistics

Quartzite	Length	Width	Thickness	Pl length	Pl thickness
Mean	43.1	18.3	8.8	10.4	5.3
S.D.	17.6	7.3	4.6	5.3	3.6
Min	16.9	4.4	2.1	1.7	0.9
Max	118.4	54.8	32.4	33.4	16.7
n =	130	333	334	215	215
Calcrete	Length	Width	Thickness	Pl length	Pl thickness
Mean	42.2	15.1	7.8	7.3	3.7
S.D.	14.5	6.6	5.1	5.3	3
Min	27.6	5.7	2.6	2.5	1
Max	72.6	33.3	19.2	18.4	9
n =	11	18	19	10	10
CCS	Length	Width	Thickness	Pl length	Pl thickness
Mean	41.75	16.7	11.85	0	0
S.D.	10.1	4.2	8.8	0	0
Min	34.6	13.7	5.6	0	0
Max	48.9	19.7	18.1	0	0
n =	2	2	2	0	0
Quartz	Length	Width	Thickness	Pl length	Pl thickness
Mean	21.7	9.5	4.7	5.2	3.3
S.D.	11.4	4	3.5	3.4	3.1
Min	9.8	4	1.3	2	0.5
Max	62.8	20.9	21	18.4	16
n =	25	59	60	33	33
Silcrete	Length	Width	Thickness	Pl length	Pl thickness

Mean	0	14	8.7	8.8	2.9
S.D.	0	9.3	4.6	8.1	1.2
Min	0	3.5	3.7	3	2
Max	0	21.2	12.7	14.5	3.7
n =	0	3	3	2	2

The assessment of dimensions shows that quartzite blades at KDC are longer than the flakes but smaller in all the other dimensions. This is also the case for the blades in the other raw materials, calcrete, silcrete and CCS blades. The quartz blades, on the other hand, are shorter than quartz flakes but narrower and thinner. Some of the blades may be referred to as bladelets (n = 49; 28 in quartzite, 19 in quartz, 1 in calcrete & 1 in silcrete) as they are <12 mm in width (e.g., Deacon 1982: 525; Orton 2004: 29; cf. Bar-Yosef & Kuhn 1999: 323). The majority of bladelets are in KAE (n = 26) and KAD (n = 17) with isolated incidences in layers JZ (n = 1), JZB (n = 2), KAB (n = 2) and KAC (n = 1). These bladelets do not strictly conform to the classic Robberg bladelets. Figure 5.8 shows selected samples of bladelets together with bladelet cores at KDC.

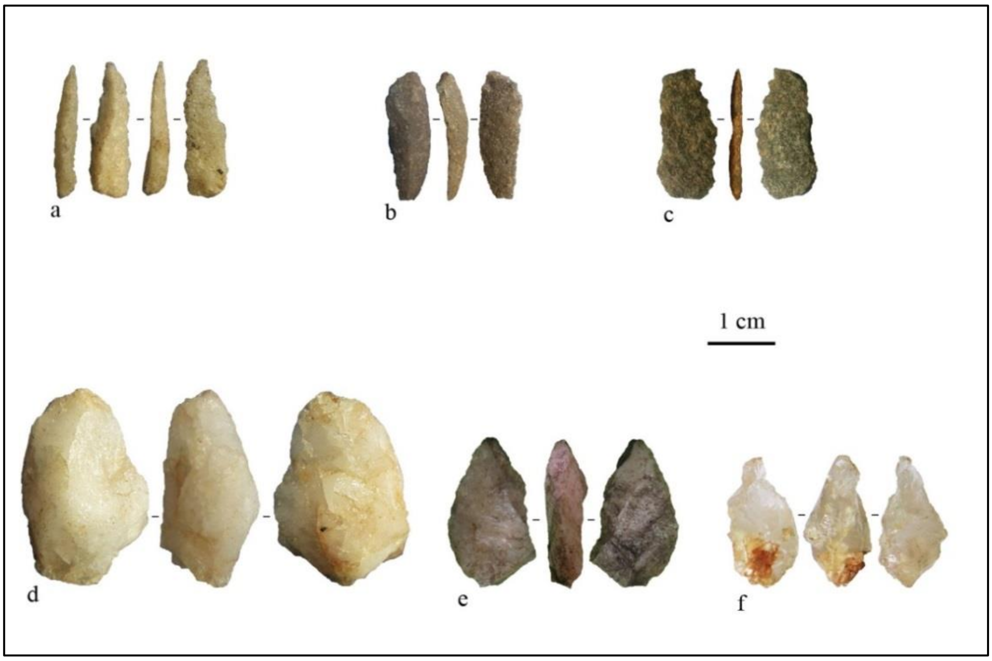

Figure 5.8 Klipdrift Cave: bladelets and bladelet cores. All bladelets are in quartzite while bladelet cores are in quartz. a, b & d) layer KAE, c & e) layer KAD f) layer KAB

The trends in dimensions of flakes and blades through time are evaluated in Tables 5.35 and 5.36. From Table 5.35 it is clear that the flakes and blades from KAE are smaller than the rest of the layers. This is possibly due to the influence of bladelets in this layer (n = 26). Therefore, the dimensions of only the quartzite flaked products were determined through time (Table 5.36) to investigate size trends.

Table 5.35 Klipdrift Cave: flake and blade descriptive statistics through time (all raw materials combined)

JYA & JY	Length	Width	Thickness
Mean	38.3	36.2	14.4
S.D.	10.2	9	3.6
Min	24.7	23.9	10.3
Max	51.4	55	22.6
n =	10	10	10
JZ	Length	Width	Thickness
Mean	45.7	40	14.2
S.D.	20.2	18.7	5.4
Min	17.4	10	5.2
Max	78.33	94	24.5
n =	17	17	17
JZA	Length	Width	Thickness
Mean	42.3	33.2	13.6
S.D.	11.7	14.6	5.6
Min	21.8	12.6	5.7
Max	79.9	79.7	28.3
n =	70	70	70
JZB	Length	Width	Thickness
Mean	38.3	30.7	12.4
S.D.	18.7	15.4	6.3
Min	15.7	10.1	3.7
Max	111.7	87.7	34
n =	66	67	67
KAB	Length	Width	Thickness
Mean	43.6	30	12.3
S.D.	20.9	14.9	6.2
Min	18.5	11.5	4.2
Max	118.4	81.7	29.1
n =	46	46	46
KAC	Length	Width	Thickness
Mean	40.5	27.2	10.8
S.D.	13.9	9.3	4.1
Min	18.7	2.7	3.8
Max	75.7	59.4	28.6
n =	64	64	64
KAD	Length	Width	Thickness
Mean	37.4	27.3	10.6
S.D.	16.9	16	5.5
Min	13.4	4.7	2.1

Max	105.1	83.2	30.2
n =	127	127	127
KAE	Length	Width	Thickness
Mean	32.2	22.2	8.6
S.D.	15.6	14.7	4.9
Min	9.8	3.5	1.4
Max	89.2	84.1	25.7
n =	98	98	98

When only quartzite flaked products are considered, the mean flake/blade length at KAE increases from 32.2 mm (see Table 5.35) to 36.4 mm (Table 5.36) and these become closer to those of KAD in size.

Table 5.36 Klipdrift Cave: quartzite flakes and blades descriptive statistics through time

JYA & JY	Length	Width	Thickness
Mean	39.1	34.1	14.7
STD	10.4	6.4	3.7
Min	24.7	23.9	10.3
Max	51.4	43.4	22.6
n =	9	9	9
JZ	Length	Width	Thickness
Mean	45.7	40.0	14.2
STD	20.2	18.7	5.4
Min	17.4	10	5.2
Max	78.33	94	24.5
n =	17	17	17
JZA	Length	Width	Thickness
Mean	42.8	33.8	13.6
STD	11.6	14.6	5.6
Min	22.6	12.6	5.7
Max	79.9	79.7	28.3
n =	67	67	67
JZB	Length	Width	Thickness
Mean	39.1	32.1	12.7
STD	19.5	15.9	6.6
Min	15.7	10.1	5.7
Max	111.7	87.7	34
n =	58	58	58
KAB	Length	Width	Thickness
Mean	44.5	31.0	12.5
STD	21.5	15.4	6.3
Min	18.5	11.5	4.2
Max	118.4	81.7	29.1
n =	41	41	41
KAC	Length	Width	Thickness
Mean	40.7	27.5	10.8
STD	14.0	9.6	4.0
Min	18.7	2.7	3.8

Max	75.7	59.4	28.6
n =	59	59	59
KAD	Length	Width	Thickness
Mean	38.9	29.3	11.3
STD	17.4	16.1	5.7
Min	13.4	4.7	2.1
Max	105.1	83.2	30.2
n =	102	102	102
KAE	Length	Width	Thickness
Mean	36.4	26.0	9.8
STD	15.4	15.3	5.0
Min	16.1	5.1	2.2
Max	89.2	84.1	25.7
n =	69	69	69

The trends in terms of length of the quartzite flakes and blades combined are shown in Figure 5.9 in Section 5.5.2.3. Layer KAE has the smallest flake sizes. There is an increase in flake size from layer KAE to KAB; mean length decreases a little in JZB. In KAD, the mean length of quartzite products is 38.9 mm, 40.7 mm in KAC and 44.5 mm at KAB. The mean length is less in JZB (39.1 mm) and increases again to 42.8 mm in JZA.

5.5.2.2 Matjes River Rock Shelter

Döckel (1998) classifies flakes as complete, broken and overhit. Complete flakes comprise 10.5% in Member LSL-C, 9.8% in Member LSL-L, 9.6% in Member LSL-U and 14.8% in the topmost Oakhurst member (Döckel 1998: 71). According to Döckel (1998: 71), overhit or *éclat* siret are exceptionally frequent and constitute between c. 60% and 71% of quartzite flakes in the Oakhurst members. She remarks (Döckel 1998:4) that "…even irregular flakes are frequently overhit, broken down the length because the blow initiating the release of the flake was misdirected." I re-analysed a sample of the MRS flakes (Table 5.37) using the approach adopted for this thesis.

Table 5.37 Matjes River Rock Shelter: flake and blade sections

Raw material	Quartzite		Quartz		CCS		Total	
Section	n	%	n	%	n	%	n	%
Complete	254	18.3	1	0.1	6	0.4	261	18.8
Proximal	47	3.4	0	0	0	0	47	3.4
Medial	6	0.4	0	0	0	0	6	0.4
Distal	5	0.4	0	0	0	0	5	0.4

Éclet siret	79	5.7	1	0.1	0	0	80	5.8
Lateral	4	0.3	0	0	0	0	4	0.3
Fragment >20 mm	979	70.6	3	0.2	1	0.1	983	70.9
Total	1374	99.1	5	0.4	7	0.5	1386	100

Table 5.37 presents combined statistics for flakes and blades at MRS although blades are <30 in number. Flake fragments >20 mm are in the majority, at 70.9% (n = 983) and complete flakes and blades are 18.8% (n = 261). In the re-analysed sample the frequency of what Döckel termed overhit (*éclat* siret) flakes is not as high as she reported for the complete sample. I found an incidence of 5.8% (n =80). Other flake sections such as proximal, distal, medial and lateral are rare. For example, proximal flakes constitute only 3.4% (n = 47) of the re-analysed sample (Table 5.37).

Table 5.38 presents the summary statistics of the re-analysed flake sample from MRS.

Table 5.38 Matjes River Rock Shelter: flake descriptive statistics

Quartzite	Length	Width	Thickness	Pl length	Pl thickness
Mean	42.6	40.0	12.1	26.4	9.8
S.D.	14.0	15.0	4.8	9.9	4.4
Min	20	13	3	4	2
Max	138	98	45	72	36
n =	319	287	369	278	278
CCS	Length	Width	Thickness	Pl length	Pl thickness
Mean	35.4	30.5	14.6	14.4	6.8
S.D.	7.4	17.8	9.9	11.6	5.4
Min	25	16	7	4	3
Max	43	60	31	33	16
n =	5	5	5	5	5
Quartz	Length	Width	Thickness	Pl length	Pl thickness
Mean	34.5	23	9.5	7	4
S.D.	12.0	0	2.1	0	0
Min	26	23	8	7	4
Max	43	23	11	7	4
n =	2	1	2	1	1

Quartzite flakes at MRS have a mean length of 42.6 mm, width 40 mm, thickness 12.1 mm; flake platform length is 26.4 mm and platform thickness 9.8 mm. The mean dimensions of CCS flakes are smaller than quartzite flakes (Table 5.38).

I investigated the dimensions of quartzite flakes through time at MRS (Table 5.39) to see whether there is a pattern as at KDC. This table shows that the size of quartzite flakes at MRS remain stable between members LSL-L and TSM-L. In Member LSL-L, quartzite mean flake length is 38.4 mm, 43.6 mm in LSL-U and 40.6 mm in TSM-L (Table 5.39). There is thus little variation in flake size through time at MRS. The size of the flakes in these members are similar to those from the upper layers of KDC.

Table 5.39 Matjes River Rock Shelter: quartzite complete flake descriptive statistics through time

TSM-L	Length	Width	Thickness
Mean	40.6	37.4	12.1
S.D.	12.6	14.1	4.9
Min	20	13	3
Max	75	90	31
n =	123	123	123
LSL-U	Length	Width	Thickness
Mean	43.6	42.5	12.4
S.D.	15.5	17.3	5.1
Min	20	13	5
Max	138	98	45
n =	113	113	113
LSL-L	Length	Width	Thickness
Mean	38.4	33.0	10.2
S.D.	11.4	8.7	4.9
Min	26	21	3
Max	55	50	18
n =	7	7	7

Although Döckel does not report on the occurrence of blades in the Oakhurst units, the re-analysis of the MRS sample shows that blades do occur, albeit in low quantities (Table 5.2), c. 1.4% of the re-analysed sample. These frequencies are proportionately lower than in the lowest layers at KDC (Table 5.3). Table 5.40 shows the dimensions of MRS blades.

Table 5.40 Matjes River Rock Shelter: quartzite blade descriptive statistics

Quartzite	Length	Width	Thickness	Pl length	Pl thickness
Mean	48.9	20.1	8.6	13.0	6.1
S.D.	17.8	5.9	3.5	4.8	3.7
Min	30	14	4	3	2
Max	99	33	15	22	13
n =	17	25	25	20	20

Blades at MRS have a mean length of 48.9 mm, width of 20.1 mm and thickness of 8.6 mm. Average blade platform length is 13 mm with a thickness of 6.1 mm. As at KDC, blades are thus longer but narrower than flakes.

5.5.2.3 Comparing Klipdrift Cave and Matjes River Rock Shelter flakes and blades

At both KDC and MRS the flake fragments dominate. Pieces considered as blades are more prevalent at KDC than at MRS. The incidence of complete flakes/blades at both sites is low, c. 22% at KDC (Table 5.32) and c. 19% at MRS (Table 5.37). The frequencies of *éclet* siret are minimal at both KDC (c. 5%) and MRS (c. 6%). The interpretation favoured here for the *éclet* siret is that they probably resulted from the use of hard hammer in flaking (e.g., Inizan *et al*. 1999: 156) and less from misdirected blows as Döckel (1998: 4) suggested.

In terms of size, blades are longer but narrower than flakes at both sites. Quartz flakes at MRS are rare but they are of the same size range as those from KDC. MRS CCS flakes are slightly shorter than those at KDC. The MRS quartzite flakes are slightly longer (by c. 4 mm) and wider (by c. 5 mm) than flakes of the same raw material in the KDC layers. There is a trend for flakes to increase in length at KDC, but MRS quartzite flakes do not show a real size difference through time (Figure 5.10).

Figure 5.9 below shows the trends in size for quartzite flakes from KDC and MRS. This figure indicates the variation between the KDC and MRS quartzite flakes in terms of length. The mean lengths of the flakes in the majority of layers at KDC (except KAB & JZA) are less than at MRS, particularly Member LSL-U.

A t-test result of the difference between the mean lengths of KDC and MRS quartzite flakes suggests that the observed difference between the two sets of flakes is significant as the P-value is 0.002. Whether this is informative in a technological sense is discussed below in Section 5.5.3.

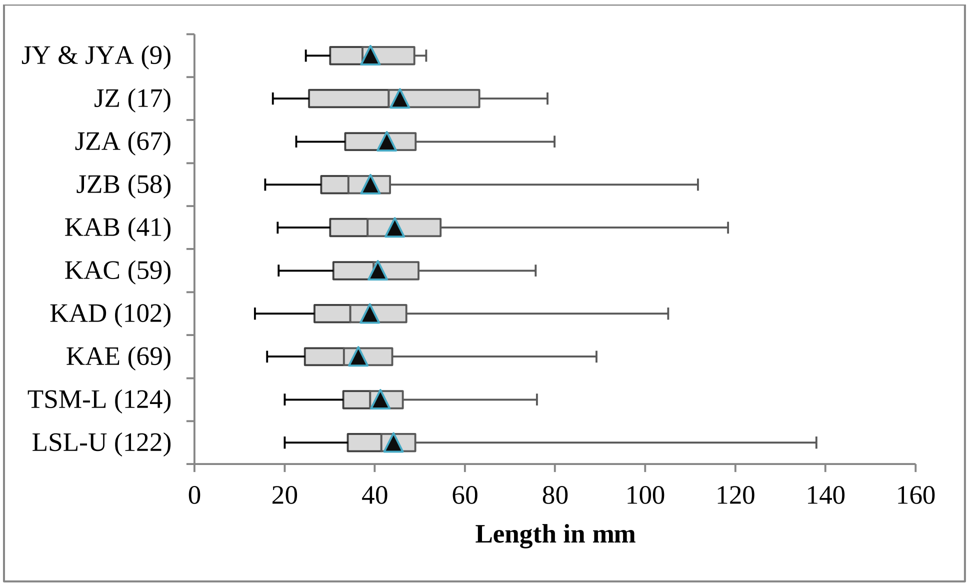

Figure 5.9 Matjes River Rock Shelter and Klipdrift Cave: box plots of the lengths of quartzite flakes through time. Numbers in parentheses indicate sample sizes. The vertical line near the centre of each box plot shows the median, the grey rectangle encloses the middle half of the data (25th and 75th percentiles), the small dark triangle shows the mean, and the whiskers indicate the range of values.

5.5.3 Technological classes

Complete flakes and blades were characterised in a number of technological categories as described in Chapter 4.

5.5.3.1 Klipdrift Cave

Table 5.41 presents technological classes of KDC flakes and blades.

Table 5.41 Klipdrift Cave: technological categories of complete flakes/blades by raw material

Raw material	Quartzite		Quartz		Calcrete		CCS		Silcrete		Total	
Technological category	n	%	n	%	n	%	n	%	n	%	n	%
Indeterminate	79	15.8	4	0.8	6	1.2	0	0	0	0	89	17.8
Angular	135	27	13	2.6	8	1.6	0	0	0	0	156	31.2
Unidirectional	105	21	10	2	7	1.4	2	0.4	1	0.2	125	25
Unidirectional convergent	6	1.2	0	0	0	0	0	0	0	0	6	1.2
Multidirectional scars	4	0.8	0	0	0	0	0	0	3	0.6	7	1.4
Débordant	36	7.2	2	0.4	4	0.8	1	0.2	0	0	43	8.6
Débordant with cortex	18	3.6	1	0.2	0	0	0	0	0	0	19	3.8
Débordant platform rejuvenation	9	1.8	0	0	1	0.2	2	0.4	0	0	12	2.4
Core management	28	5.6	0	0	0	0	1	0.2	1	0.2	30	6
Bipolar	1	0.2	5	1	0	0	0	0	0	0	6	1.2
Entame	5	1	1	0.2	0	0	0	0	1	0.2	7	1.4
Total	426	85.2	36	7.2	26	5.2	6	1.2	6	1.2	500	100

The main informative technological class is that of flakes exhibiting unidirectional flaking scars (e.g., Figure 5.10c, d & e) at 25% (n = 125). A substantial number of flakes have indeterminate dorsal faces (17.8%, n= 89). There are also many angular flakes (31.2%, n = 156) (Table 5.41) at KDC. Angular pieces are usually thick with few dorsal scars (see Figure 5.10a & b), and probably originated from the sides of cores. They do not conform, however, to the characteristics of débordant flakes in that they are irregular and not standardised in any way. *Débordant* flakes (e.g., Figure 5.11) make up 8.6% (n = 43) of the complete flakes/blades at KDC. *Débordant* blanks with cortex are 3.8% (n = 19) while *débordant* platform rejuvenation flakes constitute 2.4% (n = 12) at KDC. Core management flakes (e.g., Figure 5.12) form 6% (n = 30). Other flake types at KDC occur in minor frequencies (Table 5.41). The predominance of angular pieces and the high percentage of unidirectional flakes/blades (25%) indicate unidirectional exploitation of cores after minimal preparation at KDC.

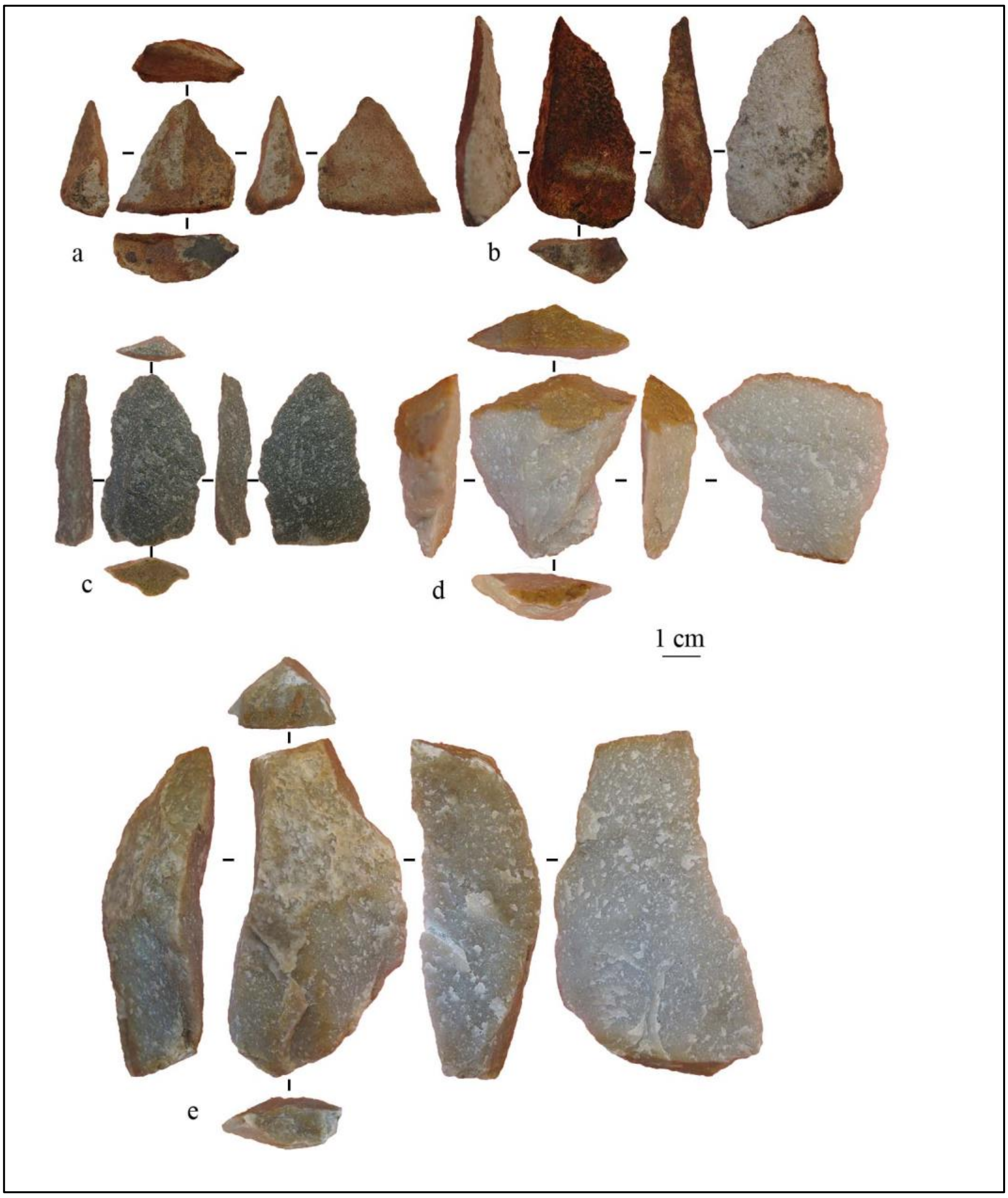

Figure 5.10 Klipdrift Cave: angular and unidirectional flakes in quartzite. a) Layer KAD, b) layer KAE, c) layer KAB, d) layer JYA, e) layer JZB

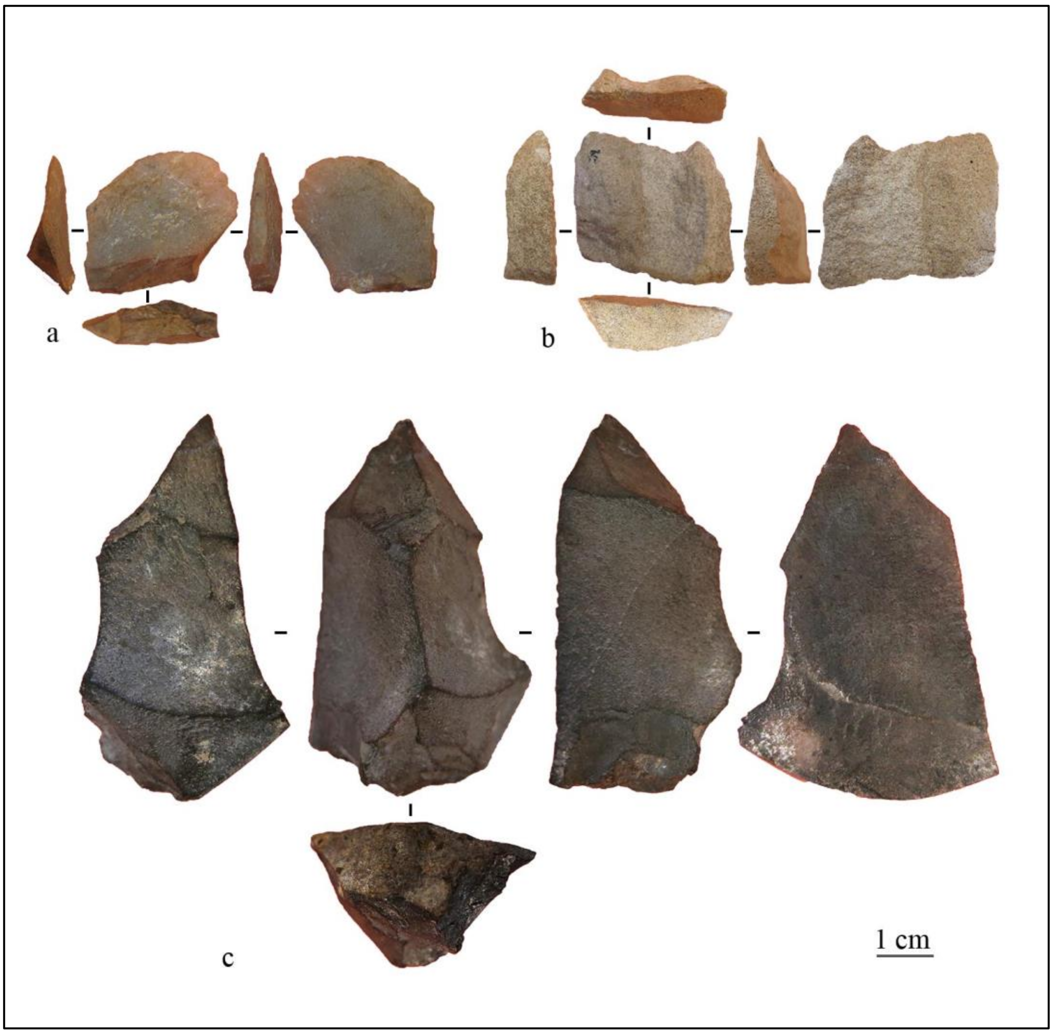

Figure 5.11 Klipdrift Cave: débordant flakes. a) CCS, layer KAE, b) calcrete, layer KAB, c) quartzite, layer KAE

