LANDSCAPE ARCHAEOLOGY OF THE LATER FARMING COMMUNITIES OF THE SHASHE–LIMPOPO BASIN, EASTERN BOTSWANA

- *Land use Diversity and Human Behaviour*

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To the memory of my mother, Gaedupe Mothulatshipi

DECLARATION

I, Sarah Mantshadi Mothulatshipi, declare that this is my own unaided work unless otherwise stated. It is submitted for the degree of PhD (research) in the University of Edinburgh, Scotland. It has never been submitted before for any other degree or examination in any other institution.

Sarah Mantshadi Mothulatshipi
October 15, 2008

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ABSTRACT

The Shashe–Limpopo Basin (SLB) is a prehistoric landscape with an extreme and extraordinary dynamic environment and it is by no coincidence it has attracted a considerable amount of research attention that contributed invaluably to the understanding of socio-cultural and economic changes in Southern Africa. Attention has, however, remained heavily skewed and sites explicitly targeted for investigation were those which could offer insights in the development of social complexity. This thesis investigates a part of the SLB situated on the Botswana side at the confluence of the Shashe and Limpopo rivers. This study demonstrates with a combination of practical methodological approaches that the development of complex social formations represents settlement structures that epitomise interaction of both long and short-term cultural and economic processes and that the organisation of such structures is randomly distributed throughout the landscape. The application of remote sensing techniques, in particular aerial photography, reveals how the attributes possessed by the landscape dictated on the human land-use and management strategies at the confluence zone of the SLB. Essentially this approach has provided the background of this study and the results obtained shows how this area remained unexplored because of its geomorphological setting and the otherwise poor visibility of archaeological sites that could parallel in size and status neighbouring sites across the political boundaries. Furthermore, the analysis of landscape attributes using GIS spatial and geochemical datasets on located sites suggests a significant influence by the terrain units on the type of activities undertaken. It is evident that the fluctuating environmental conditions of the SLB, made human habitation of the floodplain problematic and restricted settlement and social organisation to its periphery largely on high ground and hill summits, whilst different parts of the floodplain terrain were exploited as water sources, cultivation and grazing resources leaving erosional gullies, pediments and track marks. The phosphate concentration variations at Tuli Circle 2, points to the variations in site activities and calls for a revisit to the long standing belief that white 'patchy' areas (or savanna glades) are cattle or animal enclosures.

The findings of this research have also revealed, through the use of x-ray powder diffraction analysis, that the geochemistry of ceramic samples from the study sites varies within and between excavation levels, sites and clay sources suggesting that they were probably not locally produced. This further suggests that pots as movable items could have reached the area through trade or exchange. An implication of this observation is that pots, like people, have social and economic contexts and need to be understood through the issues of variety and interaction at local and regional levels. Based on these findings, this study calls for more integrated methods of ceramic analysis in order to understand their sources and production techniques, instead of the traditional but constrained typologies which were used to define migrations and identify human groups along ethnic lines. The results are considered useful and they can help in fine-tuning existing knowledge regarding known and used ceramic types of artefacts, within this new conceptual framework of a landscape whose history is now better understood. In light of the proposed Trans Frontier Park, the techniques used in this research are crucial for the discovery and documentation of sites needed for regional policy formulation and development planning.

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1. INTRODUCTION

1.1. RESEARCH BACKGROUND

The research presented in this thesis came about as a result of archaeological field surveys conducted at intervals between 2000 and 2003, within the framework of the regional research project, *Human Responses and Contributions to Environmental Change* (HRAC) sponsored by the Swedish International Development Agency (SIDA), through the Swedish Agency for Research Cooperation with Developing Countries (SAREC). The HRAC project was a collaboration initiative which involved scholars from southern Africa and East Africa, its main aim being directed toward the understanding of the dynamics of interaction between past societies and their environment at local, meso- and regional scales. The specific aims of the project involved studying the relationships between culture, biogeography and climate in the region over the last two thousand years and providing an archaeological framework for understanding and interpreting human responses and contributions to the environmental change in southern Africa (see Sinclair, 1997). However, the project has since increased in scope and perspective, and it is currently run under the name African Archaeology Network (AAN), although the interest in landscape dynamics and human interactions is still the overall objective.

The surveys covered an area commonly referred to as the Shashe–Limpopo triangle (Figure 1.1) in the Shashe–Limpopo Basin wetlands. The initial field survey of 2000 was by and large a familiarisation and reconnaissance study of the archaeological potential of the area prior to embarking on a systematic survey which took place in the following years. When the archival records of the National Museum Sites and Monuments Register were consulted prior to embarking on the fieldwork, there were no archaeological sites recorded in the area. This scenario was later confirmed by the distribution map of archaeological sites in the national site database compiled by the University of Botswana's Archaeology Unit. From the map, it became apparent that the area east to the northeast of the Motloutse river between Bobonong-

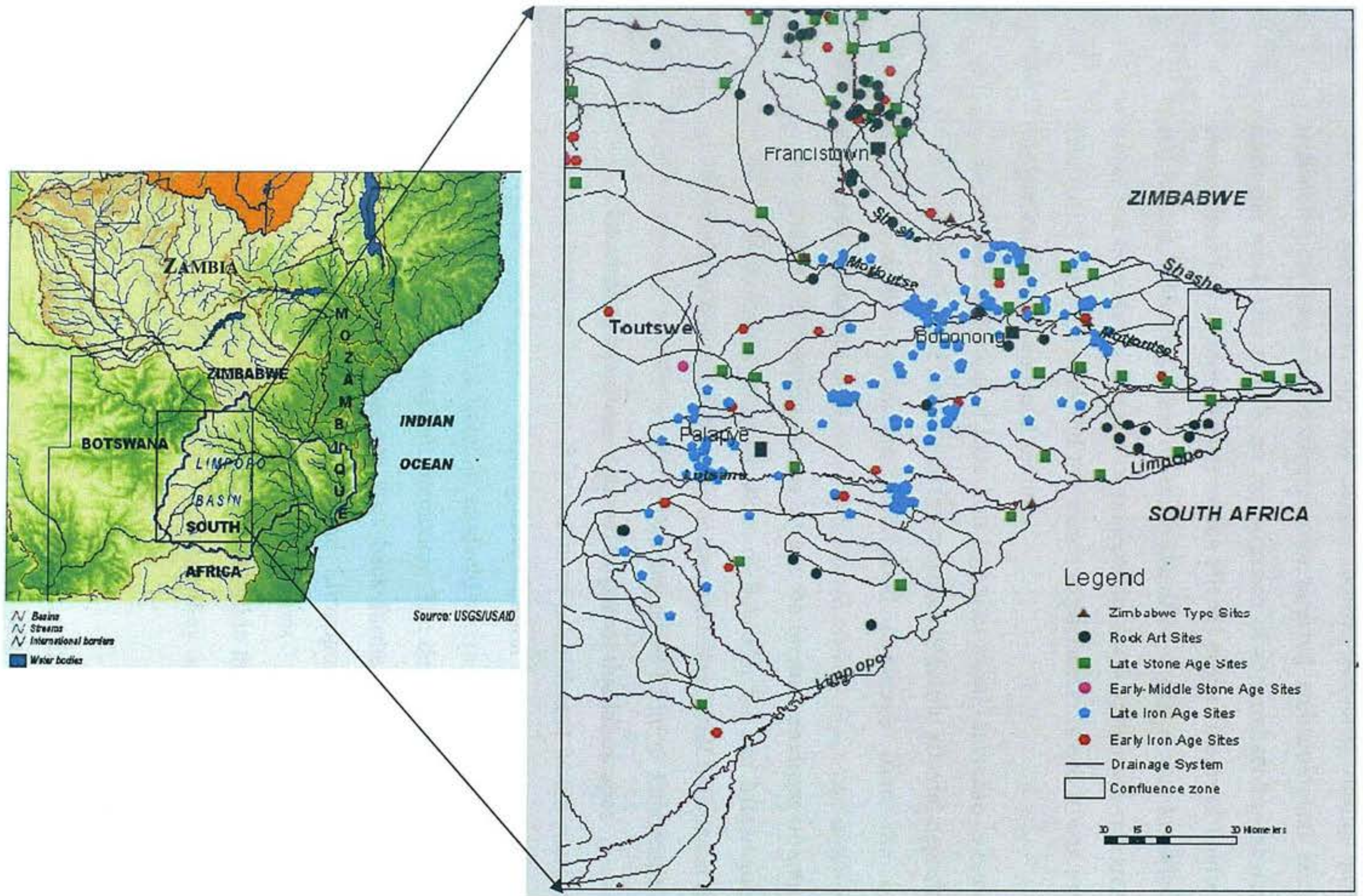

Figure 1.1 Shashe–Limpopo Basin and the eastern part of Botswana showing the distribution of sites in eastern Botswana and the confluence zone.

Gobajango and Bobonong-Lekkerport Road had no recorded sites and most significantly no Late Iron Age sites. Of particular interest was the fact that the recorded sites were, by and large, those discovered during pre-development archaeological impact assessments, not targeted archaeological research. At this stage the work was mainly an investigation of the archaeological potential of that area with a view to addressing the main HRAC project theme of landscape dynamics and human behaviour. This exercise identified a gap in our knowledge of certain areas, and provided a window of opportunity for a systematic research project. The absence of recorded sites did not match expectations, since it was assumed that in that particular environmental setting:

- the concentration of Late Iron Age sites should increase as one goes towards the confluence because of the presence of fertile alluvial deposits, exploitable for arable agriculture, and good pasturage from the open savanna environment;
- the area of investigation is within the broader environs of southern Africa's earliest known complex states of Schroda, K2 and Mapungubwe (a World Heritage Site encompassing an area inclusive of all the sites at the confluence and now referred to as the Mapungubwe Cultural Landscape (MCL)), and therefore by extension it should be part of that landscape;
- the research area also falls within an environment which could have provided a link between the Mapungubwe Cultural Landscape and that of Toutswe at the fringes of the Kalahari sandveld where previous research has emphasised some form of societal interaction. The density of LIA sites, however, was seen to increase as one goes back further west into the interior from the confluence of the Shashe and Limpopo rivers following the settlement patterns of the contemporary populations
- the part of the study area that falls within the Game Reserve should have sites that have been preserved because they are away from the main areas of contemporary human activity

More information about the area and any sites that were known was gathered from the residents of the villages in this Bobirwa sub-district. Bobonong, as a centre of the district and presumably with authority over the neighbouring villages, was targeted to assist in identifying key informants. Bobonong is a relatively new establishment, which has been in existence for not more than 100 years. The residents of this town were part of a larger group that was relocated from the confluence by the colonial administration in the early 1920s in order to make way for the development of commercial farms. Disputes arose resulting in group separation and satellite settlements mushrooming within the surrounding landscape. However, they are one ethnic group with specific lines of descent that are perfectly understood and followed. In spite of the current residents professing to have no knowledge or direct association with the sites, they were never-the-less knowledgeable about where sites had been identified.

Sites were also found by ground walking certain terrain features which, from the evidence of known sites, seemed attractive to human habitation and spatial use. This involved ground walking of hills, valleys, and river margins. The fundamental realisation came when the survey exercise reached the area with a complete absence of recorded LIA sites and previous research — the demarcated and privately owned nature reserve within the confluence zone (see Figure 1.1). Within this environment only one site was recorded in the SMR as reported by Mike Tamplin (a visiting scholar from Trent University, Canada) in 1977, but with no systematic geographical location reference, only a sketch drawing of features. Owing to its lack of a geographical reference point, it was not surprising that it did not show up on the distribution map. This site is called Mmamagwa and it is one of the two Botswana sites which feature in the regional archaeological distribution maps of the Shashe–Limpopo Basin (Huffman, 2000; Huffman, 2005; Smith, 2005). The other MCL site also not on the distribution map but known from a preliminary report of an archaeological impact assessment at the Botswana national archives was Pitsane Kopje (also known as Commando Kop). This assessment was conducted in the late 1970s by Hanisch (n.d.), for a look-out hut of the reserve. Both sites have been excavated and yielded a considerable quantity of archaeological materials, which demonstrate a continuous occupation from the AD 900 to historic times.

The survey of the confluence area within the game reserve proved successful in terms of site visibility. With the realisation that there was probably an abundance of archaeological materials on the surface and over an extensive area, more time was spent here. An intensive and more structured reconnaissance survey was conducted over an area extending from where the rivers converge to form the Limpopo that separates South Africa and Zimbabwe, to Tuli circle about 22 km away. It then

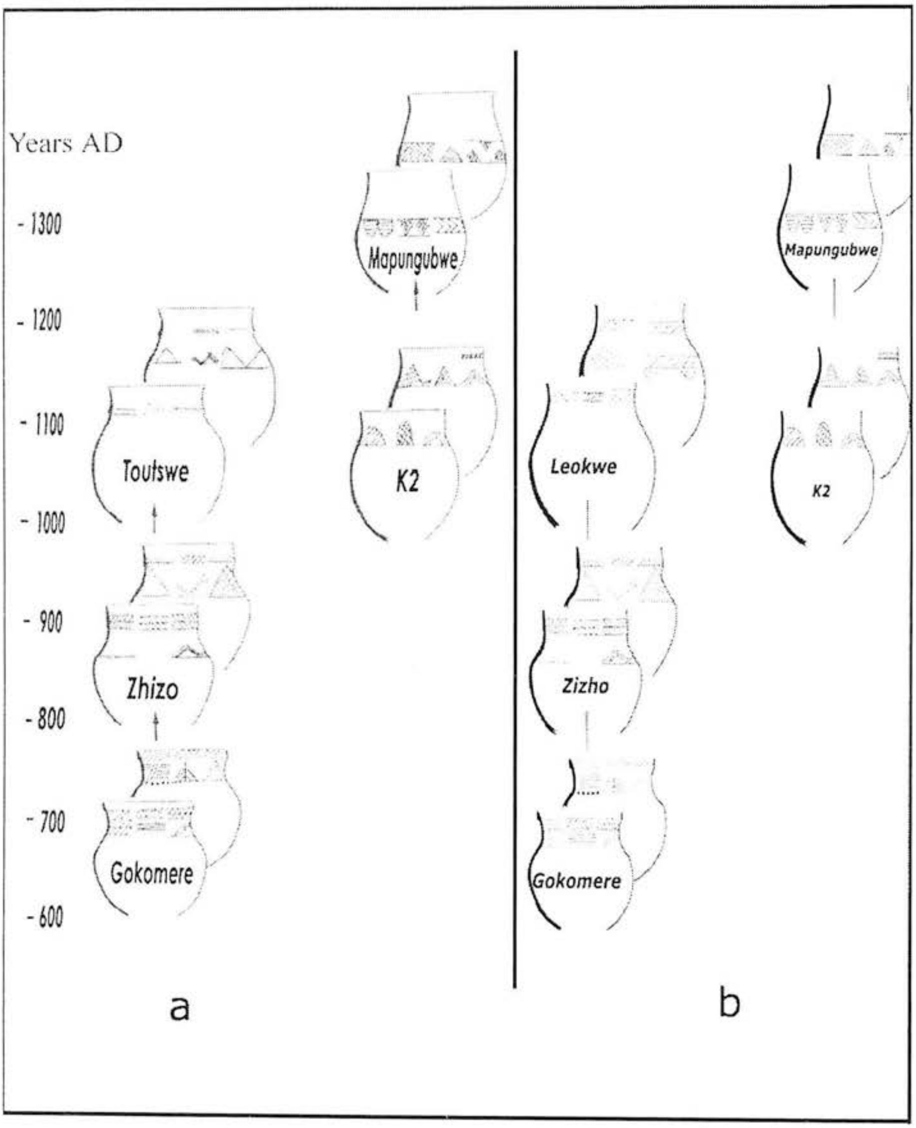

Figure 1.2 The established typological sequence of (a) Southern Africa (Huffman, 2000) and the (b) Shashe–Limpopo Basin (Huffman, 2005) as a representation of the time of arrival and occupation of key sites by different groups of people

followed the Botswana-Zimbabwe border in a north-westerly direction inside the Game Reserve fence and up to where the fence crosses the Mali River. It then follows a cut-line (or fire break) that separates Glennel and Charter Reserve from the other stakeholders (see the Current Land-use of the area in Chapter 2) to the Limpopo River. This survey concentrated on an area of approximately 15km x 25km within the reserve with less intensive work conducted outside the area such as oral interviews. It is not the intention of this study to discuss the occupational histories based on sensitive chronological stratigraphic sequences as this has been the focus of other studies. However, this information will be used to address issues of settlement location, human land-use strategies, and resilience in times of adversity.

This survey also tended to highlight features of the sites and their settings. Most of the material remains were located on hilly outcrops or raised ground, whilst low-lying areas and floodplains had no remains visible on the surface. Subsequent field surveys concentrated on sites identified during the reconnaissance survey. Test-excavations were performed in order to establish the chronology and cultural significance of the sites. Analysis of ceramic materials from the surface showed their close affinity to the two sites already reported within the reserve and across the borders in both South Africa and Zimbabwe. They fell within the established ceramic chronology of the Basin (Figure 1.2) and all periods of occupation outlined in Chapter 2 were represented. Test excavations produced some datable materials of human and animal bones; the dates obtained fall within the Zhizo cultural period of occupation in the area consistent with the ceramic typology and environmental reconstruction presented by Tyson and Lindesay (1992), Holmgren *et al.* (2003) and Holmgren and Öberg (2006). The ceramic vessels surrounding the skeletal remains were also identified as belonging to the Zhizo cultural period. From this data, it was concluded that potentially the area is part of the MCL. A major challenge was to find out why this key area, with great potential to provide information on the social formation and stratification of the MCL, has attracted no research attention. Some of the possible reasons as to why it was ignored are:

- **Previous archaeological research in the Shashe–Limpopo confluence zone had focused predominantly on the Later Iron Age sites of Schroda, K2 and Mapungubwe in South**

Africa. These sites are monumental and have large concentrations of archaeological structures and materials. They afforded an opportunity to gain insights into the social formation structures especially for these hierarchical societies with a political economy based on agropastoral and local and long distance trade networks.

- **These sites are highly visible and well preserved. They are all situated on sandstone hill outcrops bordering the Limpopo River, away from any likelihood of destruction by flooding. They are also on vantage points for possible appreciation of the surrounding landscape by the inhabitants.**

- **The area of interest in this research is in a freehold land and a sanctuary for various wildlife species. Therefore, to gain access to it requires a long process of consultation with stakeholders, and obtaining research permissions and funding. Other things to be taken into account are international boundaries, safety, and security from the animals. These factors presented difficulties for extending the margins of archaeological research interest beyond the MCL.**

- **The Botswana side of the confluence is a comparatively flat land and therefore susceptible to flooding. It therefore presents a landscape that is constantly flooded at the onset of good rainfall season. This can affect access, site preservation and visibility as one goes towards the confluence where the main centres are situated within close proximity on hilltops.**

From the results of the reconnaissance survey it was concluded that there is enough evidence to show that the Botswana side of the Shashe–Limpopo confluence is part of the MCL. This prehistoric cultural landscape has been demarcated by contemporary state boundaries with political boundaries acting as archaeological research boundaries. South Africa has had the advantage of having a long establishment of research in the area, at least from the first half of the 20th Century (see Fouché, 1937; and Gardner, 1955; Hanisch, not dated), but concentration was in prominent archaeological sites with a few sites mentioned from the colonial explorations on the Zimbabwean side. The Zimbabwean site database has since changed following Manyanga's (2006) study, also part of the HRAC project. The Botswana side remained isolated with sporadic sites only located during archaeological impact assessment undertakings.

The HRAC project had a long-term goal, and the preliminary work identified certain specific features of interest that needed investigation and could be used as stepping stones towards the intended objective of this project. The continuous occupation of the confluence zone from the 10–12th century onwards was found to be a factor critical for understanding the dynamics of interaction between human populations and the landscape. This thesis adopts an off-site archaeological approach (Foley, 1981a; Foley, 1981b) in which the invisible and intangible aspects of archaeological sites are considered. Foley argues that as archaeologists we tend to forget that it is as the result of human behaviour that sites are preferentially concentrated at spatial foci. However, not all products of human behaviour conform to this spatially centralised perception, and it is not the exact location of an activity area that tells us about the human use of the landscape. A part of a landscape unsuitable for human occupation in terms of establishing settlement structures, for example a floodplain, will remain free of artifactual accumulation because site location systems operate above ground at a regional scale. An appreciation of elements and parameters of the landscape will be the key in this research investigation to understanding how the Shashe–Limpopo population manipulated the environment they lived in, as well as their contribution in sustaining the changing centres of socio-economic and political processes on the eastern Botswana side of the confluence from AD 900 to 1300.

It is hoped that the technological advances available today and the incorporation of multidisciplinary approaches as well as combination of perspectives would help in the understanding of the various life dynamics of the confluence. The quality of fieldwork and interpretation of results was enhanced by employing GPS and GIS datasets, remote sensing (aerial photography), and geochemical analyses, as these are gradually becoming new standards in archaeological research (Grzymski, 2004). The archaeology and landscape aspect helps to provide a unified understanding of the human perception of landscape as an immediate resource for exploitation and can tell us a lot about human behaviour (Mothulatshipi, 2007).