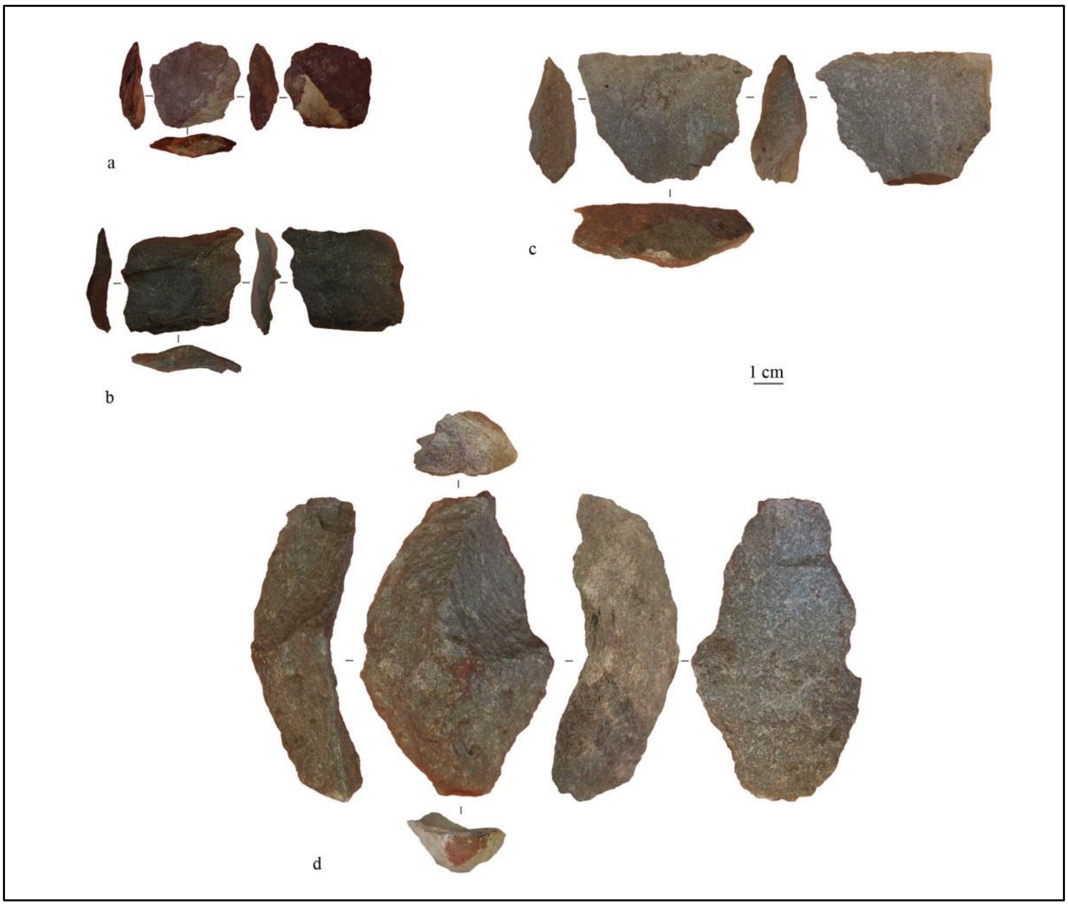

Figure 5.12 Klipdrift Cave: core management flakes. a) Silcrete, layer KAD, b) quartzite, layer KAD, c) quartzite, layer KAD, d) quartzite, layer KAB

Table 5.42 shows the amount of dorsal cortex on KDC whole flakes and blades.

Table 5.42 Klipdrift Cave: cortex percentage on whole flakes/blades

Code	% cortex	n	%
0	0	332	65.7
1	<25	109	21.6
2	25-50	29	5.7
3	50-75	22	4.4
4	>75	4	0.8
5	100	9	1.8
Total		505	100

Most of the flakes/blades at KDC have no dorsal cortex (65.7%, n = 332) with a significant amount (21.6%, n = 109) having only <25% cortex (Table 5.42). The general lack of dorsal cortex on flake/blade blanks is a consequence of the use of angular blanks for cores that rarely have cortex. At KDC there are only seven flakes with cobble cortex while all other flake pieces (n = 166) with dorsal cortex have natural cortex.

5.5.3.2 Matjes River Rock Shelter

The re-analysed sample of MRS flakes and blades are categorised (Table 5.43) like those of KDC.

Table 5.43 Matjes River Rock Shelter: technological categories of whole flakes/blades by raw material

Raw material	Quartzite		CCS		Quartz		Total	
Technological category	n	%	n	%	n	%	n	%
Angular	34	13.0	0	0	0	0	34	13.0
Unidirectional	177	67.6	2	0.8	1	0.4	180	68.7
Unidirectional convergent	2	0.8	0	0	0	0	2	0.8
Débordant	13	5.0	2	0.8	0	0	15	5.7
Débordant with cortex	14	5.3	1	0.4	0	0	15	5.7
Core management	1	0.4	1	0.4	0	0	2	0.8
Entame	7	2.7	0	0	0	0	7	2.7
Facetted	2	0.8	0	0	0	0	2	0.8
Indeterminate	5	1.9	0	0	0	0	5	1.9
Total	255	97.3	6	2.3	1	0.4	262	100

The results indicate that flakes with unidirectional scars are dominant at MRS, at 68.7% (n = 176) followed by angular pieces, 13.0% (n = 34). *Débordant* flakes make up around 11% in the re-analysed data at MRS. *Éntame* pieces in the MRS assemblage are rare (n = 7) and as Döckel (1998: 45) postulated, could suggest preparation of cores away from the site.

As at KDC, the amount of cortex on the flakes/blades was recorded for MRS flakes/blades (Table 5.44).

Table 5.44 Matjes River Rock Shelter: cortex percentage on whole flakes/blades

Code	% cortex	n	%
0	0	217	82.8
1	<25	23	8.8
2	25-50	6	2.3
3	50-75	4	1.5
4	>75	5	1.9

5	100	7	2.7
Total		262	100

Döckel (1998: 45) observed that more than 60% of flakes she analysed had no dorsal cortex and my re-analysis supports her observation where 82.8% (Table 5.44) of complete flakes have no dorsal cortex.

5.5.3.3 Comparing flake/blade technological classes between Klipdrift Cave and Matjes River Rock Shelter

At KDC, angular flakes are the most abundant (31.2%) while unidirectional flakes occur next more frequently (25%). At MRS, the same two classes dominate, but here unidirectional flakes (68.7%) occur more frequently than angular flakes (13%). The difference is due to the selection of core blanks. Flaking angular blocks produces more pieces of this nature, as is the case at KDC. The unidirectional reduction of cores was common practice at both sites because of the high frequency of flakes with unidirectional flake scars.

The other types of flakes occur in largely similar proportions at both sites. There are low frequencies of flakes with multidirectional scars at KDC but not present at MRS. Flakes without dorsal cortex are dominant at both KDC and MRS. The cause for this, as discussed above, may lie in the use of angular blocks at the former site, while at MRS primary flaking outside the shelter explains the lack of dorsal cortex.

5.6 Retouch and use

This section describes the formal tools represented at KDC and the re-analysed sample from MRS. Raw material type, choice of blank for tool manufacture, type of retouch, position and extent of retouch are considered. I also discuss the possible function of the tools here.

5.6.1 Klipdrift Cave

Quartzite is the main raw material for the manufacture of formal tools, accounting for almost all of the formal tools (35 out of 38 formal tools are on quartzite). Two formal tools are in calcrete and one in silcrete. Most of the formal tools at KDC are scrapers (n = 16, c. 42% of all formal tools) although tools with miscellaneous or informal retouch (n = 14), referred to as 'retouched', are as numerous as scrapers. Other tools include notched pieces, denticulates, an adze, and 1 *piece esquillée* (Table 5.45).

Table 5.45 Klipdrift Cave: formal tools per layer

Tool type	KAE	KAD	KAC	KAB	JZB	JZA	JZ	Total	%
Scrapers	7	3	3	2	0	0	1	16	42.1
Retouched	0	7	1	1	2	3	0	14	36.8
Notched	0	1	1	0	0	2	0	4	10.5
Denticulates	0	1	0	0	0	0	1	2	5.3
Adze	0	1	0	0	0	0	0	1	2.6
Piece *esquillée*	0	0	0	1	0	0	0	1	2.6
Total	7	13	5	4	2	5	2	38	100

Most of the formal tools occur in the lowermost two layers, KAE and KAD at KDC, and continue to occur in low frequencies from layer KAC to layer JZ. There are no formal tools in the uppermost two layers, JYA and JY perhaps due to sample size. Notched tools are the next most numerous formal tools after scrapers and 'retouched' tools. There are only two denticulates. A *piece esquillée* (scaled piece) present at KDC is classified as a formal tool (Table 5.45), but the possibility cannot be excluded that it is an utilised piece in the terms that Deacon (1982: 533) discussed. The adze is a heavy tool on a plaque-like piece, steeply and continuously retouched on the one edge (Figure 5.13). The thick edge opposite the adze-like retouch (to the right of Figure 5.13) has a black substance adhering to it.

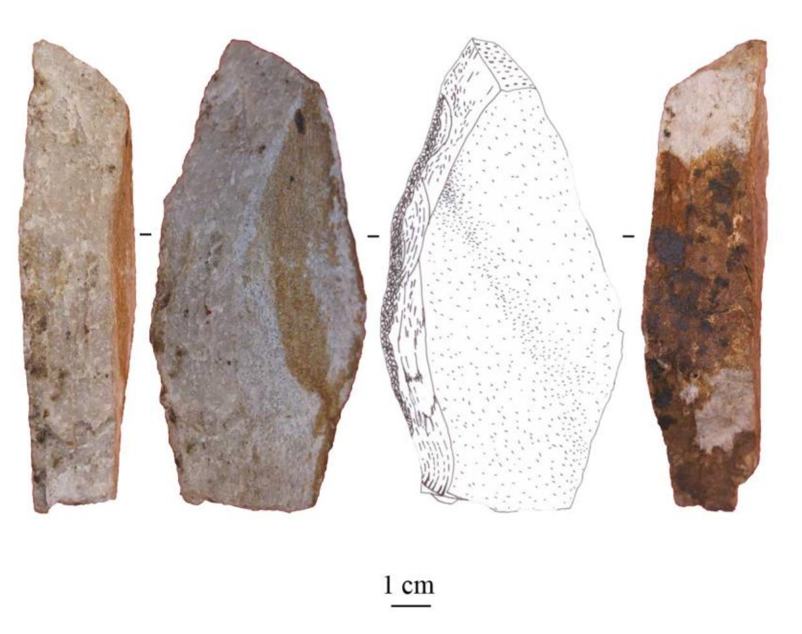

Figure 5.13 Klipdrift Cave: an adze in quartzit from layer KAD showing various views of the same retouched edge. The image on the far right shows the lateral side opposite the scraper edge, covered by a black sticky substance

The majority of the blanks selected for retouch at KDC are flakes (84.2%, n = 32), but three cores (7.9%) were chosen as blanks for manufacture of scrapers. These cores include two unidirectional cores and one irregular core. A few blades (n = 3) were also selected as blank for a denticulate and two retouched tools (Table 5.46).

Table 5.46 Klipdrift Cave: blanks selected for tool manufacture

Tool type	Flake	Blade	Core	Total
Scraper	13	0	3	16
Retouched	12	2	0	14
Notched	4	0	0	4
Denticulate	1	1	0	2
Adze	1	0	0	1
Piece esquillée	1	0	0	1
Total	32	3	3	38
% of chosen blank	84.2	7.9	7.9	100

More than half (n = 21, 55.3%) of the formal tools at KDC are retouched from the dorsal side and c. 37% on the ventral side (Table 5.47). The position of retouch for three pieces could not be determined because it was not possible to orient them into recognisable positions (e.g. ventral, dorsal, platform). There appears to be no pattern in terms of the position of retouch on the tools (see Table 5.47).

Table 5.47 Klipdrift Cave: position of retouch on formal tools

Tool type	Dorsal	Ventral	Indeterminate	Total
Scraper	8	7	1	16
Retouched	9	4	1	14
Notched	3	1	0	4
Denticulate	1	1	0	2
Adze	0	1	0	1
Piece *esquillée*	0	-	1	1
Total	21	14	3	38
% retouch position	55.3	36.8	7.9	100

The extent of retouch for the KDC tools was determined as shown in Table 5.48. The majority of formal tools at KDC have very marginal (39.5%, n= 15) to marginal (28.9%, n= 11) retouch. Other tools (15.8%, n= 6) have short to medium retouch whilst notched pieces have steep retouch (Table 5.48). Therefore, marginal retouch characterises most of the formal tools at KDC.

Table 5.48 Klipdrift Cave: extent of retouch

Tool type	Very marginal	Marginal	Short to medium	Medium to covering	Steep	Total
Scraper	3	7	4	2	0	16
Retouched	11	3	0	0	0	14
Notched	0	0	0	0	4	4
Denticulate	0	0	2	0	0	2
Adze	0	0	0	0	1	1
Piece *esquillée*	1	0	0	0	0	1
Total	15	11	6	2	5	38
% extent of retouch	39.5	28.9	15.8	5.3	10.5	100

5.6.1.1 Klipdrift Cave scrapers

The majority (43.8%, n = 7) of scrapers at KDC occur in the lowermost layer, KAE and all scrapers, except one in calcrete, are in quartzite. There are end and side scrapers at KDC. Eight end scrapers and eight side crapers occur (Table 5.49).

Table 5.49 Klipdrift Cave: scraper types per layer

Scraper type	KAE	KAD	KAC	KAB	JZB	JZ	JYA	JY	Total
End scraper	3	2	1	1	0	0	0	0	7
End scraper on core	1	0	0	0	0	0	0	0	1
Side scraper	2	0	2	1	0	1	0	0	6
Side scraper on core	1	1	0	0	0	0	0	0	2
Total	7	3	3	2	0	1	0	0	16
%	43.8	18.8	18.8	12.5	0	6.3	0	0	100

The end scrapers at KDC are not standardised in extent of retouch or blank size but the majority of them occur on complete flakes while one is on a core. One typical end scraper is in calcrete (Figure 5.14b) while the other is in fine-grained quartzite on a flake with more than 75% cortex (Figure 5.14a). The scraper retouch on the calcrete piece occurs on the dorsal side while on the fine quartzite piece retouch is towards the ventral side.

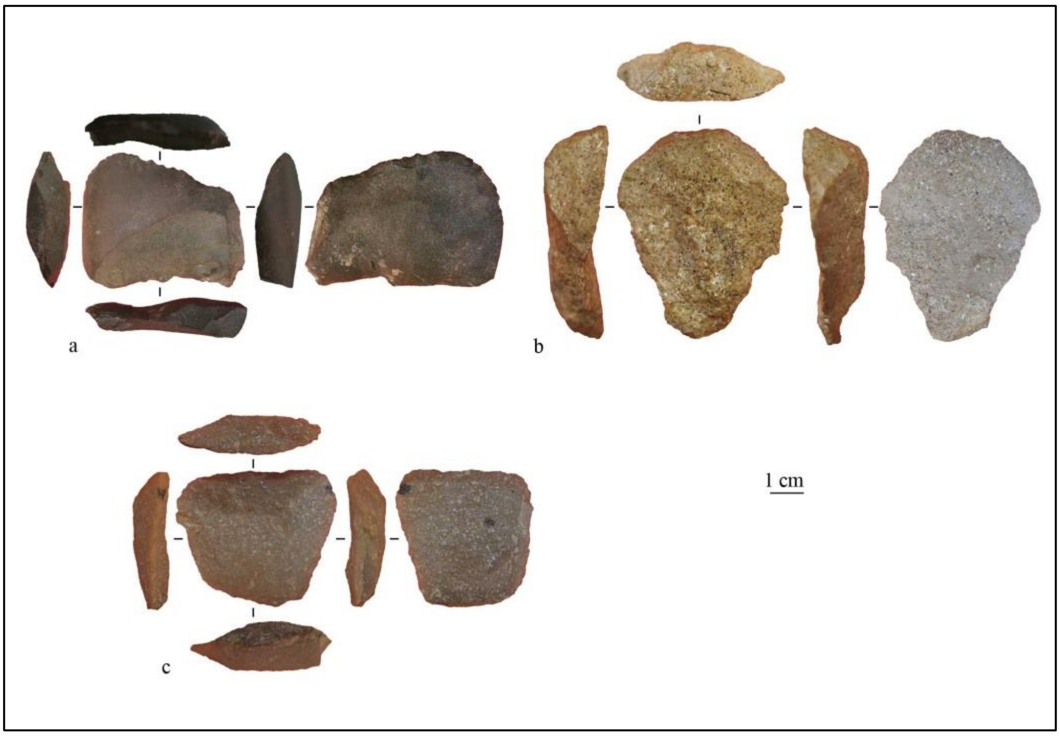

Figure 5.13 Klipdrift Cave end-scrapers. a) Quartzite from layer KAC, b) calcrete, layer KAB, c) quartzite, layer KAD

The side scrapers, like end scrapers, are also not standardised. Two of the side scrapers occur on core blanks; two are on complete flakes and four are on flake fragments. One side scraper on a complete flake (Figure 5.15b) resembles a D-shaped scraper. One of the side scrapers from layer KAC is ochre-stained on the scraper edge (Figure 5.15a).

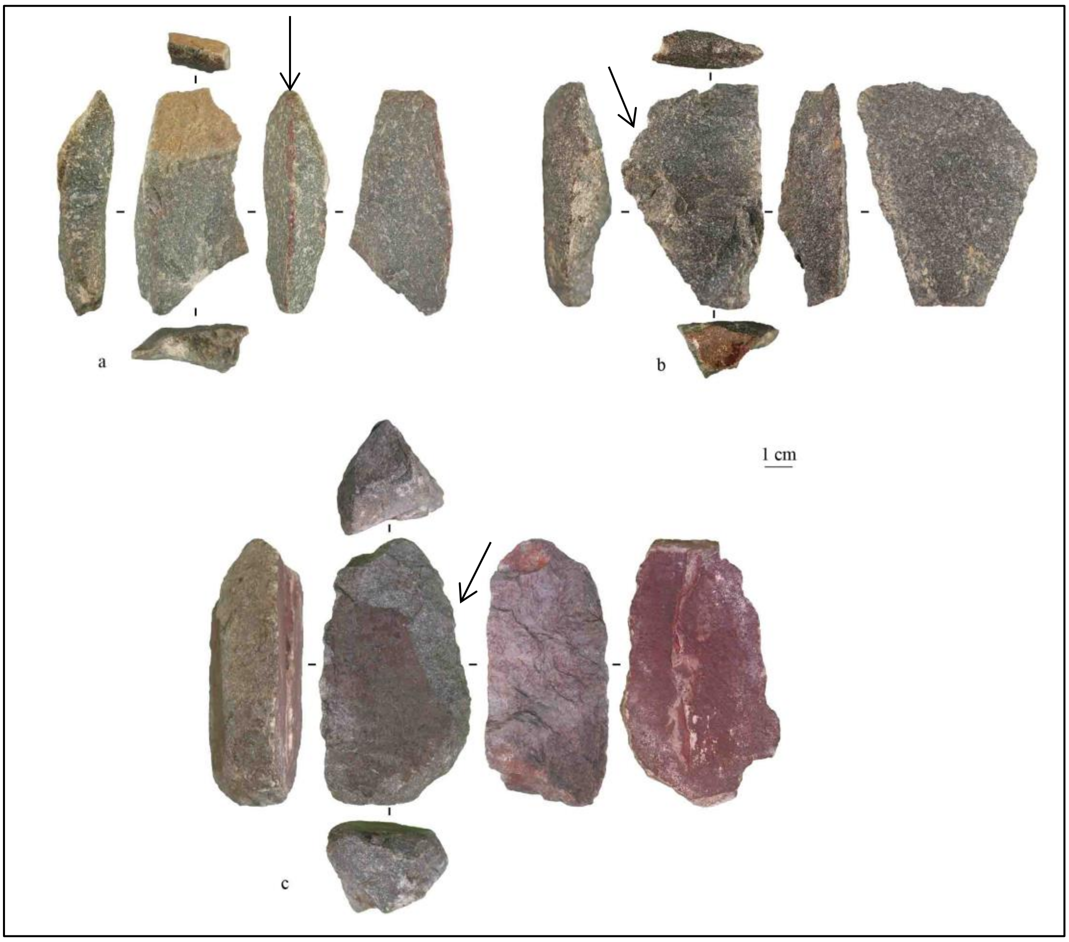

Figure 5.15 Klipdrift Cave side scrapers in quartzite. a) Layer KAC, b & c) layer KAE (the arrows indicate the direction of the the scraper edge)

I calculated the mean length, width and thickness for scrapers for layers KAE, KAD and KAC (Table 5.50). In KAB, there is only one measurable scraper, and its length is 62.7 mm, width 50 mm and thickness 13.1 mm. The one scraper in JZ is on a medial flake and its width is 69 mm and thickness 25.5 mm.

Table 5.50 Klipdrift Cave: descriptive statistics for scrapers through time

KAC	Length	Width	Thickness
Mean	60.4	46.6	19.9
S.D.	28.8	5.5	6.0
Min	40	41.8	13.2
Max	80.8	52.6	24.7
n =	2	3	3
KAD	Length	Width	Thickness
Mean	69.9	71.2	23.3
S.D.	22.3	12.9	12.1
Min	44.5	60.8	11.6
Max	86.2	85.6	35.8
n =	3	3	3
KAE	Length	Width	Thickness
Mean	73.6	48.8	25.2
S.D.	29.3	10.9	13.0
Min	39.5	32.1	10.1
Max	119.1	63.3	48.7
n =	5	6	6

There is very little difference in length of the scrapers from KAE to KAD – the mean lengths are 73.6 mm and 69.9 mm respectively (Table 5.50). The scrapers in KAC show a marked decrease in size (mean length 60.4 mm, width 46.6 mm and thickness 19.9 mm) compared to the two lowermost layers.

5.6.2 Matjes River Rock Shelter

Döckel (1998: Table 18) identified only two formal tools (scrapers) from the Oakhurst layers but during this re-analysis I identified six scrapers, seven notched tools and one tool with informal retouch (‘retouched’). All these formal tools are from the upper two members, LSL-U and TSM-L (Table 5.51), but this may be due to the sampling strategy. All the retouched tools (n = 14) in the re-analysed sample at MRS are in quartzite – there are four end scrapers and two side scrapers.

Table 5.51 Matjes River Rock Shelter: formal tool types per member

Tool type/Member	TSM-L	LSL-U	LSL-L	LSL-C	Total
Notch	5	2	0	0	7
Scraper	3	3	0	0	6
Retouched	1	0	0	0	1
Total	9	5	0	0	14

All the formal tools at MRS occur on flake blanks. Of the six scrapers, three occur on complete flakes, two on distal flake sections and one on an *éclat* siret flake. The scrapers have marginal retouch while the notched tools have steep retouch. All scrapers have retouch from the dorsal side.

Table 5.52 presents descriptive statistics, mean length, width and thickness, for the MRS scrapers.

Table 5.52 Matjes River: descriptive statistics for scrapers

Matjes River	Length	Width	Thickness
Mean	60	46.8	14
S.D.	12.7	20.5	3.6
Min	48	23	9
Max	75	78	18
n =	4	5	6

The scrapers at MRS have a mean length of 60 mm, width of 46.8 mm and mean thickness of 14 mm. The sample is too small to show trends in size through time.

5.6.3 Comparing the formal tool component at Klipdrift Cave and Matjes River Rock Shelter

The KDC and MRS assemblages analysed here have mostly the same range of formal tool type, but denticulates, adzes and *piece esquillées* are not present at MRS. Blank selection for formal tools at KDC includes cores and flakes while at MRS all formal tools occur on flakes. At KDC, there is no pattern with regards to the position of retouch for scrapers because one half was dorsally retouched while the remaining half was ventrally retouched. At MRS, all scrapers exhibit dorsal retouch. There is decrease of size through time for scrapers at KDC while this assessment was not possible for MRS scrapers due to a small sample size. However, the mean scraper size at MRS is similar to the average scraper size in layer KAC at KDC.

5.6.4 Tool function

The function of the main formal tool classes at KDC, the scrapers, notched tools and denticulates are not known. Although the function of the scrapers is debated (see Deacon & Deacon 1980), ethnographic observations provide clues. For example, the function of large scrapers studied in an ethnographic context by Gallagher (1977) in Ethiopia relate to the working of hides of larger animals (Deacon & Deacon 1980: 35).

Adzes may have been woodworking tools (Clark 1958; Goodyear 1982; Binneman 1983; Binneman & Deacon 1986) and experimental studies (Binneman & Deacon 1986; Gaertner 1994) support this hypothesis. Experimental and microwear analysis of LSA adzes from BPA (Binneman & Deacon 1986: 225), for instance, suggests they were used for the "manufacture and maintenance of wooden tools" such as digging sticks, bows and pegs.

Denticulated and notched tools might also have been used for working wood (Clark 1958), for example for making pegs or wooden spear points by whittling, as experiments undertaken by Arnold (2009) suggest. However, these tools may not have been exclusively used for woodworking (Arnold 2009: 6). Furthermore, edge wear studies (e.g., Beyries 1988) suggest that denticulates and notched tools may have been used to work wood, skin, antler, meat and bone, making them multipurpose than specialised tools.

The large scrapers that occur at KDC could have been used for a variety of functions including hide processing. Adzes, denticulates and notches may have served as multipurpose tools, including woodworking. These hypotheses need further testing with microwear, usewear, edge wear and experimental studies.

5.7 Discussion

Having discussed the results of the lithic analysis for KDC and MRS, in this section I draw comparisons between KDC and MRS with broadly contemporaneous southern Cape Oakhurst sites in terms of assemblage composition, raw material selection, methods and techniques of production, retouch and use of formal tools.

Flakes are the dominant lithic class at KDC (excluding pieces <20mm) as at other Oakhurst sites in the southern Cape, such as MRS and NBC. At BPA chips (<10 mm) dominate because of the use of quartz (Deacon 1982). The high incidence of pieces <20 mm at KDC may also be partly due to the use of quartz, as at BPA (see Deacon 1982: 143). The artefact class of blades are rare or absent in Oakhurst occurrences in the southern Cape (Deacon 1982: 229; Döckel 1998: 69). In the MRS sample, re-analysed blades were indeed rare, c. 1.4% of the re-analysed sample, and in this, it resembles the frequencies of blades from layer KAC upwards at KDC. The frequency of blades at KDC especially in the lowermost two layers where they constitute c. 20% of the assemblage is unlike other Oakhurst sites in the southern Cape.

As discussed in Chapter 4, raw material selection may be a result of choices made by prehistoric knappers and availability but can also reflect distances travelled in sourcing them (Deacon 1982: 118). Sources of raw materials may also be covered or become exposed due to changing environments (Wadley 1993). At KDC, as at MRS and NBC, raw materials such as silcrete, chalcedony, and calcrete are generally rare or absent while quartzite is dominant at these sites. At KDC this is especially so from layer KAC upwards, where it constitutes c. 80% of each layer total. The proportions of quartz at KDC are higher than at both MRS and NBC. Especially the lower layers at KDC (KAE & KAD) show a higher incidence of quartz (c. 33% versus c. 18% in the other layers). The raw material selection at KDC seems to somewhat resemble that of unit GSL at NBC, the layer in contact with the the Robberg Industry. In this lowermost Oakhurst layer, quartzite constitutes c. 86% while quartz is at c. 5% and chalcedony 6% (Deacon 1982: 229). This is the only other Oakhurst occurrence in the southern Cape coast with at least 5% of quartz in some units as a component of the raw material (see Deacon 1982: 229).

The methods of production at KDC and MRS involved minimal preparation of cores before flake removals and when organised, reduction was unidirectional. At MRS and NBC, quartzite cobbles were used as blanks while at KDC angular quartzite blocks were predominant. At KDC and MRS, as in other Oakhurst occurrences in the southern Cape, cores do not show organised patterns of reduction (Deacon 1982; Wadley 1993; Döckel 1998). However, at KDC there is a change through time in the core attributes. In the lowermost two layers, the cores are larger and bladelet cores occur mainly in layer KAE. In this regard, the closest resemblance again seems to be with the lowermost Oakhurst unit at NBC, layer GSL (Deacon 1982: 238) where two bladelet cores occur. At KDC, and perhaps at NBC, the presence of bladelets and bladelet cores in the lower layers may indicate overlap with Robberg lithic technological practices in the early Oakhurst. The KDC bladelets may conform typologically to this class, but are less regular than most of the Robberg bladelets. The lowermost KAE layer dates to 11.8 ka and layer GSL at NBC to 12 ka, consistent with this hypothesis.

The main technique of flake production at KDC and MRS was the use of hard hammer percussion as attested by the high incidences of planar platforms, broken platforms, *éclat* siret, and large and prominent bulbs of percussion. This technique was probably wide spread during the Oakhurst in the southern Cape although platform and bulb conditions have not been explicitly addressed in the publications on the other occurrences. At KDC, there is minimal use of the bipolar technique, mainly on quartz. Although Deacon (1982) does not mention this technique, it may have been important at BPA where quartz is abundant.

The flakes from KDC and MRS, like other Oakhurst sites in the southern Cape, are large, often quadrilateral or irregular in shape (Deacon 1982; Wadley 1993; Döckel 1998). At KDC, there is a trend for flakes to become larger through time and this trend has been observed by Deacon (1982: Figure 47) for the NBC Oakhurst flakes. The mean flake lengths through time at NBC and KDC are very similar; layer GSL at NBC is similar to KAE at KDC (32.2 mm) while the younger layes at NBC correspond to younger layers at KDC (from layer KAB upwards).

The range and frequencies of formal tools at KDC and MRS are low as in other Oakhurst sites such as NBC and BPA, ranging from 0.3% at KDC, 0.2% at NBC (Deacon 1982: 231), 0.6% at BPA (Deacon 1982: 237) to 0.06 at MRS. (Döckel 1998: 73). The latter is probably an underestimate as more tools were observed during this re-analysis than described by Döckel (1998). Formal tools in the KDC and MRS assemblages are dominated by large side and end scrapers, which occur mainly in quartzite. In the NBC Oakhurst layers, retouch commonly occurs at the end of the piece (i.e. end scrapers) but in samples dated from 9–8 ka “retouch also occurs down the sides or the piece has naturally steep sides” (Deacon 1982: 165).

The scrapers from the lowermost two layers at KDC are larger than most other scrapers reported for the southern Cape (Table 5.53; Figure 5.16). Other than that, there is a trend for scrapers to decrease in size through time at KDC. This is also the case in other southern Cape sites such as NBC (Deacon 1982) as shown in Table 5.53.

Table 5.53 Oakhurst scraper dimensions at four southern Cape sites (data for Nelson Bay Cave & Boomplaas Cave are from Deacon 1982: Tables 36, 37, 39, 57)

KDC - layers KAC-JZA	Length	Width	Thickness
Mean	58	55.5	18.5
S.D.	17.9	13	6.2
Min	40	41.8	12.3
Max	80.8	73.8	25.5
n =	4	6	6
KDC - layers KAE-KAD	Length	Width	Thickness
Mean	78	56.5	24.7
S.D.	29.3	14.7	11.3
Min	39.5	32.1	10.1
Max	124.2	85.6	48.7
n =	9	10	10
MRS (this thesis)	Length	Width	Thickness
Mean	60	46.8	14
S.D.	12.7	20.5	3.6
Min	48	23	9
Max	75	78	18
n =	4	5	6
NBC layer J (Deacon 1982: 265-6, 268)	Length	Width	Thickness
Mean	46.8	36.2	13.2

S.D.	25.9	17.8	3.3
Min	28	21	11
Max	101	66	21
n =	9	9	9
NBC - layers BSBJ-GSL (Deacon 1982: 265-6, 268)	Length	Width	Thickness
Mean	59.3	65.4	26.5
S.D.	21.1	20.4	11.7
Min	35	36	9
Max	103	101	42
n =	8	8	8
Boomplaas - layer BRL (Deacon 1982: 287)	Length	Width	Thickness
Mean	25.8	25.8	10.4
S.D.	12.4	11	4.7
Min	7	9	2
Max	71	70	30
n =	93	93	93

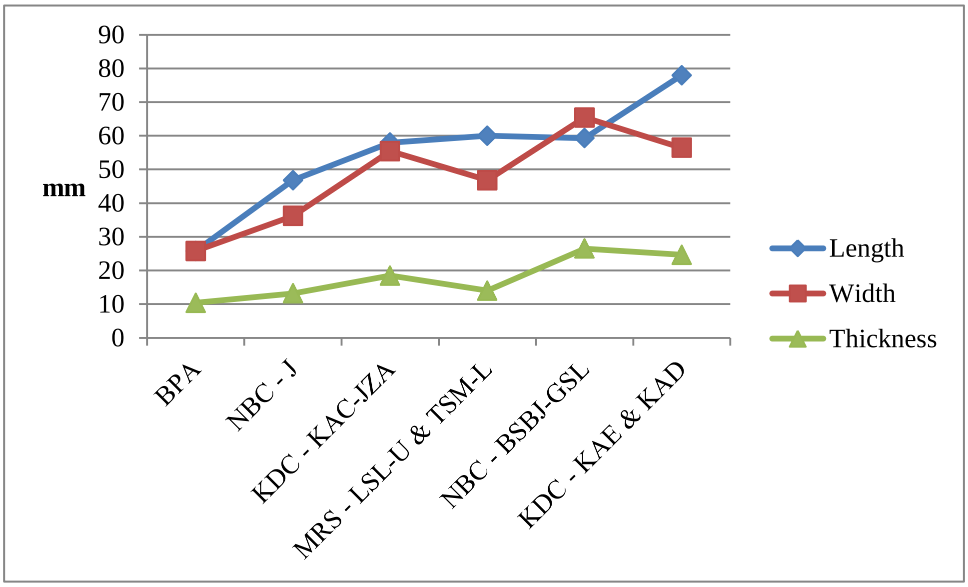

Figure 5.16 Comparison of mean scraper size in the southern Cape Oakhurst sites through time

Figure 5.16 shows that scrapers from BPA are smaller than the rest of the sites in the southern Cape in all dimensions. The scrapers from layers KAC–JZA at KDC have a similar mean length as those from the upper layers of NBC and members LSL–U/TSM–L at MRS. The mean width of scrapers from the lower layers of NBC is larger than at KDC and MRS (Figure 5.16).

5.8 Conclusion

The KDC and MRS lithic assemblages are typical of the Oakhurst period in terms of blank production and the presence of large unstandardised scrapers. The dating results (Chapter 3) indicate that KDC occurs chronologically in the early phase of the Oakhurst (12–10 ka) while MRS falls in the latter phase (10–8/7 ka). In terms of the flaking method, techniques and formal tools, the two sites are similar to other Oakhurst sites in the southern Cape, suggesting that the fashion of lithic reduction method was a regional adaptation. Especially the formal tools, which sometimes are regarded as representing a more patterned technological behaviour (Deacon 1982), are similar in terms of size and range of tools in the southern Cape Oakhurst sites, indicating that the design used to manufacture tools was also a shared behaviour between Oakhurst populations. In spite of these similarities, this study highlighted changes through time at KDC. Layers KAE and KAD are different from the other layers in a number of respects. First, there is more quartz utilisation in these layers and higher frequencies of cores that are larger. The flakes are smaller and blades and bladelets are more prevalent. In addition, there are relatively higher frequencies of scrapers, which are larger than the layers above. The lowermost two layers at KDC are most similar to the lowest Oakhurst layer at NBC, GSL. At KDC, and perhaps at NBC, technological remnants of the Robberg period are evident. The analysis of the KDC and MRS assemblages indicate that the Oakhurst in the southern Cape was not a stagnant technological convention but present subtle changes through time and space.

6. RESULTS OF SHELLFISH AND TORTOISE REMAINS

6.1 Introduction

In this chapter, I discuss the role of shellfish and tortoises in the subsistence patterns of the KDC inhabitants. Three main issues are investigated: the nature of marine shellfish exploitation, the intensity of shellfish and tortoise collection, and the extent to which climate and environmental conditions can be deduced from this data.

In the following sections the species present at KDC are examined in terms of the MNI, weight of the shells, and measurements of *T. sarmaticus* opercula, *C. oculus* shells and the angulate tortoise, *Chersina angulata*, medio-lateral humeri. The dietary contribution of the five most common shellfish species is reconstructed using MNI while shell weights of *T. sarmaticus* and *D. gigas* are converted into kilojoules. The shellfish subsistence patterns at KDC are compared with those from the Oakhurst levels at MRS and NBC. The results of the shellfish and tortoise analyses at KDC are then used to infer local climatic and environmental conditions during the occupation of the site.

6.2 Klipdrift Cave shellfish species

In this this section, I present the shellfish species found at KDC and assess the density of shellfish through time. The littoral of the nearby Indian Ocean, that is the shore zone between high and low tide points, and the zonation of shellfish species within this region are described. Of specific relevance is the location of the species found at KDC within the littoral.

The analysis of the KDC shellfish has produced eleven molluscs that could be identified to species level. These include *T. sarmaticus, D. gigas, Diloma* spp., *C. oculus, P. perna, Haliotis midae, H. spadicea*, *B. cincta*, *D. serra* and *S. spengleri* (Table 6.1).

Both *Diloma sinensis* and *D. tigirina* are present in the shellfish collection but, as the apices are usually separate from the identifiable body whorl, the shell weights and MNI have been combined for these two species and listed as *Diloma* spp. here. No shell fragments of *D. variegata* were found, and it is therefore assumed that only the former two species are represented by the apices of this Family at KDC. All of the species identified occur in the southern Cape today, and no cold water indicator species (e.g., *C. granatina*) are present.

Table 6.1 Klipdrift Cave: frequencies and percentage frequencies of shellfish species based on MNI (percentage in terms of layer total)

Layer	JY		JYA		JZ		JZA		JZB		KAB		KAC		KAD		KAE		Total	
Species	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
T. sarmaticus	279	73	167	56	280	51.9	196	63.6	14	31.1	22	14.7	17	10	44	2.4	32	2	1051	19.7
D. gigas	53	13.9	83	27.9	137	25.4	85	27.6	25	55.6	107	71.3	132	77.6	1771	95.5	1527	96.6	3920	73.6
Diloma spp.	3	0.8	10	3.4	65	12	13	4.2	1	2.2	1	0.7	1	0.6	3	0.2	1	0.1	98	1.8
C. oculus	33	8.6	31	10.4	46	8.5	2	0.6	1	2.2	1	0.7	1	0.6	1	0.1	1	0.1	117	2.2
P. perna	4	1	1	0.3	1	0.2	0	0	1	2.2	1	0.7	1	0.6	0	0	0	0	9	0.2
H. midae	1	0.3	1	0.3	0	0	1	0.3	0	0	1	0.7	0	0	0	0	0	0	4	0.1
H. spadicea	0	0	0	0	0	0	1	0.3	0	0	0	0	0	0	0	0	0	0	1	0.02
B. cincta	1	0.3	0	0	1	0.2	1	0.3	1	2.2	6	4	14	8.2	24	1.3	17	1.1	65	1.2
D. serra	7	1.8	4	1.3	9	1.7	8	2.6	1	2.2	10	6.7	3	1.8	5	0.3	2	0.1	49	0.9
S. spengleri	1	0.3	1	0.3	1	0.2	1	0.3	1	2.2	1	0.7	1	0.6	6	0.3	1	0.1	14	0.3
Total	382	100	298	100	540	100	308	100	45	100	150	100	170	100	1854	100	1581	100	5328	100

The density of shellfish from each layer and per cubic metre (kg/m^3, Bailey 1975) of excavated material is presented in Figure 6.1. This shows that the density is highest in the uppermost three (JZ, JYA & JY) and the lowermost two (KAE & KAD) layers while the density decreases between KAC and JZA. Of all the layers, KAD has the highest density of shells (374.2 kg per m^3) while JZB has the lowest density, at 28.7 kg per m^3 (Table 6.2).

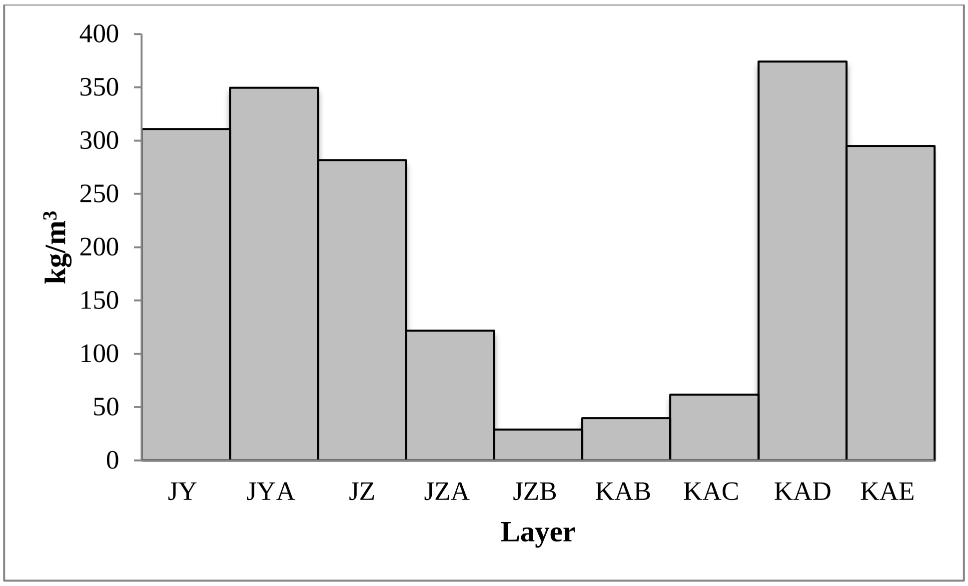

Figure 6.1 Klipdrift Cave: density of shellfish per cubic metre per layer based on weight (kg/m^3)

Table 6.2 Klipdrift Cave and Matjes River Rock Shelter: shellfish density (g/m^3) per species and layer/member

KDC	*C. oculus*	*D. gigas*	*T. sarmaticus*	*B. cincta*	*Diloma spp.*	*H. midae*	*H. spadicea*	*P. perna*	*D. serra*	*S. spengleri*	Total (g)	**kg/m^3**
JY	7684,6	15509,5	282066,1	3,8	2478,3	52,7	-	171,4	2787,1	90,6	310843,9	310,8
JYA	31424,1	72635,5	225385,2	-	18402,7	76,4	-	15,0	1384,4	54,1	349377,3	349,4
JZ	10224,8	32261,0	222479,2	3,4	15092,1	-	-	23,8	1450,3	53,9	281588,6	281,6
JZA	455,8	12523,9	104962,7	47,1	2992,0	34,2	11,5	-	503,8	38,6	121569,5	121,6
JZB	46,5	11537,0	15522,4	463,8	199,2	-	-	18,9	795,7	115,3	28698,8	28,7
KAB	91,4	26109,6	9601,6	941,1	105,1	82,9	-	39,2	2061,2	398,9	39431,0	39,4
KAC	51,9	48349,5	7708,9	2529,0	554,4	-	-	62,1	1526,5	818,4	61600,7	61,6
KAD	18,7	360443,2	10399,5	1571,0	138,1	-	-	-	625,7	995,6	374191,8	374,2
KAE	29,9	274569,8	15843,7	2975,4	56,1	-	-	-	812,9	504,9	294792,6	294,8
MRS	*Patella spp.*	*D. gigas*	*T. sarmaticus*	*B. cincta*	*Diloma spp.*	*H. midae*	*H. spadicea*	*P. perna*	*D. serra*	*C. meridionalis*	Total (g)	kg/m3
TSM-L	28811,9	341,9	19215,0	193,7	2070,2	532,6	-	28288,2	25061,9	18,9	104534,4	104,5
LSL-U	2458,6	87,0	1695,3	688,0	79,2	24,6	-	11809,4	22284,7	122,1	39248,8	39,2
LSL-L & LSL-C	244,4	24,6	-	5,4	-	-	-	459,2	18405,6	190,2	19329,4	19,3

6.2.1 Coastal zonation of the Indian Ocean at Klipdrift Cave

The shellfish species from KDC originate from all zones of the littoral region except the Littorina zone (Table 6.3).

Table 6.3 Klipdrift Cave: zonation of different shellfish species

Species	Zonation	Reference
D. gigas	Upper Balanoid to Cochlear	Langejans *et al*. 2012
T. sarmaticus	Lower Balanoid to Cochlear	Bruton *et al*. 1991; Yssel 1989
D. sinensis	Lower Balanoid	Kilburn & Rippey 1982: 22; Branch & Branch 1981: 28
D. tigrina	Lower Balanoid	Kilburn & Rippey 1982: 22; Branch & Branch 1981: 28
C. oculus	Upper and lower Balanoid	Kilburn & Rippey 1982
P. perna	From upper Balanoid to Infratidal	Kilburn & Rippey 1981; Branch & Branch 1981
H. midae	Infratidal	Kilburn & Rippey 1982: 34
H. spadicea	Cochlear/Infratidal boundary	Langejans *et al*. 2012
B. cincta	Lower Balanoid to Cochlear	Branch & Branch 1981: 28
D. serra	Upper Balanoid to Cochlear	Kilburn & Rippey 1982: 189
S. spengleri	Upper Balanoid to Cochlear	Kilburn & Rippey 1982: 179

The littoral region is made up of the intertidal area and the shallows next to it. It extends from the high water mark to the areas close to the shore that are always submerged, the latter of which can be 3–4 m deep. The area between high and low water differs in width depending on the locality. In South Africa, the vertical range of this strip varies from 1.3–1.8 m during spring tide and 0.5–0.6 m at neap tide. Five zones are identified for the littoral region on the southern Cape coast: the Littorina, the lower Balanoid, the upper Balanoid, the Cochlear and the Infratidal zones (Kilburn & Rippey 1982: 22; Branch and Branch 1981: 28; Foster 1997).

The Littorina zone has conditions that are intermediate between land and sea, and waves reach here only during high spring tide or rough seas. The main shellfish species in this zone are the small periwinkles of the Family Littorinidae and the zone is named after this Family, which can survive prolonged droughts and exposure to heat (Kilburn & Rippey 1982: 22).

The Balanoid zone forms two distinct zones, the lower and upper Balanoid (Kilburn & Rippey 1982: 22; Branch & Branch 1981). The Balanoid is a mid-tidal zone lying between high and low neap-tide levels and is named after the barnacles of the genus Balanus (Branch & Branch 1981: 26) that are dominant here. Common species in this zone are the limpets, notably the granular limpet (*Scutellastra granularis*), goat's eye limpet (*C. cochlear*) and *Diloma* species. *D. sinensis* and *D. tigrina* occur in the lower Balanoid while *D. variegata* (not present at KDC) occurs in the upper Balanoid.

Another zone is Cochlear, which is named after the main shellfish species here, *C. cochlear* (Kilburn & Rippey 1982: 22). It is also known as the infralittoral fringe, the low-tide fringe, and the subtidal fringe. This zone remains covered with water most of the time except for short periods during low spring-tides. There are dense growths of seaweeds on this zone (Kilburn & Rippey 1982: 22). The Infratidal zone is just below the Cochlear zone on the south coast (Branch & Branch 1981: 28) and it marks the lowest point of the littoral region along this coast. Dense colonies of the red-bait, *Pyura stolonifera*, and algae are common in the Infratidal zone. The zones mentioned above may support "quite different species" from coast to coast (Branch & Branch 1981: 27).

6.2.2 Species description and ecology

D. gigas is the largest chiton of the Family Ischnochitonidae that occurs in southern Africa and can attain a maximum length of >100 mm (Kilburn & Rippey 1982: 138). Chitons are primarily an intertidal group occurring in clear water to avoid gills clogging in silt environments such as estuaries and lagoons, but *D. gigas* prefers rocks covered by coarse sand. Chitons are slow movers and when dislodged tend to curl up to provide protection to soft parts of their bodies (Kilburn & Rippey 1982: 136). Chitons feed on algae, diatoms, bryozoa and hydroids but can also eat small barnacles, tube-worms, molluscs and sand grains (Kilburn & Rippey 1982: 136). *D. gigas* has a large shell, divided into a series of arched plates or valves, a narrow girdle and it is covered with a layer of microscopic spicules. This species, like most other chitons, inhabits sandy subtidal rock pools or underside of rocks between the upper Balanoid and Cochlear zones (Kilburn & Rippey 1982). The distribution of *D. gigas* is currently between False Bay and Knysna in the southern Cape and it is replaced by *D. fossus* from Port Alfred northward to Mozambique (Kilburn & Rippey 1982: 138). Anglers use *D.gigas* as bait and call it 'armadillo' (Kilburn & Rippey 1982: 138).

T. sarmaticus is a large (up to 132 mm maximum breadth or maximum shell length of >110 mm) grazing turban shellfish of the Family Turbinidae. It is a generalist grazer that can consume and digest algae from Rhodophyta, Chlorophyta and Phaeophyta (Foster 1997). The shell has a shoulder with several rows of low, rounded nodules and the base has weak spiral ridges. Its distribution is currently from False Bay to Transkei but it is particularly common in the Eastern Cape where it is used as bait and food. It is commonly known as alikreukel from the Dutch word 'alikreuk' for periwinkle (Kilburn & Rippey 1982: 47; Foster 1997). This species prefers living under submerged rocks and caverns between the lower Balanoid and Cochlear zones, and down to 8 m deep. Adults live lower down the shore while juveniles occur higher up (Kilburn & Rippey 1982: 47; Foster 1997). *T. sarmaticus* does not tolerate overly sandy conditions (Yssel 1989; Bruton *et al*. 1991).

D. sinensis, *D. tigrina* and *D. variegata* belong to the Family Trochidae and members of this Family have mostly small and elongate to globular shells. They generally live amongst seaweeds in low tide rocky pools and gullies and tend to avoid places where sedimentation is high (Kilburn & Rippey 1982). *D. sinensis* inhabits rocky shores near low water spring tide level as deep as 7 m and often where the surf is rough (Kilburn & Rippey 1982: 42). *D. tigrina* live on and under rocks in the mid-tidal region, higher up the shore than *D. sinensis* (Kilburn & Rippey 1982: 42) but both occur within the lower Balanoid zone (Branch & Branch 1981: 28; Kilburn & Rippey 1982: 22). *D. sinensis* has a broad purplish-black shell and can be as wide as 62 mm while *D. tigrina*, a shell similar to the former but with spiral ridges, has a width of 42 mm (Kilburn & Rippey 1982: 42). Most species of the Trochidae Family feed on encrusting plants and on surface deposits of diatoms, bacteria and detritus but many small deep-sea species may rely entirely on detrital matter (Kilburn & Rippey 1982: 39).

B. cincta is a whelk of the Family Buccinidae that has a thick shell and high spire with a deep furrow above the shoulder, and can attain a maximum length of 65 mm. It occupies rock pools lower down the shore between the lower Balanoid and Cochlear zones (Branch & Branch 1981; Table 6.2) and feed on any freshly dead animal carcass (Kilburn & Rippey 1982: 93).

P. perna, the brown mussel, is a bivalve of the Family Mytilidae that occurs from the Lower Balanoid down to the Infratidal zone (Kilburn & Rippey 1982: 159; Branch & Branch 1981; Kilburn & Rippey 1982). *P. perna* are abundant in the intertidal rocky shores and attach to rocks with their strong byssus threads, usually in areas of strong wave action (Kilburn & Rippey 1982: 158). The maximum length of *P. perna* is 160 mm. This species is dominant in the warm water of the Indian Ocean on the southern and east coast from False Bay to Mozambique and is largely replaced by the cold water species, *C. meridionalis*, along the west coast (Kilburn & Rippey 1982). *P. perna* has a finely pitted resilial ridge on the inside that distinguishes it from *C. meridionalis* (Kilburn & Rippey 1982: 159).

D. serra belong to the Family Donacidae and are called white mussels because of their colour (Kilburn 1982: 188). *D. serra* specifically inhabit beaches of clean, moderately coarse sand in the exposed shores of the intertidal region, mainly near river mouths (Kilburn & Rippey 1982: 189). *D. serra* have large and heavy shells with shallow radial striae on the surface and can reach maximum length of 88 mm at maturity. They are distributed from Namibia to the western Transkei (Kilburn & Rippey 1982: 189). *D. serra* are non-migratory but they may move between neap and spring tides (Kilburn & Rippey 1982) in the upper Balanoid to Cochlear zones. *D. serra*, like other sand mussels, siphon food from sandy surfaces and the surrounding water.