1.2. GEOGRAPHICAL AND CHRONOLOGICAL FOCUS

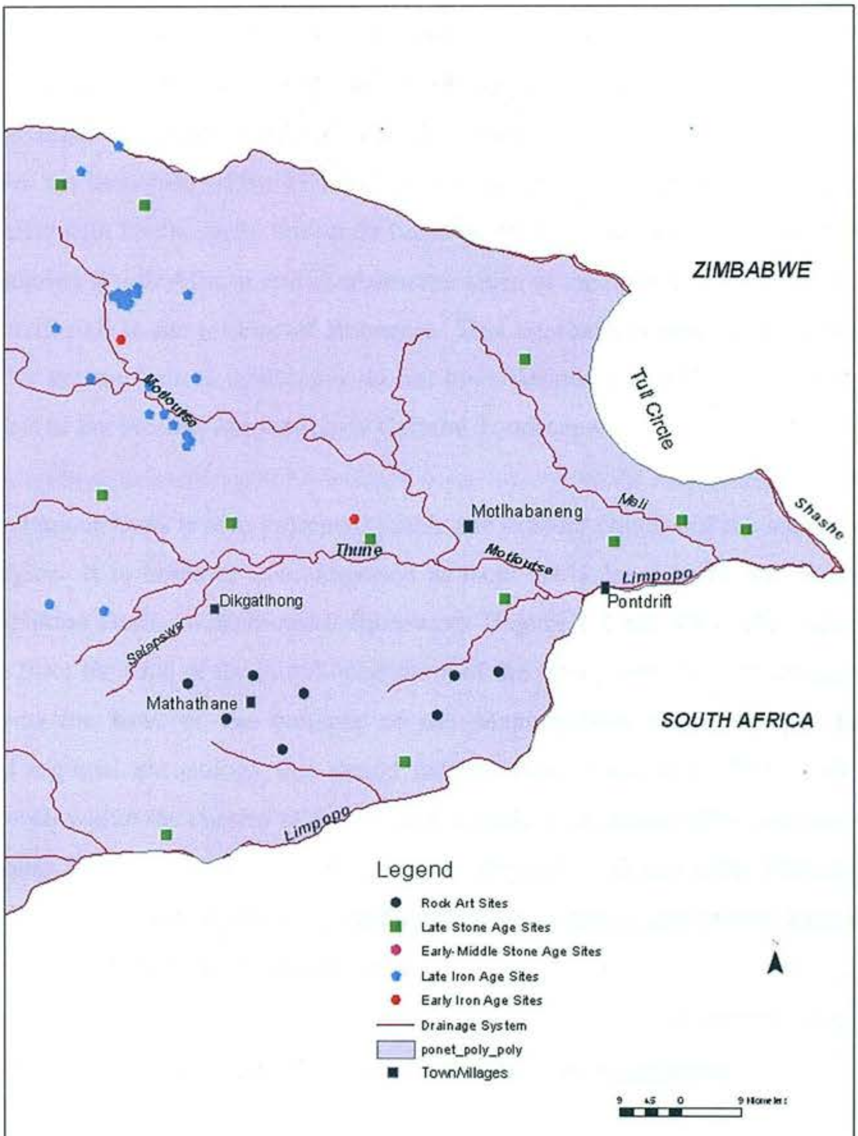

Figure 1.3 The research study area showing the distribution of recorded sites and some of the towns and villages mentioned in the thesis.

The study area is situated within the greater Tuli region, which encompasses the Northern Tuli Game Reserve within the Bobirwa sub-district of eastern Botswana. It is bounded by the Motloutse and Limpopo rivers in the south and east and the Shashe River to the north-eastern corner (Figure 1.3). Its general location is 22°S and 29°E or UTM zone 35 in the eastern Botswana hardveld land unit. Across the Limpopo River, at the confluence of the Shashe and Limpopo rivers lies the World Heritage Site of Mapungubwe, southern Africa's earliest known complex state system which developed at the beginning of the 11th century AD. Owing to the dearth of published archaeological data for this area, this study borrows from various research sources in the neighbouring South African and Zimbabwean sides of the confluence and related research conducted in the interior of Botswana. This approach is also based on the idea that the archaeological landscapes do not have defined borders and the study area was part of the broader Mapungubwe Cultural Landscape.

The chronological focus is also presented within the broader context of the southern African region. It is however contextualised at local study level to fit within the Shashe–Limpopo Basin archaeological framework (Figure 1.2 and 2.6). The period of focus is from the time of the initial occupation of the Basin, and the confluence in particular, to the time of the collapse of the Mapungubwe system. From the established regional chronology this period extends from about AD 900 to 1300, which fits well within the context of this study that seeks to understand the landscape dynamics and human interaction of the farming population in the area. Previous studies have concentrated on artifactual and architectural remains and little is known about how the spaces between sites were used.

1.3. Archaeological Overview and Previous Research

The Shashe–Limpopo Basin and in particular where the two rivers converge is a cultural landscape with a long settlement history dating from the Late Stone Age (see, e.g., Eastwood and Blundell, 1999, Hall and Smith, 2000) through the farming periods (Hanisch, 1981; Huffman, 2005) and into recent times (Dingalo, 2006; Manyanga, 2006). There is evidence of interaction between the foraging and farming populations within the broader basin under variable climatic conditions (Holmgren and Öberg, 2006; Huffman, 1996a; O'Connor and Kiker, 2004; Smith, 2005). Significantly, the first interruption in settlement took place after the 13th Century AD, when the entire state collapsed and the Basin had to be abandoned due to deteriorating environmental conditions, and new trade links established elsewhere (Huffman, 1996a). It is not yet clear where the occupants moved to as there is no evidence to suggest that they were part of the newly formed state in the central Zimbabwean plateau some 250km away, where a new centre emerged after the confluence zone was abandoned. However, the area was resettled from the 15th century AD and less significant interruptions in settlement patterns due to regional instability occurred such as the *difeqane* war and Anglo-Boer war during the 19th Century AD. The confluence zone in particular, was not only a confluence of rivers, but conflicts in the 20th Century with the Botswana side on the receiving end from the hostilities of the neighbouring apartheid governed South Africa and liberation struggle in Zimbabwe. The zone was abandoned due to the colonial division of land into farms by Cecil John Rhodes' British South Africa Company in 1920s, which saw the relocation of the Babirwa sub-group of Sotho-Tswana origin (Tsheboeng, 2001). They had to give way to the envisaged commercial farming, and when farming proved futile, the land-use was changed into a nature reserve in the 1960s.

Archaeological investigations of the SLB follow the established chronological nomenclature used for the region, where the Iron Age is divided into Early and Late Iron Age and 'the period 900–1100 AD taken as the transitional period between the two' (Pikirayi, 2007:288). These classifications were devised within the context of the Bantu migration theory (discussed in Chapter 3) which dominated archaeological discourse in southern Africa at the time. As the major emphasis of the Bantu migration theory was to account for the introduction of agriculture south of the Sahara as an explanation for the replacement of hunting and gathering economy, the southern African Iron Age is defined by typological classification of ceramics associated with sites which have evidence of sedentary lifestyle, agro-pastoralism and metal working. Although the origins and mass movement of Bantu-speaking people from their presumed homeland in the northern fringes of the equatorial forests southward is considered controversial (see Eggert, 2005; Schoenbrun, 2001), it is generally agreed that they reached southern Africa through some form of migration (Pikirayi, 2007). The classification is on the basis of their decorative motifs and morphological character, which is also used to indicate movement of people into the region at different times. Therefore these stylistic distinctions in ceramics generally represent cultural identities and ethnicities of those communities, who spread into different parts of southern Africa. The period of interest for this study, the Later Farming or Later Iron Age in the Shashe–Limpopo Basin is dominated by ceramic types which characterise the centres situated in the eastern Kalahari sandveld, Toutswe (AD 700–1300), northern Limpopo province of South Africa, Mapungubwe (AD 1220–1270) and western regions of the Zimbabwe plateau at Great Zimbabwe (AD 1290–1550) as shown in Figure 1.2.

These centres are also the regions earliest complex states, which saw the emergence of socio-political stratified populations who were also engaged in local, regional and long distance trading. The earliest visible agro-pastoralist occupation site of Schroda, dating between AD 900 and 1010, is categorised as the Leopard's Kopje A or Zhizo ceramic group of the Nkope cultural group of the eastern Bantu-speaking people (Smith, 2005). This site also stands out as one of the earliest settlements in the interior to have been involved in manufacturing and production of ivory objects and trading of imported glass beads from as far as India through the Mozambican coast (Manyanga, 2006). After AD 1010 this ceramic design disappears and the second millennium AD ceramic cultural phase is predominantly Leopard's Kopje ceramic chronostratigraphic ceramic designs. This stylistic design is named after a site where ceramics of this type were first found, called Leopard's Kopje (Leopard's hill or *Ntabazingwe*) in western Zimbabwe (Manyanga, 2006)). As most of the research in the Basin was by and large engaged in establishing cultural sequences, any sites located followed this categorisation. When Schroda ceased to exist or was abandoned, through assimilation or marginalisation of its inhabitants, a new centre was formed at K2, situated less than a kilometre away south of Mapungubwe. The K2 ceramic type is called Leopard's kopje A. There is evidence that at around the time Schroda collapse, Zhizo type ceramics increased at Toutswe further in the interior of Botswana, a significant implication being that Toutswe could have been where the Schroda people moved (Denbow, 1983). There is also evidence that points to the fact that there was not a total displacement as Zhizo type site ceramics have been discovered in the vicinity of K2 at Leokwe hill (Calabrese, 2000; Smith, 2005). K2 was also dramatically abandoned around *ca.* AD 1220 and replaced by intense occupation at the nearby hill of Mapungubwe. It is characterised by Mapungubwe type ceramic designs or Leopard's Kopje B style.

However, unlike with Schroda, this is regarded as relocation rather than abandonment and the arrival of a new cultural group as there is a continuation of the K2 type ceramic style in association with that of Mapungubwe (Smith, 2005). Smith argues that this represents an element of spatial expression whereby a new settlement organisation with Mapungubwe as an elite capital controlling the surrounding area strengthens the idea of the rise of social complexity from kin-based to class based in the region. This spatial expression is observed beyond the limits of Mapungubwe where settlements with close affinity to those of Schroda, K2 and Mapungubwe are established in Botswana and on the Zimbabwean side of the confluence. The sites of Pitsane Kopje and Mmamagwe just over 20km from Mapungubwe have been excavated and shown to have been continuously occupied throughout the 8–13th century AD and later (Hanisch, not dated; Plug, 2000). The Botswana side of the confluence was also perceived as having ecological elements which could have been exploited for crop cultivation and grazing to ease pressures of carrying capacity on the centres (Smith, 2005). Outside the Tuli Reserve there are Later Iron Age sites as shown on Figure 1.1. These have been identified typologically and recorded in the SMR, but no systematic research has been undertaken. A recent study by Manyanga on the Zimbabwean side of the confluence, has chronicled and analysed sites which were previously unknown (Manyanga, 2006). Manyanga's work demystifies the perception associated with the current view of the Basin as hot and dry and unsuitable for human habitation as a premise behind the theory of the area being abandoned at the onset of dry spells. He shows how, through the resilience of these semi-arid environments coupled with human innovation and local knowledge, the area has sustained continuous occupation even in the face of seasonal variability in rainfall and major long term climatic variability.

Within the study area, there is also evidence of interaction and co-existence within the wider Basin landscape between the hunter-gatherer and farming populations. There is generally poor artifactual visibility but archaeological deposits have yielded remains showing that wild fauna rather than domesticates dominated the diet (Plug, 2000), as well hunting implements found in association with LIA materials (see Fagan, 1970 ; Fouché, 1937; Gardner, 1955). Otherwise the presence of the Stone Age populations in the Basin is often implied through surveys of rock art sites. These sites predominate on the sandstone ridges of the Basin in the South African and Zimbabwean side and in the hilly outcrops south of the Motloutse River on the Botswana side. At the confluence zone there are no rock art sites recorded by previous work or in the SMR.

Recent researches on landscape are general in nature, and they vary from environmental reconstruction and historical ecology (Smith, 2005), to scientific and systemic socio-economic development approaches (Holmgren and Öberg, 2006; O'Connor and Kiker, 2004; Smith, 2005) and cognitive and phenomenological perspective (Manyanga, 2006) as guided by all that is known and visible. There is little or no emphasis directed towards moving from the site and settlement specific to understanding the key elements that unified the populations in that particular setting. The site distribution maps create an impression of large coverage of research when they are actually identified sites which could vary from a few pottery scatters to a large architectural establishment.

1.3.1. Statement of the Problem and Theoretical Considerations

> *"The archaeological record is not a fixed and immutable entity but a product of our own perception. Hitherto this perception has been limited, and we have been afraid to experiment with our data source, its origins and character,*

> *and equally reluctant to probe its complexity.*" (Foley, 1981b:157)

The burgeoning interest in Iron Age studies in southern African archaeology has contributed a lot to the understanding of the region's prehistoric societies over the past 2000 years. However, these studies have tended to be heavily skewed towards understanding the processes of socio-cultural change and the growth of complex societies as outlined in Chapter 3 and Section 1.3 above. This had led to research , particularly in Botswana, being directed towards developing a progressive developmental political, economic and socio-cultural model framework (Denbow, 1983; Denbow, 1984 ; Denbow and Wilmsen, 1983). As a result sites which were explicitly targeted for investigation were those deemed important for their ability to contribute to knowledge of the development of complexity in societies. It has to be understood that development of complex states, like urbanism in contemporary societies, by and large represents settlement structures that epitomise an interaction of both long- and short-term cultural, economic and environmental processes. In times of economic and environmental stress, when societal demands are more than production levels and social aggregation exceeds sustainable levels in local communities, it is acceptable to become apprehensive about the future. An interesting and contradictory scenario emerges where in spite of the declining climatic conditions of the second millennium AD, there was agricultural expansion accompanied by population growth (Holmgren and Öberg, 2006) within the Basin (see section 2.5, Figure 2.6). Even though subsequent years of occupation are believed to have witnessed further climatic deterioration accompanied by demographic and land carrying capacity leading to the eventual decline of Mapungubwe, there is also evidence of the Basin being reoccupied at the time when the environmental conditions were much worse than at the time of the collapse. The continuous occupation of the Zimbabwean side of the Basin from the 14th century up to today (Manyanga, 2006) shows us how mass movement of populations suggested by earlier interpretations is inadequate in linking the pattern of environmental deterioration with total abandonment of sites. The Botswana and South African sides would still be inhabited were it not for the relocation and displacement of people during the colonial era. This presents a classical example of how in the past, the future of a society could have appeared so bleak and faced with difficulties similar to those experienced by contemporary cultures at global, regional and local scales and at the same time remain resilient and thrive under such adverse conditions. As Ekblom (2004) argues, the archaeological scholarship in the region has depended on common knowledge in discussing issues of long-term environmental change. With little or no evidence of environmental dynamics in the past, problems of over-population, carrying capacity and environmental degradations are key issues embedded in sequences of events leading to occupation and abandonment of sites.

From the preliminary archaeological reconnaissance survey of this study it was observed that areas not represented in the archaeological map were not explored. The reasons for this situation are not immediately obvious; they are assumed to be lack of access, poor visibility and availability of insignificant sites that could offer valuable insights in the socio-cultural formation of the area. It is imperative to emphasize that the Shashe–Limpopo Basin is a dynamic landscape that exhibits an exceptional variability of environmental resources over space and time. The South African and Zimbabwean sides of the confluence zone have produced a considerable number of sites and literature exists concerning this research, as shown Figure 1.4 below. Within eastern Botswana a significant number of sites have been recorded largely through archaeological impact assessments such as the ones conducted in construction of dams and roads. These are usually GPS coordinates of sites and they are not systematically studied. The larger part of the study area is within a fenced freehold area and a reserve. Developmental projects in this unit of land are therefore minimal, and as a privately owned enterprise there has been little or no consideration given to engaging archaeologists to do assessment prior to any development. For example an airstrip was recently constructed within the Mashatu Game Reserve and according to the records an assessment was not undertaken. Thus, rather than

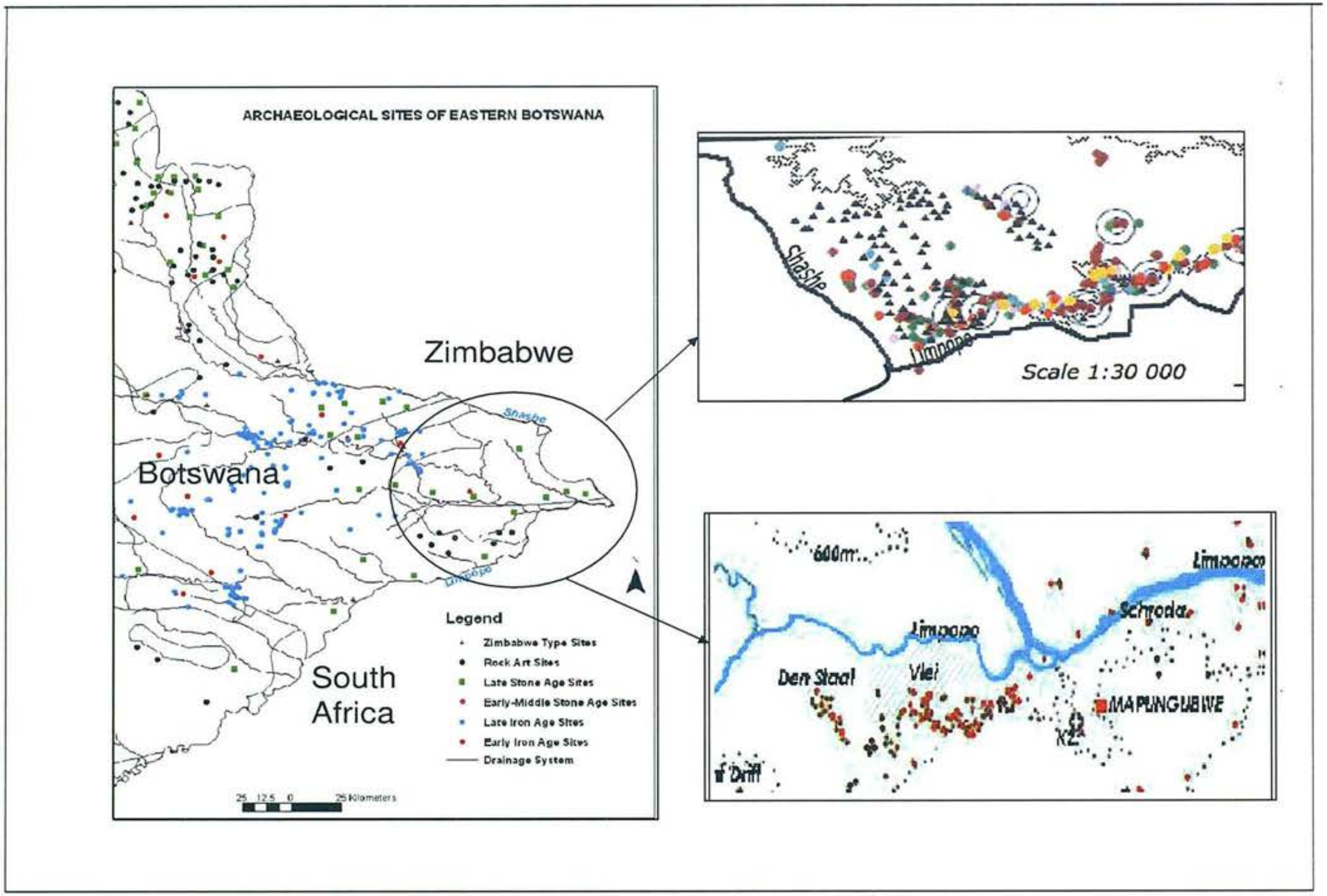

Figure 1.4 The distribution of archaeological sites at the confluence zone of the Shashe–Limpopo Basin from the Late Stone Age (Botswana and Zimbabwe) to Late Iron Age. Source for Zimbabwean sites, Manyanga (2006) and Huffman (2005) for South African sites

focussing on spectacular sites there is a need to extend our inquiry to contemporary sites through a comprehensive survey which could be linked to a national, but preferably a regional database, as this could provide a synopsis of the variability and chronology of the archaeological data. There are tangible physical structures of the settlements which seem to be easy to handle, but there are equally important intangible aspects of the whole settlement organisation that are not immediately obvious to the researcher and yet critical to archaeological inquiry. While archaeological data from the Shashe–Limpopo basin has increased in the last few decades, issues regarding the community dynamics as preserved on the landscape have remained unexplored. Research has also remained polarised and delimited by political boundaries; even though archaeological surveys have shown these not to have played any significant role in the past in terms of creating a barrier to interaction.

Past archaeological research on the settlement patterns and community dynamics of the basin have often emphasised excavation to recover information for interpreting various aspects of site organisation. This was then followed by analogical reasoning (Lane, 1995, Lane, 2005) where through a) an analysis of ceramic styles and morphological discontinuities of design elements on the record and changing cultural traditions were reflected upon; b) monumental structures and architectural designs, and ornamental remains, labour inputs, elite power structures and status wealth differentials could be explained (Smyth *et al.*, 1995); and c) application of ideological and world view theories were used to reflect on social organisation and presented, as in Huffman's model of the Central Cattle Plan (Huffman, 1996b). While analogical reasoning, especially based on stylistic designs of ceramics, and to some extent architectural variations, have yielded a lot of information, understanding how such variations in form relate to site organisational dynamics still remains problematic because activities that sustained the community livelihoods occurred off site within seemingly open or vacant spaces. Often concentric zones are used to describe the distribution of community levels and their social status. They frequently show an inverse relationship between distance, social status and the centre of the settlement; i.e. the further away you are from the centre, the lower the status level (Denbow, 1983) and this organisation is graphically mapped as a series of concentric circles radiating outward from the centre, with high status individuals residing at the centre and lower status members at more distant settlement peripheries (Denbow, 1983; Hall, 1987; Smyth *et al.*, 1995). As if conforming to laws of nature as governed by the principle of superposition accorded to the stratigraphic record, Huffman thinks since spatial order organises people, spatial and social organisations are different expressions of the same thing and the underlying structure must be part of a society's world view and by extension societies sharing the same world view organise their settlements according to the same principles wherever they live (Huffman, 1996b). Since they were farmers, this organisation is believed to demonstrate the integral role cattle played in their social life, ideology, and worldview (Lane 2005; Mitchell, 2002) and central byre to represent a court, formal political power and male activities (Smith, 2005). These ethnographic narratives are problematic as settlement organisation of varying status and utilisations are randomly distributed throughout the landscape. The problem lies in our limited focus which is influenced by what we see on the ground, and we have not been able to find out what other segments of the unoccupied areas were used (Binford, 1964; Foley, 1981b; Foley, 1981a; Ur, 2003). What we can see is also influenced by the type of landscape we are working on. In a riverine environment like that of the Shashe–Limpopo basin, the search for archaeological remains would necessarily require special techniques as many of the sites would have been buried or obliterated (Hassan, 1997). It is usually impracticable to excavate on a floodplain due to poor visibility of sites which could be covered by thick layers of sediment. As a result settlements sites located at the confluence are restricted to granite and sandstone outcrops and river terraces on margins of the floodplain. Systematic analysis, and comparison of independent and off site archaeological data sets need to be brought into play in order to fully understand the dynamics of the society at large, whether within, between or outside those constructed concentric zones. Aspects of the landscape with ordinary structures, commoner settlement, and secondary sites contributed to the dynamics of settlement systems and are important in addressing issues of interactions. We need to look beyond the built environment in order to understand issues of human behaviour and land-use diversity.