S. spengleri belong to the Family Mactridae, have large, trigonal shells, and are somewhat larger than *D. serra*, with a maximum length of 113 mm (Kilburn &

Rippey 1982). Like *D. serra*, *S. spengleri* burrow shallowly in clean sand, from low down in the surf zone to about 8 m (Kilburn & Rippey 1982: 178). *S. spengleri* are found from False Bay to East London and are now common in False Bay. Live individuals are rarely seen but large numbers may be found dead or stranded after being washed up by storms, hence the Cape fishermen term 'dead mussel/*doodmossel*' (Kilburn & Rippey 1982: 179).

C. oculus (formerly *Patella oculus*, Ridgway *et al*. 1998) have ribbed shells, externally dull, greenish-brown to black in colour with a maximum length of 110 mm (Kilburn & Rippey 1982: 38). *C. oculus* is a limpet, belonging to the Family Patellidae (Kilburn & Rippey 1982: 36). *C. oculus* is a rapid growing species that occupies the high to low-water neap tide in the lower and upper Balanoid zones and feed on a variety of algae or black lichens and diatoms (Kilburn & Rippey 1982: 38). When limpets are disturbed they become difficult to dislodge without breaking the shell margins but can be collected by dislodging with a flat implement. Gastropods and starfish predate on limpets and *C. oculus* may raise its shells and trap them when challenged (Kilburn & Rippey 1982: 36).

H. midae and *H. spadicea* are gastropods of the Family Haliotidae. Haliotids are capable of rapid movement owing to their flattened shells and powerful feet (Kilburn & Rippey 1982). *H. midae*, named 'Perlemoen' in South Africa or 'abalone' in the United States, have large and heavy shells, a maximum length of 190 mm, with 8 to 11 respiratory pores and a projecting flange forms outside of the columella in adults. The colour is greyish or purplish-brown but reddish pink on the west coast. Adults occur mainly in caverns and crevices to a depth of about 22 m often in dense colonies (Kilburn & Rippey 1982: 34) in the Infratidal zone. *H. midae* is distributed between Saldanha Bay and the western Transkei and adults feed mainly on the the giant kelp, Ecklonia (Kilburn &Rippey 1982: 34). *H. spadicea* ('Venus ear') have pear-shaped shells, maximum length 80 mm, with a concave outer lip and 5–8 respiratory pores. They are externally dark-purplish brown in colour and irregularly blotched in white. *H. spadicea* have orange apical stains interiorly. They live around the cochlear and Infratidal zones but as they are well concealed they are often difficult to locate (Kilburn & Rippey 1982: 35). *H. spadicea* are distributed between Table Bay and the north coast of Natal (Kilburn & Rippey 1982: 35).

6.2.3 Klipdrift Cave shellfish species through time

The two dominant species in the KDC shellfish collection, *T. sarmaticus* and *D. gigas*, occur throughout the sequence (Table 6.1) but show fluctuating prominence across the layers. *D. gigas* dominates in terms of both MNI (n = 3920, 73.6%) and weight (n = 127551, 64.5%) for all layers combined while *T. sarmaticus* constitutes 19.7% (n = 1051) in terms of MNI (Table 6.1) and 32.0% (n = 63167) of overall weight (Table 6.4).

When assessed for each layer, *D. gigas* dominate the lower half (KAE-JZB) of the sequence, constituting between 96.6% (n = 1527) and 55.6% (n = 25) in terms of MNI. In the lowermost two layers, KAE and KAD, *D.gigas* forms >95% in MNI (Table 6.1; Figure 6.2) of the assemblage, and become somewhat less prevalent in layers KAC and KAB (c. 70% of the MNI, Figure 6.2). *T. sarmaticus* form between 31.1% (n = 14) in JZB and 73.0% (n = 127) in JY in terms of MNI (Table 6.1). Other species occur only in minor frequencies. *C. oculus* is at 2.2% (n = 117), *Diloma* spp. 1.8% (n = 98), *P. perna* (0.2%, n = 9), *H. midae* (0.1%, n = 4), *H. spadicea* (0.02%, n = 1), *B. cincta* (1.2%, n = 65), *D. serra* (0.9%, n = 49), and *S. spengleri* at 0.3% (n = 14) in total MNI (Table 6.1).

Table 6.4 Klipdrift Cave: weights of shellfish species in grams

Layer	JY		JYA		JZ		JZA		JZB		KAB		KAC		KAD		KAE		Total	
Species	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
T. sarmaticus	16477	90.7	4959	64.5	19605	79	15889	86.3	534	54	735	24.3	520	12.5	2168	2.8	2280	5.4	63167	32
D. gigas	906	5	1598	20.8	2843	11.5	1896	10.3	397	40.2	1999	66.2	3261	78.5	75142	96.3	39509	93.1	127551	64.5
Diloma spp.	145	0.8	405	5.3	1330	5.4	453	2.5	7	0.7	8	0.3	37	0.9	29	0	8	0	2422	1.2
C. oculus	449	2.5	691	9	901	3.6	69	0.4	2	0.2	7	0.2	4	0.1	4	0	4	0	2131	1.1
P. perna	10	0.1	0	0	0	0	0	0	1	0.1	3	0.1	4	0.1	0	0	0	0	18	0
H. midae	3	0.02	2	0.03	0	0	5	0.03	0	0	6	0.2	0	0	0	0	0	0	16	0
H. spadicea	0	0	0	0	0	0	2	0.01	0	0	0	0	0	0	0	0	0	0	2	0
B. cincta	0	0	0	0	0	0	7	0.04	16	1.6	72	2.4	171	4.1	328	0.4	428	1	1022	0.5
D. serra	163	0.9	30	0.4	128	0.5	76	0.4	27	2.7	158	5.2	103	2.5	130	0.2	117	0.3	932	0.5
S. spengleri	5	0.03	1	0	5	0.02	6	0.03	4	0.4	31	1	55	1.3	208	0.3	73	0.2	388	0.2
Total	18158	100	7686	100	24812	100	18403	100	988	100	3019	100	4155	100	78009	100	42419	100	197649	100

The five most common shellfish at KDC are presented in Figures 6.2 and 6.3. These clearly show the change in abundance of the two most common species through time both in terms of MNI (Figure 6.2) and weight (Figure 6.3). *D. gigas* is most abundant in the lower layers, and *T. sarmaticus* most frequently collected in the upper layers.

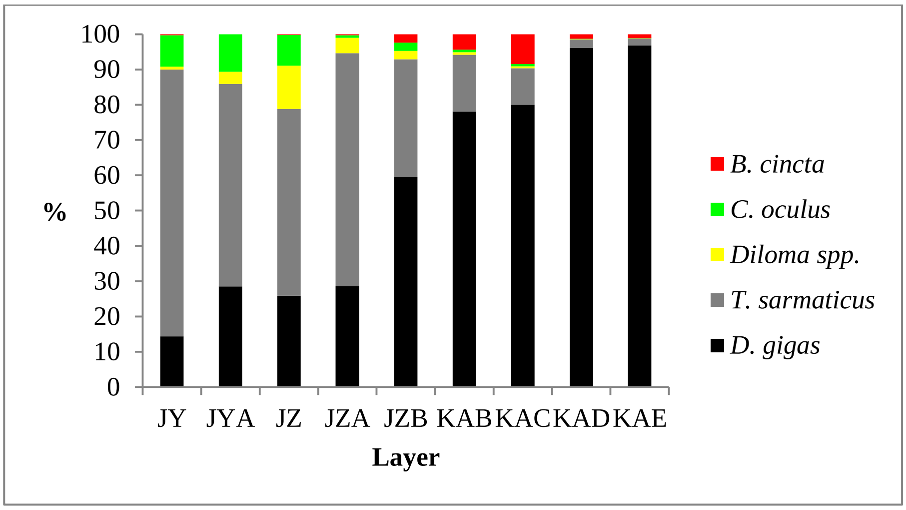

Figure 6.2 Klipdrift Cave: relative abundance (%) per layer of the five most common shellfish species based on MNI

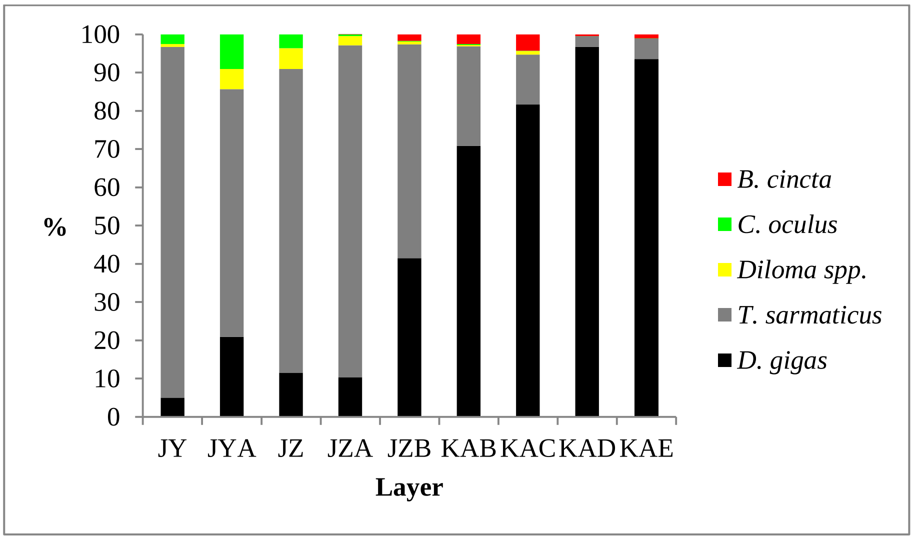

Figure 6.3 Klipdrift Cave: relative abundance (%) per layer of the five most common shellfish species based on weight

In addition to the clear increase and relative decrease of the two most abundant species, other temporal patterns are apparent. *B. cincta* is most common in the layers containing abundant *D. gigas*, and all but disappears in the younger layers where *T. sarmaticus* dominates (Figure 6.2). *B. cincta* constitute some 1.1% to 8.2% between layers KAE and JZB (Table 6.1). Conversely, *Diloma* spp. (0.8% in JY to 4.2% in JZA) and *C. oculus* (between 0.6% and 10.4%) (Table 6.1) are more common in the younger layers, and sparsely represented in layer JZB and below. *P. perna* are absent from the lowermost two layers and layer JZA, and only constitute between 0.2% and 2.2% of MNI in the layers in which they do occur (Table 6.1). *H. midae* and *H. spadicea* occur in negligible quantities, but it is notable that they are only present in layers above JZB, with the exception of a few fragments in KAB (Table 6.1).

6.3 Shellfish at Matjes River Rock Shelter and Nelson Bay Cave

The frequencies of shellfish species represented in the Oakhurst layers at MRS (Döckel 1998) are listed in Table 6.5.

Table 6.5 Matjes River Rock Shelter: minimum number of individuals of shellfish species in the Oakhurst members (modified from Döckel 1998: 55, Table 10)

Member	TSM-L		LSL-U		LSL-L		Total	
Species	n	%	n	%	n	%	n	%
D. serra	5144	20.8	16925	55.1	4354	93.8	26423	44
P. perna	12570	50.8	10755	35	135	2.9	23460	39.1
C. meridionalis	88	0.4	1578	5.1	140	3	1806	3
Patella species	3249	13.1	393	1.3	3	0.1	3645	6.1
D. sinensis	560	2.3	31	0.1	0	0	591	1
H. midae	92	0.4	22	0.1	0	0	114	0.2
Burnupena species	143	0.6	405	1.3	2	0	550	0.9
T. sarmaticus	2615	10.6	418	1.4	0	0	3033	5
Other*	260	1.1	184	0.6	8	0.2	452	0.8
Total	24721	100	30711	100	4642	100	60074	100

The grand total of MNI at MRS (n = 60 074) is much larger than at KDC (n = 5328; Table 6.1) but this reflects the difference in the extent of excavation at the two sites. When the density of shellfish is calculated by dividing the total weight of shell in each member (kg) by the total volume of deposit (m^3) (see Döckel 1998: 68 for raw data) it is evident that the density of shellfish at KDC is considerably higher than at MRS (Figure 6.4; see also Table 6.2).

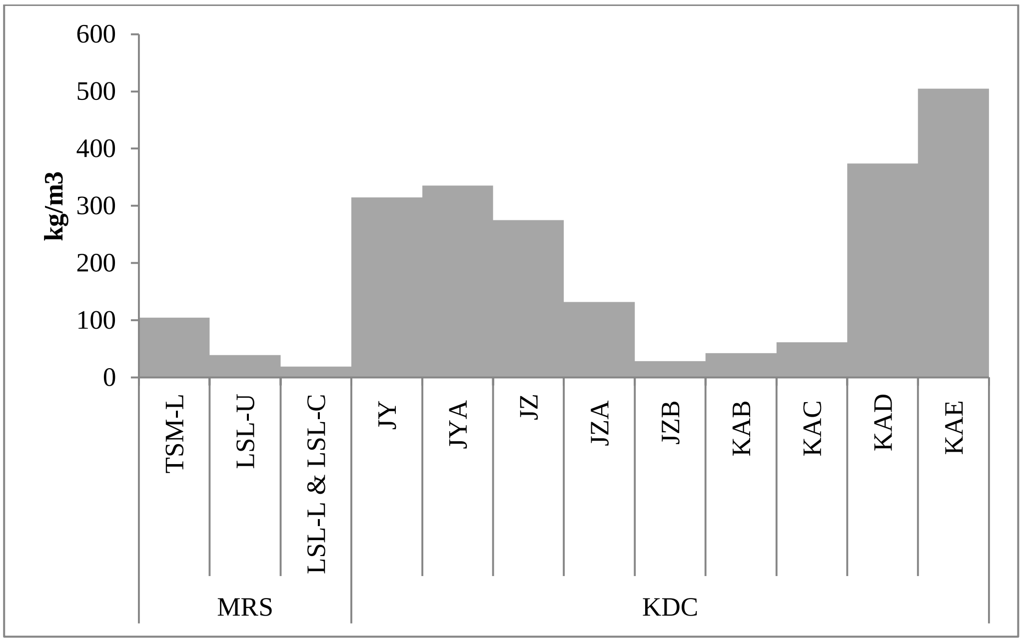

Figure 6.4 Klipdrift Cave and Matjes River Rock Shelter: comparison of shellfish density. Data for MRS have been abstracted from Döckel (1998: 55)

The species at MRS include *P. perna*, *D. serra*, *C. meridionalis*, *H. midae*, *D. sinensis*, *T. sarmaticus*, and Patella and *Burnupena* species. Patella species present are *S. longicosta*, *S. granularis*, *S. barbara*, *S. argenvillei*, *S. cochlear*, *C. oculus* and *C. miniata* (Döckel 1998: 55–56). The species presented as "Other" in Döckel (1998: 55) are Ostrea spp., Fissurellidae, and *D. gigas* (Döckel 1998: 52).

D. serra (44.0%, n = 26 423 of total) and *P. perna* (39.1%, n = 23 460) are the main species present at MRS (Table 6.5). *D. serra* dominates the lower Member, LSL–L, at 93.8% (n = 4354) and frequencies drop to 55.1% (n = 16925) in the middle Member LSL–U and further to 20.8% (n =5144) in the upper Oakhurst Member, TSM–L. Numbers of *P. perna* increase from 2.9% (n =135) in the lower member to 50.9% (n =12 570) in the upper member where *D. serra*, as mentioned above, still occur as one of the main exploited species (at 20%). Patella species are rare in the two lowermost members, but they account for 13.1% (n = 3249) of total shellfish in the uppermost member, TSM-L. *T. sarmaticus*, the species that dominate in the upper half of KDC, occur in much lesser quantities at MRS, mostly in the upper part of the sequence (10.6% ,n = 2615). It is very sparse in the middle of the sequence (LSL–U Member, 1.4%, n = 418) and absent in the base member of the Oakhurst, LSL–L (Döckel 1998: 55). *C. meridionalis* forms 3% (n = 140) in Member LSL-L, 5.1% (n = 1578) in Member LSL-U and drop to 0.4% (n = 88) in TSM–L. *D. gigas*, the main species exploited in the lower layers at KDC, were so sparse at KDC that they were included in the category "Other" at MRS, constituting from 0.2% (n = 8) in Member LSL–L to 1.1% (n = 260) in TSM–L (Döckel 1998: 55).

At NBC, *C. meridionalis* and *B. cincta* are the most common species in the three lowermost Oakhurst units (GSL, CS & BSL) where the former constitutes c. 42% and c. 13% of the MNI of all species (Klein 1972b: Figure 4; see also Figure 6.5, this chapter). *P. perna* dominates the uppermost Oakhurst layer (J), at c. 38% followed by *B. cincta* and *D. serra* at c. 22% each. *P. perna* decreases from c. 20% in BSL to <5% in CS at NBC. *T. sarmaticus* at NBC occurs rarely and constitutes c. 8% in layers GSL, BSL, and J and much less in layer CS. Unidentified chiton species (n = 133) at NBC form around 5% in GSL and almost disappear thereafter (Klein 1972b: Figure 4).

Percentage frequencies of common shellfish species are compared here for KDC, MRS and NBC (Figure 6.5). For this figure, the stratigraphic sequences of the sites have been divided into lower and upper based on the distinct changes in dominant species. Whereas *D. serra* and *P. perna* are dominant at MRS and NBC, they occur rarely at KDC. *D. gigas* and *T. sarmaticus* are the dominant species at KDC while they are relatively rare at MRS and NBC. There are no *C. meridionalis* at KDC but they make up at least 5% at MRS and almost 42% in the lower layers of NBC (Figure 6.5). *B. cincta* forms between 13% and c. 22% in different layers at NBC, occurs in significantly lesser amounts in KDC, and is very rare at MRS. *Diloma* species are rare at all sites. It is noteworthy that in all three sites there is a change of species through time as reflected in Figure 6.5. In addition, shellfish exploitation at NBC is more similar to that of MRS than KDC.

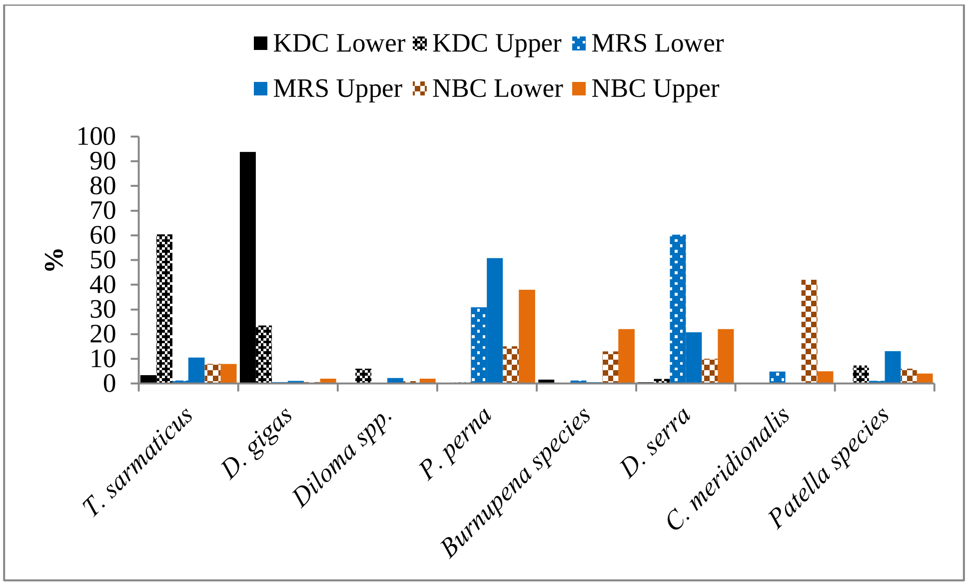

Figure 6.5 Percentage frequencies of main shellfish species found in the Oakhurst layers at Klipdrift Cave, Matjes River Rock Shelter and Nelson Bay Cave based on MNI of the main species. Matjes River Rock Shelter data were extracted from Döckel (1998: 55) and percentage frequencies for Nelson Bay Cave shellfish species extrapolated from Klein (1972b: Figure 4)

6.4 Shellfish subsistence at Klipdrift Cave

Although eleven species of shellfish are represented at KDC, the data shows that five species were important in the diet of the site's inhabitants. These are *D. gigas*, *T. sarmaticus*, *Diloma* spp., *C. oculus* and *B. cincta*. Their dietary contribution has been calculated based on estimated fresh meat yields (Table 6.6), which are calculated by multiplying average weight of individual shellfish species by its MNI. Kilojoules were further reconstructed from *D. gigas* and *T. sarmaticus* per 100 g of shell weights (see Chapter 4, Section 4.3.1.3).

According to the fresh meat yield estimates, the five most abundant shellfish species from the excavated sample at KDC provided a total of 220.2 kg of fresh meat during the period of occupation (Table 6.6). *D. gigas* have the highest meat contribution with an overall yield of 176.4 kg (80.1%), followed by *T. sarmaticus* (42 kg, 19.1%) with minor contributions from *C. oculus* (1.1 kg, 0.5%), *Diloma* spp. (0.4 kg, 0.2%) and *B. cincta* (0.3 kg, 0.1%).

There is variation in the meat yields across the layers at KDC. *D. gigas* form 98.1% of the fresh meat yields in KAE, 97.7% in KAD, c.89% in KAC, 84.1% in KAB, 66.5% in JZB and 32.6% in JZA. There is a relative increase in the contribution of *T. sarmaticus* from layer JZA upwards. The relative proportions of *T. sarmaticus* are 66.8% in JZA, 61.9% in JZ, 62.1% in JYA and 80.4% in JY. In the lower layers, *T. sarmaticus* occur in lower quantities but increase progressively from 1.8% in KAE to 33.1% in JZB. The contribution of *Diloma* spp. is highest in layer JZ (1.4% of the fresh meat yields in this layer). While *T. sarmaticus* and *D. gigas* are relatively large shellfish, their dominance in the assemblage is due not only to their shell weight (Table 6.4), but also in terms of numbers relative to those of smaller species (Table 6.1).

Table 6.6 Klipdrift Cave: estimated fresh meat yields (g) of the five most common shellfish species

Layer	JY		JYA		JZ		JZA		JZB		KAB		KAC		KAD		KAE		Total	
Species	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%
D. gigas	2385	17.2	3735	34.7	6165	34.1	3825	32.6	1125	66.5	4815	84.1	5940	88.9	79695	97.7	68715	98.1	176400	80.1
T. sarmaticus	11160	80.4	6680	62.1	11200	61.9	7840	66.8	560	33.1	880	15.4	680	10.2	1760	2.2	1280	1.8	42040	19.1
Diloma spp.	12	0.1	40	0.4	260	1.4	52	0.4	4	0.2	4	0.1	4	0.06	12	0.01	0	0	388	0.2
C. oculus	330	2.4	310	2.9	460	2.5	20	0.2	0	0	0	0	0	0	0	0	10	0.01	1130	0.5
B. cincta	0	0	0	0	0	0	4	0.03	4	0.2	24	0.4	56	0.8	96	0.1	68	0.1	252	0.1
Total	13887	100	10765	100	18085	100	11741	100	1693	100	5723	100	6680	100	81563	100	70073	100	220210	100

The relative contribution of shellfish to the diet may also be assessed by converting shell weights into calorific values (Buchanan 1986; Clark & Kandel 2013; see Chapter 4, Section 4.3.1.3 for details). Contributions of *D. gigas* and *T. sarmaticus* in kilojoules are presented in Table 6.7. The calorific value from three species, *B. cincta*, *C. oculus* and *Diloma* spp. could not be established as no relevant research has been done on these species. Table 6.7 shows that *D. gigas* provided a higher calorific value, at 446,427.2 kilojoules while *T. sarmaticus* contributed a total of 221,083.8 kilojoules. When the total kilojoules (667 511; Table 6.7) from KDC is divided by a modern nutritional requirement of 8370 kilojoules per person per day (Clark & Kandel 2013) the shellfish meat from the two species alone would have fed c. 80 persons for one day (Table 6.7). It is during layers KAE and KAD that more shellfish kilojoules were obtained.

Table 6.7 Klipdrift Cave: estimated calorific contribution (kilojoules) of *Turbo sarmaticus* and *Dinoplax gigas* (See text for details on calculations)

Layer	*T. sarmaticus*		*D. gigas*		Both species combined	
	shell weight	kJ = total weight/100*350	shell weight	kJ= total weight/100*350	kJ	Persons fed/day
JY	16477.1	57670	906	3171	60841	7.3
JYA	4959	17356.4	1598.1	5593.5	22949.9	2.7
JZ	19604.6	68616.1	2842.8	9949.8	78565.9	9.4
JZA	15888.8	55610.6	1895.8	6635.3	62245.9	7.4
JZB	534.5	1870.7	397.3	1390.4	3261.1	0.4
KAB	735.2	2573.1	1999.2	6997	9570.1	1.1
KAC	519.9	1819.5	3260.5	11411.9	13231.4	1.6
KAD	2168	7588	75141.9	262996.7	270584.7	32.3
KAE	2279.8	7979.4	39509.1	138281.7	146261	17.5
Total	63166.8	221083.8	127550.6	446427.2	667511	79.8

Despite the fact that shellfish provide relatively fewer calories compared to terrestrial resources (Erlandson 1988; Buchanan 1986; Clark & Kandel 2013), its importance as a source of polyunsaturated fatty acids (Broadhurst *et al*. 2002; Cunnane & Stewart 2010; Parkington 2010) essential for human brain energy requirements is significant. Shellfish is an excellent source of protein (Bigalke 1973; Erlandson 1988; Foster 1997; Parkington 2010) and the meat is rich in omega-3 polyunsaturated fatty acids (Broadhurst *et al*. 2002; Tattersall 2010).

These are essential for normal human brain growth and development (Cunnane 2010; Cunnane & Stewart 2010). Although they can be obtained from terrestrial sources, shellfish, pro-rata, are especially rich in these nutrients (Broadhurst *et al*. 2002; Cunnane 2010; Cunnane & Stewart 2010). Shellfish consumption could have assisted during crucial foetal development in the third trimester and in the post-natal development of childrens' brains (Parkington 2010). The advantages of shellfish consumption extend to the prevention of diseases such as kwashiorkor, a protein deficiency condition. In the Transkei, for example, this condition is rare as shore living people exploit shellfish (Bigalke 1973). Bigalke comments that it is the shellfish that confer the dietary benefit, as the livestock such as cattle, goats, and sheep kept by these coastal dwellers serve mainly as economic and ceremonial assets, and do not contribute significant protein to the diet of people in this area.

6.5 Shellfish as tools

Some of the shells that occur in the lower layers at KDC may have been used as tools. Examples include D. *serra* and *S. spengleri*. In other sites such as BNK 1, level 12 (Schweitzer & Wilson 1982: 89), EBC (Orton 2006: Figure 6), MRS layer C (Ludwig 2005: 99) and the Noetzie Midden (Orton & Halkett 2007: 7) there are perforated fragments of *D. serra*. The function of the perforated fragments is not known for certain but they may have been used as leg rattles as observed for Khoesan people (Orton & Halkett 2007) or as scraping tools (Schweitzer & Wilson 1982; Orton 2006; Orton & Halkett 2007).

At KDC there are 14 *D. serra* shells, from throughout the sequence, which show modification in the form of ≥10 mm perforations through the centre of the valve. In a few instances it appears as if the perforation was retouched to form a scraper-like tool (Figure 6.6). This species appears to have been collected live for food and subsequently used as a tool or cultural artefact, as the shells are not waterworn, and do not contain any encrusting marine organisms. Several valves of the less common angular surf clam, *S. spengleri*, which occurs subtidally in the deeper surf zone, also appear to be culturally modified. These shells do not appear waterworn. However, due to its habitat, this species is difficult to collect alive but specimens do wash up after storms (Branch & Branch 1981). Branch (pers.comm. 2013) reports that these are seldom damaged or waterworn, and was the probable source of the shells in the cave. The scraper-like retouch that occurs on the ventral side of the shells, indicated by arrows in Figure 6.6 may relate to use as scrapers, but the possibility that the damage was fortuitous cannot be excluded until further microscopic investigation is undertaken.

Figure 6.6 Klipdrift Cave: possible shellfish tools (*Donax serra* fragments a –c and *Scissodesma spengleri* shell remains d–e). a) Layer JY, b) layer JZ, c) layer KAB, d) layer JZ, e) layer KAB (Photos: Samantha Mienies)

6.6 Shellfish and tortoise sizes

The sizes of shellfish and tortoises from archaeological sites can provide an estimate of the extent and intensity of harvesting of these animals as food (Klein & Cruz-Uribe 2000; Klein *et al*. 2004; Avery *et al*. 2008; Klein & Steele 2013). The sizes of shellfish species from different occurrences and time periods are compared below. I compare the sizes of *T. sarmaticus* opercula, *C. oculus* shells and tortoise mediolateral distal humeri. In this section the results in terms of mean size are presented while the implications are discussed in Section 6.7.

6.6.1 *Turbo sarmaticus* opercula

As whole *T. sarmaticus* specimens are rarely found in archaeological collections, opercula are used as a proxy of size (McLachlan & Lombard 1981; Yssel 1989). Descriptive statistics for *T. sarmaticus* opercula from KDC are given in Table 6.8.

Table 6.8 Klipdrift Cave: *Turbo sarmaticus* opercula descriptive statistics

Layer	n	Min	Max	Mean	Median	S.D.
JY	94	18	46	32.4	33	6.23
JYA	50	10	46	31.7	32	6.69
JZ	114	20	44	33.8	34	5.61
JZA	52	17	48	35.4	36.5	6.43
JZB	7	26	41	34.7	36	5.19
KAB	7	13	36	28.3	30	7.23
KAC	5	14	38	29.8	33	9.83
KAD	13	24	47	37.1	39	6.55
KAE	6	16	45	32.3	35	11.13

The mean length of the opercula is highest in layer KAD, at 37.1 mm and lowest in KAB (28.3 mm). The data for KDC *Turbo* opercula were also summarised using box plots (Figure 6.7). This figure shows some variations within the sequence. For example, more large individuals are apparent in layers KAD and JZA while KAB and JYA have proportionally smaller individuals.

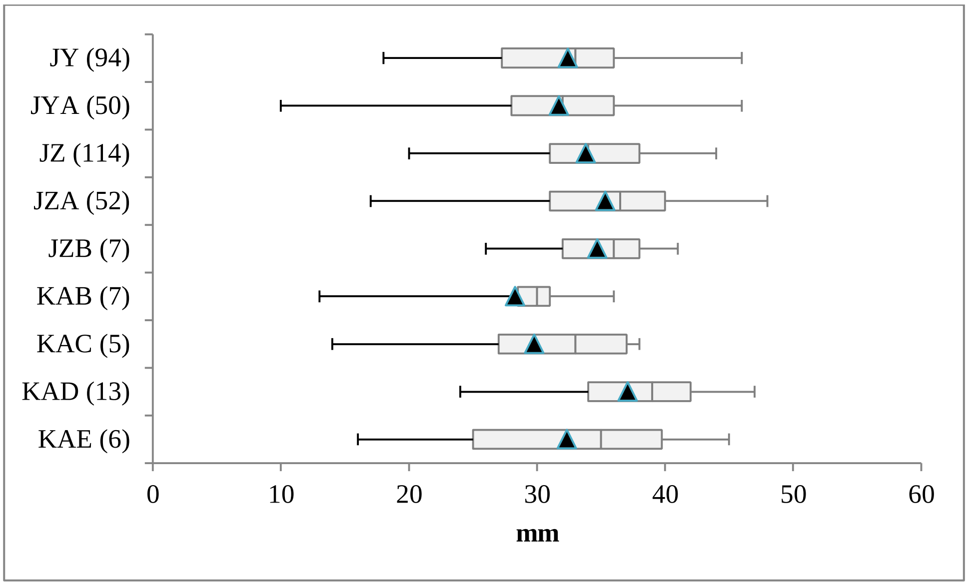

Figure 6.7 Klipdrift Cave: box plots summarising the lengths of *Turbo sarmaticus* opercula through time. Numbers in parentheses indicate sample sizes. The vertical line near the centre of each box plot shows the median, the open grey rectangle encloses the middle half of the data (25th and 75th percentiles), the small dark shaded triangle shows the mean, and the whiskers show the range of values

Due to the small sample size of opercula in layers KAE–JZB, it was necessary to combine the data for statistical comparison of the various layers of KDC and those of other sites. When KAE–JZB layers are combined the mean length is 33.3 mm (Table 6.9), slightly less than the mean length for layer JZA alone. A Kolmogorov-Smirnov (K-S) test suggests that the difference between the lower and upper layers of the KDC sequence is not significant (K-S statistic = 0.06 & 0.23, $P<0.05$). Note however that the KAE–JZB layers have a small sample (n = 38) and K-S test results are only broadly reliable when one sample in a comparison has <40 values (Klein 1986: 10). The opercula in JZA, however, are significantly larger than those from layers above (K-S statistic: JZA and JYA = 0.28 & 0.26, $P<0.05$; JZA & JY = 0.26 & 0.24, $P<0.05$).

T. sarmaticus opercula lengths from KDC were compared with those available from BBC M2 phase, BBC LSA, and Blombosfontein (BBF) LSA sites 3 (6 ka), 4

(5.6 ka), and 9 (0.5–1 ka) (Henshilwood 1995: 99, 2008) (Table 6.9) and illustrated using box plots (Figure 6.8).

Table 6.9 Comparative opercula descriptive statistics: Klipdrift Cave, Blombos Cave, and Blombosfontein sites. Dr. Karen van Niekerk provided the raw data for Blombos Cave and Blombosfontein

Site/layer	BBC-M2	KAE-JZB	JZA	JZ	JYA	JY	BBC LSA	BBF 3	BBF 4	BBF 9
n	362	38	52	114	50	94	375	412	116	893
Mean	44.5	33.3	35.3	33.8	31.7	32.4	29.0	31.0	30.9	27.3
S.D.	4.9	8.1	6.4	5.6	6.7	6.2	5.4	6.0	6.2	5.8
Median	45	34.5	36.5	34	32	33	29.3	31.8	31.7	26.7
Min	25	13	17	20	10	18	10.9	14	11.6	10.4
Max	56	47	48	44	46	46	47.1	44.8	42.8	45.6

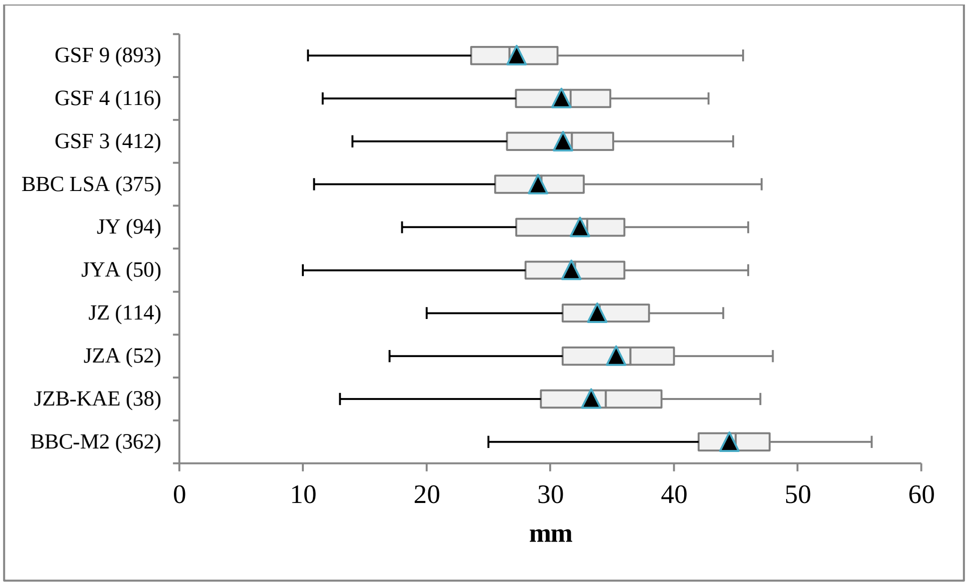

Figure 6.8 Box plots for *Turbo sarmaticus* opercula lengths: Klipdrift Cave, Blombos Cave MSA, Blombos Cave LSA and some Blombosfontein sites. Raw data from Blombos Cave and Blombosfontein sites are thanks to Dr. Karen van Niekerk. Numbers in parentheses indicate sample sizes. The vertical line near the centre of each box plot shows the median, the grey open rectangle encloses the middle half of the data (25th and 75th percentiles), the small dark shaded triangle shows the mean, and the whiskers show the range of data.

The BBC MSA M2 phase *T. sarmaticus* opercula are larger than those from KDC and other LSA specimens. K-S test results (K-S statistic = 0.68 & 0.10, $P<0.05$)

show that there is a significant difference between BBC M2 phase and KDC (all layers combined). Figure 6.8 also suggests that there is a difference between KDC *T. sarmaticus* opercula sizes and those from BBF 3 and younger sites such as BBC LSA. This difference between KDC and post-Oakhurst LSA sites is significant when tested using the K-S method (K-S statistic: KDC & GSF 3 = 0.19 and 0.09, P<0.05; KDC & BBC LSA = 0.34 and 0.10, P<0.05).

The difference between MSA, Oakhurst and post Oakhurst opercula sizes was further explored. Data from the box plot figures of the *T. sarmaticus* opercula presented in Sealy and Galimberti 2011 (409, Figure 17.3) and Klein and Steele (2013: Figure 4), and from KDC (this thesis), BBC and BBF (van Niekerk, pers. comm. 2013) were utilised to compare size through time (Figure 6.9; Table 6.10). Figure 6.9 and Table 6.10 indicate that there is a general decrease in *T. sarmaticus* opercula size through time, from MSA to LSA. The opercula from the Oakhurst sites are markedly smaller than those from MSA collections. The Oakhurst opercula are furthermore larger than the post-Oakhurst specimens.

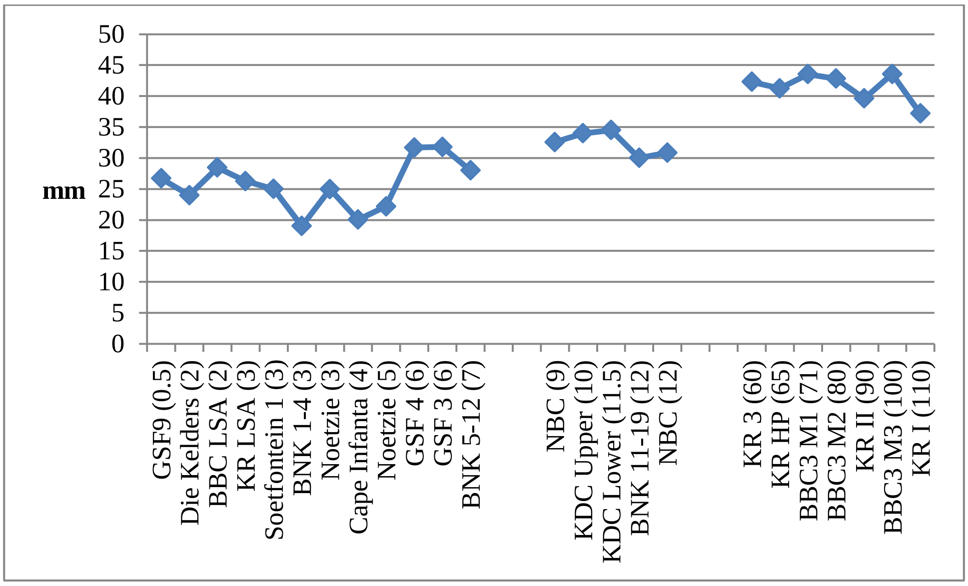

Figure 6.9 Variations in the lengths of the *Turbo sarmaticus* opercula between Middle and Later Stone Age sites using median (see also Table 6.10). Numbers in parenthesis indicate average age of assemblages

Table 6.10 Middle and Later Stone Age *Turbo sarmaticus* opercula descriptive statistics. Data arranged roughly from youngest to oldest. *Values extrapolated from Sealy and Galimberti (2011: 17.3)

Reference	Site	Age in ka	Median	n	Min	Max
Dr. Van Niekerk (pers. comm.)	BBF9	0.5	26.7	893	10.4	45.6
Sealy & Galimberti 2011*	Die Kelders	2	24	2308	8	53
Klein & Steele 2013	BBC LSA	2	28.46	198	14.4	45.75
Klein & Steele 2013	KR LSA	3	26.28	166	14.36	42.24
Sealy & Galimberti 2011*	Soetfontein 1	3	25	305	9	46
Sealy & Galimberti 2011*	BNK 1-4	1 to 3	19	703	7	38
Klein & Steele 2013	Noetzie	3	24.97	151	8.97	39.17
Klein & Steele 2013	Cape Infanta	4	20.05	16	13.4	36.7
Klein & Steele 2013	Noetzie	5	22.18	2112	8.92	43.87
K van Niekerk (pers. comm.)	BBF 4	5.6	31.7	116	11.6	42.8
K van Niekerk (pers. comm.)	BBF 3	6	31.8	412	14	44.8
Sealy & Galimberti 2011*	BNK 5-12	7	28	1381	9	52
Klein & Steele 2013	NBC	9	32.56	55	19.55	44.95
This thesis	KDC Upper	10	34	310	10	48
This thesis	KDC Lower	11.5	34.5	38	13	47
Sealy & Galimberti 2011*	BNK 11-19	12	30	7	19	37.5
Klein & Steele 2013	NBC	12	30.86	108	18.03	43.31
Klein & Steele 2013	KR III	60	42.3	11	35.82	48.85
Klein & Steele 2013	KR HP	65	41.25	410	19.5	51.35
Klein & Steele 2013	BBC3 M1	71	43.54	187	17.37	53.35
Klein & Steele 2013	BBC3 M2	80	42.83	272	22.8	53.06
Klein & Steele 2013	KR II	90	39.62	1832	14.59	55.04
Klein & Steele 2013	BBC3 M3	100	43.56	463	19.99	57.16
Klein & Steele 2013	KR I	110	37.19	100	18.11	48.51

6.6.2 *Cymbula oculus* shells

The shells of *C. oculus* were combined for all layers due to the rarity of this species at KDC and they provided a mean length of 61.1 mm and a median which is very close to the mean, 60.5 mm (Table 6.11).

Table 6.11 Klipdrift Cave: *Cymbula oculus* summary statistics (mm)

n	Min	Max	Mean	Median	S.D.
20	42	81	61.1	60.5	10.28

C. oculus specimens from KDC are smaller in size than those from the NBC Oakhurst layers (Table 6.12) using the median index (66.5 mm & 63.4 mm) (Klein & Steele 2013: Figure 2; see also Table 6.12). *C. oculus* specimens from MSA sites such as Klasies River (KR) and BBC are larger than those from KDC by at least 10 mm (Table 6.12).

Table 6.12 Minimum, maximum and median length (mm) of *Cymbula oculus* from several southern Cape sites, including Klipdrift Cave

Site	Age (ka)	n	Min	Max	Median	Reference
KDC	11.8-9.7 ka	20	42	81	60.5	This thesis
NBC	9	147	37.8	91.7	66.5	Klein & Steele 2013: 10912
NBC	12	132	47.2	87.5	63.4	
KR III	60	4	76.1	78.6	78.1	
KR HP		54	53.1	92.1	74.2	
KR II		81	52	92.2	69.4	
KR I	120	11	58.8	85	69.8	
BBC MSA		64	-	-	78	

6.6.3 Tortoises

Tortoise mediolateral humeri were measured in order to compare the results with those from MSA and other LSA sites. It was assumed that the tortoise remains from KDC belong to *C. angulata*, as they are the most common or exclusive tortoise species found at southern and Western Cape coast archaeological sites (Klein *et al*. 2004; Steele & Klein 2005-06; Avery *et al*. 2008; Klein 2008; Klein & Steele 2013). There were 58 measurable tortoise humeri at KDC and descriptive statistics have been computed through time and compared with results from BBC MSA phases (Table 6.13). Due to small samples in some layers at KDC, data were grouped (e.g., JYA & JY; KAC-JZB).

Table 6.13 Klipdrift Cave and Blombos Cave MSA: summary statistics for tortoise medio-lateral diameter (mm). Data for Blombos Cave tortoises are from Nel (2007: 56)

Layer	n	Min	Max	Mean	Median	S.D.
JYA & JY	6	6	11	8.2	8	1.6
JZ	7	7	10	8.4	8	1.3
JZA	10	4	9	6.8	6.5	1.9
KAC-JZB	5	5	8	6.4	6	1.1
KAD	16	5	8	7.5	8	1.0

KAE	14	6	9	7.8	8	0.8
BBC M1	315	-	-	-	7.9	-
BBC M2	288	-	-	-	8.1	-
BBC M3	339	-	-	-	8.1	-

As discussed in Chapter 4, it is the median that is used as an index because tortoises keep growing (Klein & Steele 2013). KDC data shows that the median in layer KAE (8 mm) is similar to those in the upper layers (JZ, JYA & JY). There is a decrease in tortoise size in the middle layers, KAC–JZB (6 mm) and JZA (6.5 mm). The tortoise sizes from KDC lower and upper layers are broadly similar to those from BBC MSA phases (M1 = 7.93 mm, M2 = 8.13 mm & M3 = 8.01 mm; Nel 2007: 56) and data from west coast MSA sites such as Diepkloof Rock Shelter (DRS), Hoedjiespunt 1, and Ysterfontein 1 which have medians ≥8 mm (see Klein *et al*. 2004: 5711, Figure 2; Avery *et al*. 2008: Figure 12).

Tortoise humeri from MSA sites are generally bigger than those from the LSA assemblages of EBC, Tortoise Cave, Bakoond and Kasteelberg (Henshilwood *et al*. 2001: Figure 15; Klein *et al*. 2004: Figure 2; Avery *et al*. 2008: Figure 12) where they tend to have a median of c. 7 mm. However, some LSA phases at EBC (EBC 19, 18 & 17) and BNK 1 (layers 13–17), dating to the Oakhurst period, have medians very close to those of MSA sites (see Henshilwood *et al*. 2001: Figure 15; Klein *et al*. 2004: Figure 2). The implications of this are discussed below.

6.7 Discussion

The first issue addressed is whether the change in shellfish species over time at KDC could be attributed to climate, environment and/or human choices. The other issue is to explore whether human agents were responsible for the differences in the shellfish and tortoise sizes at KDC, other LSA sites and MSA sites.

6.7.1 Change of shellfish species composition at Klipdrift Cave: climate, environments or human choice?

The KDC data presents two clear patterns of exploitation, the dominance of *D. gigas* in the lower layers, with AMS dates centering on c. 11.8–11 ka and the high frequency of *T. sarmaticus* in the upper layers, from layer JZA (Figures 6.2 & 6.3). The question I explore here is whether this shifting presence of species is related to changes in sea surface temperatures, habitat change or deliberate human choice. Shellfish species composition is often used as an indicator of the sea surface temperatures (Klein 1972b; Thackeray 1988; Döckel 1998; Galimberti 2010; Sealy & Galimberti 2011).

Klein (1972b) and Döckel (1998), for example, use the presence of *C. meridionalis* in the southern Cape coast sites such as NBC and MRS to infer cool sea surface temperatures during the Oakhurst period as this species is now mostly found in the cold west coast waters. In the Oakhurst layers at NBC (Klein 1972b) and MRS (Döckel 1998) *C. meridionalis* occurs mostly in the lower layers. Both Klein (1972b: 188) and Döckel (1998: 58) argued that its presence in the lower layers suggests cold sea surface temperatures c. 10 and 9.5 ka respectively.

These inferences may need rethinking as only a few species are effective temperature indicators. These include *C. granatina* and *Aulacomya ater* (Branch & Branch 1981: 29, Figure 24; Langejans *et al*. 2012) that occur on the west coast and are considered cool water temperature indicators. The (non-food) species such as *Cellana radiata capensis* and *Alaba pinnae* indicate warm waters (Langejans *et al*. 2012) but these species do not occur at KDC. The species conventionally used as temperature indicators are *C. meridionalis*, characterised as 'mostly cool' and *P. perna* and *C. oculus*, which indicate 'mostly warm' sea surface temperatures. They cannot, however, be regarded as reliable proxies for sea surface temperatures (Langejans *et al*. 2012: 83). An experimental study by Clark and Griffiths (1990) has suggested that *C. meridionalis* do not thrive in temperatures above 18^{o} C. Marshall and McQuaid (1993) have on the contrary observed that *C. meridionalis*can co-exist with *P. perna* in the south coast surviving in sea surface temperatures above 20^{o} C. This supports the Langejans *et al*. (2012) inference that C. *meridionalis* and *P. perna* may not be good sea surface temperature indicators. It is further suggested that there are minor habitat differences between *C. meridionalis* and *P. perna* (Marshall & McQuaid 1993) and that these conditions may cause them to co-exist spatially separated in the same locality. The black mussel, for example, occurs on rocks on the low shore that are associated with sand while the brown mussel occurs on the high shore on rocks that are not usually covered by sand (Marshall & McQuaid 1993).

As the majority of the species that occur at KDC thrive in both warm and cool sea temperatures (Table 6.14) it is difficult to infer sea surface temperatures at the time of occupations, between c. 11.8 and 9.7 ka. Therefore, the absence of *C. granatina*, a better cold water indicator species, at KDC, NBC and MRS suggests that sea surface temperatures in the southern Cape coast were mildly warm during the Oakhurst Industry.

Table 6.14 Klipdrift Cave: shellfish species and sea surface temperature

Species	Sea surface temperature indication
D. gigas	Warm and cool
T. sarmaticus	Warm and cool
D. sinensis	Warm and cool
D. tigrina	Warm and cool
C. oculus	Mostly warm
P. perna	Mostly warm
H. midae	Warm and cool
H. spadicea	Warm and cool
B. cincta	Warm and cool
D. serra	Warm and cool
S. spengleri	-

Species representation can also reflect past habitats. In this regard it is surprising that *C. meridionalis* is not present, even in the lower KDC sequence, as the dominant presence of *D. gigas* suggests sand inundated rocky shores, a habitat that is attractive to *C. meridionalis*. The low incidence of sessile mussels such as *P. perna* at KDC (Table 6.1) is also unusual as they are typically common in LSA sites of the southern Cape such as NBC (Klein 1972b), MRS (Döckel 1998) and BBF sites (dating from c. 6 to 0.5 ka; Henshilwood 2008).

An explanation for the fluctuating presence of *D. gigas* and *T. sarmaticus* at KDC may be due to changes in the habitat best suited to each species over time. *D. gigas* and *T. sarmaticus* thrive in waters with similar sea surface temperatures hence this could not be a factor. The shift from the dominance in numbers of the sand loving species, *D. gigas*, in the lower layers (11.8–11 ka) to the ascendancy of *T. sarmaticus* numbers in the upper layers (c. 10.5–9.7 ka) may suggest scouring out of sand in the later period. *T. sarmaticus* would have thrived in a habitat with more exposed rocks and less sand (see also Yssel 1989).

The near absence of sessile mussels at KDC may suggest a sheltered sandy bay in front of the cave at times, an environment not favored by these species (Lasiak & Dye 1989; Bustamante & Branch 1996). The slight increase in *P. perna* towards the top of the sequence could further indicate a change to more rocky shores and rock pools that would also have attracted *T. sarmaticus* and limpets such as *C. oculus* (Lasiak & Dye 1989; Bustamante & Branch 1996: 346).

The subtle changes in coastal morphology suggested by the shifting dominance of the species may have been a result of rising sea levels and less likely due to changing sea surface temperatures. The complete absence of *H. midae* and the low incidence of *P. perna* and *C. oculus* in the c. 10.5 ka layers, species that do not tolerate overly sandy environments (Zardi *et al*. 2008; Kilburn & Rippey 1982), support a scenario of a sandy dominated marine environment around this time.

A final scenario to consider for the change of species composition at KDC is whether this relates to human choice, but it is a difficult task to detect whether changes are due to human choice rather than environmental ones (Jerardino *et al*. 2008; Sealy & Galimberti 2011). Although the dominant species at KDC, *D. gigas* and *T. sarmaticus*, prefer slightly different habitats, it is common for them to occur in close vicinity suggesting that both could have been available for collection during gathering events.

One possible indication that humans were responsible for the difference in representation through time is the size of *T. sarmaticus* in the lower layers. If the coastal zones were newly colonised by this species in the lower layers, then one would expect the population to consist of smaller animals, migrating from crowded subtidal populations, not the larger ones that tend to stay in the lower subtidal areas (Kilburn & Rippey 1982; Foster 1997; Foster *et al*. 1999). While *Turbo* measurements in the lower layers at KDC (Table 6.8) indicate a relatively small average size, there are some large individuals present, particularly in layers KAE and KAD (Figure 6.7). The presence of such large individuals suggests that a mature *Turbo* population was present and available, and could be seen as tentative evidence that people actively chose to collect *D. gigas* in the lower levels, despite the availability of good sized *T. sarmaticus*.

It seems more convincing at present to suggest that the shifting dominance of *D. gigas* and *T. sarmaticus* at KDC was caused by habitat change rather than human preference. This argument may be tested by later research when refined palaeonvironmental reconstructions of KDC become available. In the instance of *C. meridionalis* and *P. perna*, it is unlikely that people would discriminate between the former and the latter when collecting, as there is little to distinguish them in terms of size and taste (Klein 1972b: 188). Thus the absence of *C. meridionalis* and the rarity of *P. perna* may be most likely explained by environmental factors rather than human decision not to collect them.