Another aspect that is considered problematic is ceramic typology. As outlined above in Section 1.3 southern African prehistoric populations and their changing culture and ethnicity are seen through changing patterns and styles of ceramic vessels. Patterns are observed to emerge from studying large collections of materials described by being grouped together as assemblages according to observed traits, which are given spatial and temporal definition through the Childean concept of cultures (Lock, 2003). This is a simplistic view that translates into equating a dynamic culture with a static material culture (Shennan, 1994) and for a long time this methodological advance in archaeological reasoning in the region, has been criticised by many scholars, (e.g., (Hall, 1984; Hall, 1987; Pikirayi, 1997; Pikirayi, 2002; Pikirayi, 2007; Tsheboeng, 1998)) who call for more robust procedures in which pottery typology and stylistic designs should not be the dominant methods for defining human groupings and behaviour in the past. The static archaeological records that are used to account for human expansions and cultural identities based on these radiocarbon-dated stylistic distinctions in ceramics (Smith, 2005) are products of dynamic processes of the past. In other words the archaeological material is spatially continuous and the stratigraphic record of the site may not form the most suitable framework for analysis. It is not entirely correct to establish traditions and cultures on the basis of modes which persisted through time or disappeared from the regional record and assume that a break in the record represents the cessation of one tradition (or culture) and the commencement of its successor.

This study therefore is of the opinion that the approaches used in southern Africa classification lack theoretical foundations. The classification procedure does not allow for formulation of systematically designed questions with systematic techniques to answer them, and for those in favour of it, "establishing a culture-sequence based on pottery typology is a routine procedure that comes before hypothesis and interpretation" (Hall, 1984:262). Due to lack of well-structured questions prior to undertaking field research, interpretation tends to occur prior to and simultaneously with the excavation process of the archaeological deposit. Over and above this there seems to be a general assumption that pot-making and its products occurred at possibly household levels. This is in spite of the fact that the manufacturing and circulation of ceramics in the past is poorly understood. Amongst contemporary societies pot-making is considered a very specialised and rare skill with its production more often limited to one or a few families within a settlement. In addition to that, depending on the geological setting of a settlement, availability of clay raw materials can also be a significant problem. This could result in clay and its associated products being exchanged across a broad territory. It is therefore possible that the cultures/traditions and phases attributed to the inhabitants of those sites did not even produce those characteristics used to classify them. Studies of the geochemistry of ceramic remains and characterisation of the clay sources could offer alternative explanations of the origins of the artifacts and insights into whether pottery *(i)* was locally produced and there were local trade and exchange systems available, and the style difference(s) was a marketing strategy and consumer choice, and *(ii)* if a given pottery style was found at several different sites with differing chemical signatures, then it could be that some sort of production specialisation was available in the area. The latter could further suggest that a market was available within the community, with clay products sourced from different places, and the style was consumer driven.

Furthermore, practitioners of archaeology should view the wider archaeological landscape as time-specified land surface with an interacting web of settlement, population, technology, resources and the environment (Connah, 2001, Robinson, 1996). For example, for trade to develop and flourish there should be already established local and regional exchange networks onto which a scale of demand and supply of commodities could latch themselves (Sutton, 2004). These provide elements of the archaeological manifestations that archaeologists should look out for in the landscape in order to design research questions that would lead them to understand the organisational dynamics of past societies and their relationship with the land in which they lived. With the increasing development and easy access to high-resolution techniques in the form of digitised and georeferenced satellite and aerial images, there is improved visibility in archaeological landscapes. This affords us an opportunity to network data over a wide area and to construct meaning from dimensionless sites. The Botswana side of the confluence has sites which have close affinity to the established archaeology of the Shashe–Limpopo Basin, and this study posits that as a peripheral area it sustained the lives of communities at the confluence throughout its occupation and its contribution needs to be assessed.

1.3.2. Research aim and objectives

The archaeological characterisation of the Confluence Area on the Botswana side is explored and an attempt is made to discuss the manner in which human social, political and economic systems interacted and how the inhabitants intentionally manipulated the landscape. The emphasis is put on the role of the broader landscape rather than focussing solely on the 'loci of intensive behaviour we call sites' (Ur, 2003:102). From the preliminary study, it was considered practical to undertake a designed and structured field research survey to establish the contribution of the Botswana side of the confluence to the overall archaeology of the Basin. Even though there is generally poor visibility of archaeological sites in site distribution maps and relatively few surveyed sites to have attracted any research interest, this area has the agro-economic potential to have sustained human populations for long periods of time. It is also evident that the geomorphological setting played a significant role in decision-making processes regarding land use in the study area. This strategic planning supported a significant population, which increased over time and space with intensifying social development needs. It is therefore considered necessary to employ aspects of landscape archaeology to understand how the past inhabitants of this Basin utilised it. Landscape archaeology is defined as:

> "a geographical approach whereby a region is investigated in an integrated manner, studying sites and artefacts not in isolation, but as aspects of living societies that once occupied the landscape." (Clark *et al.*, 1998):1461)

Restricting our views to discrete sites and outstanding monuments does limit our understanding of the lifestyles of the past societies. Societies categorise and organise their activities on the land guided by different environmental attributes the landscape offers to them. It is critical to utilise the spatial continuity of human activity in the landscape as a means to understanding past socio-political, cultural and economic dynamics. Indeed, the inferred changes in trade patterns and social networks, agricultural transformation and economic practices in the Shashe–Limpopo Basin may reflect a land-use management strategy (Ekblom, 2004). This study assesses the landscape dynamics of the confluence zone of the Shashe–Limpopo Basin by employing research approaches which may:

- assist in determining the broad archaeological potential of the confluence area
- locate, identify and establish the significance of sites over space and time in relation to the broader archaeological and cultural landscape of the confluence
- introduce the concept of off-site archaeological investigation to account for poor visibility of sites and to show the spatial distribution of sites and decipher the probable use of the landscape by past occupants of the basin

Established ceramic typologies and environmental reconstructions from previous studies will be used in this study to contextualize the chronological sequences of the study area. Landscape attributes will be assessed for their potential importance in site selection and preference for human use. These attributes will be analysed for the types of cultural activities undertaken within the broader spectrum of the landscape and establish whether they were influenced by the terrain units of the landscape. As previous studies used ceramic styles and motifs to identify cultures and cultural changes over space, an analysis of a limited but substantive sample will be conducted of the mineralogical composition of the ceramic remains. This is considered critical as it is generally assumed that ceramics were locally produced in the Basin and not part of the socio-economic network. This is in spite of the fact that the geochemistry of clays, clay quarries and manufacturing sites is still not known. Hence, this research needs to identify and quantify factors necessary for human use of land at a societal level. Ethnographic information will be sourced from contemporary societies in the area and used as comparative data.

1.3.3. Justification

The contribution of the Botswana side of the Shashe–Limpopo Basin to the social transformation of the Mapungubwe Complex is usually acknowledged within the archaeological research on sites located in the eastern margins of the Kalahari sandveld, such as Toutswe and Bosutswe in east-central Botswana. The societal integration of this establishment is further acknowledged as far as the Makgakgadikgadi salt pans. The archaeology of the area in the immediate environs of this cultural landscape has been subsumed in studies of the major sites in South Africa, with no targeted research being undertaken. This has resulted in the Botswana side being presented as an area with no archaeological sites, whilst the neighbouring countries are littered with sites (see Figure 1.4). The present study views this as a gap in research and seeks to change that perception and to demonstrate the contribution of the confluence landscape to the Shashe–Limpopo population by identifying not only isolated sites but the aspects of landscape as products of human modification.

Landscape archaeology as a sub-discipline of archaeology emphasises the role of the entire landscape in the past, rather than focussing exclusively on loci of artifactual concentrations. It is a relatively new field of archaeological inquiry, and in southern Africa it is still largely unexplored. For example, it is not offered as a course in its own right in any of the institutions that teach archaeology in the region, and has been rather left to find its place within the broader context of Environmental Archaeology. However, this study has a limited time-frame and for more aspects of landscape archaeology to be realised the area of investigation needs to be broadened. This will allow for a broader picture of the diversity of land-use approaches as a function of landscape attributes to emerge. This could assist in building a database for future surveys on ancient landscapes that will be useful for the development of archaeological and heritage management policy, planning and implementation. This research has revealed aspects of landscape dynamics that can be useful in bio-diversity management policies because it is situated in and deals with an environmental setting that has fluctuated between wetland and dryland,

and is a haven for wild fauna and flora. It can therefore contribute to national and international bio-diversity initiatives regarding changing landscapes.

It is hoped that the present work has identified some of the gaps that exist in archaeological knowledge at a local scale in the Shashe–Limpopo confluence and will help to guide future research efforts as well as providing a preliminary framework within which findings can be incorporated. It is further hoped that this study perspective is novel in southern African archaeology, and researchers working on complimentary research projects in the Confluence area will assess its appropriateness as a viable, alternative research methodology.

1.4. THESIS STRUCTURE

This thesis is organized in such a way that it presents a logical flow of events based on its conception, the setting and the current practice by drawing from different and diverse sources, and application of scientific analytical methods of practice used in archaeological discourse.

Chapter 2 introduces the environmental setting of the study area. It describes the current land-use and environmental conditions and uses the data to discuss and contextualise the archaeology of the Basin over time and space. It further reviews the past climatic variability and how archaeological interpretation has used these data to argue for occupation and abandonment of landscapes. Usually this correlation is based on simulated data on rainfall and temperature variability. It emphasises the need to exercise caution when dealing with micro-environments as it is availability of water not rainfall that is significant and in this Kalahari thirst-land water can be sourced by other means just to meet the basic demands of a society. It concludes by arguing that adaptation strategies such as, long and short-term flexibility, mobility and re-organisation of resources, as well as flexibility in agricultural practices and in types of staple crops, transhumance, digging of wells, and diversification of resources, and even control in the distribution of resources through established cultural structures can be explored. These adaptation strategies are discussed based on the results of the research survey and analysis (see Chapter 5).

Chapter 3 reviews conventional ideas on the archaeology of southern Africa which are based on a model of Bantu-speaking farmers replacing the hunter-gatherer economic practices. It reviews current ideas on migration theory and linguistic association, and how this association is considered inadequate and unsubstantiated in archaeological and scientific scholarship. It concludes by putting the archaeology of the Basin within the context of these debates and evaluates existing data based on the correlation of the occupation of the Basin with cultural materials of the presumed Bantu-speaking populations and the changing environmental conditions. It notes that areas of investigation are too sporadic and scattered to allow for continuous comparison. Some areas in the region have received more attention and their record presents a coherent and convincing data-set, whilst others remain unexplored.

Chapter 4 deals with the methods and investigative techniques employed in this study. It explains the conceptual framework of the research and explores how the methods employed fit within the aims and objectives of this study. The techniques employed include desktop, field and post-field work analysis. This chapter also outlines the limitation of undertaking research in an area that is dependent on archaeological sources from elsewhere and the generally hostile environment in which it is conducted. These are viewed as potential constraints that could affect the quality of the results.

Chapter 5 presents the results of the field research following the structure outlined in the previous chapter. It presents the results of the preliminary reconnaissance survey contextualising how the methodologies that encouraged the field survey were conceived and objectified. The results are also discussed within the context of the techniques applied and a summary of these results immediately follows each section.

Chapter 6 brings the discussion of all the chapters and synthesises them within the context of archaeology and landscape of the Basin. It evaluates the results and their relevance to the hypotheses set out and the goals of the research. It outlines recommendations for future archaeological work in the area and how collaborations between scholars in the field and integration of data on the region should not be limited by existing political boundaries and visible archaeology.

2. ENVIRONMENTAL BACKGROUND

2.1. INTRODUCTION

This chapter outlines the current environmental conditions of the region and how they have changed over time. Against that environmental background the archaeological context is discussed by looking at past climatic models and relevant palaeoenvironmental reconstruction studies for the region and the study area in particular. The potential and constraints of the environment that may have influenced the strategies of the prehistoric inhabitants need to be contextualised in order to understand the dynamics that may have affected human behaviour over space and permitted continuous occupation of the confluence landscape.

2.1.1. Current Land-use

The current land use of the study area is that of a freehold exclusively owned by the Northern Tuli private game reserve. Owing to the limited amount of human activity the area boasts a considerable diversity of wildlife species which are largely browsers and grazers. As a freehold privately owned enterprise, the reserve has of late seen increasing wildlife numbers due to the demands of tourism-related activities. It is home to over 500 elephants (*Loxodonta africana*), the second highest such concentration after the Chobe National Park (Mainah, 2005). The reserve is controlled by different stakeholders and the study area falls under the management of the Charter Reserve Trust. These reserves do not have physical boundaries between them, so the animals are allowed to roam freely. The presence of animals is however not a new phenomenon that came with the management strategy, but goes back to prehistoric times where trade was largely based on ivory. Archaeological research has shown that wild animals were part of inhabitants' diets long before the arrival of domestic livestock (Plug, 2000).

2.2. The Physiographic Setting

Botswana lies in the centre of southern Africa between latitude 18°S and 27°S and longitude 20°E and 29°E. It covers a total area of 582,000km^2 (about the size of France). It has a relatively featureless landscape; over eighty percent of its area is covered by gently undulating windblown Kalahari sands, which form sand plains with low shrub vegetation, palaeo-river channels, and salt pans. In some instances the sand deposits overlie basalts and sedimentary rocks in which case they give a landscape character with minor valleys and ridges to low hills. The remaining part of the country, about 20% of the land area, is classified in land use systems as hardveld, an undulating plain with occasional hill ranges comprising basalts, sandstones, and granitic genesis rock outcrops found mainly in the eastern part of Botswana. Therefore, it is hardly surprising that three quarters of the contemporary population resides in the eastern part of the country, an environmental and land-use setting that matches the distribution of archaeological sites, especially those associated with Late (Iron Age) Farming Communities as shown on Figure 2.1. The hardveld land system provides pockets of land units, in the form of low-lying areas with alluvial soils, which are exploitable for livestock grazing, game reserves and conservancies, as well as seasonal arable agriculture. The major crops are: *Zea mays* (maize), *Sorghum bicolour* (sorghum) and *Pennisetum glaucum* (millet), melons, dry beans/cowpeas, groundnuts, and sunflowers in some areas.

This scenario has resulted in Botswana being envisaged as comprising two major physiographic regions: the Kalahari which extends to all the surrounding countries of Zimbabwe, Namibia, South Africa and Zambia, and the Limpopo Valley, a depression that is part of the main Shashe–Limpopo Basin which extends into Zimbabwe, South Africa and Mozambique. None of the rivers of eastern Botswana has a perennial flow but they all drain into the Limpopo, which also does not flow in dry seasons; they all occasionally have pools of water remaining all year round. The Shashe River and its tributaries originate from the periphery of higher altitude zones in south-western Zimbabwe. It then converges with the Limpopo to form the major Limpopo River of southern Africa which eventually drains into the Indian Ocean.

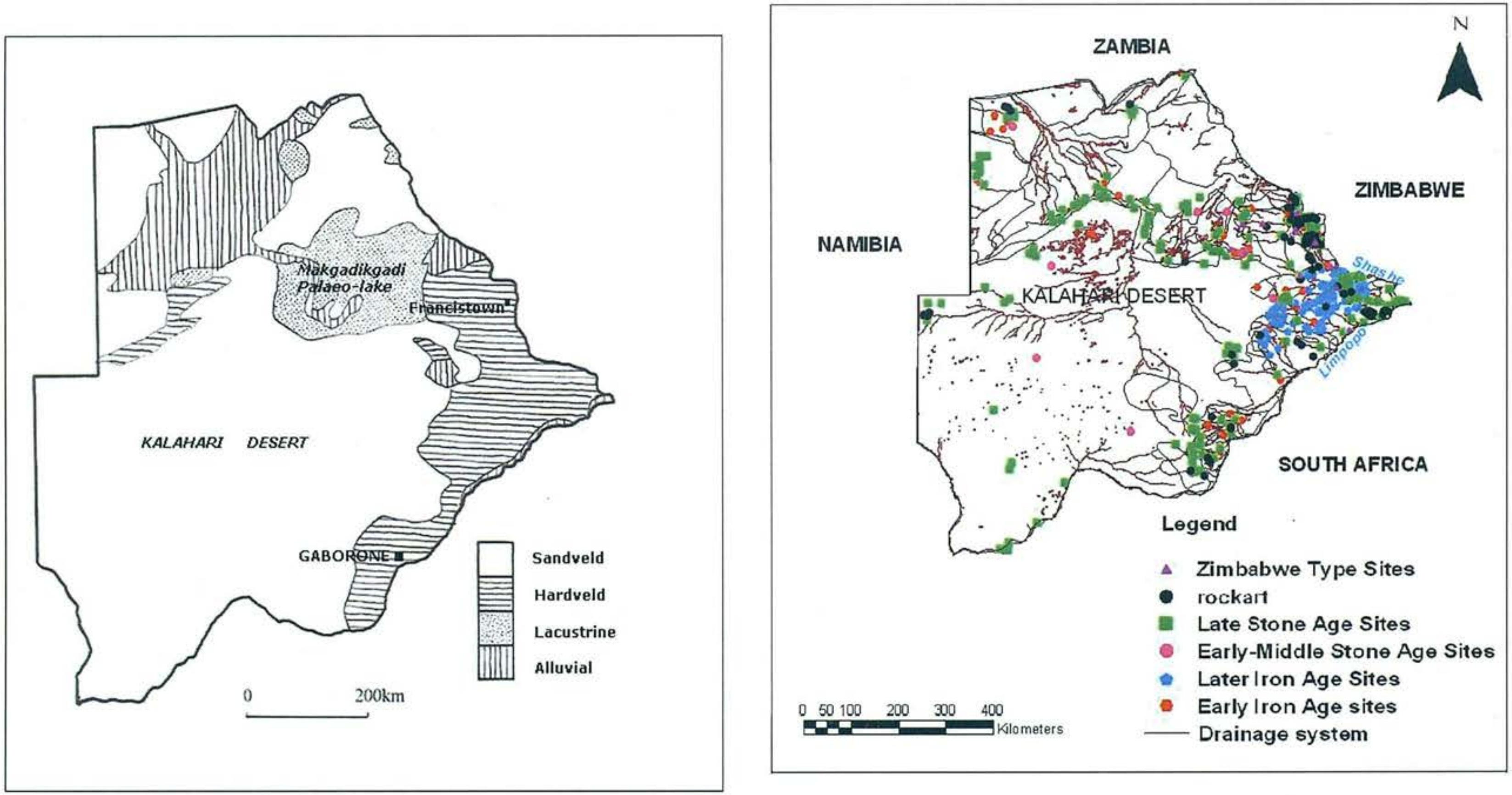

Figure 2.1 The land divisions (left, Hitchcock, 1982) and the distribution of archaeological sites in the country from the site and monument register of the Botswana National Museum.

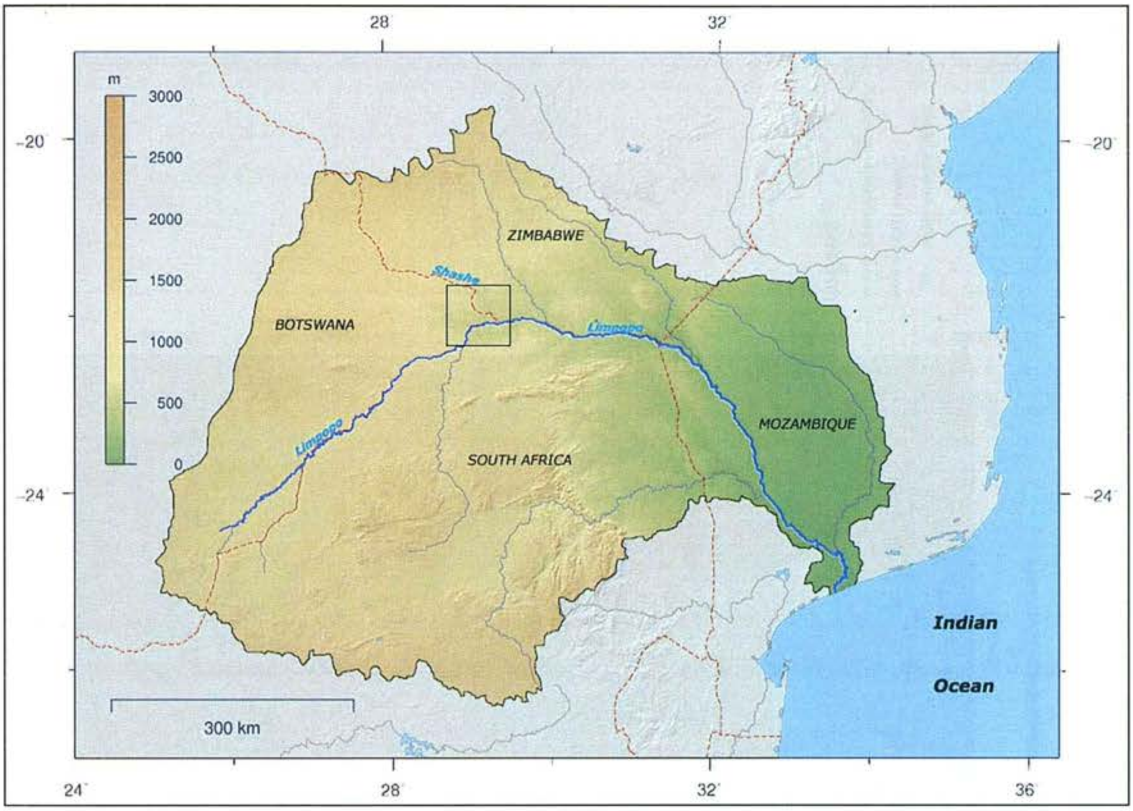

Figure 2.2 Location of the Shashe–Limpopo Basin and its margins and the study area (insert). (source of the map: Imagico (2007))

In this study, the area of interest falls within UTM zone 35 within the Limpopo Valley where the main focus is at the confluence of the Shashe and Limpopo rivers, an area that separates Botswana, South Africa and Zimbabwe (Figure2.2). Its catchment margins are defined by the Motloutse River and its tributaries which drain into the Limpopo River, and the Shashe River which is fed by tributaries from the Zimbabwean plains. The physiographic character of the confluence zone differs from the entire Kalahari because there is an "encroachment of Quaternary erosion cycles along the river courses" which "give rise to a zone roughly parallel to the rivers, between them and the uplands, of marked minor dissection and streams incision where areas of outcrops and shallow and stony sites predominate (Bawden and Stobbs, 1963:6). The character of the landscape, however, closely reflects that of the overall geology of eastern Botswana with structurally similar topography, soils and vegetation, and localised micro-environmental conditions. The last mentioned has been brought about by localised distinct