6.7.2 Cause(s) of size reduction

Shellfish and tortoise sizes in archaeological sites have been linked to human population sizes and the intensity of harvesting, as discussed below. In this thesis, the comparison of shellfish size between MSA and LSA sites in the southern Cape is based only on *T. sarmaticus* opercula and *C. oculus* shell measurements. Given the relative rarity of *C. oculus* at KDC, their overall small size (Tables 6.11 & 6.12) is unlikely to be due to human predation pressure. There is no criterion established for comparing *D. gigas* sizes although they are numerous in KDC and in the BBC MSA occurrences (Henshilwood *et al*. 2001; Langejans *et al*. 2012) and are also present at MRS, between 10 and 8 ka (Döckel 1998). Comparing their size through time may be a subject for later research.

As detailed in Section 6.5, the data shows that the KDC *T. sarmaticus* opercula are smaller in size than those from the MSA of BBC M2 and KR sites, but larger than the post-Oakhurst assemblages from BBC, KR and BBF. *C. oculus* at KDC are very few, but they are also smaller than those from MSA sites and more similar to those from the Oakhurst layers at NBC.

6.7.2.1 Shellfish

More intensive harvesting of shellfish leading to a reduction in average size is presumed by some to be a result of larger human populations during the LSA than MSA (Klein *et al*. 2004; Steele & Klein 2005-06; Klein 2008; Avery *et al*. 2008; Steele & Klein 2013). However, others (Tonner 2005; Jerardino *et al*. 2008; Jerardino 2010a, b; Sealy & Galimberti 2011) question this proposition. Jerardino *et al*. (2008) and Sealy and Galimberti (2011), for example, point out that *C. meridionalis* in MSA and LSA occurrences are similar in size, but that limpets (e.g. *C. oculus* & *S. argenvillei*) and turban shells (e.g. *T. sarmaticus*) are smaller in the LSA. Klein and colleagues (Klein *et al*. 2004; Steele & Klein 2005-06, 2008; Avery *et al*. 2008; Klein & Steele 2013) believe that the lack of significant difference in *C. meridionalis* sizes between MSA and LSA sites on the west coast is due to this species' rapid colonisation relative to that of slower growing gastropods or turban shells such as *T. sarmaticus*. In addition, both the MSA and LSA occurrences on the west coast contain mussels of a variety of sizes and this could indicate that they were using the same method of procurement during both periods, by removing wracks at a time (Lasiak & Dye 1989). Sizes of *P. perna* from archaeological sites have not been established (but see Döckel 1998: 75 for some efforts to measure fragmented specimens), mainly because it is not possible to reconstruct sizes from fragmented remains as this species does not have a prismatic band. The prismatic band is used to reconstruct the size of individuals, for example, in the case of *C. meridionalis* (Jerardino *et al*. 2008: 285). However, it is possible to estimate length of the brown mussel by measuring a pedal retractor muscle scar and relating it to the length of complete specimens

(Thackeray 1988: 28; see also Hall 1980), a technique, which has not been widely employed in LSA sites, and also not applied at KDC.

It may be significant that non-food shellfish such as *Nassarius kraussianus* from the MSA at BBC are significantly larger than those from the LSA levels at the same site and at Die Kelders (Sealy & Galimberti 2011: 413). It is highly improbable that the reduced sizes of *N. kraussianus* in LSA contexts can be attributed to intensive collection because "there simply are not enough shell beads in LSA sites …" to indicate that this species was heavily harvested during this time (Sealy and Galimberti 2011: 413). Hence, Sealy and Galimberti (2011; see also Jerardino *et al*. 2008) hold that the differences in sizes of shellfish, especially limpets and the turban shells in the MSA and LSA sites, may have been caused by a combination of factors , including climatic and environmental, as well human factors.

Non-human factors that affect the shellfish growth rates include sea surface temperature and turbidity, salinity, topography, wave action, desiccation, shellfish population densities and food supply (McQuaid 1981; McQuaid & Branch 1984; Bruton *et al*. 1991; Foster 1997; Foster *et al*. 1999; Jerardino 2010a, b; Sealy & Galimberti 2011). Oceanic productivity, or the production of organic matter by phytoplankton, generates food for marine life such as shellfish (Sigman & Hain 2012). Productivity changed over time and it is, for example, known that the primary productivity of the Subantartic Ocean changed over the last 70 ka with marked algal production at c. 58.8, 53, 46 and 38.5 ka (Sachs & Anderson 2005). Oceanic productivity data for the southern Cape coast is not available but it may have been influenced by the Subantarctic Ocean (Sealy & Galimberti 2011). Variations in oceanic primary productivity affect the food chain and in turn may affect size and distributions of shellfish species (Sealy & Galimberti 2011). An experimental study on *T. sarmaticus'* diet has shown that the growth of this species is affected by a lack of and the quality of food (Foster 1997; Foster *et al*. 1999). *T. sarmaticus* individuals that were fed coralline algae exhibited a slower growth than those which consumed seaweeds *Gelidium pristoides* and *Ulva rigida*

(Sea lettuce) or a mixed diet (Foster 1997; Foster *et al*. 1999). Changes in oceanic productivity may have resulted in changes in the availability and the quality of food on the southern Cape coast, affecting the growth rates of *T. sarmaticus* prehistorically. Oceanic productivity may have been lower during the terminal Pleistocene and Holocene and could have led to smaller sizes of certain species.

In the case of the KDC data, to test whether increased predation led to a decrease in size, I predict a mean size reduction in *T. sarmaticus* from the older to the younger layers, when exploitation of this species might have been intensified. This is based on the premise that a present but unexploited *Turbo* community will contain many large specimens (Foster & Hodgson 2000; Proudfoot *et al*. 2006). It has also been hypothesised that humans tend to target the largest specimens first when gathering shellfish and the younger ones may be collected later and thus the overall size distribution would become skewed (Halkett *et al*. 2003; Parkington 2003, 2008; Klein *et al*. 2004; Tonner 2005; Klein & Steele 2006, 2013; Avery *et al*. 2008). If shellfish collectors were intentionally seeking out a species at KDC, one would expect the initial assemblage to contain the largest specimens, and a gradual reduction in size through time as increased predation leads to less large ones being available (Klein *et al*. 2004; Steele & Klein 2005-06; Tonner 2005; Avery *et al*. 2008). In the KDC sequence, *T. sarmaticus* is present in all layers, but its presence is much higher from layer JZA and upwards (Table 6.1; Figures 6.2 & 6.3).

Opercula measurements show that sizes decrease from layer JZA upwards. The difference in size between JZA and the uppermost two layers, JYA and JY, is statistically significant (Section 6.6.1). Thus, the decrease in size through time of *T. sarmaticus* opercula at KDC especially after JZA may support a scenario of intensive exploitation leading to reduction in size. This suggestion that there was probably intensive harvesting of *T. sarmaticus* after layer JZA leading to reduction in size does not, however, explain why the KDC opercula are smaller than those in MSA contexts (Figure 6.8). It is possible that *T. sarmaticu*s at KDC had slower growth rates than for example MSA turban shells at BBC. Growth rates may have been constrained by as yet unknown environmental factors. The fact that *T. sarmaticus* were rare in the lower part of the sequence of KDC, when presumably little exploitation occurred, but still smaller than MSA ones at BBC strengthen the argument that an environmental cause was responsible for the constrained growth rates of this species during the LSA.

The inference of larger human populations during the LSA (e.g., Klein & Steele 2013) needs to be verified by independent evidence for human population growth during the Oakhurst Industry (Jerardino *et al*. 2008). Also, more frequent harvesting may have been responsible for size reduction in LSA shellfish and not necessarily larger human populations (Jerardino *et al*. 2008). Until all the causal factors are carefully weaved together, larger human populations as the only driver of shellfish size reduction is premature (Jerardino *et al*. 2008). A careful assessment is required before concluding that human impact solely influenced the size of shellfish remains.

6.7.2.2 Tortoises

Factors that can affect tortoise growth rates are climate (Klein & Cruz-Uribe 1983, 2000; Klein *et al*. 2004; Nel 2007), resource competition and isolation (van Heezik *et al*. 1994). Climates and habitats may exert selection pressures on tortoise populations. For example, warm and dry climate resulting in karroid semi-arid vegetation promotes tortoise growth while cool and wet climate restricts growth (Klein & Cruz-Uribe 1983). As in the case of shellfish, the general small size of tortoises found in LSA sites have been used as a proxy for larger human populations during the LSA compared to the MSA period (Klein 1983, 2008; Klein & Cruz-Uribe 1983, 2000; Klein *et al*. 2004; Avery *et al*. 2008; Klein & Steele 2013). It is argued that if the number of tortoise collectors was higher during the LSA than the MSA it would explain the decrease in tortoise size in the LSA, particularly because harvesting tortoises does not require a specialised technology (Klein *et al*. 2004: 5711; Avery *et al*. 2008: 77).

However, gathering of tortoise does not always lead to a decrease in tortoise size. Nel (2007) has studied the BBC tortoise data from M1, M2, and M3 MSA phases and she shows that, although there is abundance of tortoises during the M3 phase, reduction in overall size of the tortoises did not occur, as would be expected if they were heavily harvested (*vide* Klein *et al*. 2004; Avery *et al*. 2008; Klein & Steele 2013). Nel (2007) favours a climatic explanation for rapid tortoise growth rates particularly during M2 phase where conditions were warm and dry in this region at c. 76 ka. However, the tortoise sizes in the three phases at BBC are almost similar in size.

Average individual tortoise sizes vary markedly from site to site and over time (Klein & Cruz-Uribe 2000; Henshilwood *et al*. 2001; Klein *et al*. 2004; Avery *et al*. 2008) and in some LSA sites average tortoise sizes are close to those of the MSA (e.g., Henshilwood *et al*. 2001: Figure 15). The tortoise sizes at KDC (Table 6.13) are more or less similar to that of MSA sites such as BBC, DRS, Hoedjiespunt 1 and Ysterfontein 1. This is also the case at BNK 1 (c. 13–10 ka) and EBC (c. 12–8 ka, see Henshilwood *et al*. 2001: Figure 15). Thus the size pattern through time at KDC (Table 6.13) does not support intensive harvesting leading to reduced tortoise sizes as some of the largest tortoises are found at the top of the sequence. Alternatively, tortoises were never systematically collected at KDC and a larger sample may be required to investigate this issue further.

6.8 Conclusions

Of the eleven mollusc species that occur at KDC, two are dominant. *D. gigas* is abundant between layers KAE and JZB while *T.sarmaticus* is more numerous from layer JZA. The main calorific contribution of shellfish came from *D. gigas* (127 550.6 kilojoules) and *T. sarmaticus* (63 166.8 kilojoules). The shellfish provided crucial nutritional elements such as protein and omega-3 polyunsaturated fatty acids to KDC inhabitants.

The density of shellfish at KDC is lower between layers KAC and JZB (Figure 6.1) and this may be due to sea level regression or less intensive occupation of the site at that time. The shift from the dominance of *D. gigas* to *T. sarmaticus* may have been caused by rising sea levels, and less likely by changing sea surface temperatures, resulting in environmental changes from sand covered rocky shores prior to c.10.5 ka and more exposed rocks thereafter. The absence of *C. meridionalis* at KDC, which is present at both NBC (Klein 1972b) and MRS (Döckel 1998) during the Oakhurst, and the rarity of *P. perna* may be due to an unsuitable habitat at KDC, and not warmer sea surface temperatures. Effective sea surface temperature indicator shellfish species are not present at KDC because the majority of species present at the site adapt to both warm and cool sea surface temperatures. During the Oakhurst at KDC the terrestrial climate was most likely warm and arid as discussed in the next chapter.

The sizes of *T. sarmaticus* opercula and *C. oculus* from the Oakhurst levels at KDC and NBC are smaller than those from MSA sites. The opercula are larger than in the post-Oakhurst LSA sites. This decrease in size of *T. sarmaticus* opercula after layer JZA at KDC may be due to intensive harvesting although this does not automatically mean the presence of larger human populations. Further environmental reconstructions are needed for this hypothesis to be tested. KDC tortoises in the lower and upper layers have median sizes similar to a number of MSA and LSA sites and the rarity of these animals suggests that they were not systematically targeted. Thus, for KDC the size of medio-lateral distal humeri is not informative on predation patterns.

7. CLIMATE, TECHNOLOGY AND SUBSISTENCE PATTERNS

7.1 Introduction

In this chapter I discuss the implications of the results from Chapters 5 and 6 in terms of the broader theoretical contexts such as palaeoclimate and related socio-ecological models.

7.2 Major climate systems affecting the southern Cape

There are different factors that influence the climate patterns of the southern Cape. These can be grouped into atmospheric and oceanic circulation systems (Preston-Whyte & Tyson 1988; Tyson & Preston-Whyte 2000; Carr *et al*. 2006; Chase & Meadows 2007; Chase *et al*. 2011; Lewis 2011).The southern Cape is a confluence region between the winter and summer climate regimes (Deacon & Lancaster 1988; Chase & Meadows 2007; Lewis 2011), and is known as the "the year-round rainfall zone (YRZ)" (Chase & Meadows 2007: 105). As a confluence region, the southern Cape receives the westerly wind-driven winter rainfall between April and September and summer rain caused by easterly flows during October–March period (Carr *et al*. 2006; Chase & Meadows 2007). Although the southern Cape gets rain throughout the year, maximum precipitation falls in spring and autumn (Deacon & Lancaster 1988). The southern Cape coast receives regular and greater amounts of rainfall than the northern section of the YRZ which is more sensitive to boundary shifts (Quick 2013: 20).

The summer rainfall is linked to the Inter-Tropical Convergence Zone (ITCZ) (Tyson & Preston-Whyte 2000; Chase & Meadows 2007; Quick 2013). The ITCZ is a region of high convection where tropical processes interact with temperate processes. Three major near surface air flows are involved in the ITCZ over Africa south of the equator and affect southern Africa in summer. These include the South Atlantic air that moves in the equatorial westerlies, the north-east monsoon air of East Africa moving south across the equator from the north-east, and the deep tropical easterlies from the Indian Ocean (Tyson & Preston-Whyte 2000: 162). The ITCZ migrates from the southern to the northern hemisphere between January and July (Tyson & Preston-Whyte 2000: 161). As these airstreams interact it leads to convergence or subsidence and cloud formation, resulting to summer rains in southern Africa. This process involves the easterlies, which form easterly waves and low air flows and subsequent formation of summer rain from the interior of South Africa and this rain reaches the southern Cape (Preston-Whyte & Tyson 1988; Tyson & Preston-Whyte 2000; Chase & Meadows 2007).

The rainfall in winter in the southern Cape is caused by temperate frontal climate systems contained in the westerlies that originate on the Western Cape coast. The weather in winter is largely controlled by the movement of cold fronts coming from the South Atlantic to the south and west of Cape Town (Deacon 1982: 49). Disturbances such as waves and eddies are contained in the vortex of westerly winds and these control daily weather (Preston-Whyte 1988; Tyson & Preston-Whyte 2000: 154). The westerlies transport warm air to the continent and once the air condenses it develops clouds and eventual precipitation (Kruger *et al*. 2010).

Two main oceanic circulation systems further influence climate, rainfall and temperature in the southern Cape. These are the Agulhas and the Benguela currents. The Agulhas Current is driven by the South Indian Anticyclone while the Benguela Current is directed by the South Atlantic Anticyclone (Tyson & Preston-Whyte 2000; Noah 2010; Quick 2013). In the Agulhas system, the Agulhas Current transports warm waters from the east coast of South Africa to the South Atlantic Ocean (Beal *et al*. 2011). Where it separates from the continent, it feeds back into the Indian Ocean through the eastward Agulhas return current. This loop, which is called the Agulhas Retroflection, transports heat into the upper arm of the Atlantic meridional overturning circulation (AMOC). This transport of warm, saline waters from the Indian Ocean to the Atlantic Ocean is called the Agulhas leakage. The intensity of the Agulhas system depends on the position of the westerly winds and the subtropical front (Beal *et al*. 2011).

The increase in atmospheric circulation due to the impact of the Agulhas Current (Lutjeharms *et al*. 1996) influences the patterns of rainfall on the adjacent south coast (Jury *et al*. 1993). The current enhances surface winds and cloud development (Lutjeharms *et al*. 1996; Beal *et al*. 2011) and regulates the amount of moisture flux and onshore winds in the adjacent coastal lands (Jury *et al*. 1997; Rouault *et al*. 2000). Along the southern Cape and east coasts, there is thus a large moisture flux caused by the Agulhas Current to the atmosphere (Lee-Thorp *et al*. 1999). The warm waters of the Agulhas Current increases wind stress, deepens the marine-atmospheric boundary layer and leads to formation of convective clouds (Beal *et al*. 2011: 432). Due to enhanced atmospheric baroclinicity (temperature/pressure interaction), caused by the Agulhas Current, storms develop and this may also lead to extreme rainfall events and tornados. There may be a correlation between increased rainfall events and warm anomalies in the Agulhas system as influenced by the subtropical Indian Ocean Dipole and El Niño/Southern Oscillation cycles (Beal *et al*. 2011: 432).

The sea surface temperature also influences the amount of summer rainfall in the southern Cape. The summer rainfall shows a large-scale gradient from northeast to the southeast of the southern Cape coast that follows the direction of the sea surface temperatures (Jury *et al*. 1993). There may be local variations in the large-scale gradient along the shore depending on the orientation of the coast, the width of the continental shelf and the upward slopes of the coastal plains (Jury *et al*. 1993: 1282). For example, where the shelf is narrow, the coastal plains rise steeply and the uplift of air moving onto the coast is more sudden (Jury *et al*. 1993: 1286). The Agulhas Bank in this case forms the “most prominent feature” of the continental shelf in the southern Cape coast (Quick 2013: 16) and movement of air to the coast would likely be slow (*vide* Jury *et al*. 1993).

The other current system that influences climate in the southern Cape is the Benguela upwelling system. The change in sea surface temperature may affect rainfall patterns in the southern and Western Cape coasts (Lutjeharms *et al*. 2001). This system, which occurs on the South Atlantic coast, is driven by strong winds and consists of several upwelling cells, the central cell being active all year round while the southern cells exhibit strong seasonal patterns. The most intense upwelling happens during the austral summer at the time when the South Atlantic Anticyclone is displaced poleward (Lutjeharms *et al*. 2001: 122). As the wind stress increases over the South Atlantic Ocean, the cold upwelled water is advected further offshore. When South Atlantic Anticyclone is intensified it may lead to increased atmospheric subsidence, less cloud formation, increase in insolation and higher atmospheric temperatures on the South Atlantic coast (Lutjeharms *et al*. 2001: 122).

7.3 Palaeoclimate

There have been cyclic climatic changes during the most recent period in the Cainozoic era, the Quaternary. The changes involved rotation of glacial and interglacial conditions on a global scale. Several theories have been advanced to explain the interchange between glacials and interglacials (Imbrie & Imbrie 1979; Bradley 1985; deMenocal 2004), with the most plausible hypothesis being the orbital forcing theory (Willoughby 2007: 68). The orbital forcing theory as proposed by the Serbian astronomer, Milutin Milankovitch, is based on variations in the amount of solar radiation reaching the earth and this primarily affects the climate system (Broecker & Denton 1990; deMenocal 2004; Willoughby 2007).Three factors regulate the amount of solar radiation reaching a particular part of the globe, leading to formation of ice if insolation is reduced. These factors include obliquity, orbital eccentricity and precession (see Broecker & Denton 1990; Willoughby 2007). The northward migration of the subtropical front and circulations of sea surface temperatures, for example, depend on the Milankovitch factors (and the strength of southwesterly winds) (Bard & Rickaby 2009).

During glacial periods in southern Africa the subtropical front off the southeastern coast of South Africa migrates northward by up to the 7^{o} latitude blocking the Agulhas Current which carries heat and salt from the Indian Ocean to the AMOC (Flores *et al*. 1999; Bard & Rickaby 2009: 381). At this period southwesterly winds also migrate northward to 5–9^{o} latitude (Bard & Rickaby 2009). This latitudinal shift of the southwesterly winds supports a scenario of reduced Agulhas leakage to the AMOC, a consequent substantial decrease of North Atlantic deep water formation, and concomitant increase of North Pacific convection. The decrease in exchange of saline and warm water to the AMOC leads to reduced polar heat transport and as a result it influences the growth of northern ice sheets and lowering in sea levels (Bard & Rickaby 2009: 382).

7.3.1 Climates and environments in the southern Cape since the Last Glacial Maximum to c. 7 ka

Climatic and environmental changes from the Last Glacial Maximum (LGM) up to about 7 ka in the southern Cape, South Africa, are summarised here. Chase and Meadows (2007) divide this period into three phases: the LGM, the Lateglacial, and the Holocene. The LGM is placed between 24 and 18 ka (Chase & Meadows 2007; Deacon & Lancaster 1988) or from 23 to 19 ka (Gasse *et al.* 2008 following Mix *et al.* 2001, 21 ± 2 ka).

The LGM was generally characterised by steady reduction in humidity (Chase & Meadows 2007: 120; Gasse *et al*. 2008). Van Zinderen Bakker (1967, 1976) proposed that southern African climate during the LGM was influenced by the expansion of the Antarctic ice which in turn caused the winter rainfall regime to expand and the southward displacement of the ITCZ. This expansion of Antarctic sea-ice during glacial periods may have displaced the westerlies towards the equator leading to frequent and intensive humidity and winter rainfall in south-western Africa (van Zinderen Bakker 1976; Stuut *et al*. 2004). However, the hypothesis remains a matter of significant debate among climate reviewers. Some scholars (Hesse 1994; Lamy *et al*. 1998; Shi *et al*. 2000; Chase & Meadows 2007; Chase 2010), for example, support the idea of an equatorward migration of westerlies during the LGM while others (Ammann *et al*. 2001; Lee-Thorp & Beaumont 1995) argue that there was no significant shift of these winds.

The Lateglacial is the transition from the LGM to the Holocene, defined to be between 18 and 11.5 ka cal BP in southern Africa while the Holocene is the time during which interglacial conditions were established, approximately during the last 11.5 thousand years (Chase & Meadows 2007). Towards the beginning of the Holocene, a short cold spell known as the Younger Dryas occurs c. 13 and 11.5 ka cal BP (Dansgaard *et al*. 1989; Berger 1990; Mayewski *et al*. 1993, 1996; Thackeray 1987; Scott *et al*. 1995; Abell & Plug 2000; Raynaud *et al*. 2000; Thackeray & Scott 2006; Chase *et al*. 2011). This brief climatic phase within Chase and Meadows' (2007) Lateglacial marks a return to almost glacial conditions and briefly punctuated the deglaciation process. With regards to the KDC sequence studied for this thesis, the Younger Dryas broadly corresponds to the lower layers, KAE–JZB (Roberts 2013).

The effect of the Younger Dryas in the southern hemisphere, unlike the northern hemisphere, is equivocal (Abell & Plug 2000; Chase *et al*. 2011) as, for example, palynological evidence suggesting aridity in the interior part of South Africa does not correlate with the timing of this cold spell (Scott *et al*. 1995). Despite the lack of strong signals, the South African record for the Younger Dryas and its climatic impact are discussed below (Section 7.4). The causes of the Younger Dryas are not obvious but may include factors such as positive feedback (albedo CO_2 and oceanic circulation interaction), collapse of ice sheets, and external forcing factors (e.g. volcanism, solar output, supernova, and cosmic dust) (Berger 1990). However, factors that triggered the Younger Dryas may be more complex and might be linked to the great oceanic conveyor that includes the Agulhas system; and in this case the great conveyor may have been temporarily shut down leading to brief cold conditions (Broecker 1991). The shutdown of the conveyor may in turn be associated with the reduced Agulhas leakage to the AMOC (Broecker 1991) as noted above.

The final climatic phase since the LGM is called the Holocene Altithermal (HA) by Chase and Meadows (2007). It is the period with highest temperatures during the Holocene between 8 and 4.5 ka cal BP (Chase & Meadows 2007: 106). This occurred after the period involving the Oakhurst Industry and will not be emphasised here.

7.3.2 Sea level changes since the Last Glacial Maximum

The fall in the sea level during the LGM was caused by the growth of ice sheets due to the decrease in summer insolation in the northern hemisphere, Pacific sea surface temperatures, and reduced CO_2 (Peltier & Fairbanks 2006). At a global scale, marine regression began before the LGM, c. 33 ka falling to c. 24 m below present day levels of the northern hemisphere (Clark *et al*. 2009). Global LGM sea levels are estimated to have been between 120 and 130 m below present day levels (see Shackleton & Opdyke 1973; Yokoyama *et al*. 2000; Peltier & Fairbanks 2006; Clark *et al*. 2009). Sea levels started rising rapidly at the end of the LGM. This rapid rise is estimated to have been from –120 to –75 m in only 5000 years (i.e. 0.9 cm/year) from 19 to 14.5 ka (Clark *et al*. 2009; Compton 2011). There was another rapid rise in sea level of 16 m in 300 yr (Hanebuth *et al*. 2000) or 20 m in 560 years between 14.17 and 13.61 ka (Stanford *et al*. 2006). This is related to the Melt Water Pulse 1A (MWP1A) event (Compton 2011).

Along the South African shoreline the sea level trends are generally similar to those in the Caribbean islands although limited data preclude robust comparisons (Ramsay & Cooper 2002). During the LGM, sea level along the southern Cape coast fell to a maximum of 130 m below present day level (Deacon & Lancaster 1988; van Andel 1989; Ramsay & Cooper 2002) but Dingle and Rodgers (1972) gave a higher estimate of 140 m as observed from the Agulhas Bank geomorphology. At NBC, for example, Klein (1972a: 138; see also Lewis 2011) interpreted the almost absence of shellfish during the Robberg period as evidence for reduced sea levels, where the shoreline may have been c. 75–80 km from NBC.

By c. 17 ka the sea level was –130 m at Cape St. Francis (Vogel & Marais 1971; Ramsay & Cooper 2002) and –120 m by 13 ka (Vogel & Visser 1981; Ramsay & Cooper 2002), a rise of about 10 m in a 4000 year period. Sufficient data on sea level in the southern Cape do not exist but Compton (2011) estimates a rapid sea level rise from 13.8 (14.2–13.6) ka to 11.1 (12–10.6) ka where sea levels rose from –75 m to –45 m, covering 30 m within a 2700 year duration. There was a slower sea level rise from c. 11 ka that may be linked to the end of a brief warm event, MWP1B which broadly coincides with the advent of the Younger Dryas event (Bard *et al*. 1996).

By the beginning of the Holocene, sea level in the southern Cape coast can be inferred from east coast locations as there are no estimations from the southern Cape coast. A wood fragment on bedrock at Mkomazi Estuary indicates that the sea level was –48 m by c. 10 ka while at 9 ka the sea level was –28 m at the same locality (Ramsay & Cooper 2002). At about 6.8 ka the sea level was 3 m above the present level (Compton 2001) on the southern Cape coast. By c. 5 ka sea levels returned to present day levels and remained within ±1 m of present day levels (Reddering 1988; Ramsay & Cooper 2002; Compton 2001).

7.4 Palaeoclimatic/palaeoenvironmental indicators

A range of archives and proxies have been used to infer past climatic and environmental conditions. For example, oxygen isotope records obtained from deep-sea cored sediments and cave deposits constitute some of the best indicators for Quaternary climates and are used to designate glacial or interglacial episodes (Bard & Rickaby 2009). For the southern Cape, several archives and proxies have also been used to reconstruct palaeoclimates and environments. These range from faunal remains (macro- and micro-fauna), charcoals, pollen, sediments accumulated through natural weathering, sediments and pollen accumulated by aeolian activity, speleothems, fossil groundwater to cored marine sediments (Klein 1972a, 1974, 1978, 1980; Deacon 1979; Avery 1982, 1984; Deacon *et al*. 1984; Deacon & Lancaster 1988; Talma & Vogel 1992; Avery 2004; Carr *et al*. 2006; Chase & Meadows 2007; Faith 2011a, 2013).

Macro faunal remains (Klein 1974, 1978, 1980) indicate that the LGM was dominated by grassland environments in the southern Cape. At sites such as NBC and BPA, for example, macro-faunal remains (dated between 22 and 15 ka) indicating grassland environments include *Syncerus caffer* (African buffalo), *Taurotragus oryx* (eland), *Damaliscus dorcas* (blesbok/bontebok), *Hippotragus* sp. (roan), *Alcelaphus caama* (red hartebeest), *Antidorcas marsupialis* (springbok) and *Connochaetes gnou* (wildebeest), *Equus zebra* (mountain zebra) and *Equus quagga* (quagga) (Klein 1972a; Lewis 2008, 2011). Charcoal and pollen remains show that vegetation was less diverse during the LGM and woodland taxa were rare (Deacon *et al*. 1984; Scholtz 1986).

Sedimentological analysis of the Vankervelsvlei core, near Knysna (Irving 1998) suggests aridity or the drying out of the wetland during the LGM. Proxies from other archives, for example, micrommalian faunal remains (Avery 1982, 1984; Thackeray 1987), sediments with frost-weathered roof spall containing iron compounds and decalcified shell at NBC (Butzer 1984), pollen and charcoal evidence from BPA (Deacon *et al.* 1984; Scholtz 1986), the Uitenhage aquifer and Cango Cave stalagmite (Talma & Vogel 1992) corroborate the sedimentological evidence in suggesting aridity between 24 and 17 ka for the southern Cape area (Deacon & Lancaster 1988). The charcoal at BPA during the LGM are dominated by Asteraceae, Compositae and Leucadendron species which are today found in drier situations such as the lee and higher slopes of the Swartberg (Deacon 1982: 49). Other indicators of aridity during the LGM include lack of pollen preservation in wetland systems in the southern Cape (Quick 2013: 289). The aridity during the LGM may have been due to the weak circulation of moisture carrying cold fronts from the coast to reach as far as NBC (Lewis 2008).Temperatures were lower than present by c. 5–6^{o} C between 21.5 and 14 ka cal BP (Chase & Meadows 2007). The temperatures colder than present have been inferred using oxygen isotope data from the Uitenhage aquifer and the Cango Cave stalagmite (Deacon *et al*. 1984; Deacon & Lancaster 1988; Talma & Vogel 1992; Chase & Meadows 2007).

All the archives and proxies (grassland, charcoal, and pollen remains from BPA) that suggest a cool climate have been interpreted as evidence for reduced precipitation (Deacon *et al*. 1984). However, Chase and Meadows (2007) argue that reduced atmospheric CO_2 and highly seasonal rainfalls may have acted as forcing mechanisms for vegetation change instead of reduced precipitation. A recent analysis of ungulate diversity (Faith 2013) that includes sites in the southern Cape, NBC and BPA, indicates a decline in ungulate richness during the LGM–Lateglacial. This decline in ungulate diversity is interpreted as evidence for increased effective precipitation (precipitation–evaporation; P–E) during this time (Faith 2013). The inference of increased effective precipitation for the LGM-Lateglacial contradicts earlier reconstructions that the LGM in the southern Cape was arid. Faith (2013: 198), like Chase and Meadows (2007: 123), suggests that palaeoclimatic proxy data (e.g., charcoal remains) that indicate aridity can also imply marked seasonal variations in precipitation.

From the Lateglacial, (c. 18 ka cal BP) there was a sudden shift in temperatures (Deacon 1982; Chase & Meadows 2007) from cold to warm. A rise in temperatures at this time is suggested by oxygen isotopes from Cango Cave II (Vogel 1983) and the decrease in size of micro-fauna such as the red musk shrew, *Crocidura flaviscens* (Avery 1979, 1982; Deacon 1982; Thackeray 1987). The period between 17–14 ka cal BP (c. 14.2–12 ka; Chase & Meadows 2007) experienced the highest effective precipitation in the last 80 ka (Scholtz 1986: 7; Deacon & Lancaster 1988: 132; Chase & Meadows 2007). The relative abundance of micro-faunal species (*Mysorex varius* & *Otomys irroratus*) which today occur in wet conditions supports the scenario of increase in effective precipitation (Avery 1979, 1982; Thackeray 1987) between 14.2 and 12 ka. At this time there was also a marked increase in plant diversity as suggested by preserved woodland taxa at BPA (Scholtz 1986; Deacon & Lancaster 1988: 132). Rhus and Olea/Dodonea species which occur in moist environments today are dominant in contrast to the arid species, Compositae and Leucadendron which dominate the layers dating prior to the Lateglacial at BPA (Deacon 1982: 55).

By the beginning of the Oakhurst Industry, from c. 12 ka (c. 14 ka cal BP) increasing terrestrial temperatures may have led to a gradual drying in the southern Cape (Scholtz 1986; Chase & Meadows 2007: 123). A trend to drier conditions has been noted at BPA (Scholtz 1986) and now at KDC (Roberts 2013). At KDC oxygen isotope ratios, $\delta^{18}O$, of ostrich eggshells from the layers indicating aridity date to between c.11.8 ka (13.8 ka cal BP KAE) and c. 11 ka (13.1 ka cal BP for layer JZB). The stalagmite at Cango Cave, near BPA stopped growing from 12 ka, further suggesting arid conditions (Talma & Vogel 1992; Holmgren *et al*. 2003). In the interior of South Africa drier conditions during the Oakhurst period have been indicated by isotope data at hyrax midden sites (Chase *et al*. 2011) and the lack of growth in the stalagmite at the Makapansgat Valley (Holmgren *et al*. 2003). The tortoise data at KDC may be consistent with arid environments around this time, as the median size is generally large, suggesting that tortoise growth was supported. Tortoises grow more rapidly in warm and arid environments than in wet situations (see Klein & Cruz-Uribe 1983).

During the Oakhurst period the grasslands environments of the Robberg were replaced by more closed habitats, starting probably prior to c.12 ka (Klein 1974; Deacon 1982; Deacon *et al*. 1984; Chase & Meadows 2007). At KDC the carbon isotope ratios, $\delta^{13}C$, from ostrich eggshell indicate the persistent presence of C_4 plants in the diet of ostriches, and year-round rainfall conditions (Roberts 2013: 83). At BPA, in the BRL member, thicket taxa such as *Mnylenus*/*Pterocelastras*/*Euclea*/*Diospyros* become common (Scholtz 1986: 7). The fauna species indicative of the bushier habitats or woody vegetation cover are small non-gregarious browsers such as bushbuck (*Tragelaphus scriptus*), bushpig (*Potamochoerus larvatus*), and grysbok (*Raphicerus melanotis*) at NBC and BPA (Klein 1972a, 1980, 1983; Fisher *et al*. 2010; Faith 2011a, b). Several terrestrial fauna (e.g. *Equus capensis, Pelorovis antiquus,* and *Megalotragus priscus*) went extinct between c.12 and 9 ka and were replaced by small non-gregarious game, characteristic of the Oakhurst period (Klein 1974, 1980; Faith 2011a). The disappearance of eland and warthog c. 12 and 9 ka supports the hypothesis of declining grassland environments (Klein 1972a: 138). However, there is a possibility that the extinction of these animals may have been caused more by hunting practices than environmental changes (Klein 1978, 1980: 271–272).

A brief punctuation in the deglaciation process may have taken place in the southern Cape during the Younger Dryas (between 13 & 11.5 ka cal BP). In the northern hemisphere temperatures became cooler than before and after this period. Although the effects may not have been the same everywhere in South Africa and neighbouring sites, the general trend recorded is that of increasing aridity, reduced moisture content (see Scott *et al*. 1995; Roberts 2013) and cooling of sea surface temperatures (Cohen *et al*. 1992). Evidence of this event in South Africa is recorded in a number of sites, including Wonderkrater (Thackeray and Scott 2006), EBC (Cohen *et al*. 1992; Parkington *et al*. 2000), Bushman Rock Shelter (BRS) (Abel & Plug 2000; Badenhorst & Plug 2012), and the Western montane sites (Quick 2013). The paleoclimatic evidence relating to the Younger Dryas at EBC includes isotopic enrichment of *Scutellastra granatina* between 11 and 10 ka (Cohen *et al*. 1992: 382) and wood charcoal and pollen remains (Parkington *et al*. 2000). The EBC shell isotopic ratios suggest the cooling of the sea surface temperatures (Cohen *et al*. 1992; Scott *et al*. 1995). Isotopic enrichment in pollen remains indicates low moisture in De Rif, Cederberg between 12.7 and 11.5 ka cal BP (Quick 2013: 75). Oxygen isotope ratios of the giant land snail, *Achatina immaculata* at BRS during the terminal Pleistocene and early Holocene suggest cold conditions (Abel & Plug 2000; Badenhorst & Plug 2012). The palynological evidence from Wonderkrater indicates a drop in terrestrial temperatures and moisture (Thackeray & Scott 2006; Quick 2013) but the palynological record here and other sites in the interior is still subject to debate and sometimes evidence from different layers contradict each other (see Scott *et al*. 1995). The $\delta^{18}O$ from KDC ostrich eggshells discussed above is relevant to the effect of the Younger Dryas in the southern Cape where increased aridity at KDC is indicated (Roberts 2013: 79). The greatest aridity, occurred in layer JZA (Roberts 2013: 83), which was not dated but likely to be of the same age as the layer below it, JZB dating to 11 ka (13.1–12.7 ka cal BP; see Chapter 3).

Warmer temperatures in the southern Cape reached a peak by c. 7 ka during the Holocene (Deacon & Lancaster 1988; Chase & Meadows 2007). After the Oakhurst period, during the Holocene Altithermal, between 8 and 4.5 ka cal BP, terrestrial temperatures were 2–3^{o} C higher than the present records (Scott & Thackeray 1987; Thackeray 1990; Chase & Meadows 2007).

7.5 Lithic technological adaptation: palaeoenvironment and socio-ecological models

A major theme of LSA archaeology in southern Africa since the 1970s has been to link environmental changes, artefact assemblages and subsistence strategies into a coherent whole (Mitchell 2002b:149). Mitchell (2002a) notes that hunter-gatherer research has, in recent decades, focused much more attention on the MSA than on LSA. This chapter explores the technological and subsistence behaviours of the Oakhurst people at KDC in relation to broader palaeoclimatic and ecological models.

The changes that occurred in the different LSA lithic industries (*viz*. Robberg, Oakhurst & Wilton) in the south-eastern Cape (Deacon 1976) have been explained in terms of the concept of homeostasis. Deacon (1976), for example, treated archaeological assemblages as parts of larger systems. When technological conditions remained similar, it represents a homeostatic plateau, reflecting periods of stable adaptations. Hence, Robberg, Oakhurst, and Wilton industries were viewed as marking plateaux or equilibria and the break points between the industries were seen as homeostatic adjustments towards the beginning of a new industry. On one level, the shift from one industry to another technologically meant "rapid change from one equilibrium plateau to another" coincident with environmental and subsistence patterns as well as change in social organisation and demography (Deacon 1976: 81). On another level, the changes in, for example, scraper classes within an industry were described as minor adjustments to maintain a system in relative constancy (Deacon 1976: 81).

Deacon (1969, 1972) described phases at the Wilton Larger Rock Shelter site from another point of view, using a cultural ontogeny model (developmental model) proposed by Clarke (1968). This theoretical framework suggests five phases of development: birth/death, formative or growth phase, maturity or climax phase (where there's a highest degree of diversity), post-coherent phase, and death/birth phase that may mark the beginning of a new tradition. Although the cultural ontogeny model successfully described assemblage variability through time in the southern Cape, other writers (Parkington 1980; Humphreys & Thackeray 1983) doubted the extent to which this pattern could be recognised in other areas.

Changes between and within LSA lithic industries have also been explained from an evolutionary perspective (Deacon 1982: 467). Technological changes during the LSA in the southern Cape might have been triggered by multiple factors – environmental, social/demographic and technological – operating at both macro- and micro-evolutionary scales (Deacon 1982: 351). Two main types of changes may be identified: innovative (appearance of new items) and post-innovative changes (shifts in the frequency, size, shape and raw materials usage in the manufacture of tools and in the by-products of tool manufacture). Deacon (1982) argued that while innovations can be related to factors that trigger the appearance of an item, post-innovative changes could be considered as stylistic markers that could take the form of size and shape of a particular item. For example, the appearance of a scraper would be considered to be triggered by factors related to environmental change but subsequent change in size and shape would be considered stylistic. Based on modern technological analogues, it was assumed that on a macro-evolutionary level the LSA should show a progression towards increasing complexity, greater standardisation and miniaturisation if there were no negative factors disrupting the evolutionary momentum (Deacon 1982: 355). The Oakhurst, c. 12–7 ka, represents a deviation from the expected pattern of change (Deacon 1982: 369) as instead of these trends, the size of flakes increase, coarse grained raw materials become common, and bladelet production becomes rare or cease and large scrapers dominate the formal tool class. The shift from Robberg to Oakhurst Industry broadly correlates with the change in the hunting strategy (hunting of smaller, solitary game such as antelope) but does not directly correlate with environmental changes (vegetation & climate) as the latter occurred much earlier, 2–4000 years before technological change (Deacon 1982: 370). The new hunting strategy probably had impact on the socio-demographic patterns in terms of group size, distribution and seasonal movements (Deacon 1982: 389).

Industrial change, for example from bladelet production to the production of larger scrapers, may have resulted from social stress probably stimulated by environmental changes (Deacon 1982: 389). This hypothesis has been criticized as difficult to test archaeologically and that wholesale disappearance of bladelet production would not have been caused by stylistic factors alone or without this technological change having any economic consequences (Barham & Mitchell 2008: 320).

The Oakhurst technology in the southern Cape has also been discussed in terms of subsistence and settlement strategies (Ambrose & Lorenz 1990). Ambrose and Lorenz (1990:3), following Dyson-Hudson and Smith (1978) and Wilmsen (1973), evaluated archaeological data in terms of predictive ecological models of hunter-gatherer social and territorial organisation. They (Ambrose & Lorenz 1990) link environmental change, resource structure, technology, mobility and social organisation and argue that this could account for differences between the Robberg and Oakhurst industries at NBC in the southern Cape. They suggest that the Robberg complex, for example, shows almost exclusive use of fine grained, non-local raw material due to existence of exchange networks or high residential mobility. The Oakhurst on the other hand is characterised by the use of locally available course-grained raw materials due to decreased mobility and perhaps occupation of much smaller defended territorial ranges. Environmental change did occur from the Robberg to the Oakhurst period in the southern Cape, as reflected in for example, the different faunal populations, discussed in more detail above. In the KDC and MRS assemblages lithic artefacts (including formal tools) are made on locally available raw material; quartzite and quartz. Other Oakhurst sites in the southern Cape (NBC, BPA; Deacon 1982) also reflect exploitation of local raw materials. In this regard, the Oakhurst populations were thus less mobile than the Robberg groups as they used locally available resources.

Ambrose and Lorenz's (1990) ecological model may be more relevant than the Deacon stylistic explanation of artefact change (Barham & Mitchell 2008: 321). Nevertheless, Ambrose and Lorenz's model is not without weakness because

Mitchell (1995: 31) showed that in some sites such as Sehonghong Rock Shelter in Lesotho, assemblages similar to Oakhurst replaced Robberg-like occurrences but this replacement did not go along with the substitution of opalines or other fine-grained materials by coarser-grained rocks. At Sehonghong Rock Shelter in Lesotho, for example, there is a continued use of opaline raw materials in the succeeding Oakhurst Industry (Mitchell 1993).

Another way of explaining the nature of the Oakhurst Industry in relation to the Robberg and Wilton is in terms of energy invested in lithic production. Binford and Binford (1966) made a distinction between maintenance and extractive tasks in prehistoric hunter-gatherer economies, suggesting that some artefacts were used for repairing others while other artefacts (extractive tools) were used for obtaining subsistence resources. From this perspective, lithic analysts (Binford 1977, 1979; Gould 1980; Bamforth 1986; Shott 1996) distinguished between curated and expedient technologies. In curated technologies there is manufacture of a range of sophisticated implements for anticipated use (Bamforth 1986). Curated tools can be effective for multiple tasks, and may be reused and maintained, especially where raw material is scarce (Bamforth 1986: 40). In a curated technology, energy is invested to maximise the return (Bamforth 1986: 38) of production. In expedient technology, on the other hand, limited time is invested in the manufacture of stone artefacts. Tools are most likely made to cater for immediate need, without anticipation for future tasks (Binford 1979; Bamforth 1986). Expedient tools are discarded after use without need for maintenance (Gould 1980; Bamforth 1986) and reflect little of the group or manufacturer’s individuality and are often unstandardised (Wadley 1986: 96, 2013).

In addition, curated and expedient tools can be interpreted in terms of reliability and maintainability and involving different costs and benefits (Binford 1973; Bleed 1986) and risk (Torrence 1989; Bamforth & Bleed 1997; Bousman 2005: 197). Expediency involves low manufacturing costs but low utility as tools are not repaired; maintainability encompasses moderate manufacturing costs with relatively higher utility because of efforts involved to repair when the tool has dulled; and reliability has higher manufacturing costs but with concomitant higher tool utility (Bousman 2005: 197). When subsistence resources are scarce and thus the severity of failure is high (e.g., Torrence 1989), human groups tend to be more mobile, and invest much time in manufacturing tools for anticipated tasks. In such conditions, the use of non-local raw materials and curation may be due to the scarcity of raw material (Bamforth & Bleed 1997). Conversely, in areas with plenty subsistence resources, tools may be expediently used and rarely repaired while locally available raw materials are exploited (Bousman 2005: 219). From this perspective, Bousman (2005) interprets the LSA patterning at Blydefontein Rock Shelter as a consequence of managing risk. The final form of the Wilton and Smithfield LSA end scrapers from Blydefontein Rock Shelter thus results from intensity of use and resharpening, and "not a reflection of norms of manufacture" (Bousman 2005:205).

The Oakhurst layers from KDC, MRS and other sites evidence a simple expedient method, minimally preparing cores and unidirectionally striking flakes off cores using direct percussion technique. The main formal tool type is the scraper, end or side scrapers, with marginal retouch. This is typical of an expedient technology with low manufacturing costs and low utility containing tools that are not repaired or maintained. This technological organisation would likely be related to low risk environments. The lithic assemblage at KDC further reflects that human populations were less mobile than during the Robberg times as locally available raw material resources were exploited.

The four lower layers at KDC (KAE, KAD, KAC, & KAB) date to between c. 11.8 and 11.7 ka (Table 3.2, Chapter 3), the time towards the onset of the Younger Dryas. The ostrich eggshells isotope data discussed above show increasing aridity from this period culminating in layer JZA, dating to after c. 11 ka. There is no gradual technological adaptation to this drying trend at KDC. Some changes do occur through the sequence. In the lowermost two layers, the stone tool industry contain the highest diversity of raw materials including significant exploitation of quartz, more scrapers than in the other layers, larger and more cores, in addition to a few bladelets. From layer KAC to the top of the sequence, the stone tool industry is similar. There is thus no robust link between environmental and technological change at KDC. The relationship between shellfish exploitation and environmental change is much clearer, as discussed below in Section 7.6.

Although rainfall was low during the occupation at KDC, the local environment represented a predictable and easily accessible subsistence resource in which intensive investment into procurement technologies was not necessary. The coast at KDC provided a locally available rich resource base for the exploitation of shellfish, as discussed in Section 7.6 below. This would have been one of the main reliable food sources (Langejans *et al*. 2012).

7.6 The environment and Oakhurst subsistence economy

Shellfish remains occur rarely in the Robberg layers (e.g., at NBC, Deacon 1978) as sea levels were lowered during the LGM but shellfish become abundant during the Oakhurst period and thereafter. The rise in shellfish subsistence during the Oakhurst coincides with the rise of sea levels. The sea level rise after 14.5 ka (Clark *et al*. 2009; Compton 2011) brought the coastline very close to the level of present day Oakhurst sites on the southern Cape coast. As discussed in Chapter 6, the shellfish species exploited at Oakhurst sites differ somewhat from MRS and NBC, and changes through time are evident at all three sites. At KDC, for example, the dominant shellfish species is *D. gigas*, which is almost replaced by *T. sarmaticus* after/around 11 ka (from layer JZA), the period that coincides with the driest environment in the sequence. At MRS and NBC *P. perna* replaces *C. meridionalis* at about 10 ka. These changes are likely due to changes in local habitat conditions through time and site specific shores, and may relate to the temperature changes of the Younger Dryas as discussed by Thackeray and Scott (2006). At KDC for example, in Chapter 6, Figures 6.2 and 6.3, it is indicated that there is a change from the dominance of *D. gigas* to *T. sarmaticus* in the sequence, most noticeably from layer JZA. The isotopic data also indicate maximum aridity in the sequence in layer JZA as discussed in Section 7.4 above. Furthermore, the shellfish density is at its lowest in layer JZB (Chapter 6, Figure

6.4). When these trends are compared to the temperature data for the terrestrial sequence of pollen at Wonderkrater (Thackeray & Scott 2006: Figure 2; reproduced here as Figure7.1) it can be seen that layer JZB, where the lowest density of shellfish is recorded, coincides with the time when temperatures were probably the lowest during the Younger Dryas.

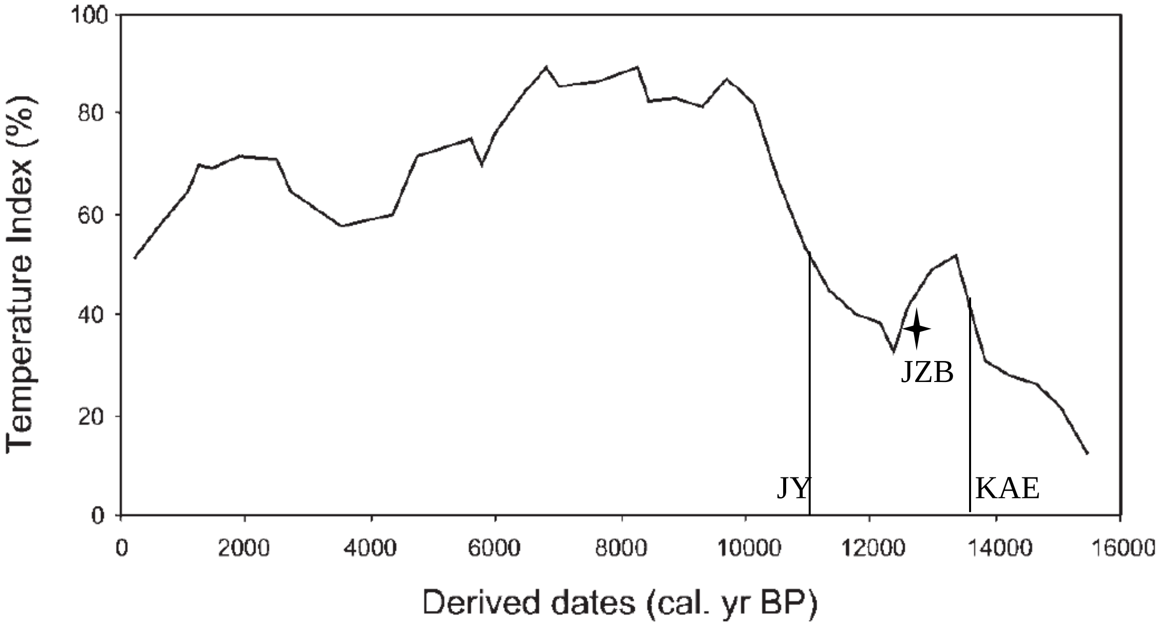

Figure 7.1 Temperature index for Wonderkrater within the past 16 000 years (calibrated dates) showing layers KAE, JZB and JY at KDC. Layer JZB, where the shellfish density is the lowest, coincides with the times when temperatures might be relatively low within the Younger Dryas. Figure modified from Thackeary and Scott (2006: Figure 2)

The change in shellfish composition probably reflects habitat change that involved removal of sands off the rocks after/around 11 ka due to increasing sea levels. The decrease of the sand mussels at MRS and NBC in the upper layers also supports the shrinking of sandy shores at this time. It is interesting that the shellfish subsistence practices track the change in environment much more closely than the technology at KDC.

7.7 Conclusion

The environment during the Oakhurst period was characterised by a hot and relatively dry terrestrial climate with closed habitats that supported non-gregarious fauna such as bushbuck/antelope. Sea levels resulted in a diversity of subsistence resources, and shellfish formed an important part of the diet.

The adaptation of the Oakhurst populations involved the manufacture of expedient stone artefacts such as large unstandardised scrapers for immediate use that were probably discarded after use. On the whole, the lithic technology at KDC and MRS reflects low economic risk situations and the use of locally available resources for tool manufacture.

The initial occupation, layers KAE–JZB and probably JZA, at KDC corresponds to the Younger Dryas. During this period at KDC arid terrestrial environments, as indicated by ostrich eggshell oxygen isotopes, prevailed. The stone tool technology of the lowest two KDC layers, containing a few Robberg elements, is somewhat different from the rest of the sequence in which the technology remains stable. In contrast, the shellfish patterns show a change from layer JZA as habitat specific changes probably necessitated the replacement of *D. gigas* by *T. sarmaticus* c. 11 ka. At KDC thus, technological change and subsistence patterns, as far as shellfish is concerned, followed largely independent trajectories.

8. SUMMARY AND CONCLUSIONS

The new investigation of an Oakhurst occurrence in the southern Cape provided the opportunity, for the first time in more than a decade, to re-evaluate the technology and subsistence behaviours associated with this technocomplex. Investigations in the 1970's and 1980's established the Oakhurst, also named the Albany in the southern Cape, as a macrolithic industry mainly in quartzite with characteristic scrapers. It is associated with a marine subsistence economy and the hunting of mostly medium and small bovids often adapted to closed bushy environments. The lithic technology from KDC sequence, dating to between c. 11.8–9.7 (13.8–11.1 ka cal BP), was studied and compared with the MRS sequence, and the shellfish and some tortoise remains were analysed to inform on subsistence behaviour. In this chapter, I summarise the contributions of the analyses carried out for this thesis in relation to the research aims and hypotheses set out in Chapter 1.