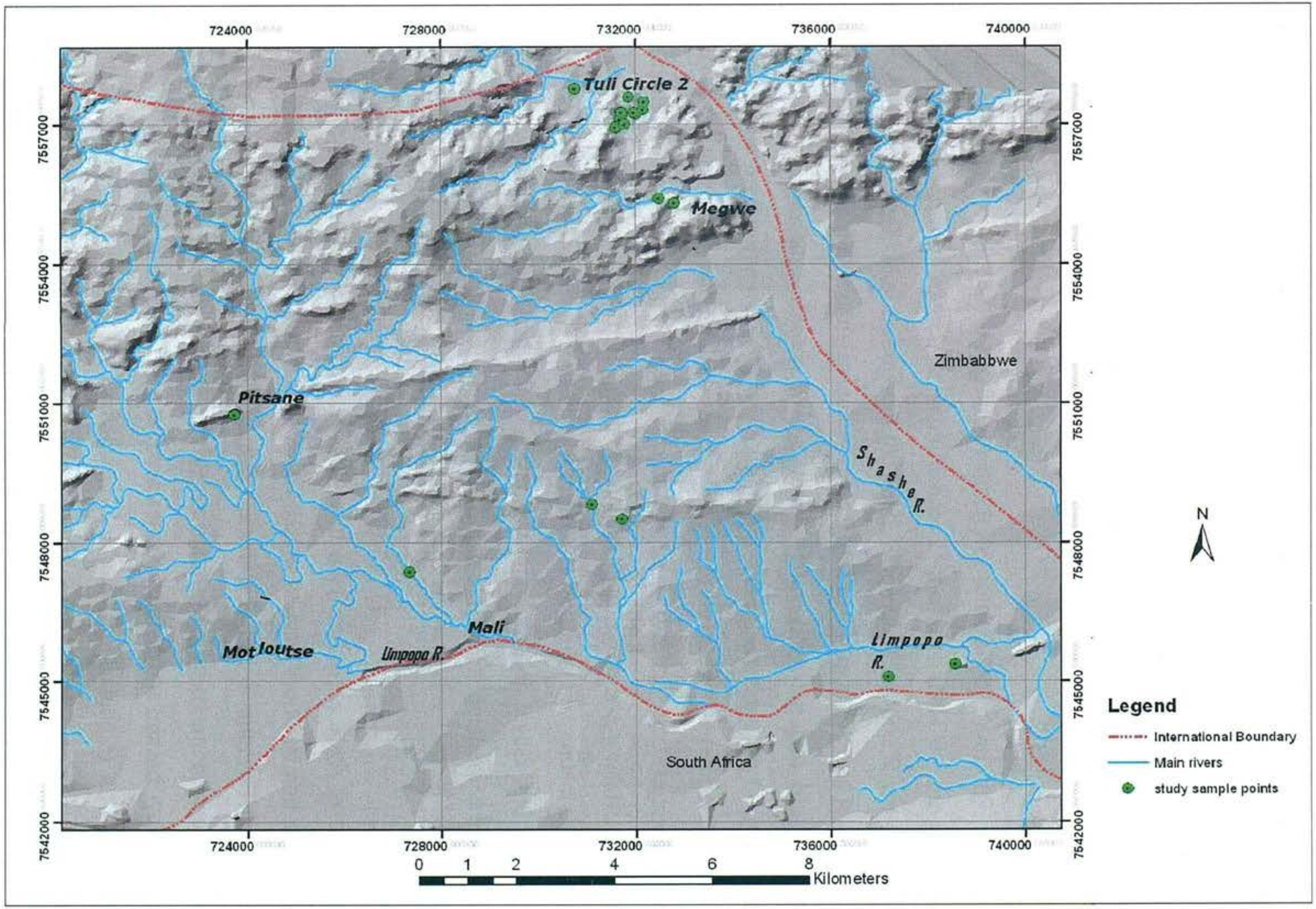

Figure 2.3 The typical landscape showing escarpment hills dissected by valleys (towards the rivers) with rich silty clay loam soils.

physiographic features which include amongst other things a very varied geology with metamorphic tectonic units which gives it a complex topography with belts and dykes forming valleys and hills that dissect the area (Timberlake, 1980). The valleys in between the pediments often bear evidence of streams that run parallel and into the main rivers of Shashe and Limpopo as shown on Figure 2.3. This dissected geomorphological setting is associated with flat to gently sloping pediments and soils that represent both recent and fossil alluvial deposits.

Perhaps influenced by the water retention capacity of alluvial soils and high water table of the Shashe River, in particular, the confluences of these channels and the main rivers bear lush riparian vegetation throughout the year. When the Limpopo River reaches the confluence however, it descends gradually from 914m to 518m above sea level, making it the point of minimum altitude in the entire valley (Bawden and Stobbs, 1963). Because of the predominance of down-cutting over lateral erosion, the Limpopo River and its tributaries are narrow and deep. As a result their contemporary alluvial floodplains are confined to the river and only appear as disconnected fragments within loops of the river further upstream. The main floodplain is on the western, Botswana, side but when the Limpopo reaches the confluence, its floodplain extends a short way up to the north-west along the Shashe River, forming alluvium-rich levees and terraces on the Botswana and Zimbabwean side. On the South African side there are sandstone ridges which seem to mark the maximum extent of the floodplain.

Ethnographic data in the form of interviews with local residents, such as 81-year-old Simangeni Mpande (*interviewed August 2005*), confirms how the large and voluminous Shashe pushes back the Limpopo River water when it is full or angry. This results in extensive flooding immediately at the confluence and further upstream. Mpande believes this is why the floodplains could not be permanently settled but instead were used for cultivation (especially the valley immediately before Chaile Kopje) and grazing of livestock and abundant wildlife. Recently the author and other archaeologists from South Africa and Zimbabwe had a symposium and an excursion was organised to the sites in Botswana and South Africa. A day prior to the trip torrential rainfall occurred and access to the Botswana sites was blocked due to flooding. In a way this confirmed the theory postulated by this study that at the time of occupation wet climatic conditions made the Botswana side inaccessible. During this trip sites on the South African side of the border were easily visited.

Bawden and Stobbs (1963:53) describe these terrain units as subject to flooding and, though their morphological characteristics differ, there are useful generalisations which can be made:

> the levees profiles are generally brown to yellow-brownish and have a light texture (fine sand to light loam). Occasionally at depth (usually over 0.5m) a clay loam or clay horizon is encountered. The profiles are usually of considerable depth but some weathering of bedrock is sometimes encountered at over 1.5m, an indication of the way in which adjacent river is being incised into the present landscape. These soils are slightly acid (pH 6.2+) but the subsoil is alkaline. Though such soils form long discontinuous strips, these are rarely more than 100 yards wide, bordering the river, and the total area covered is usually small.

These create pockets of land that are cultivable in winter or in summer when the rains have failed. At stream and river junctions, pits/wells are dug to water livestock. Such an observation was made during a field visit to the Zimbabwean side where communities still follow this practice. On the South African side the floodplain is used for commercial farming.

2.3. CLIMATE

The confluence is in a semi-arid savanna environment characterised by two distinct seasons — summer or rainfall season, which is hot and wet and extends from October/November to March/April, and the cool, sunny and dry winter season from March/April to July/August. In between the two distinct seasons, from August to the onset of the rainy season, it is generally hot with maximum monthly temperatures ranging between 24.7°C and 32°C and characterised by infrequent rain showers at times used to facilitate preparation of fields for early farming (Manyanga, 2006; O`Connor and Kiker, 2004). The months of January and February are regarded as peak months for the rain during the summer and almost all rain occurs during this period. Mean maximum temperatures are highest in December, especially in the weeks preceding the cooling summer torrential rains. In winter, daily temperatures range between 22°C and 23°C on average, and they range between 10°C and 12°C on average at night. Temperatures can drop dramatically to near freezing at night and in the early hours of the morning because of the absence of cloud cover, resulting in frost.

In southern Africa rainfall is highly influenced by the position of the Inter Tropical Convergence Zone (ITCZ), a low pressure belt caused by the convergences of the south-east and north-east monsoon trade winds, oscillating between the Equator and the Tropic of Capricorn. The southward movement of the ITCZ marks the beginning of a rainy season and the further south it moves the more promising is considered to be the wet spell. Regional climatic models confirm that extended wet spells are caused by an invigoration of the tropically induced circulation disturbance forced by tropical East trade winds, whilst the circumpolar vortex causes the extended dry spells and increased occurrence of westerly disturbances. During the dry spells, the summers are drier in the summer rainfall region and winters tend to be somewhat wetter resulting in the overall decrease in rainfall (Tyson and Lindesay, 1992). Rainy seasons are generally accompanied by an increase in cloud cover, and the maximum temperatures are usually lower than during the extended dry spell period. As a result during wet spells, summer rainfall increases whilst winter rainfall decreases.

In Botswana, however, rainfall is a very unpredictable and unreliable phenomenon. It is controlled by two systems: the Zaire Air Boundary system to the north which brings thunderstorms and heavy downpours of rain, and the South Atlantic Oscillatory system which moves in and out of the country from the west and south west bringing in very cold spells and winter rainfall (F.A.O, 1980). The majority of rain in Botswana, however, falls only during the summer period. This takes place when the thermally induced low-pressure system allows moist air from the Indian Ocean to penetrate the interior (Denbow, 1983). Otherwise, the sub-tropical high pressure belt, also known as the Botswana High Pressure zone system (responsible for the circumpolar vortex described above), if present for extended periods of the summer season, can push the rain bearing ITCZ away, usually to the eastern margins of the region. If this happens it can create long dry spells resulting in droughts of varying severity across the whole of southern Africa.

At other times southern Africa's climate is also influenced by the El Niño Southern Oscillation (ENSO). This phenomenon can severely affect the regional rainfall pattern by bringing above- or below-average precipitation. It tends to bring either heavy rains often accompanied by severe floods (F.A.O, 1980) as in the 1999/2000 summer season when the region experienced the largest floods in decades and the confluence and parts of Mozambique were severely hit.

The confluence currently receives on average 350mm of rainfall per annum with a mean annual evaporation six times greater at 2200mm (O`Connor and Kiker, 2004; Smith, 2005). Due to its location, it is persistently under the influence of the drier south-easterly winds, thereby making it receive comparatively less rain in summer than anywhere in the entire country outside the Kalahari Desert in the west. The rainfall pattern is erratic and highly variable, so that sometimes it is preferable to describe it in mean annual or seasonal precipitation rather than monthly values (Smith, 2005). There are no long term records of rainfall from any weather station close to the study area on the Botswana side of the confluence. The nearest from the country is the 40-year annual precipitation record from Francistown, a town over 300km away. There are, however, records available from neighbouring weather stations in Zimbabwe and South Africa dating from the early 20th century. For example, an agricultural research station at Messina, South Africa, less than 80km from the confluence, has an appropriate long-term record, where mean annual rainfall was 339mm between 1934 and 1990 with a coefficient of variation of 37% (O`Connor and Kiker, 2004). This trend compares well with those observed at the Francistown (Botswana) and Beitbridge (in Zimbabwe) stations and confirms how annual precipitations have been just sufficient in most years for the production of more drought resistant crops such as sorghum and millet (Denbow, 1983; Manyanga, 2006). This implies that the area has been persistently a drought prone environment for almost the last 100 years and on average every 1.2 years (Manyanga, 2006). This presents prolonged and short-term drought scenarios, which would have had detrimental effects on both livestock and crop production. Cattle are extremely vulnerable to droughts and need successive and continuous good seasons to recover from a severe drought, whilst small stock can reproduce in a much shorter time. In an area with livestock and wildlife there is high potential for intense competition for herbaceous biomass particularly amongst grazers and browsers and these can be highly pronounced in times of dry climatic conditions (O`Connor and Kiker, 2004).

Previous archaeological researchers have posited, at times with little and unsubstantiated environmental data, the tendency to temporary migration or complete abandonment of sites by prehistoric communities whenever climatic conditions changed from wet to dry, and the opposite to occur when wet conditions prevailed (see Huffman, 1996). Their conclusions would have been based on extrapolations and direct inferences from long-term large-scale sub-continental climatic models such as those of Tyson and Lindesay (1992) and Holmgren *et al.* (1999) which could vary significantly at local and micro-scales. This could seriously misrepresent the actual events and responses which took place at the time of occupation. For example, Sanford (1979) cautions that drought should not be equated with absolute annual rainfall, but defined in terms of a particular community's demand for water, as annual rainfall variation may not necessarily translate into water demands exceeding its supply. Indeed, water in southern Africa is a scarce resource that cannot be reduced to a secondary determinant for site location, and therefore it is water, not actual rainfall, that is important (Lindholm, 2006; Walker, 1995). For example, in places of normally very low rainfall with, say, 100mm per annum, a year with an average of 200mm may result in excessive floods; whereas another place normally receiving 600mm per annum will be severely impacted if it were to receive 200mm in that year. For mixed agriculturalists involved only in crop production, we cannot underestimate the potential importance of rainfall, but for pastoralists other factors such as availability of pasture and ground water would be critical. In Botswana, for example, where the cattle population is one-third more than the human population, cattle posts are located in the grassland and dry country of the Kalahari Desert.

Ethnographically, strategies for dealing with drought periods involve shifting and distributing fields over different soil types with different water or moisture retention properties. In addition there are elements of social structure that are mediated by ideological, political and individual perceptions and they govern decision making. They are based on established historical networks, risk assessment and management strategies aimed at reducing loss or increasing access to economic resources at a societal level. For example, amongst the Sotho-Tswana of the twentieth century, a harvest tribute, *dikgafela*, was commonly practised during times of plenty. In this process cereal grains, in particular *Zea mays* (maize), *Sorghum bicolour* (sorghum) and *Pennisetum glaucum* (millet), were contributed by every household at the end of the harvest period to the king/chief, and stored. The grains would be redistributed to the needy and the farmers during drought periods (Hitchcock, 1979) and at the start of the ploughing season, especially the season following poor rains years.

Livestock can also be shifted around to areas where grazing and water have been replenished (Denbow, 1983; Smith, 2005). Supportive alliances based on the establishment of social and exchange networks amongst communities in close proximity to one another are common phenomena in southern Africa (Smith, 2005). If the other community is hard hit, ecological zone boundaries may be ignored and access permitted to livestock and agricultural soils in times of environmental stress. A study by Hitchcock (1979) on Botswana pastoralists and agriculturalists suggested mobility as one of the responses that farmers undertake to overcome the impacts of drought. Another more recent study by Lindholm (2006) showed how the pastoral ambition of accumulating livestock by the *Omaheke* peoples of Namibia in the Kalahari desert, could be understood from an indigenous knowledge of the management of a dryland ecosystem and the digging of wells. These observations are in direct contradiction to earlier suggestions by archaeologists that the collapse of the states at the confluence was because agriculturists retreated in dry periods (see Huffman, 1996:57). Short-term strategies can be explored if the drought is not prolonged and recovery to previous levels is possible amongst agro-pastoralists. The cost of a total movement to a new location could severely outweigh the benefits of staying and making do with the circumstances. It is therefore not convincing to equate environmental variability with total migration as the people always go back when conditions improve. It is also possible that at the time the communities utilised different species of wild game, fruits and herbs which were available in large quantities all year round to supplement their diet, as is common practice among southern African farming societies today.

It is true, at local and micro-environmental scales that seasonal variations significantly impacted on the people. However, people can become resilient in such times of adversity. Exploitation of landscape resources for food security and risk management strategies, and characteristics of resilient plants are factors that could have forged a sustainable relationship between the environment and people. Manyanga's (2006) study of the socio-environmental dynamics of the Zimbabwean side of the confluence shows how these resilient landscapes permitted continuous occupation of the Shashe–Limpopo

Basin and confluence for millennia, even after restriction of movement by the demarcation of the area with borders marking international boundaries and private game reserves and freehold farms. However, areas associated with key resources for provision of needs at times of scarcity are still not fully identified and investigated. This is probably due to the patterns of research having been influenced by what is visible within the landscape in terms of material culture, and not necessarily the land-use strategies.

2.4. VEGETATION

The research area is located within a savanna biome and, as in any environment of this type, a major factor delimiting the biome is the lack of sufficient rainfall. As a result the Shashe–Limpopo confluence area, is commonly described as a barren environment with a dry, vast, lowland bush associated with sandy soils and the presence of tsetse fly (*Glossina* spp) which provides unfavourable conditions for farming and livestock rearing (Summers, 1961) as compared to the coastal area downstream in Mozambique (Ekblom, 2004). There are no vegetation inventories for the study area. This is in spite of the common assumption that the emergence of farming communities in the first centuries AD was a consequence of enhanced precipitation and increased vegetation cover (see section 2.5). These studies are at regional scales and their focus is mainly on the relationship between the distribution of plant species and geology, soils and climatic patterns, as well as for range ecological management policies (Bawden and Stobbs, 1963; F.A.O, 1980; Sebego, 1999; Wear and Yalala, 1971). Archaeologists use the data to make inferences about past settlement and possible use of the landscape. The vegetation description presented here, therefore, follows the general regional vegetation inventories. Little has been done at a smaller scale, local or micro-environmental, to elucidate culture–environment relationships. It is imperative that future studies assess whether cultural signatures on the landscape could have contributed to the ecological patterning of certain plant species found in and around archaeological sites.

Using remote sensing techniques of aerial photography for a reconnaissance survey of eastern Botswana, Denbow (1979) made an observation that there was a consistent association between *Cenchrus ciliaris* and Iron Age sites. This association made it easier for archaeological sites to be identified from aerial photographs (and satellite images — see Figure 2.4)) over a large area. Some of the sites picked out from the aerial photographs belonged to contemporary Tswana cattle enclosures. This led Denbow to suggest that grass on prehistoric middens possibly indicates a similar use of the sites as animal enclosures (Denbow, 1979:405). The present study employed the same technique to locate sites but, as discussed in chapter 5, spatial patterning and concentration of sites coupled with geochemical analysis of soils do not entirely support Denbow's hypothesis of the use of such sites as cattle enclosures.

However, there are more recent studies with a specific focus on assessment of vegetation transformations for their palaeoecological data as well as human use (see Ekblom, 2004 for a study region in Mozambique). Smith's (2005) work in South Africa and some parts of eastern Botswana is useful, even though her focus was on the reconstruction of the regional agropastoral palaeoecology. But central to her results and useful in this study is the data regarding past land-use management strategies. From stable carbon, nitrogen and oxygen isotope values of animal bones and teeth she inferred vegetation and rainfall patterns over the different times of occupation of the Basin. Teeth reflect the isotopic signature of the animal's diet and environment during tooth formation, while bone gives the lifetime average. Carbon isotopes are an indicator of what vegetation the animals were eating, while periods of aridity or drought can be determined through nitrogen and oxygen isotopes. These preliminary results are not entirely in concordance with the regional environmental sequence suggested by, for example, Tyson and Lindesay (1992) and (Holmgren and Öberg, 2006) from cave deposits. The results from Smith's (2005) work are, however, augmented by the identification of areas of pasturage for such livestock using strontium isotope analysis. Strontium isotope analysis pinpoints possible geological areas suitable for pasturage, and the associated vegetation cover. The latter is critical as it helps this study to put into context its findings regarding landscape signatures, especially 'savanna glades', identified using remote sensing techniques.

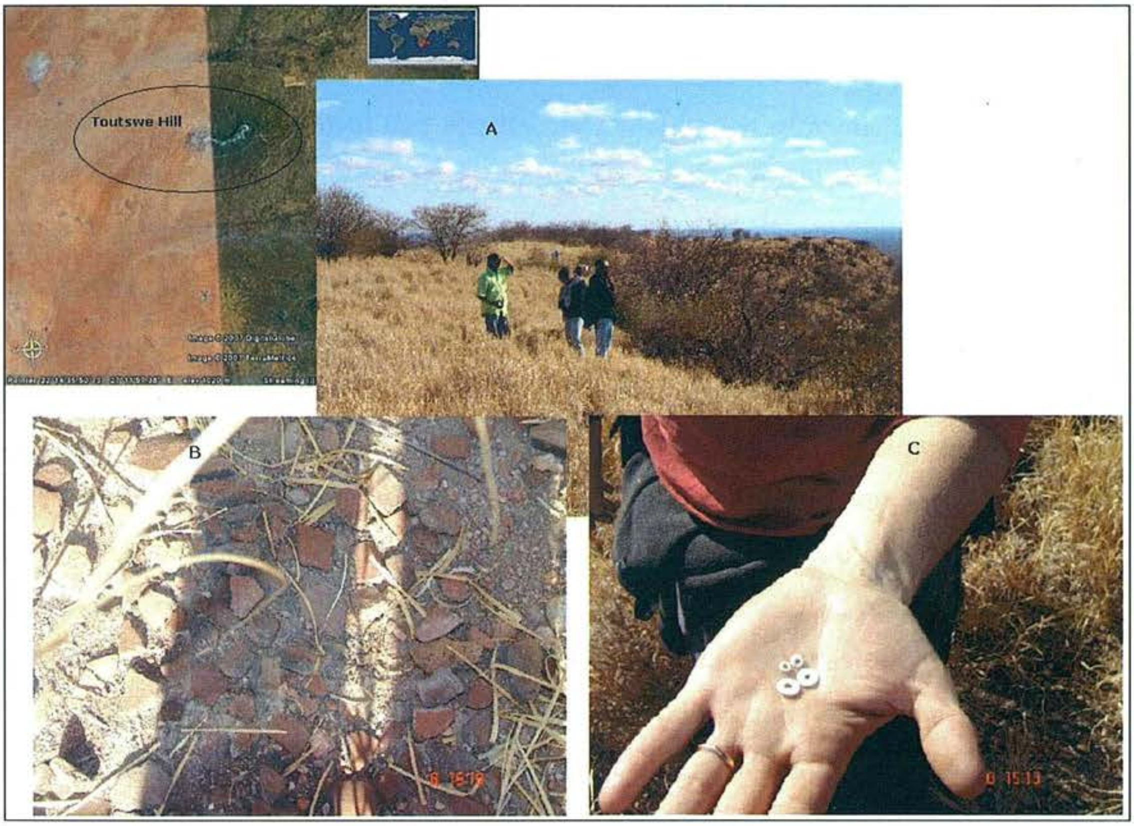

Figure 2.4 From a satellite image (source Google earth[2007]), the archaeological site of Toutswe can easily be recognised from the white and highly reflective *C. ciliaris* (shown as A). On the site surface is an extensive amount of cultural materials (B and C).

During fieldwork Palgrave's (1983) guide book to the *Trees of Southern Africa* was used as a reference sourcebook to confirm species of trees. Secondary data available from published and non-published work on the ecology of the study area such as that of Manyanga (2006) undertaken in the Zimbabwean side of the border and those above-mentioned research studies will be used where relevant.

As already mentioned eastern Botswana is the only land unit marked with topographical features, hence referred to as hardveld. Therefore the vegetation in this environment is comparatively more diverse than that of the sandveld due to the large range of parent material, soils and climate. It has a variety of associations with woody plants dominating. The confluence area, however, generally supports uniform tree savanna vegetation within a range of habitats comprising mainly riverine forest and shrubs and open savanna. The dominant tree species are *Peltophorum africanum, Acacia tortilis, Combretum apiculatum, Acacia nigrescens* and *Colophospernum mopane*. It also comprises various combinations of *Maytenus* species, which are sometimes found in association with *Lonchocarpus capassa* and *Acacia tortilis* frequently dominant on terrace sites, and pockets of *Faidherbia albida, Acacia albida* and *Pseudocadia zambesiaca* and species of *Croton* are also common (Bawden and Stobbs, 1963). The open tree savanna vegetation typified by C*olophospernum mopane*, *Acacia nigrescens* and *Terminalia species*, appears locally as tree or shrub savanna on shallow soils of gently undulating terrain further away from main river courses. *C. mopane* is commonly exclusively on its own or with *A. nigrescens, C. imberbe, Andosonia digitata and Terminalia pruniodes* on rugged rocky terrain with shallow basalt-derived soils that overlie granitic bedrock further away from the river valleys and flood plains (Manyanga, 2006). The most important constituent of grass cover in this area is *Cenchrus ciliaris*. *Cenchrus ciliaris* is associated with calcimorphic soils and in archaeological sites it is suggested to denote a humanly-induced landscape, and the probable introduction of chemicals such as calcium and phosphates to the soils.

The confluence vegetation supports a substantial range of large herbivores including *Loxodonta africana* (African elephants), *Syncerus caffer* (buffalo), *Connochaetes taurinus* (wildebeest)) and *Equus burchelli* (zebra), *Giraffa camelopardalis* (giraffe), *Aepyceros melampus* (impala) and *Tragelaphus strepsiceros* (kudu). According to a study conducted by (Ben-Shahar, 1996) on a national park in the north of Botswana, elephants cause major destruction of woodland environments and they have the potential to convert woodland into shrub vegetation. The daily movements of these other migratory species also cause extensive damage to seedlings through trampling and when combined with the browsing and grazing effects, the situation can be detrimental especially during the dry season. Previous research indicates that the influence of elephants in particular on tree density is species specific and, in most environments, *C. mopane* is a principal food source for elephants thereby exhibiting a significant reduction in tree densities with the increase in local elephant abundance (Ben-Shahar, 1996 citing Barnes (1983), Lewis (1991) and Van Wyk and Fairall (1969)). In the study area this scenario is highly pronounced. These data on the effects of animals on vegetation cover are considered relevant in this study as (1) *C.mopane* dominates the vegetation of the entire hardveld and that of the Basin and (2) the justification often cited for the intensification and complexity of cultures in the basin is their involvement in the trading of ivory from the elephants which occurred in great numbers at the time of occupation, as they still do today. It can be suggested that their presence in the area should also be factored into the human-ecological dynamics of the Shashe–Limpopo Basin. If the age and growth rates of these trees could be estimated, then probably a better understanding of ecological and sustainable management practices could be developed.

O'Connor and Kiker (2004), did an assessment of livestock and wildlife competition for limited resource under deteriorating climate conditions that could have led to the demise of Mapungubwe. They concluded that food security was obviously threatened by competition from wildlife, which could have exacerbated the influence of drought on livestock. An appreciation of non-equilibrium grazing systems is made where livestock would die during drought episodes irrespective of wildlife presence or animal numbers. Their study, however, makes a convincing case that drought increases the probability of density-dependent effects through drought-related mortality depending on the amount of consumption of key vegetation resources, which is directly dependent on animal numbers during the critical dry seasons (O`Connor and Kiker, 2004:61). In their study, *Equus burchelli* (zebra) was singled out as a dominant species that competed with livestock for pasture, even though other migratory grazers such as *Syncerus caffer* (buffalo) and *Connochaetes taurinus* (wildebeest) contributed. The effects were compounded by the fact that agro-pastoralists are sedentary and so do not move their livestock over large areas. This data suggests that more work needs to be done to fully account for the problems that led to the eventual collapse of the complex system at Mapungubwe and certainly that the evidence exists within the landscape and is not visible to the naked eye.

Bawden and Stobbs (1963) and Timberlake (1980) have identified several vegetation zones within the broader area of eastern Botswana, but for the confluence there are two distinctive zones:

1. *Riparian Woodland*: This woodland is found only along major river courses of the Shashe and Limpopo and at the intersections of their tributaries (Figure 2.5). It occurs on recent and old alluvial deposits of these terrains. Probably influenced by the water retention capacity of alluvial soils and high water table of the

Figure 2.5 The distribution of vegetation at the confluence (source Google Earth 2007)

Shashe River, this forest tends to attain its greatest extent at the confluence of the two main rivers. As a result this creates a micro-habitat frequented by large mammals, mainly browsers such as African elephants, as well as other plant species. The vegetation is generally mixed communities with predominant species being the *Maytenus*, *Lonchocarpus capassa* and *Acacia tortolis* frequenting terraces, *Acacia albida* and *Pseudocadia zambesiaca* and species of *Croton*.

2. Tree Savanna with areas of savanna woodland is predominantly *Colophospermum mopane* which come within the Zimbabwean *C. mopane* and South Africa *mopane* veld (Bawden and Stobbs, 1963). There are also few species of *Terminalia pruniodes, Acacia xanthophyllous, A. nebrownii, A. nigresscens, A. tortilis, Pouzolzia hypoleuca, Hexalobus monopetalus, Cadaba aphylia, Combretum hereroense* forming a sparse shrub layer. This vegetation type dominates rugged and rocky terrain formed from basalt and further way from margins of water courses. Even though it is the dominant species in the study area, the absence of *C. mopane* in particular is highly conspicuous in the floodplain. It however immediately borders the floodplain margins. This is crucial as *C. mopane* is regarded as an indicator of infertile soils and it is also considered intolerant of the growth of an under-storey of grass and herbs (Bawden and Stobbs, 1963; Henning and White, 1974), a useful indicator for this study. The ground cover is generally very light with frequently rather sparse grass cover. The dominant grass species is *C. ciliaris*.

2.5. Past Climates and the Archaeological Reconstruction of the Study Area

The Last Cold/Glacial Maximum in southern Africa, with mean daily temperatures between 3–6°C colder than today, is postulated to have occurred at about *ca.*19,000 BP (Holmgren *et al.*, 2003; Walker, 1995). The ITCZ would have been pushed out of the tropics further up towards the equator and during that time conditions would have been much more arid than today. The conditions are predicted to have changed after about *ca.*15,000 BP when the low pressure zone moved further southwards following the system outlined above in section 2.3, bringing in wetter conditions. This prediction is consistent with the detailed climatic record from Makapansgat Cave (located about 120km from the confluence in the Limpopo Province of South Africa) based on oxygen and carbon isotope analysis of stalagmites, in which higher $\delta^{18}O$ and lower $\delta^{13}C$ reflect generally warmer, wetter conditions, respectively, while the reverse means cooler, drier conditions. Around that time increased $\delta^{18}O$ values were caused by the amount of moisture effect and the lower $\delta^{13}C$ values reflected an environment dominated by vegetation following the C_3 photosynthetic pathway (including trees, small shrubs and grasses), indicative of generally wetter conditions (Holmgren *et al.*, 2003). This is also in agreement with lake level fluctuations observed in central Botswana where calcrete formations on river terraces are indicative of a drastic and abrupt change in climate after *ca.*12,000 BP (Shaw *et al.*, 1997) and mark the beginning of the Holocene environmental regime characterised by a vegetation-poor and very dry environment. From about 5000 years ago, the drying intensified with negative $\delta^{18}O$ values recorded from stalagmites between *ca.* 2500 and 6000 BP. Holmgren *et al.'s* (2003) Makapansgat stalagmites analysis shows warmer periods to have occurred again between *ca.*1000 and 2000 BP, followed by the resumption of a decline thereafter even though interspaced by evidence of Medieval warming and a Little Ice Age between *ca.*200 and 500 BP. This last 2000 years of palaeo-environmental information is quite significant to this study as adverse conditions of climate coincide with the southward movement of farming communities into southern Africa by Bantu speaking societies from eastern Africa (Chapter 3). Ironically, even though the occupation of the Shashe–Limpopo Basin is generally explained by the favourable climatic conditions, the same reasoning is not used to compare and contrast how it may have influenced and even initiated the movement of incoming groups into East or Western Africa. This would be interesting to know considering the inverse rainfall pattern and drought prevalence in the eastern and southern African sub-regions.

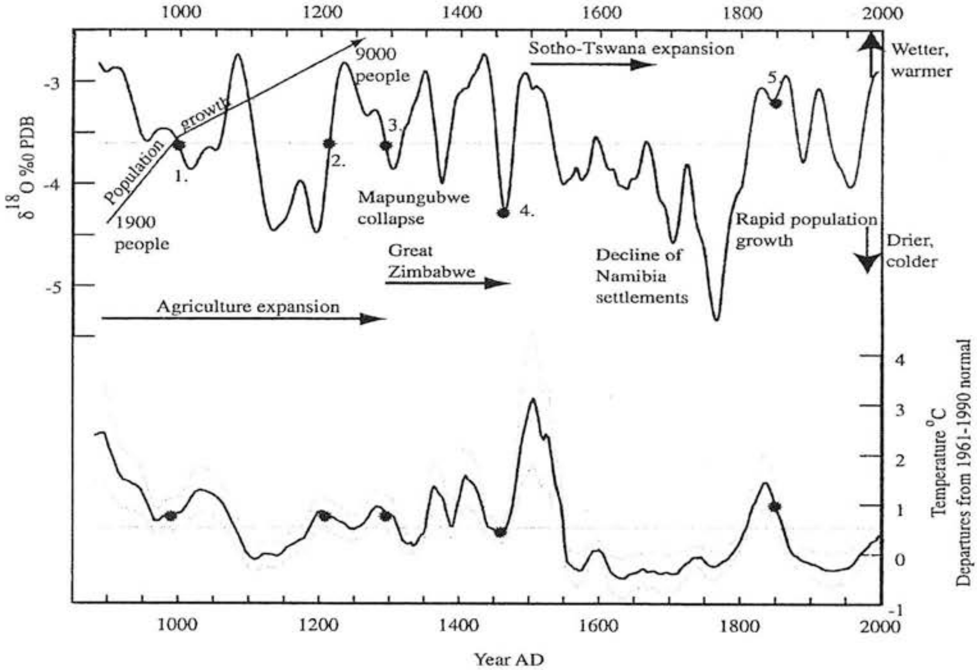

Figure.2.6 Palaeoclimate curve showing the relative changes in temperature and moisture obtained from cave stalagmites and oxygen-isotope variations, and associated human population shifts in occupation of the confluence of the Shashe–Limpopo Basin. The numbers denote: 1, shift of centre from Schroda to K2; 2, shift of centre from K2 to Mapungubwe,; 3, fall of Mapungubwe; 4, fall of Great Zimbabwe; 5, Difecane, colonial war (source: Holmgren and Öberg, 2006)

Even though the climate has fluctuated between warmer, wetter periods and colder, drier periods, with a quasi-periodicity of about 80 years (Holmgren and Öberg, 2006), the temporal rainfall pattern is in agreement with the approximately 18-year frequency proposed for southern Africa with characteristic severe droughts on average lasting for up to 3 years (O'connor and Kiker, 2004; Tyson and Lindesay, 1992). The changes in water resources are of regional scale and they influence both ecological and socio-economic processes. They can have both positive and disastrous impacts at society level and indeed result in societal development adjustments locally and regionally. For example within contemporary societies changes in global temperatures due to the increase in atmospheric CO_2 have implications, the effects of which are already being felt due to changes at different scales in regional precipitation patterns, temperatures and biodiversity. These definitely spark fears among global and regional populations even though their direct impacts are not particularly evident as humans have mechanisms to counteract them. For example, hybrid crops which are drought resistant and could harvest within a short period of time, storage of crops in times of plenty and distribution in times of need. This is because past studies often use climate changes (cause) as the driving force in human displacement (effect). In fact, climate change and socio-political and economic development and subsequent changes are largely correlated in most archaeological studies in the region (Huffman, 1996, 2000; Tyson and Lindesay 1992; Holmgren *et al.*, 2003; Holmgren and Oberg, 2006 and O'Connor and Kiker, 2004). The wetter conditions of the Medieval epoch are believed to have influenced the formation of the socially stratified Mapungubwe centre, whilst the subsequent droughts of the 'Little Ice Age' strengthen the argument for its abandonment (Ekblom, 2004; Huffman, 1996) as discussed below. Holmgren and Oberg (2003, 2006) have produced an archaeological chronological sequence using the climatic evidence, which suggests a causal relationship between environmental change and the cultural dynamics of the Shashe–Limpopo Basin from *ca.* AD 900 as shown on Figure 2.6. The discussions in this section will, therefore, focus primarily on the evidence of the environmental changes that took place in the last 1000 years and their relevance to cultural manifestations in the study area. Accordingly, the climate series from oxygen and carbon isotope analysis of cave stalagmites seems conclusive to the extent that demographic expansion in the Basin took place at times of changing climate. From Figure 2.6, Holmgren and Öberg (2006) present the following climatic–chronological situation:

- at about *ca.*AD 900, climatic conditions were much more favourable and this could have influenced the occupation and development of the centre of Schroda as a centre of power and trade by the Zhizo cultural group.
- This centre shifts around *ca.*AD 1030 to K2, and this shift occurs at the time when climatic conditions are rather unfavourable.
- The K2 occupation lasts until about *ca.*AD 1220 when the people relocate to nearby Mapungubwe and, coincidentally, this happens when the climate has changed for the better. But this situation did not last long as the climate began to

deteriorate again around *ca.*AD 1300. However, the decline was not as big as the one before.

- This climatic downturn is believed to have resulted in the total collapse of the Mapungubwe state and the build up of Great Zimbabwe some 250km away. Great Zimbabwe is situated in an area with escarpments and the rain there is generally good even today.
- However, it experienced a short-lived drought around *ca.*AD 1400 and this accordingly does not seem to have resulted in any significant change in the habitation of the area even though the ensuing drought after *ca.*AD 1450 appears to have had a dramatic effect that resulted in total abandonment just as at Mapungubwe.
- This abandonment coincides with the establishment of Sotho-Tswana settlements back in the Shashe–Limpopo basin and eastern Botswana when the climate improves at around *ca.*AD 1475 to 1525. This expansion continues in spite of harsh environmental conditions, which can be blamed for the collapse of some large settlements in Namibia.

The period between *ca.*AD 900 and 1300 is generally referred to as the Medieval Warm Epoch in the region. It is evident that even though the climate fluctuated it was mainly a climatically favourable epoch and therefore encouraged human occupation, innovation and wealth accumulation in southern Africa. During this period centres were established throughout the region where Schroda, K2/Toutswe, Mapungubwe, and Great Zimbabwe gained prominence (Manyanga, 2006).

According to (Holmgren and Öberg, 2006:188), even though it is evident that there were societal expansions, there seems to be no direct correlation between the changes in climate and societal development. The first agricultural expansion resulted in a population growth of about four times (1900 to 9000) between *ca.*. AD 900–1290. This expansion took place in spite of the drier conditions prevailing between *ca.* AD 1100 and 1200. During this period however, there was a shift in settlement location from

Schroda to K2 at the confluence and at Toutswe and its environs in central Botswana, an outcome that could have been a measure to circumvent the catastrophic event without any abandonment or societal collapse taking place. Problems and hardships were certainly experienced as population may have reached unsustainable levels, with water shortage and famine, and consequent competition for available scarce resources and livestock carrying capacity possibly being exceeded. A similar event occurred at Great Zimbabwe where the inhabitants survived one period of drought and then flourished with an even more rapidly growing population when the climate became wetter and warmer. The period between *ca.*AD 1500 and 1800 is recorded as the most prolonged cold, dry period and coincides with the 'Little Ice Age' period in high latitudes of the northern hemisphere. It is also a period that is marked by the largest expansion of the Sotho-Tswana cultural groups in the region where many communities relied heavily on drought resistant grains such as sorghum during the first half of the 18^{th} century and later *Z. mays* in the succeeding years to present times.

A recent study by Smith (2005), however, posits cool and dry climatic conditions for the same period. Using multi-stable isotope analyses of *Bos taurus* and *Ovis/Capra,* Smith suggest that there was greater expansion of livestock management over a large geographical sphere which necessitated the Shashe–Limpopo floodplains to be left for cultivation during the ploughing season. The isotope results also suggest that the floodplains would have been utilised by livestock when fields were left fallow to grow fodder to offset diminished winter grasslands (Smith, 2005:195). Even though these results are limited and preliminary, they are indicative and valuable for assessment at a local scale especially on terrains which have no visible archaeological remains. The focus on sites away from outstanding monumental and elitist structures could provide insights into the diversity of land-use at various periods by past societies.

Archaeological interpretation of the confluence has always stressed the importance of climatic changes to explain the distribution of past human occupation of several different localities in the region. Wetter and warmer conditions attracted settlement whilst colder and drier conditions implied drought generally signifying collapse and abandonment of settlement. The argument presented here is that harsh environmental conditions existed in the past, but just like today societies persevered and it is not convincing to link the collapse of past centres of development like Mapungubwe to the prevalence of drier conditions as the driving factor. It is however, possible that its persistence might have triggered the societal hardships. Nevertheless, it is still far fetched to link the collapse with the existence of famines due to droughts, as in such times of hardship people can be resilient. Considering the economic strength of the area at the time to have been largely dependent on extensive trade and exchange network systems, possible diversification of resources was an option. The environmental setting of the area also provided ecological niches which contemporary communities continue to strive on, in climatic conditions of more or less similar character. Mechanisms exist in sedentary societies as mentioned in section 2.3, particularly as the link is largely to do with climate change in terms of rainfall variability and inadequacy. It is in this light that the present study concurs with the conclusions made by Smith (2005) and Holmgren and Öberg (2006), that even though societal changes coincide with climate changes, the changes are not absolute. The human response to environmental changes varies depending on their subsistence patterns and how close the population is to the carrying capacity of the land. Societies can cope with environmental changes by exploring adaptation strategies such as, long and short-term flexibility, mobility and re-organisation of resources, flexibility in agricultural practices and in types of staple crops, transhumance, digging of wells, increasing wild resources within their diet, relocating fields to unaffected areas of the landscape, and diversification of resources including the controlling distribution of resources through established cultural structures. In the Shashe–Limpopo Basin it is likely that other factors came into play, such as political instability, population pressure, over-stocking and a marked imbalance between people and resources in order to produce a total collapse. This therefore implies that for us to fully understand what exactly happened at the confluence, Butzer's (1982) human-ecological systems approach, which identifies factors that may have played a role in cultural changes recognised in the archaeological record, need to be factored in. A simultaneous reconstruction of changes to climate, the physical landscape and biological environment during the same time can be useful in examining which one of them coincided with the cultural changes.