8.1 Technological behaviour at Klipdrift Cave

To achieve the first research aim, describing the technological behaviour at KDC, 13 512 lithic artefacts were analysed using the conventional typological approach in combination with *chaîne opératoire* principles as discussed in Chapter 4. The analysis showed that the KDC occurrence shares many characteristics typical of the Oakhurst Industry from the southern Cape, for example in the dominance of flakes, occurrence of irregular cores and typical large side and end scrapers. However, the lowermost layers at KDC (KAE & KAD) are different in that there are relatively fewer flakes and higher proportions of blades, bladelet cores and bladelets. This change in the KDC sequence could not be correlated to any climatic or environmental change. There are no other sites in the southern Cape, apart from perhaps the lowest unit at Nelson Bay Cave (NBC), where blades and bladelets form a noteworthy part of an Oakhurst assemblage. This indicates a degree of overlap with the terminal Robberg Industry.

Examining the *chaîne opératoire* of the KDC Oakhurst assemblage provided details of the artefact manufacturing process. Quartzite is the main raw material exploited at KDC, as in other Oakhurst sites on the southern Cape coast, including NBC and MRS. However, at KDC there are proportionately higher frequencies of quartz than at the other sites. In the lowermost two KDC layers, 40% of the industry is in quartz and in the rest of the sequence this drops to 20%. At other southern Cape coastal sites, the highest frequencies of quartz is c. 5% in the lower Oakhurst layers of NBC and <1% in the upper layers of MRS. The method of producing blanks at KDC involved unidirectional production of blanks after minimal preparation of cores.

As documented for other Oakhurst occurrences, cores are mainly irregular, but more informative unidirectional cores also occur. Direct percussion by hard hammer was the preferred percussion technique applied, but some bipolar flaking also occurred. Cores were reduced by removing a few flakes sequentially in a short series from a single platform or multiple, unorganised platforms. The flakes carry almost always unidirectional scars, and are, as noted by earlier research, quadrilateral or irregular in shape.

At KDC, similar to other Oakhurst sites, the formal tools are predominantly scrapers, end- and side-scrapers. The average size of scrapers decreases through time, but all of the scrapers reflect the early phase of the Oakhurst Industry. No woodlot scrapers, typical of the later phase of the Oakhurst, occur. The scrapers and other tools were probably multifunctional and may have been used for hide processing, woodworking and maintenance of other artefacts, but confirmation of this awaits micro-wear and residue studies. The KDC lithic occurrence is thus typical of the early phase of the Oakhurst technocomplex that occurs in the southern Cape and South Africa between c. 12 and 10 ka.

The re-analysis of the MRS sample was aimed at determining to which degree the KDC lithics resemble another coastal Oakhurst site. Different raw material exploitation patterns occur at the two sites and different sources were used to obtain raw materials as blanks for cores. These were exclusively quartzite cobbles at MRS, and predominantly quartzite and quartz angular blocks at KDC. However, the method of production was virtually identical. The same simple flake production method, resulting in the production of irregularly shaped and unstandardised flakes, was used at both sites. The MRS industry occurs within a later period of the Oakhurst Industry (c. 10–7 ka), and contained very few blades and no bladelets. As the KDC layers KAE and KAD, are most similar to the lowermost layer at NBC, with a date of c. 12 ka, the second hypothesis is only partly true. The KDC and MRS lithic assemblages both belong to the same technocomplex, the Oakhurst, but they differ in raw material exploitation patterns.

8.2 Shellfish subsistence behaviour at KDC

One of the main aims of this thesis was to reconstruct the shellfish exploitation patterns of the inhabitants of KDC and to determine whether this changed through time, as is the case at other Oakhurst sites. The relative abundance of each species in terms of MNI and weight indicated that *D. gigas* and *T. sarmaticus* were the main sources of nutrition derived from shellfish, and that, as hypothesised, their relative abundance changed through time. In the lower half of the KDC Oakhurst (KAE–JZB) sequence, dating to between c.11.8 and 11 ka, *D. gigas* was most often consumed, while in the younger layers, *T. sarmaticus* became the dominant species. However, the hypothesis that similar shellfish species were exploited at KDC, MRS and NBS must be rejected. At NBC and MRS, *D. serra*, *P. perna* and *C. meridionalis* and *B. cincta* were the main species exploited. At MRS *P. perna* replaces *D. serra* in the upper layers, around 8 ka and at NBC the most abundant species in the lower layers, *C. meridionalis* and *B. cincta* are replaced by *P. perna* in the upper layers dating to 9 ka. Shellfish exploitation patterns at KDC are thus completely different compared to those at MRS and NBS.

8.3 Palaeoclimatic/palaeoenvironmental implications from Klipdrift Cave shellfish and tortoise data

The change in relative abundance of species through time at KDC leads to the question whether changes in sea surface temperature and the environment are related to this pattern. The hypothesis was that shellfish composition would reflect sea surface temperature, and indirectly habitat at KDC. However, a literature review indicated that the frequently used temperature indicator species such as *P. perna* and *C. meridionalis* are not useful for inferring sea surface temperatures. The shellfish species from KDC are therefore not informative regarding sea surface temperatures because most of them adapt to both cold and warm temperatures.

The KDC sequence falls within the Younger Dryas event, c. 13–11.5 ka cal BP (c. 11–10 ka); a brief colder spell interrupting the warming trend that occurred after the LGM. The southern Cape may have been affected, as has been shown for sites further north in South Africa. Isotopic analysis of ostrich eggshells indicate that the KDC assemblage relates to a period of relatively dry and hot climate, with a persistent presence of C_4 vegetation, relating to increasing summer rain. The oxygen isotopic analysis reflects increasingly dry environments through time at KDC, culminating in the upper part of the sequence, after c. 11 ka.

The change in shellfish species representation over time at KDC indicates habitat changes consistent with this hypothesis. The sessile mussel, *P. perna*, is completely absent in the lower layers (below JZA) at KDC suggesting a sheltered sandy bay on the coast. The dominance of *D. gigas* that prefer inundated rocky shores during this time further supports the inference of a rocky shore that is covered by a thin layer of sand. In the upper part of the sequence (c. 10.5–9.7 ka), coastal habitats changed in the form of scouring out of sand as suggested by the high presence of *T. sarmaticus*. This species prefer a habitat with more exposed rocks and less sand than *D. gigas*. *P. perna* is also present in this part of the sequence. These changes were probably triggered by minor sea level fluctuations due to climatic shifts relating to the Younger Dryas event.

The relative sizes of *T. sarmaticus* opercula, *C. oculus* shells and tortoise mediolateral humeri from KDC were determined to investigate whether they can provide an estimate of the extent and intensity of harvesting of these animals as food, the final research aim of this thesis. The sizes of *T. sarmaticus* opercula and *C. oculus* from the Oakhurst levels at KDC and NBC are smaller than those from MSA sites, but larger than post-Oakhurst LSA occurrences. This may suggest more intensive exploitation when compared to the MSA, but environmental causes such as lesser marine oceanic productivity cannot be excluded as reason for the reduction in size of *T. sarmaticus* at KDC. The latter argument is strengthened by the fact that although the average size of *C. oculus* shells is smaller than those of MSA specimens, the data cannot be used to argue for intensive exploitation as there are only rare specimens of this species indicating that they were not intensively collected.

As emphasised in Chapter 6, a careful assessment is required before concluding that human impact solely influenced the size of shellfish remains in the LSA. The tortoise sizes at KDC, and some other Oakhurst sites, are similar to that of MSA sites. The distribution of tortoise medio-lateral humeri mean sizes through time at KDC does not support the hypothesis that intensive harvesting led to reduced tortoise sizes as some of the largest tortoises are found at the top of the sequence.

8.4 Concluding remarks

In this thesis I have established technological and shellfish subsistence patterns relevant to the Oakhurst Industry of the southern Cape, hence broadening the understanding of this period. The KDC Oakhurst Industry chronologically dates to the early part of this technocomplex. Although the KDC Oakhurst Industry occurs earlier than the MRS occurrence, they relate technologically in terms of having characteristically similar cores and core by-products.

The shellfish remains show that exploitation of these resources change through time as dictated by environmental changes related to climatic and sea level fluctuations. Human preferences may have also influenced the dominance of the shellfish species present in the site. The popular assumption of human predation pressure , resulting in size reduction, on shellfish and tortoises during the Oakhurst period may need testing by robust palaeoclimatic and palaeoenvironmental reconstructions and this calls for a multidisciplinary approach in future research.

APPENDIX A: THE SCHEME OF LITHIC ANALYSIS FOLLOWED IN THIS THESIS

A1: ASSEMBLAGE COMPOSITION

i. Pieces <20 mm in maximum dimension

Pieces <20 mm in maximum dimension are those artefacts resulting from the knapping process but which have no recognisable characteristics of flakes or blades. This is similar to the 'debris' category of Inizan *et al*. (1999: 34, 138).

ii. Chunks

Chunks are angular lithic pieces >20 mm in maximum dimension and with one or two negative flake scars (see also Deacon 1982: 517; Thackeray 1981: 58; Döckel 1998: 66) resulting from breaking up of the raw material during the knapping process. The basic criterion here is the presence of at least one or two flake scars because when a piece has more than two negative flake scars it is classified as a core (see below).

iii. Hammerstone/anvil

These are stone pieces that served as hammer and/or anvil during the knapping process and as a result, they developed pitting damages (see also Thackeray 1981: 61; Humphreys & Thackeray 1983: 301).

iv. Grindstone

Because of grinding some surfaces of these stones became smoothed, pecked or polished (see also Thackeray 1981: 60). There are two groups of grindstones: lower and upper grindstones; the latter are also called rubbers (Thackeray 1981: 60–1).

v. **Hearthstones**

Hearthstones are lumps of rocks found in contexts believed to be fire places (hearths) because they are associated with charcoal and ash remains.

vi. **Ochre**

Ochre is a colouring material that can occur in different colours, mostly yellow or red. The ochre at KDC is a red haematite.

A2: RAW MATERIAL CLASSES

As mentioned in Chapter 4, the raw materials in the KDC lithic assemblage are quartzite, quartz, calcrete, silcrete, hornfels and CCS. At MRS, quartzite, chalcedony and quartz occur (Döckel 1998: 43).

i. Quartzite is a sedimentary rock, which has cemented to a point that the resulting quartzite is uniformly compact and breaks across than around individual grains. The majority of quartzites become partially metamorphosed by pressure or replacement (Hamilton & Cooke 1960: 120). Quartzites in the southern Cape are common in the Witteberg Series of the Cape Supergroup (Du Toit 1954: 236).

ii. Hornfels is a metamorphic rock that forms when mudstone or shale contacts with hot igneous material (Hamilton & Cooke 1960: 150). In the southern Cape hornfels occur as dark fine-grained rocks in thin sections of the Malmesbury Series (Du Toit 1954: 168).

iii. Quartz is a mineral that forms when silicon (Si) combines with oxygen (O_2) and occur in different colours such as transparent (rock crystal), white and translucent (milky quartz), pink (rose quartz), purple (amethyst), brown to black (smoky quartz), lemon-yellow (citrine) and vitreous lustre. Quartz is the most abundant and distributed mineral (can occur in river sands) and an essential constituent in rocks such as granite and gneiss (Hamilton & Cooke 1960: 35). At KDC, quartz is mainly milky but there are a few rock crystals.

iv. CCS is a fine-grained rock with aggregate crystals <3 µm in diametre) (Hamilton & Cooke 1960).

v. Chalcedony is a special variety of CCS formed with minutely fibrous structure (Hamilton & Cooke 1960: 35).

vi. Silcrete is a highly indurated siliceous (sedimentary) rock formed when surface sand grains and gravel are cemented by silica (Du Toit 1954: 447). Silcrete on the Cape coast forms cappings, ≥ 5 cm thick, on highly weathered and dissected residual surfaces of different lithologies or formations. It occurs on or between weathering profiles, which developed in a wide range of lithologies such as shales, tillites and phylites (Summerfield 1983: 896). In a few localised occurrences, silcrete on the Cape coast consists of silicified sand and Witterberg quartzite instead of occurring in deeply weathered profiles (Summerfield 1983: 897).

vii. Calcrete is a calcareous limestone that can occur as nodules in the soil or as more or less continuous sheet beneath the soil. Its formation is by evaporation of ground water that brings carbonates from the underlying rocks to the surface. The calcareous material then cements together in spots to form small pellets or irregularly shaped nodules (Du Toit 1954: 445).

A3: METHOD OF PRODUCTION

I Cores

Cores are pieces with three or more negative flake scars indicating systematic flake or blade removals through percussion or bipolar techniques. The following sub-types occur at KDC:

i. Core fragments are equivalent to Conard *et al*.'s (2004) indeterminate broken cores. These are not informative on the method(s) of production.

ii. Irregular cores are those cores with three or more irregular or unorganised flake scars. Irregular cores here equate to multidirectional cores of Conard *et al*. (2004).

iii. Unidirectional cores (UC) are pieces with removals directed from one platform. Cores with informal/unorganised unidirectional scars (UCI) have also been included in the UC category.

iv. Bladelet cores are lithic pieces used to detach small flakes called bladelets and generally small blades (e.g., Deacon 1982: 519).

v. Bipolar cores indicate the bipolar technique, use of hammer and anvil, in the knapping process.

vi. Platform cores as Conard *et al*. (2004) suggest may have more than two surfaces but in this study, the rare platform cores have two surfaces. The striking platform is well defined.

II Core blanks

The blanks for core production at KDC and MRS include:

i. Angular blanks, pieces of raw material used as core and some of them may have a rough natural cortex on their surfaces.

ii. Cobble blanks are large rounded pieces with smooth cortex (nodules >64 mm) due to weathering.

iii. Pebble blanks are pieces like cobbles but smaller in size (nodules <64 mm).

III Core dimensions

I measured the length, width and thickness of cores. Core length is as a maximum dimension perpendicular to the striking platform. This definition may be problematic because it only easily applies to unidirectional or bidirectional cores but becomes controversial when applied to multidirectional or irregular cores (Andrefsky 2005: 145). In this study, therefore, the length of the core is any maximum linear dimension regardless of its orientation. Consistent definition of width and thickness of cores is also elusive because they too can be difficult to measure and establish meaningful comparison (Andrefsky 2005). Core width here is any maximum dimension of the horizontal line across the length line.

A4: TECHNIQUES

I Striking platform:

Features that are relevant to the techniques employed by lithics knappers are platform and bulb conditions. Here platform types include:

i. Plain platforms are flat platforms without cortex.

ii. Cortical platforms have cortex on the impact area.

iii. Broken platforms are broken at the point of impact and thus only some part of the platform is left.

iv. Facetted platforms show specific preparation of the core before removal.

v. Faceted unspecific platforms show informal preparation, suggesting minor preparation of the core before removal.

vi. Very small platforms are smaller than other platform types and usually localised.

vii. Dihedral unspecific platforms are platforms which show two or more informal scars “meeting in a distinct ridge at or near the point of force application” (e.g., Clarkson & Hiscock 2011: 1063).

viii. Shattered platform occurs when the striking blow obliterated any recognisable traces of the platform and led to crushing of the contact area.

ix. Indeterminate platform; these are flakes/blades whose platforms could not be determined with accuracy.

II Bulb of percussion

Bulbs of percussion for flakes/blades from KDC and MRS are:

i. Prominent bulbs are protruding bulbs, normally with a curve-like pattern.

ii. Weak bulbs are flakes bulbs, which are only marginally protruding as seen by the naked eye.

iii. Bulbar scar. A bulbar scar (Inizan *et al*. 1999), also known as *éraillure* scar (Crabtree 1972), is a small flake scar(s) in association with the bulb of percussion.

iv. Indeterminate bulbs are bulbs that do not fall in the categories above.

III Blank description:

Flakes, blades and bladelets

Flakes are pieces with discernible bulb of percussion and/or striking platforms, dorsal and ventral surfaces (Schweitzer & Wilson 1982; Orton 2004). In this thesis, pieces with no discernible bulbs/striking platforms are known as flake fragments (see also Orton 2004: 28) because they are of flake origin but do not fit into the class of chunks and too big to fit into the class of pieces <20 mm. A difference was made between flakes and blades based on length and width ratio where blades are flakes which are twice as long as they are wide and often parallel-sided (see also Schweitzer & Wilson 1982: 30; Bar-Yosef & Kuhn 1999; Orton 2004: 29). Bladelets are blades with width <12 mm (Deacon 1982: 525).

Flake breakage condition

Flakes and blades were further classified according to the breakage condition as complete, proximal, medial, distal, split and lateral flakes (see also Sullivan & Rozen 1985; Kuijt *et al*. 1995; Amick & Mauldin 1997; Andrefsky 2005: 87-88). Split (Siret) flakes are pieces that sheared laterally on the mid axis of the platform to their distal end (e.g., Amick & Mauldin 1997: 19; Döckel 1998: 43) or simply accidental "snapping in two of a flake along the debitage axis" (Inizan *et al*. 1999: 34). In this thesis, split flakes differ from lateral flakes. The latter retain most of the striking platform while for the split flakes the breakage takes place along the mid axis perpendicular to the flake length. Figure A1 below shows breakage conditions of some flakes as defined in this study.

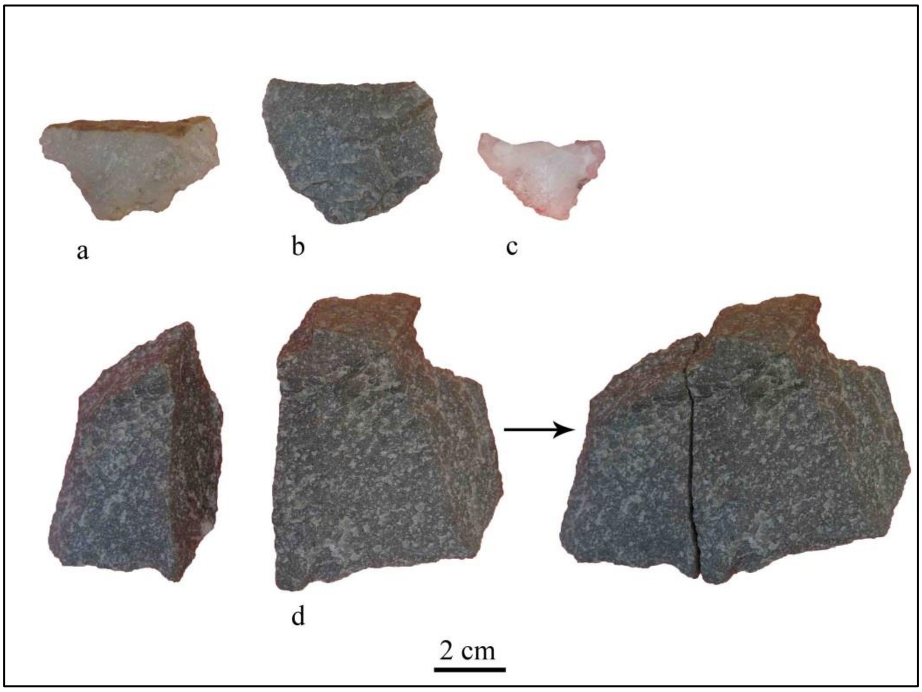

Figure A1 Klipdrift Cave: flake breakage conditions. a) Complete flake (layer KAB), b) proximal flake (layer JZA), c) distal flake (layer KAD), d) two split flakes from the same piece and the arrow shows the piece after attempt to refit (layer JZ). a, b & d are in quartzite, c is in quartz

Flake technological classes

Flakes and blades are further categorised into the following groups that relate to the reduction method followed:

i. Indeterminate flakes or blades are flakes/blades in which flaking patterns on their backs do not fit in the categories described below.

ii. Angular flakes or blades show angular surfaces of the pieces on their dorsal sides.

iii. Unidirectional flakes or blades have scars on their dorsal faces, which originate from one platform or the same edge (see Gillespie *et al*. 2004).

iv. Unidirectional convergent flakes/blades show unidirectional scars that tend to converge towards the direction opposite the striking platform.

v. Multidirectional informal flakes or blades are pieces with dorsal scars originating from multiple platforms.

vi. *Débordant* flake (*éclat débordant)* refers to the piece produced on the core edge (Soressi & Geneste 2011). Some of these pieces have cortex on their sides i.e. *débordant* with cortex on back.

vii. *Débordant* platform rejuvenation flakes are *débordant* flakes that show evidence of adapting the platform or improving the angle of impact (Odell 2003) before attempting another removal. They differ from core management flakes in that they retain the edge of a core.

viii. Core management flake is a piece that retains evidence of shaping the core volume during its use (see Barham 1989: 147).

ix. Bipolar flakes are those pieces that exhibit features of bipolar flaking such as crushing on both proximal and distal sections (e.g. Barham 1987).

x. *Entame* flakes, also called 'first flakes/opening flakes' (Inizan *et al*. 1999: 141; also cortication flakes, Odell 2003: 121), are primary pieces produced from a core. Such flakes are produced when opening up the striking platform (Arzarello & Peretto 2010; Sharon 2011) for subsequent removals. The main defining feature of *entame* flakes is that it is cortical on the butt and the upper face (Inizan *et al*. 1999: 141).

Dimensions of flakes and blades

The analysis of flakes/blades in this thesis has involved the measurement of continuous variables such as length, width, and thickness (Deacon 1978, 1982; Andrefsky 2005). The measurements have been done using calipers. Flake or blade length is a straight line or the longest dimension between the proximal and the distal ends, perpendicular to the width (Deacon 1982: 582; Andrefsky 2005: 99; Figure A2). For width, the maximum dimension or the widest point of the artefact perpendicular to length is measured (Figure A2). I also measured proximal, distal, and medial breaks of flakes/blades on their widest sections to obtain the widths to include in metrical calculations. Deacon (1982) and Döckel (1998) measure complete flakes/blades only from different layers.

Figure A2 Flake length and width measurement (not to scale)

Flake/blade thickness measurements approaches can vary from measuring maximum flake/blade thickness or the thickest point, thickness at midpoint, thickness at various points along the length of the flake/blade, to the thickness at the bulb of percussion (Andrefsky 2005: 101). Here, flake/blade thickness is the maximum dimension from the dorsal side to the ventral side of the flake/blade perpendicular to the length line. Flake/blade platform lengths and platform thickness are also measured as part of metric attribute analysis. Flake/blade platform thickness is the maximum dimension on the striking platform from ventral to the dorsal side (Andrefsky 2005: 94).

Blank cortex

I recorded the presence or absence of cortex on blanks. Cortex is an exterior weathering of the stone that results from chemical and/or moisture while mechanical weathering may result from rolling of stones in the river or in sand, producing a smooth-polished stone surface (Andrefsky 2005: 103). The amount of dorsal cortex may indicate the reduction stage for retouched tools and non-retouched blanks (e.g., Morrow 1984). In this thesis, dorsal cortex was estimated using both nominal and ordinal scales. Where a blank was incomplete (e.g., proximal flake) presence or absence of dorsal cortex was noted as present or absent by coding using numbers 1 or 0 respectively. For complete blanks (flakes/blades) ordinal scale was used to estimate the amount of dorsal cortex from 0 to 100 percent cortex, whereas zero means no dorsal cortex at all while 100 means that the piece is completely covered by dorsal cortex. Ranking of dorsal cortex amount in complete flakes and blades, involved coding by numbering from zero to five (Table A1).

Table A1 Complete flake/blade dorsal cortex amount ranking procedure

Rank	Percentage
0	0
1	< 25
2	25-50
3	50-75
4	> 75

5	100

A5: TOOLS

Tool types in the KDC and MRS lithic artefacts include the following:

i. **Scrapers**

Scrapers are artefacts with marginal to steep edge retouch, forming angles between 30^{o} and 110^{o} along a portion or the entire perimeter of the piece (Thackeray 1981: 61). They are flakes or pieces with at least one unifacially retouched edge which is <70^{o} (Shea 2013: 33). Scrapers are often sub-categorised according to size (small, medium, large scraper; Deacon 1982: 541; Wadley 1986: 208) and position of retouch relative to the bulb of percussion (end or side scraper) (Thackeray 1981: 62; Shea 2013). However, Thackeray (1981: 62) mentions that these criteria used to categorise scrapers have limited interpretive powers and thus she suggests that scrapers be treated as a single homogenous class though they may vary in lengths and widths. In this thesis, scrapers are categorised according to position of retouch (e.g., end or side scrapers) as described below:

a. End scraper has retouch on their distal ends (see Shea 2013: 98).

b. End scraper on core is an end-scraper that occurs on a core.

c. Side scrapers have trimming on the edge between the proximal and distal parts or “one dorsal retouch on one lateral edge” (Shea 2013: 96).

d. Side scraper on core is a side scraper as defined above but that occurs on a core.

ii. Retouched

These are artefacts with 'informal' retouch but cannot readily be classified into conventional tool types.

iii. Notched artefacts

Notched artefacts show at least one well-defined notch (concavity) around the perimeter or on the lateral edge of the piece (Thackeray 1981: 66; Shea 2013: 33, 98). The notch may range from 5 to 10 mm (Thackeray 1981: 66).

iv. Denticulate

A denticulate is a tool characterised by two or more contiguous notches (concavities) on the same edge of the blank (Picin *et al*. 2011). Shea (2013: 98) defines a denticulate as a flake or piece "with a jagged edge formed by a series of unevenly spaced notches".

v. Adzes

Adzes are pieces with steep step-flaking on one or both lateral sides (but the shapes can have considerable variations (Thackeray 1981: 65; Humphreys & Thackeray 1983: 304). For Deacon (1982: 559), adzes have a secondary step-flaking resulting from use in addition to the primary straight or slightly convex working edges. Adzes are normally "plano-convex in cross section" and the flatter surface is the ventral side (Shea 2013: 234). In southern Africa, adzes are generally larger than scrapers, mean length between 25 and 40 mm (Deacon 1982: 559).

vi. Piéces esquillées

Piéces esquillées or *outils écailleés* (in French), also called scaled pieces, are flake fragments with concentration(s) of flake scars on the edges of the dorsal and/or ventral surfaces (Shea 2013: 36). These pieces may be similar to core reduced pieces (residues of cores) but have secondary crushing around the curved, chisel-like striking platform (Deacon 1982: 533). Deacon (1982) opined that the crushing may be a result of use of this artefact as a chisel or due to attempts to remove more flakes from the core (see also Shea 2013). Deacon (1982) included *piéces esquillées* in her utilised category but they can also be treated as formal tools (Shea 2013: 36) as in this study.

The extent of retouch

The extent of retouch describes the invasiveness of retouch removals (Inizan *et al*. 1999: 141)

i. Marginal retouch is trimming confined to the edge of the piece (see also Clark & Kleindienst 1974: 85). ‘Marginal retouch’ is slightly more visible than very marginal retouch, and only a small surface on the edge is concerned;

ii. Very marginal retouch is almost invisible to the naked eye;

iii. Short to medium retouch, a larger surface on the edge is affected, and may extend to 5 mm on to the dorsal part of the flake;

iv. Medium to covering extend from 5 mm to covering the entire dorsal face of a flake;

v. Steep retouch is between 60^{o} and 90^{o} or more (Clark & Kleindienst 1974: 85).

The retouch position

The retouch position is either ventral or dorsal but some pieces may have retouch on both sides.

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