3. ARCHAEOLOGICAL BACKGROUND

3.1. SOUTHERN AFRICAN ARCHAEOLOGY: AN OVERVIEW

Prior to 1500 BC Africa south of the Sahara was characteristically the domain of hunter-gatherers (Bellwood, 2005) and eastern and southern Africa, in particular, remained like that until the 1st millennium AD (Phillipson, 1977a). These last two regions were colonised by Bantu-speaking farmers who spread from a presumed homeland centred on Cameroon in West Africa until they reached their limits at the edge of the Kalahari Desert and the Mediterranean zone of winter rainfall at the Cape of Goodhope, South Africa (Bellwood, 2005). The first millennium AD in eastern and southern Africa is accordingly marked by the appearance of an apparently homogeneous ceramic stylistic tradition (Phillipson, 1977b, 1977a) known as the 'Chifumbaze Complex' (Phillipson, 1993) typified by *Urewe*-type ceramics. This complex emerged first in Uganda between 500 and 200 BC and spread by a mass movement of people southward until it reached the tip of South Africa in the mid-first millennium AD (Figure 3.1). What is remarkable about this appearance of pottery in southern Africa is its association with evidence of metal working, especially iron and copper, thereby falling within what is generally known as the Iron Age (Lee Thorp *et al.*, 1993; Phillipson, 1968) of Southern African prehistory, where people led settled lives and used iron tools for forest clearance and soil tillage. Culture-historians argue that similarities in ceramic design with recent pottery traditions provide an association between Chifumbaze and eastern Bantu-speakers. These conclusions are arrived at based on archaeological records interpreted using the ethnographic analogies of recently spoken languages and their geographical distribution (Phillipson, 2002) in spite of the fact that the archaeological evidence may have remained relatively undisturbed. Archaeologists have used the linguistic and historical sources based on the two sets of modern data to estimate the timing and routes of entry of farming societies into southern Africa. To processualists this reflects a fascination in southern African archaeology with origins and immigration

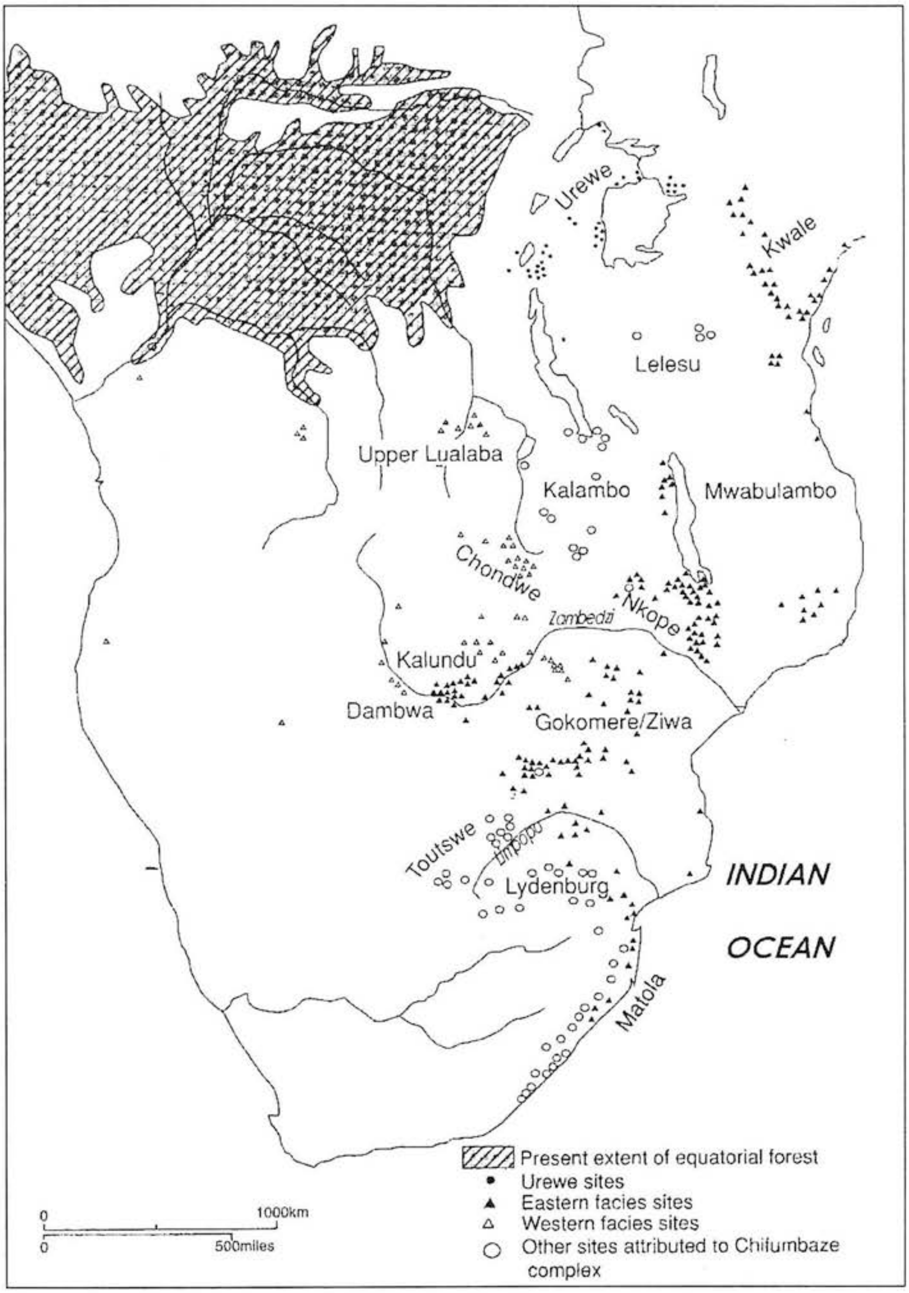

Figure 3.1 The Bantu migration routes and their associated ceramic traditions (after (Bellwood, 2005)

characterised by uncritical reliance on ethnography (Sinclair, 2002). The arrival of Bantu-speaking people in southern Africa meant that it was occupied by agropastoral people for over 2000 years and a cultural system that was intrusive among Late Stone

Age societies (Pwiti, 2005) of the region, where according to Phillipson (1977a) settled existence was previously unknown but hunting and gathering was the economic core practised by the entire population. As a result 'Iron Age' is merely a technological term used to describe a culture system characterised not only by the use of iron for various purposes, but also the building of semi-permanent villages, the making of similarly decorated ceramic vessels, and an economic system based on agriculture and the herding and domestic animals (Pwiti, 2005). The whole 'Chifumbaze Complex' generally is an agro-pastoral package with a high degree of cultural similarity and homogeneity with incorporation, in some regions, of native Stone Age materials. The Bantu-speaking people are therefore a cultural group with a distinctive ceramic technology and style, as well as knowledge of metallurgy, who spoke the same language or a set of closely related languages (Eggert, 2005), and who migrated to southern Africa and introduced a completely new economic system based on crop cultivation and animal husbandry. To some extent, this has contributed to the conventional archaeological classification which recognizes only two chrono-technological divisions in southern Africa, Stone Age and Iron Age. On the other hand, it has created problems as there is a considerable amount of overlap between the two (Reid *et al.*, 1998). In some early herding sites associated with an abundance of lithic artefacts there is evidence of the use of pottery and a complete absence of iron or traces of its manufacture or use. By implication, ceramic technology, although associated with the arrival of Bantu-speaking agro-pastoralists from the north, has instances where it pre-dates that event — that is, there were pre-existing hunter-gathering societies using lithic technology who had access to livestock and manufactured and used ceramics (Reid *et al.*, 1998). This obviously conflicts with on the scenario of the arrival of new people bringing in new technologies as part of a linguistic, economic and technological package.

Nevertheless, from a regional farming perspective, two broad distinctions of the farming populations in southern Africa are recognized: the Early Iron Age (EIA) or Early Farming communities, and the Late Iron Age (LIA) or Late Farming communities (see Huffman, 2007). Both are associated with important changes in the archaeological record regarding economic, socio-political and cultural organisations. During these times societies became more complex in terms of their settlement. In this study it is the LIA period that is of concern and will be discussed in detail in Section 3.2, below. The EIA people, however, are believed to have occupied the region in the first millennium AD and prior to their arrival, archaeological assemblages appear to show no evidence of material culture that can be linked to farmers. Owing to the perceived homogeneity of their material culture and its rapid introduction without a local precursor, archaeologists are convinced that this reflects the physical movement of a substantial number of people. There is less agreement on the directionality of this movement, with Phillipson (1993) proposing a movement exclusively from the east and others agreeing with him but arguing for evidence of another spread from the western part of the sub-continent (Denbow, 1990, 1999; Huffman, 1989, 1996b) of people who mixed with the Chifumbaze complex emanating from the east (Bellwood, 2005). Huffman calls this western movement the *Kalundu* tradition, while Denbow prefers 'western stream'; both authors suggest that in a way it provides a 'missing link' in southern Africa of the western movement across the continent through what is now the Democratic Republic of Congo. The ceramic ware associated with this western wave is called *Bambata*. It is named after a cave in Zimbabwe where it was first reported in the 1930s, and has an earliest date of *c*. 2140 BP. It is stylistically linked to the *Kalundu* tradition farmer pottery with its earliest citing in the north-western part of Botswana at a site called Toteng, and dating to between the 1st and 4th centuries AD (Reid *et al.*, 1998). It is commonly associated with stone tools and an economy reflecting primarily hunting and gathering mode of subsistence, suggesting that it was made and or even used by foragers who had access to sheep, if not by herders themselves. The sites associated with this ceramic-type have been reported in Zimbabwe and South Africa; they are sporadic and isolated and, as Reid *et al.* (1998) argue we seem to know more about their spatial distribution than about the behaviour of the people who used them. They may well represent a ceramic ware that was used by a variety of different societies. However, it is worth mentioning that there are sites pre-dating the *Bambata* ceramic wares which have been located far to the south, in the Cape (Sealy and Yates, 1994) and Namibia (Reid *et* *al.*, 1998), also associated with herders and foragers. It is evident from the duration of occupation of such sites that EIA communities practised a herding economy and used both lithic and ceramic technologies, making them distinct from the LSA and LIA societies. Whether the inhabitants were hunter-gatherers with livestock or farmers using stone tools is a contentious issue, but falls outside this study. Based on immigration routes proposed by linguists, archaeologists have for a long time turned to the central Zambezi as a potential source area for the introduction of domestic sheep into southern Africa (Mitchell and Whitelaw, 2005) following the Phillipson migration model of the Chifumbaze complex. Research has shown that there is enough evidence that sheep and pottery reached the southern tip of South Africa long before the arrival of the Bantu population. It has also further been assumed that, owing to the technological similarities of the ceramics, this indicates migration from the dry thirst-land of the Kalahari, Botswana and Namibia, to the climatically favourable Cape coast by herders. The dating evidence, however, does not support these hypotheses, as securely dated deposits from the Cape Coast have produced dates which differ by margins of hundreds from those of Botswana (Reid *et al*, 1998). Sadr (2003) cautions against this simplistic analogical view and argues that because of the diversity of ceramic decoration evident at the three sites in Namibia, Cape Coast of South Africa and Botswana, it is incompatible with a straightforward north to south movement of migrating herders (Sadr, 2003). This implies that they may have been indigenous hunter-gatherer societies who herded sheep and made pottery (Mitchell and Whitelaw, 2005) as Reid *et al.* (1998) suggested. The earliest, well contextualised dates for sheep and ceramics support an introduction from the south via Namibia not through the south African interior as previously suggested (Mitchell and Whitelaw, 2005).

The Late Iron Age period (or Late Farming Period) is generally characterized by mixed farming economies based on plant and animal husbandry, and it only appears in the archaeological chronologies after the 6th century AD in most of the relatively wetter parts of the region associated with people manufacturing characteristic ceramics and speaking the same language. Another dimension of the migration package interpretation evident during this period is the migration of ideas and ideologies. In addition to the ceramics and language, special attention has been paid to the spatial distribution of this farming population, site layout and metallurgy, which have been interpreted using

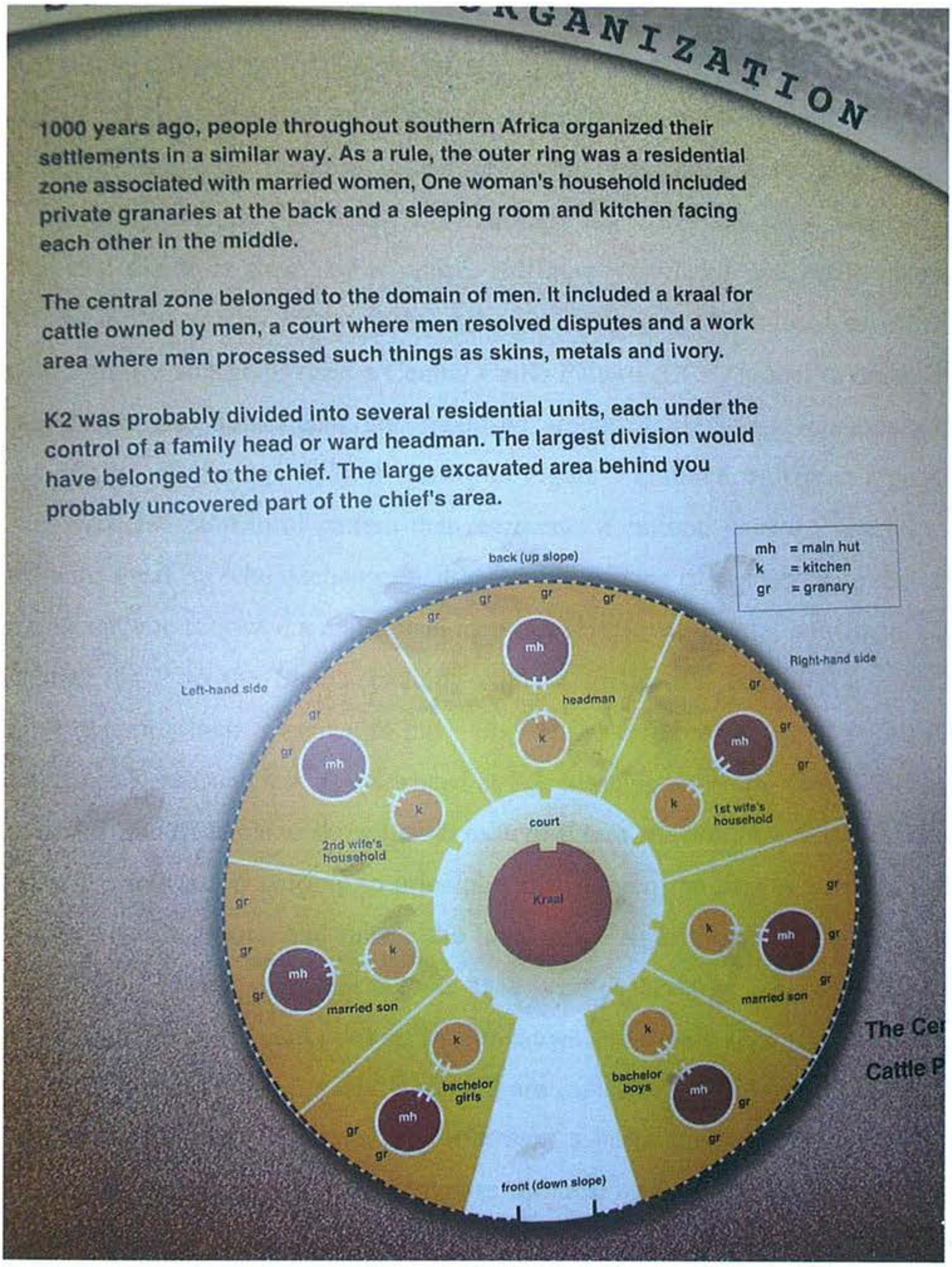

Figure 3.2 An interpretation panel at K2 explaining the Central Cattle Pattern plan of the K2 kraal midden (Photo: S. Dingalo, August 2005)

ethnographic models from contemporary and historical farming societies to reconstruct how they perceived space or their worldview (Lee-Thorp, 1993; Huffman, 1989). Worldview may be defined as an aggregate of symbols that give meaning to social organisation; a system of rules to govern and a set of values to decide choice (Huffman, 2000:15). According to Huffman, the LIA occupants of the Shashe–Limpopo Basin were eastern Bantu-speakers, who from the ethnographic record of the Nguni and Sotho-Tswana cultural group had a set of beliefs which emphasised patrilineal ideologies about procreation, bride-wealth transaction through cattle, male hereditary leadership, and ancestral primacy in daily life. These were strongly interconnected and governed their behaviour and therefore their use of space. Huffman postulated that cattle played an integral role in the structural relationship between settlement layouts and social life of the cultural groups and he devised a Central Cattle Pattern (CCP) model to demonstrate how settlements and homesteads are organised around cattle byres (Denbow, 1983; Denbow, 1986 ; Huffman, 1986) as shown on Figure 3.2 above. Huffman argues that CCP is a restricted patrilineal pattern that represents a cultural package unique to the eastern Bantu speakers who exchanged cattle for wives. This is in contrast to that of the western stream who followed a matrilineal ideology (Huffman, 1996b; Huffman, 2000). He attributes CCP to the Shona-speaking cultural group and collectively calls it a Zimbabwe pattern which is known to have emphasised different levels of political and social divisions based on class as evidenced at K2, Mapungubwe and Great Zimbabwe. As a result this model tends to show that in eastern Bantu-speaking societies, residential settlements are laid out according to principles that govern the organisation of society into different social groups and mirror the ideological significance of these divisions (Lane, 2005: 31). These settlement layouts have been observed at a number of sites in eastern Botswana, and adjacent portions of Zimbabwe and South Africa, and it is argued by some that the deep dung deposits observed are indicative of the expansion of large herds of livestock and the deposits only represent a basic ecological response which occurs when new species of animals colonise an area with a favourable environment (Denbow, 1999). It can also be argued that despite the fact that the model produces a timeless image of southern African societies bound by an adherence to tradition, there is no evidence that links the origin or tradition of the model to ancestors of the Nguni and or Sotho-Tswana eastern Bantu-speaking groups elsewhere. Equally interesting, CCP was associated with the Bantu-speaking population of K2 and Toutswe who through trade with the east coast, accumulated wealth and became highly socially stratified and produced centres like Mapungubwe and Great Zimbabwe, and there is no evidence that links them with Sotho-Tswana cultural groups used in the ethnographic models.

3.2. Archaeological Background of the Shashe–Limpopo Basin: Bantu Migration Context

In the Shashe–Limpopo Basin, although there is evidence of a farmer presence between AD 350 and 450 (Huffman, 2000), there seems to have been a long hiatus in occupation prior to the intense occupation in the second millennium AD by the LIA populations. There is however, enough evidence in the form of lithic and rock art that shows the presence of the LSA populations (Eastwood and Fish, 1996; Eastwood and Blundell, 1999; Hall and Smith, 2000). The period of agricultural expansion in the Shashe–Limpopo Basin is reliably recorded from *c.* AD 850 to 1290 (Holmgren and Öberg, 2006), a time of increased precipitation coincident with the Medieval Warm Epoch (Tyson and Lindesay, 1992). During that time agriculture, gold and ivory trading were the main economic activities that contributed to the accumulation of wealth of the growing centres of Schroda, K2 and Mapungubwe, which were inevitably accompanied by population increase. The sequence of occupation in the Shashe–Limpopo Basin is based on the extensive work of Thomas Huffman, an archaeology professor who has worked in the area from the 1970s to present. His work largely reflects the movements of people as presented by the Bantu-speaking migration premise and has remained unchanged and/or unchallenged. The routes of the new arrivals and their ceramic association speak volumes on their spatial variability, and the direction they entered and left the confluence is usually known. It begins with the Basin being occupied by the *Zhizo* ceramic-type cultural group. This is an outgrowth of the EIA ceramic tradition of

Gokomere (see figures 1.2 and 3.1 on the ceramic chronology and area of origin). It is associated with type sites in Zambia and is thought to have been an offshoot of the *central stream* of the Bantu-speaking branch of the Chifumbaze complex that settled at the site of Schroda in the Confluence area. The *Zhizo* ceramic style is also found at sites in south-west Zimbabwe and adjacent parts of Botswana, and dates between AD 790 and 1020 (Huffman, 2000). Schroda is the largest and most important tenth-century settlement site in the Shashe–Limpopo Basin, which demonstrates its political and social role and suitability to be the Zhizo capital (Huffman, 2000; Mitchell and Whitelaw, 2005). Its socio-political complexity centred on the manufacturing and control of metallurgical technologies in the Basin. At the time of occupation, the area was teeming with wildlife, in particular elephants which were sustained by *C. mopane* vegetation. The presence of such wildlife species gave the area a base for trading ivory to the Indian Ocean coast as chronicled by early Arabic travelers who record ivory being traded with Swahili traders from southern Mozambique at a *Zhizo*-type site of Chibuene which lies roughly at the same latitude as Schroda (Huffman, 2000; Mitchell and Whitelaw, 2005). This trading aspect is discussed in Section 3.4. At about AD 1000±25, the site of Schroda was abandoned as evidenced by the complete disappearance of their characteristic ceramic style. It is replaced by a distinctive pottery belonging to the Leopard's kopje (type site) stylistic cluster of the K2 cultural group. Huffman (2000) posits the Leopard Kopje ceramic style to have been introduced into the basin by the large-scale movement of the Shona-speaking eastern Bantu people of the *Kalundu* tradition branch and collectively calls the K2 and subsequent occupants the Zimbabwe culture. K2 has evidence of iron and copper production and implements which are linked with political leadership, metallurgical production and beliefs regarding fertility (Calabrese, 2000a; Calabrese, 2000b) associated with Kalundu tradition ideologies (Huffman, 2000). Contrary to Huffman (1980; , 1982) who initially strongly advocated complete replacement of the Zhizo people, there is evidence that shows their characteristic pottery style contemporaneous with that of K2 at the sites of Pont Drift and Leokwe within the Basin and not far away from Schroda, as shown in Chapter 1 (Figure 1.2) (see Calabrese, 2000a; Calabrese, 2000b; Hanisch, 1981). This suggests that not all Zhizo people left the confluence zone and relocated to Toutswe. Toutswe is a ceramic-type site found at several sites in central Botswana which dates to the period immediately after the collapse of Schroda, in the early eleventh century AD. After this period there is a considerable increase in Toutswe-tradition pottery style and settlements, which can be taken to imply emigration (Mitchell and Whitelaw, 2005). However, Huffman maintains the two (Zhizo/Toutswe and Leopard Kopje) are not related because they grew out of two distinct and separate origins (Huffman, 2000:18 and figure 17), *Gokomere* from the central stream (*Nkope* tradition) and Leopard Kopje from the *Kalundu* tradition of eastern Bantu-speaking. Where the two appear in the same contexts it is attributed to contact indicating marriage transactions. As will be discussed later in the paper, this shows how equating artifacts, humanly-modified moveable objects, with cultural groups and population movement can be problematic, and emphasizes the need for more empirical methods to investigate materials.

K2 was also abandoned abruptly around AD 1220 and nearby Mapungubwe Hill less than a kilometre away established as a new centre. It lasted for some seventy to eighty years. It has a characteristic pottery, contemporaneous with that of K2 in the earlier levels of the sequence. Later this is replaced by the Mapungubwe style which has a spatial pattern quiet distinct from that of the central cattle pattern (CCP) practiced at K2, which evolved into the one reflecting exclusive elitism, incorporating stone walling as a form of barrier demarcating entrances to elite areas, noble housing and town centre boundaries, much more similar to that at Great Zimbabwe in Zimbabwe, which was apparently its successor (Huffman, 2000). K2 and Mapungubwe show evidence of continuity of occupation. As in earlier sites, the change in ceramic style is not used exclusively to represent a new cultural group, a possible indication that style can evolve as a product of the same people. It is, however, attributed to increase in population, level of economic interaction, and emergence of specialization. Unlike Schroda and K2, Mapungubwe controlled a large territory with evidence of great social complexity qualifying it to be the first complex state of southern Africa with a population in excess of 9000 people (Huffman, 2000). By about AD 1250, the Mapungubwe population began declining and the site was finally abandoned in AD 1290. Previous studies had suggested that a change in climate to cold dry conditions forced people to abandon the whole basin for some areas not known but possibly in the more favorable environments in the south east of the basin towards the mountains. However, recent studies suggest that no climate change took place at the time of the abandonment of Mapungubwe in AD 1290 (Smith, 2005) and that the initial impact of the 'Little Ice Age' (Holmgren and Öberg, 2006; Tyson and Lindesay, 1992) around that time could not be blamed for the collapse and a shift of political power to Great Zimbabwe (Mitchell and Whitelaw, 2005) as previously proposed (Huffman, 1996a; Huffman, 2000; O'connor and Kiker, 2004). Carrying capacity may have been exceeded and was possibly the driving force in the abandonment. However, it is evident that the successor of Mapungubwe was Great Zimbabwe, even though people did not move there *en masse* as the ceramic evidence shows that it was a different population that resided at Great Zimbabwe (Huffman, 2000). The area was however, resettled after the collapse of Great Zimbabwe by Sotho-Tswana groups after AD 1450. The Great Zimbabwe collapse coincides with a rapid decline in rainfall and temperature which are thought to have been followed by water shortage, famines, political instability and decline in trade (Holmgren and Öberg, 2006).

Often overlooked in previous discussions of the Shashe–Limpopo Basin archaeological record and still evident in the archaeological discourse of the basin today, is the role played by hunter-gatherer populations. They are mentioned in the early archaeological works as having been present before, during, and even after its occupation by agro-pastoralists (Eastwood and Fish, 1996; Eastwood and Blundell, 1999; Fagan, 1970 ; Fouché, 1937; Hall and Smith, 2000; Plug, 2000), but in the later studies they are hardly ever mentioned. The abundance of rock art and associated hunter-gatherer materials in the basin and its periphery attest to their presence throughout the occupation periods. According to Mitchell and Whitelaw (2005), foragers may have been constrained in their use of the landscape and may have acted as suppliers of raw materials and or labour to the farming population. They further suggest that the high level of intensification in the socio-economic development entailing trade and elite control could have pushed them to the margins and just like the residents of the basin during the colonial period their land was probably appropriated by farmers.

To summarise, the migration model remains an enigma to some researchers who even question if there was ever a mass movement. There have been theories devised to argue for and against the model and the ones deemed relevant to this study are discussed in Section 3.3. In general, as shown above, archaeological interpretations are based on analogies drawn between regions, localities and sites. In conjunction with the ceramic variations, linguistic analogues from records of languages of recently spoken languages and their recent geographical distribution (Phillipson, 2002) are used to explain sudden cultural changes in the stratigraphic record. This direct historical approach has led to the selection of certain analogies being specific to certain geographic localities (Lane, 2005) where ethnographic datasets are employed, and continuities between past and present populations are assumed to exist. Arrays of chronological terms have been devised and built up to define the transition of phases, traditions, cultures and populations and in most cases are used interchangeably, creating confusion and problems. Analogical reasoning has been widely accepted and it so dominates archaeological research in this region that it is difficult to mirror it in other studies elsewhere. The premise behind this concept is that objects sharing observable similarities are highly likely to share other less observable similarities, including language and the peoples' world view. Proponents of this reasoning also think that if they increase the sampling coverage, they also increase the number of observable characteristics between samples compared, and therefore the probability that they have other factors in common, both tangible and intangible. Some scholars have argued that this reasoning is a very simplistic ethnographic parallel, as observed similarities may not necessarily imply the presence or absence of those inferred commonalities (Lane, 2005). Others think that it is time to acknowledge the social context in which ceramics were produced and to relate pottery to their networks of interaction, exchange and trade as well as the social meaning they communicate (Pikirayi, 2006). For example, Denbow (1999), even though he appreciates the analytical insights into ceramic decorative variation that Huffman uses, he strongly disapproves of his explanatory concepts of fixed cultural forms associated with particular people and the corollary that *all* changes in material forms are the results of migrations of whole peoples (Denbow, 1999:110). Reconstruction of past language is also a complex endeavour as it involves detailed linguistic comparisons that at least attempt to determine the form and content of ancestral languages from which one or more modern languages are derived (Moore, 1994; Phillipson, 2003).

It has to be noted that the areas investigated are sporadic and too widely scattered to allow for continuous comparison. There are some areas within the region that have received considerable attention and documentation is available and their record presents a coherent and reliable impression of continuity of occupation even if it was by different groups in the past such as in the Shashe–Limpopo Basin. Botswana, as some scholars have already noted (e.g. Segobye, 1998), was at first not considered viable in offering any archaeological insight due to its aridity and was therefore considered hostile to agro-pastoral farming practices associated with Bantu farmers. Sites have since been located, such as Toteng and Toutswe, which pre-date most of the known archaeological sites in the region. These sites are interpreted as filling gaps in understanding the general archaeological process of the region. This could also be the reason why sites on the Botswana side of the Mapungubwe Cultural Landscape are not deemed important in the archaeological debates concerning the Basin.

However, presented with these problems, it is also often difficult to sketch the broadest outlines of the Bantu people's territoriality, and this makes it even more difficult for archaeologists to link archaeological features with linguistic phenomena and to identify possible routes of language diffusion. For example, the equatorial rainforest, a specific archaeological biotope, and a transcontinental expansion which linguistically almost belongs to the Bantu of the western spread, has not yet linked the oldest and stylistically differentiated pottery of the interior Congo basin to ceramics of other regions within and outside the forest (Eggert, 2005: 321). Linguists, as far as the Bantu migration theory is concerned, created the event that never was (Ehret, 1998) and archaeological practitioners would be better off not being absorbed into questions of origins but look for alternative lines of inquiry for possible explanations of this problem. There are some other parts of Africa, Central Africa for instance, which have not yet been explored to add to the enigma and they are possibly the missing pieces to the migration problem. At regional and local level there is a need to strive for an intensive and systematic archaeological research integrating multi-disciplinary fields which would augment this culture-historical agenda, if not revise it. It is anticipated that such an approach could help understand other intricate issues of human behaviour that were previously of less concern. Employing pragmatic analytical techniques which can probe the on- and off-site archaeology of the landscape can tell us more about the holistic use of the landscape — settlement location, settlement and site organisation, and their various activities in and around the areas shown to have been occupied. If these are observed to be consistent over large areas and on the routes of migration, they could plausibly be the signatures the people left on the landscape. At the moment the linguistic explanation in this part of the sub-continent seems to be flawed and have been packaged to fit into the debates of migration theory. Ceramic materials, just like other items of trade, can move from one place to another, and it is not convincing for the stylistic designs of ceramics to be used extensively to categorise cultures, traditions and ethnicities. Ceramic vessels (with their styles) can independently move from one place to another and analysis of the mineralogical chemical compositions of clay and identification of their sources could offer an alternative explanation as to whether it was the migration of pots or people. However, all is not lost as some workers who were influential and spent a long time advocating this theory, now argue against attempts to identify dispersal routes. They maintain that the dynamics of language differentiation in Bantu do not support a scenario of migration along specific routes (Vansina, 1995) and believe the linguistic and archaeological evidence totally discredit the once-persuasive migration hypothesis (Eggert, 2005: 314). Also, there are those who have long argued that pottery and herding of livestock, especially sheep, do not support the hypothesis of population migration from the north to south (Reid *et al.*, 1998; Sadr, 1997; Sadr, 2003). These challenges include the presence of pre-EIA type pottery in LSA sites, stone tools of LSA in EIA, an indication of continuity of occupation between LSA and EIA/LIA groups and generally critique against the linguistic theories at the root of Bantu migration theory (Ekblom, 2004:8).

3.3. Migration and Farming Hypothesis: The New Focus

As outlined above in Section 3.1, the thrust of the Bantu migration theory is based on the idea that the new form of subsistence (farming), along with new technology (iron) was carried southwards of the Equator from west Africa to southern Africa by a new people who spoke the same or related language, Bantu speakers, in the 1st millennium BC. The term, Bantu, was first coined by Bleek at the turn of the 19th century to describe languages that he observed to possess a number of common characteristics and had a greater uniformity in grammar and vocabulary in South Africa (Meinhof, 1929). He also noticed that these languages were neither 'bushmen' nor 'Hottentots' (Schoenbrun, 2001). This observation-cum-concept became popular, even though Bleek at the time had inadequate material evidence and the area of coverage was too small to reconstruct the original parent language of the sub-continent. However, a number of studies were later conducted using modern languages and geographical localities to support Bleek's theory (for example, (Greenberg, 1949, 1955; Guthrie, 1959; Murdock, 1959). It is believed, that this language family is the largest in the world today with possibly 300 million speakers of Africa's estimated half a billion population (Bellwood, 2005:218)). Even though Bantu was originally coined in a purely technical sense without any non-linguistic connotations, it was transformed into a designation referring indiscriminately to language, culture, society and race (Eggert, 2005: 302). This has as a result further shaped the Bantu historical studies, using language as a phenomenon with an implication of a common origin of groups of people occupying a large area of sub-Saharan Africa with no substratum survival of languages outside the Khoisan territories in southern Africa. Scholars acted as mediums and inferred their existence from the linguistic repertoires of more recent 'Bantu' speakers. As it came out, many researchers, mainly linguists and archaeologists were intrigued by this supposition as it implied a common origin, and by extension culture, for these widely geographically distributed languages (Eggert, 2005). However, the assumptions were only generated on language and speech similarities not differences, that is only languages which were similar were considered and used to represent common origin. Schoenbrun (2001) strongly feels that any study that does not take into consideration the connections and differences between language and speech avoids the central source of contemporary cultural and political investment in nature of the Bantu languages. This was notwithstanding the fact that the linguist's primary source material was restricted to records recently spoken languages and their recent geographical distribution (Phillipson, 2002). Surprisingly, archaeologists accepted the linguistic and historical sources based on the two sets of modern data to estimate the timing and routes of entry of farming societies into southern Africa even though archaeological evidence, on the other hand, may have remained undisturbed or only subjected to limited taphonomic problems. However, as time went on it became clear that the archaeological information was made to 'best fit' the linguistic assumptions. Eggert describes in detail the two competing linguistic paradigms which were the bases for the Bantu expansion (Eggert 2005). For the purpose of this study an attempt has been made in the previous sections, using Eggert and other scholarly discussions, to review the Bantu migration theory with a view to contextualising it within the southern African archaeological discourse and exploring its relevance to that of the Shashe–Limpopo basin in particular. In this section the discussion is largely to do with the issues and problems with this theory and how in the process it has affected the scholarly nature of the archaeological interpretation of the region and that of the Basin.

3.3.1. Issues Regarding Linguistic Evidence

It has been realised and argued that linguistic analysis does not provide time depth data that is independent from the archaeological record (Blench, 2006). The proponents of the theory have also recently accepted that language and material culture are both independent reflections of past processes and events which can only be understood within their own socio-political and economic contexts (Phillipson, 2003:179). This is considered a big problem compounded especially by the fact that when reconstructing languages, the history of language family can only go as far back in time as the proto-language at the base of the language tree-diagram (Moore, 1994 and Bellwood, 2005). That is to say, it does not take into account any other previous language patterns that existed and other minor languages which may have been spoken and perhaps influenced those being reconstructed. According to Renfrew (2003) the origin and distribution of the world's language families has presented the most enduring problems in archaeology, anthropology and historical linguistics. He considers it a puzzle which has proved problematic since the early recognition of language families and which, over the years, has given rise to an extraordinary range of speculation (Renfrew, 2003:3). Some even think that linguists are replacing racial hierarchies constructed by colonialists with sequences of divergences of speech communities which tell us nothing about how the languages might have spread (Schoenbrun, 2001). Furthermore, in the case of sub-continental approaches Renfrew (2005) cautions that it has to be understood that the convergence effects of populations operating over a long period of time may produce a linguistic area effect without genetic relatedness but simply because of long term interaction as in the case of the Bantu people. This is because in reconstructing languages, linguists tend to make assumptions that 'true' language families which can be shown by comparative analysis are intrinsically genetically structured and for them to spread over so large an area is because they derive from a fairly homogeneous prehistoric language which had been disseminated by migration out of a smaller area (Bellwood, 2005:190-191)This is actually where the Bantu migration theory stems from. It is a theory, according to Moore (1994) that is synthetic in nature and geared towards explaining geographical distributions of language, culture and physical type of people and relationship between them which are wrong and not appropriate for the *migration* task (Moore, 1994:924). He posits that the assumptions are cladistic (*a philosophy of classification that arranges organisms only by their order of branching in an evolutionary tree and not by their morphological similarity)* in nature and they contain theoretical premises that are largely unexamined. Like Renfrew (2005) and Schoenbrun

(2001) above, Moore argues that the basis for this theory lacks emphasis on the extent to which each human language, culture or population is considered to be derived from or even rooted in several antecedent groups. Furthermore, because of that simplistic view, he further argues that cladistic theorists tend to think human groups they are dealing with have always been bounded together so much that their languages, culture and physical type have coevolved, and thereby making them products of an ancestral lineage composition which has experienced no or minor changes. This could be due to the fact that this theory is borrowed from biology and it advances the notions of the evolution of species, where the logic is singular and it reconstructs a developmental series of events through time in which the daughter taxa can ideally be used to reconstruct the parent taxon and specify the order in which changes occurred (Moore, 1994:927). As a result, in the process people have been grouped systematically as characterised by logical reasoning to show that the biological population and the linguistic community are one and the same. Modern languages are used as starting point and statistical probabilities are used to reconstruct the original parent. This is a hypothetical reconstruction which has flaws. We certainly can only reconstruct that which is in the same form or still exists in the languages of today; a discourse that is concerned with real living populations, as Blench (2006) also argues. In archaeology, on the other hand, we are concerned with ancestral societies that lived at some specific time in the past, and it is therefore not convincing that the graphical representations that are made to show the geographical distribution of the language, culture and/or population distribution are made to compare the real antecedent populations.

Others argue that migration history is more complex than previously thought and that human expansion should not be viewed as a single sweeping migration of farmers (*eletter* responses by Galla *et al.* 2003) to review Bellwood and Diamond (2003). They are of the opinion that migration comprises slow diffusion of peoples and cultures and sometimes cultures which may be driven by other factors not necessarily to do with farming. To emphasise their point, like Meinhof (1929) on Bleek, Golla *et al.* (2003) are of the opinion that the data used by Bellwood and Diamond rely on very limited linguistic evidence and tend to support (Moore, 1994) and (Renfrew, 2003) that genetic patterns correlate strongly with space and they cross-cut linguistic boundaries. They stress the point that languages can be borrowed and are subject to hybridisation more so that, circumstances could have favoured different elements such as social cohesion. A review of language grouping diagrams and their related cultures of origin presents a structure that gets less and less as you go back to where they originated, which says nothing about the species (people) that co-existed with the postulated ancestral populations, languages and or cultures, and ideologies as for example presented by the CCP model discussed in Section 3.2 above. It appears that little or no attention at all was paid to understanding how the Bantu languages had been transmitted, or how their speakers have related to the previous inhabitants they encountered. The other problem, as noted earlier, is that only similarities in languages and not differences were of concern (Schoenbrun, 2001) and little attention was paid to the co-existing groups. This, of course, presents an ambiguous situation as to whether we are dealing with a single uniform/homogeneous language (or other minor and insignificant) which was spoken before it spread and expanded to sub-continental proportions and probably because of the interaction the other languages ceased to exist. It is possible that this theory could be based on the language spoken by a very small proportion of the co-existing societies of the time (Moore 1994). Another due consideration is that phonetic and grammatical structure as well as lexicon can be transferred from one language to another and, as Renfrew (2003) argues, the effect of convergence over a long period of time can produce a language area effect which could be totally different from where it all began.

Recent studies working towards supporting linguistic evidence for the spread of farmers have employed new approaches to try to broaden their data. They have introduced the biological or DNA analysis as an alternative to confirm any relationship and possibly explain the geographical distribution of languages, cultures and populations using phylogenetic trees. It has not been applied generally in southern African archaeology to support or refute the earlier interpretations regarding the spread of farming and languages (though in areas it has been attempted), nor has it been spared from criticism.

Critics are of the opinion that since this approach uses hierarchical diagrams of languages as derived from gene frequencies in modern populations not ancestral populations (Moore, 1994), it is difficult to say to what extent it reflects reality since it is based on only those languages which have survived into the present (Eggert, 2005; Bellwood, 2005, Blench, 2006). More importantly, the limitation of this approach, as Moore notes, is that "a node in the hierarchy merely connects two taxa that are more similar to each other than they are similar to the other taxa...*[therefore]* often two populations connected by sequence similarities of a certain gene are distinct if one looks at a different gene" (Moore, 1994: 934). Also from the branching diagrams, "in no case do the ancestral nodes necessarily represent real populations of co-residents human beings" (Moore, 1994: 934). That is, nodes are not *demes*. In biology, a *deme* is another word for a local population of organisms of one species that actively interbreed with one another and share a distinct gene pool. If demes are isolated for a long time they can become distinct subspecies or species (http://en.wikipedia.org/wiki/Deme_%28Biology%29 accessed March 12, 2006). Therefore, mitochondrial DNA (MtDNA) produces diagrams generated from nodes with postulated gene of each individual, and each node of the diagram represent an individual with a postulated gene (Moore, 1994: 934). In linguistic analysis (lexicostatistics) (Vansina, 1995) was also not convinced by the tree models' inflexibility, whereby every language could only be derived from only one ancestor language, excluding the possibility of mixed languages that go back two or more ancestors (Eggert, 2005). In reality, the way in which genes flow among societies shows how it is inconceivable that one group of people could be characterised as homogeneous and exclusively possessing one definitive genetic structure at one time (Moore, 1994). It is consequently considered misleading to say that nodes on genetic diagrams are tribal groups of people or even absurd to mention regional or continental populations. It is now believed that another paradigm shift should come into play to show that it is actually the languages which spread and not necessarily people (Eggert 2005), and the convergence effect of Renfrew (2003) and hybridisation of completely different languages which could produce a derivative of a new language need to be explored. Even the DNA evidence does not tell us anything about the migration of people, because the mtDNA says nothing about where the individual carriers of the genotype lived let alone what the variability in the local population might have been (Moore, 1994). The problem with the ethnohistorians, linguists and anthropologists of the early to mid 20th century is that they had a prevailing methodological research approach or attitude that assumed that since all members of a society shared the same culture, and can speak the same language, one informant was as good as another. Heterogeneity or differences in perspectives among tribal sectors was not a focus of attention, with little emphasis placed on patterns of other intrinsic factors which could have been indicative of contact or diffusion in archaeology. Multi-cultural and multi-lingual polities were as normal in the past as they are today Moore (1994) and their language morphologies are not easily discernable in the archaeological record as previously thought.

It is evident that models of human history are based on an overwhelming assumption that the farther back one goes on time the simpler is the picture of human existence, so much so that language diagrams show fewer languages and fewer examples as one moves further back in time. This by implication says that there were not as many languages in the past as they are now. However, this counteracts the ethno-genetic perspective which argues for humans to have evolved as species and not as unconnected regional populations, and that there have always been admixed populations. There have always been in human history multi-regions, characterised by interactions across profound ethnic and cultural boundaries, by amalgamation of linguistic traits and by the current hybridisation of cultures, patterns of languages, culture and physical types, and they were no simpler than now. Therefore, in order to account for the possible relationship, we should know something about the entire spectrum of possible changes that could occur in the language, culture and biology (Moore 1994).

At the same time it has been stressed that language, culture and physical type have changed independently through time, and it is widely accepted that biological type can change without affecting cultural type and vice-versa. This counteracts the migration theorists who assume that material culture, physical type and language must change as a result of migration or invasion. In the Shashe–Limpopo basin, no biological analysis of occupants has been done nor any work on languages, but based on material culture several settlement groupings have been devised based on the great Bantu migration theory where sites were interpreted as waves of migration. Probably, if the speed at which the languages change could be measured, ethnographically and ethno-historically, it could prove helpful in eliminating problematic cases.

It is however important to note that many of the archaeologists who spent much of their work advocating and interpreting sub-Saharan and indeed southern African prehistory using this theory (Phillipson, 1977b, 1985, 1993) do not think it still holds (Phillipson, 2002). Recently, scholars like Eggert (2005) and to some extent Blench (2006) have been questioning why a particular proto-language should be related to a particular material culture and not to some other? They propose that archaeologists should not only think of asking whether a language or proto-language is associated with a particular material culture, but instead whether a given linguistic entity is concomitant with a specific material expression at all — as it is through the material culture that they (archaeologists) approach a bygone reality of whatever dimension and temporal distance (Eggert, 2005: 319). Phillipson (2002) further cautions that correlation between the two entities should not always be seen as an end in itself but as a possible route to a more comprehensive understanding of the past cultural processes.

3.3.2. Shashe Limpopo Basin: Migration and Archaeological Evidence

Section 3.3.1 has attempted to outline the use of language as a tool to understand the prehistory of Bantu farming populations in sub-Saharan Africa and that of southern Africa in particular. These languages were supported by factual archaeological data derived from parameters and variations in material culture distributions. It is evident that as culture history became the explanatory paradigm, this led to variation being used in temporal and spatial frameworks with a view to tracking change through time and interaction over space (Eerkens and Lipo, 2005). In particular, in the study area variations in the abundance of certain ceramic types were interpreted as a function of change in the occupation of the region over time. Periods of occupation are identified by chronologically sensitive artefact types, which are used as a guide to identifying sites belonging to different cultures. For example, in the Shashe–Limpopo Basin, farming sequences have phases, and it is these phases that mark significant reconfigurations of the Bantu-speaking agro-pastoralists in this landscape (Smith, 2005). The sequences are confirmed by radiocarbon dating, and associated distinctive ceramic styles are thought to represent broad cultural identities produced through learned and communicated tradition within those specific cultural settings.

However, just like languages, it is now strongly believed that these material distributions do not necessarily coincide with those of human societies as recognised on socio-political, linguistic or other bases (Phillipson, 2005). Phillipson further believes that owing to the fact that there is considerable uncertainty about the significance of material groupings, this makes it difficult to distinguish between variation due to different functions, stylistic traditions and preferences as well as other factors which could have played a role at the time of occupation, such as availability of raw materials. In addition, Eerkens and Lipo (2005) think that despite the reliance on using these variations there is little or no knowledge of the conditions that encouraged the generation of these variations or the conditions under which variants disappear. It is possible and practical for a single society to engage in multiple-distinct lifestyles, in one or more areas and environments at different times of the year. The activities undertaken could be reflected in archaeological assemblages and can represent a single community or sub-groups within that community at different times and localities (Phillipson, 2005). There is a need to assess ceramics beyond typology and ethnicity but also to focus on the social context in which the artifact was produced. Ceramics are actively communicative and can represent environment, ritual, ceremony, interaction, trade and exchange and the decorations can be more ideographic than ornamental (Pikirayi, 2006).

From the late 1970s Huffman employed a multi-dimensional analysis — using three variables: vessel profile, decoration layout, and motif — to categorise cultural groups from known contemporary groups (Mitchell, 2002). He argued for a model that demonstrates that there is a connection between the movement of social groups and their cultural materials and settlement organisation. The classification of ceramic remains from archaeological records was perceived as traditions and/or phases and lines of descent in which ceramic attributes could be traced through successive generations. Huffman's approach using ceramics epitomises what Dewar (1997) calls a synchronic paradigm. This paradigm perceives the archaeological record as a structure with established traditions representing modes which either persisted through time or disappeared with a clear break that indicates the cessation of one tradition and the commencement of its successor (Hall, 1984). In Hall's (1984) view, change was seen as not potentially continual within a dynamic ceramic tradition. Huffman saw ceramic traditions as a series of periods of stylistic stability separated by short intervals of rapid readjustments. The tradition of making pottery and associated culture was also at times considered synonymous and the terms used interchangeably — pots as people and people as pots. This shows how a static archaeological record, a product of dynamic processes of the past, can limit our view of how dynamic societies could have used their surroundings. To many this approach is not surprising as it exemplifies how the general trends in the region were and how the ethnographic concepts applied used closed cultural traditions that took on an 'apartheid-like' appearance in the Southern African context (Denbow, 1999: 110).

Before the introduction of farming, archaeological assemblages had no evidence of material culture that could be linked to agriculturists (Mitchell, 2002). Even though evidence of farming is recorded as early as the first millennium AD, the study area was only occupied by agro-pastoralists almost a thousand years later. It is nevertheless considered necessary to discuss briefly the early period as it is significant in the prehistoric settlement and land-use dynamics of farming populations in southern Africa, eastern Botswana and the Shashe–Limpopo Basin.

The earliest evidence of farmer presence and occupation in the region has type sites in some parts of Botswana such as Toteng in the northwest (Reid, 1998), Bosutswe in the interior (Denbow, 1984, 1999; Plug, 1996), Zimbabwe at Matopos (Walker, 1998), Namibia and South Africa (Reid *et al.*, 1998). There are very few known sites dating to the EIA period in the Shashe–Limpopo Basin and none recorded in the study area (Figure 1.3). There also seems to have been a lacuna in the farming population presence between the occupation of the Basin and these earliest sites. An intense occupation occurs around AD 900 by the *Kalundu* ceramic tradition group, spreading southwards from East Africa through Malawi, Zambia and Zimbabwe, and into eastern Botswana and the northern part of South Africa around what is now known as the Limpopo Province (Figure 3.1). From their ceramic typology this group is called *Zhizo* and belongs to the *Nkope* tradition branch of the *Urewe* cultural tradition (or central stream) of the eastern Bantu-speaking group, and they accordingly settled the area for a little over a century, from AD 900 to 1010. Schroda was presumably their capital because of its spatial extent as compared to other Zhizo-type ceramic sites. It is also believed to have had strong trade network links with Swahili Arabs on the East African coast. This is based on the quantity of exotic glass beads and a significant amount of trade items present (Huffman, 2000; Huffman, 2005). Presumably, this link could also have emanated from their supposed origin in that region and therefore this trade connection could be due to their probable contact with the East coast littoral, where the Arabs had already established trade links with the Far East by that time. The trade intensified due to the presence of communication and market connections through the river systems of Shashe and Limpopo that linked the confluence with the Mozambican coast and Indian ocean where similar sites have been located (Ekblom, 2004; Sinclair, 2004). Despite its great extent and presumed political strength and business prowess to lure and attract people, this ceramic style-defined cultural group ceases to exist beyond AD 1010 and is replaced by yet another powerful cultural group also identified with the Shona-speaking eastern Bantu of the *Kalundu* tradition whose settlement organisation emphasised stratification based on political and social class. Their world view and ideological style is typified and explained by the CCP model discussed in Section 3.1 (Figure 3.2). A new and even larger capital is established at the K2 site. Trade which also intensified beyond the capacity of that at Schroda is cited as a potential motivation which could have led the Shashe–Limpopo to be settled by this group of people (see Denbow, 1983; Denbow, 1984 ; Huffman, 2000). It is often difficult to assess the basis of these assumptions as for the most part there is neither sufficient supporting data nor evidence of a trade background in their area of origin sufficient to justify the conclusion. It is, however, still possible to assume that since they are from the eastern Bantu migration route, they probably had prior contact with the Arabs of East Africa and had knowledge of established market centres to trade with. It is also possible to think that, since trade links were already established by their predecessors (*Zhizo*), the trade intensified during their occupation. For trade of that magnitude to develop and flourish there should be already established local and regional exchange networks onto which a scale of demand and supply of commodities could develop (Sutton, 2004), more so that there is evidence of *Zhizo* cultural people at the confluence, at Leokwe and further afield in Botswana at Toutswe, Bosutswe and around the Makgadikgadi salt pans (Reid and Segobye, 2000) which continued to exist. Smith (2005) argues this could imply that the displacement was not absolute and this Zhizo group could have continued to play a role in the economic dynamics of the area. This makes it appropriate to think that change in ceramic style may not necessarily imply a new cultural group but an urban pull-migration equivalent, where populations from peripheral settlements continued to occupy the area as competition intensified in long distance and local trade. They also had to diversify their local production of materials and exchange with other communities in and outside the area of concentration.

The K2 occupation accordingly lasted for a couple of hundred years before people relocate to Mapungubwe, a hill less than a kilometre away, around AD 1220. This is the only cultural phase that has been argued to represent an *in situ* social and political change, not a displacement by a new cultural group. This continuity is justified by the presence of the K2 ceramic style in association with those of Mapungubwe. Mapungubwe enjoyed the economic links that its predecessors had established but what is most significant about this culture is the shift in the rise of social complexity typical of a class-based system with distinct social and political hierarchies where the relationship between elites and commoners was distinct (Huffman 1989, 2000) as compared to the Schroda and K2 polities which were predominantly kin-based. It is also suggested that this new settlement organisation at Mapungubwe showed how the CCP could no longer express the social and political distinction between the elites and commoners, derived from increasing centralisation of the east coast trade (Smith 2005: 12). The change was probably inevitable considering the significance of the economic development taking place, which resulted in population increase and therefore unequal access to materials of value such as ivory, gold, glass beads and other commodities. This could have had an effect on power relations, with some members becoming more economically powerful and controlling, and not a cultural change resulting from new people displacing others as previously thought. A similar settlement attributed to differences in economic relations was observed at some sites in eastern Botswana (Denbow, 1983; Denbow, 1984) earlier in date than Mapungubwe. They are, however, comparatively less materially adorned which supports the thesis of Mapungubwe being an established trade centre which had a pull effect. In Denbow's settlement pattern analysis sites co-existed but their status and size was inversely proportional to the distance from the centre, i.e. sites further away from the centre were small and insignificant and regarded as commoner settlements.

At the confluence, research has been concentrated on the South African side of the border and in Zimbabwe. The Zimbabwean site intensity has recently increased as a result from a systematic survey by Manyanga (2006) with the location of many sites that were previously unknown. Manyanga, like most studies that address the importance of landscapes, was more concerned with the socio-economic dynamics of the prehistoric occupants in the Basin by providing a detailed outline of their resilience and how they survived in times of adversity. It is possible that beyond these identified sites there were activities such as mining production centres, clay quarries, ceramic manufacturing and trade centres, cultivation, pasturage which produced these observable traits and were missed out in the past studies. They are not pronounced and hence not readily visible in archaeological surveys. This is because they were not part of the research inquiry focussed on understanding land-use diversity as a possible factor that governs human behaviour. It must be stated that previous archaeological interpretations based on the migration theory made it difficult to fully understand whether the changes are in ceramic designs, cultures or movement of people. Their conclusions, however, strongly advocated that changes in cultures were due to new people moving in and replacing others. Accordingly, the study of archaeological stratigraphic records revealed the development of cultures through time and space. This is, indeed, an understanding which is dependent on a body of data that links cultural dynamics and their consequences to what may be apparent in the static material record (Binford, 1964). In addition, even though specific correlations are difficult to ascertain (Mitchell, 2002) there was a belief that ceramic typologies mirrored shared languages and could be useful in reconstructing their movements (e.g. Huffman, 1980; Huffman, 2000).

Furthermore, it is critical to acknowledge that despite this reliance on and adeptness in using variation to study past events little is known about the processes related to their origins. As already mentioned above, the problem is also that archaeologists have little knowledge about the conditions which led to the generation of these variations, neither do they know the conditions under which variants disappear (Eerkens and Lipo, 2005). This problem is further compounded by our inability to determine whether variation is the result of a single process or produced by a combination of processes that vary according to their character and the environment of transmission (Eerkens and Lipo, 2005; Phillipson, 2005; Pikirayi, 2006).

Information on ceramic design and elements of the language was based on contemporary ethnographic models. The idea of discontinuous change as well as the equation between concepts of culture allowed analysts to identify units through archaeological analysis which could be equated with the cultures and tribes of the ethnographic record thereby producing unimpeded archaeological records. Similarly the equation between ceramic style and elements of language re-emphasised the involvement of archaeology with one of the fundamental concerns of the 'settler paradigm' (Garlake, 1982) — the directionality and chronology of the migration of black communities (Hall, 1984:268). The intention was to divide indigenous people into ethnographic tribes using ceramics, an attribute associated with colonial and post-colonial administration in the region where people were grouped in terms of their lines of descent and put into homelands during the South African apartheid rule. Pottery classification was justifiably made to reflect people and this intensified when the documented cultures provided South Africans with shared ethnic (tribal) images and symbols which allowed them to communicate through time and space and see themselves as members of specific ethnic groups. As a nation South Africa was categorised with distinct tribal groups called 'homelands' and this is even reflected in their pottery classification. Subsequent archaeological data from neighbouring countries, particularly Botswana, were seen through the eyes of the South African practice and sites interpreted and understood according to established regional nomenclature. This shows how archaeological research in the region was influenced by the environment in which it was conducted and in this case classification was built into the data, categories labelled within typologies to support the migration theory. Interrogative and practical methods of archaeological inquiry were not sought, and archaeological records were seen as waves of migration with distinctive borders.

In spite of the gaps in the spatial and temporal change of the southern African archaeological evidence, the Shashe–Limpopo Basin was occupied by farmers from AD 900 onwards. During the initial stage of occupation the mode of subsistence was based on crop cultivation and herding of livestock (Pwiti, 2005), though people also relied heavily on the hunting and gathering of wild fauna and flora ((Plug, 1997; Plug, 2000; Plug and Voigt, 1985). Mining was limited to the production of iron ore which was used specifically in the manufacturing of agricultural implements, and to a limited extent jewellery (Maggs, 1984), but subsequent populations were involved in intensive trade of gold, ivory and glass beads concentrated at Mapungubwe, an established regional centre ideally located for long distance and local exchange trade network. It is possible that it attracted migrant workers from the hinterland and beyond and was heavily populated and exceeded its carrying capacity, which has even been suggested as a factor that could have led to its demise (Smith, 2005).

However, it has not been systematically questioned how big the scale of this mode of socio-economic practice was and how it manifested itself on the landscape. Sites are activity areas, people use the physical landscape for their sustenance and there are traces of this land-use that could be used to augment the migration, ceramic classification or other attempts postulated to explain and interpret the prehistory of the region and study area. This study has adopted methods of landscape analysis using remote sensing techniques in the form of aerial photography and the interpretative spatial dataset of GIS, geochemical analysis of phosphates and heavy metals, as well as X-ray powder diffraction analysis of ceramics in an attempt to understand the land-use diversity of the confluence and the Basin. The intention is to present Shashe–Limpopo Basin archaeology based on a more pragmatic approach without the importation of anachronistic models, which manufactured the history of these societies from ethnographic and linguistic sources. The general opinion of this study is that the growth of Mapungubwe does not seem to fall within the concept that is usually used; that land-use intensification was a product of population and urban growth as well as associated demands or stresses on the rural production systems (Connah, 2001) which would include the broader landscape of the site. According to Huffman (2000), Mapungubwe at its peak could have supported a population of 9000 inhabitants (see O`Connor and Kiker, 2004; Smith, 2005). This justifies the theory brought forward by this research that land management strategies were established for socio-economic and cultural practices to support such a large group of people for such a long time, and the need for the landscape to be investigated. This is because we also know that a diverse economic base was in place in the form of local and long distance trade of ornamental products such as ivory, beads and gold, and possibly other products such as ceramic vessels. Trade of that magnitude developed and flourished because of the already established local and regional exchange networks supported by some of the production undertaken at the marginal sites. The Mapungubwe complex landscape needs to be viewed as an amalgamation of human landscape with diverse activities, which stretched way beyond its boundaries and the contribution of sites on the side of Botswana should be considered as part of this landscape.

4. RESEARCH METHODOLOGY

4.1. CONCEPTUAL FRAMEWORK

The methodological approach employed in this study is inherently interdisciplinary and has been chosen to create an opportunity to explore both experimental and deductively derived ideas which can be used to critique the more traditional, socio-cultural way of interpretation. The premise is to explore theories that are designed to predict and understand human behaviour over time and space but with less emphasis on material culture. Previous archaeological studies in the Shashe–Limpopo Basin have been geared toward defining different societal groups and their cultural origins and were mainly perpetuated by colonial and patrician agendas. The sites targeted for investigation at the time were those that were taken as key indicators of cultural progress, and which therefore promised to offer insights into the antiquity of agriculture, metallurgy and social complexity (Stahl, 2005:11) as viewed from the perspective of the migration of Bantu-speaking people from the western part of the sub-continent. The approach adopted in this thesis is not confined to the environmental deterministic approach of the *New Archaeology*, nor does it align itself within the realm of relativism discourse. It rather acknowledges that there is an interconnection between humans and their surroundings whereby people used those surroundings for their everyday survival. Hence the author's theoretical dimension is more systematic and empirical and inclined towards the processualist stand point.

Since the archaeology of the Basin has been shaped by insights provided for by linguists, ethnography and oral history to best-fit the reconstruction of cultural-histories, there is a need for more robust alternative approaches that are theory laden and practically testable. The migration theory envisages the arrival of Iron Age communities together with an early agricultural subsistence mode of production, beginning in the 1st millennium AD (Chapter 3) and reaching the Shashe–Limpopo Basin after the 10th

Century AD, constituting one large group of people who over time came to occupy particular geographical and ecological zones. Assuming this to be the case, then their past activities are signatures left on the landscape, visible and non-visible, which can be of great value in telling us more about how those people conducted themselves. Pottery classification and architectural styles, as well as radiocarbon dates, have been used as primary sources of evidence to confirm these insights. However, gaps still exist in understanding the behaviour of the people occupying these areas in terms of land use management. Regarding the use of pottery, some scholars (Cochraine and Hunt, 1996) have argued that its classification, even though it produces good chronologies, still remains untestable and tells us nothing about the lifestyles of the people behind the pots. The pots do not even tell us where the finished products or their tempers originated, and whether they were transported to where they were discovered. It must always be borne in mind that typologies are created by archaeologists as basic measurement devices, and may simply address a limited preconceived set of questions. Pottery remains are the most ubiquitous of all archaeological finds in the study area but questions about the production and circulation of pottery have not been examined. There are numerous studies available which demonstrate that chemical and petrographic analyses are essential for providing information regarding materials used in pottery manufacture (Rice, 1996a, 1996b). Studies of ceramic technology are also important in defining both inter- and intra-regional contexts between settlements (Hall, 2001). For example, style differences in addition to the possibility of suggesting ethnicity or cultural group, as was previously thought, could indicate: (1) different groups residing with one another, (2) internal exchanges by the same and/or different cultural groups, and (3) different manufacturers with no cultural affiliation but using the same local source of material (Hall, 2001). Within this conceptual framework, the present author believes that using pottery alone or as the major source of evidence is limiting, and has not fully addressed the character of the Basin and the region in prehistory. The reconstruction of human behaviour over time and space, and people's perceptions of how to use the landscape for their immediate needs, requires the use of a range of methods and approaches that complement one another and combine to meet the overall research goals.

4.2. Methodological Approaches

Earlier studies of the confluence area, with Mapungubwe as the centre, espoused what can be defined as a 'world' systems theory. This theoretical approach emphasised the asymmetrical political and socio-economic exchange system between a highly developed core and less developed periphery. This systemic approach — sometimes referred to as complex (hierarchical) systems theory — seeks to explain relationships in terms of hierarchies, using many variables at different levels. The present author does not subscribe to this school of thought, as even in modern societies industrial centres, for example, can cease to exist owing to depletion of resources or products becoming economically unviable. The complex system model is limited by the available archaeological evidence, and little or no work has been conducted to show that the wider archaeological landscape is a time-specified land surface with an interacting web of settlement, population, technology, resources and the environment (Connah, 2001,Robinson, 1996, Tilley, 1995) and could have contributed significantly to the processes and development of that system. The landscape archaeology concept emphasises the need to realise that people did not just discard, live and build sites and monuments but also interacted with their broader surroundings (Renfrew and Bahn, 2005, Wilkinson, 2003, Smyth *et al.*, 1995, Wilkinson, 1992). Visible structures such as monuments and sites are habitation and/or special activity areas. Beyond these structures are exploitable features of the landscape which do not have the materials that archaeologists use as the principal indicators for their search of the past. The present author favours the frequently cited, but under-researched, theory that as an important centre, Mapungubwe would have been supported by the periphery to sustain its dominance (*e.g.* Connah, 2001). An array of activities took place and these are reflected in the cultural remains found at the centre and its vicinity, which had a significant impact on the lives of the inhabitants over a long period of time. Certainly, as an agropastoral society that was also engaged in trade, the loci of their activities went beyond what is known archaeologically. Another important factor is that the Basin was occupied continuously before and after the collapse of these complex states. This implies that the Basin landscape has always been attractive and is indeed a dimension of human antiquity. Therefore, it should be acknowledged that the landscape structures an inhabited area by supplying environmental opportunities for the settlement to develop in the first place, and that area structures the landscape around it. That is, there is no simply direct environmental determinism, nor cultural determinism in operation, but each influences the other.

The data collected from the preliminary survey called for further assessment of the confluence in order to understand the interactions between the Mapungubwe community and its immediate landscape. The landscape dynamics approach stresses the inadequacy of a single source of evidence, in this case pottery classification or culture-historical approaches, in interpreting the past. Other lines of evidence such as faunal (Plug, 2000) and skeletal (Steyn and Nienabar, 2000) remains, and even environmental and climatic reasoning (Holmgren and Öberg, 2006; Huffman, 1996; O'Connor and Kiker, 2004), have been explored, but they tend to be used to substantiate traditional thinking and justify the earlier interpretations. In the present study, the landscape characteristics will be investigated using the remote sensing techniques of aerial photography and satellite imagery and spatially analysed datasets through GIS applications. The advantage of using these techniques for landscape analysis is that events that took place in the past can be traced, analysed and integrated. Being equipped with that valuable data can in turn help us to evaluate and understand the susceptibility of the land and vulnerability of its occupants, and why they made the land-use management choices they did. This information could also be integrated into planning processes by constructing maps of areas with archaeological potential, where no archaeological research has been undertaken previously. This would be particularly important in Botswana where there are large territories that have not been studied archaeologically and development projects are threatening the archaeological heritage. GIS, on the other hand, is employed as an analytical tool to capture and analyse data against remote sensing datasets with the overall aim of providing insights into the relationships that might have existed between sites and their settings. GIS has the advantage of integrating spatial data sets into a common analytical environment. This is because it permits the organisation of different components of the same map into distinct thematic layers such that in one digital display many different elements can be combined, each of which can be individually switched on or off, queried, modified, reclassified and edited (Connolly and Lake, 2006). Thus, by allowing remote sensing images and other geospatial datasets to be used as thematic layers, GIS provides an interpretative framework for collating, analysing and interpreting remote sensing data on the contemporary and past landscapes (Connolly and Lake, 2006:66). This is critical to landscape analysis as human behaviour and decision-making strategies for using the land based on its attributes can be assessed. GIS has been used successfully with remote sensing data in western Syria, where Ur (2003) used declassified CORONA images to show past land use traits over an extensive area, and in the Vale of Pickering (North Yorkshire) Powlesland *et al.* (1998) identified and mapped previously unidentified landscape features such as track-ways, enclosure systems, and cemeteries through the incorporation of multi-spectral imagery.

Remote sensing techniques, especially aerial photography, have been used in other parts of Botswana. However, this has not been coupled with other practical data analysis techniques in the form of, for example, GIS in order to strengthen the results and enhance their interpretative potential. It is hoped that the outcome of using remote sensing techniques with GIS will be a more constructive approach to the archaeological interpretation of the Basin and a challenge to conventional views. The overall aim is to provide an alternative line of thinking in the interpretation of prehistoric communities living in this region and beyond.

Further, the research will show that the archaeological record incorporates more than just the visible features, by employing the technique of geochemical analysis. Soil samples were collected from a small, localised area and analyzed for phosphate and pH concentrations. The results of the analyses and the spatial coordinates of the samples were entered into a GIS database and spatially managed as thematic layers. Such data show how subtle changes can occur as a result of varied human activities within a settled environment, and in turn can be used to identify the nature and spatial extent of those activities.

Hitherto, pottery classification has been used extensively to try to document temporal and spatial variability in the occupation of the Basin. In the present study, X-Ray Powder Diffraction (XRPD) analyses of ceramic samples are used to determine the mineralogical composition of ceramic materials in order to test the validity of the traditional classifications. The rationale for adopting this method is that, hitherto, archaeological ceramics have been used 'exclusively' to address issues of chronology and the socio-political systems of past human occupations of sites, rather than economic aspects such as trade and exchange over a specific area. Unlike other commodities, such as beads, minerals and trophies, ceramics have always been considered to have originated where they are found, except for a few isolated cases where they would have migrated as an item of social value. It is true that interaction can be measured visually by the presence of a stylistically foreign sherd in an assemblage, but combining stylistic with chemical information can make the analysis more meaningful and lead to a more subtle understanding of the process of interaction (Jacobson *et al.*, 1995). There are certain unique attributes which could have made ceramic materials items of value. Their form, decoration and durability, which would have depended on their primary constituents, would also have played a role in their trade both locally and over long distances. As items of value, pottery vessels need a holistic approach in order to be understood. The XRPD analysis approach may reveal more of the subtleties of social and economic interaction between Iron Age communities than a study of ceramic style alone. In Southern Africa, and Botswana in particular, clay is a scarce resource and its availability would have depended upon trading networks of both raw and finished products. For example, if a vessel's decorative motif is stylistically similar to that of another vessel from the same site, it can be determined chemically whether it originated (or not) outside the sphere of that site's stylistic tradition. In the same way, it is possible that a vessel which appears on stylistic grounds to have been imported could have been manufactured locally, and this can only be ascertained through empirical analysis.

However, owing to time and financial constraints, it was only possible to analyse ceramic remains for variability in their mineralogical composition, with a view to identifying variation at a local level. It is hoped that future studies of pottery, especially on large-scale projects, will find this approach useful for broadening our understanding of the socio-economic dynamics of past societies in the region.

This multi-faceted approach is intended to help understand the use of the broader Mapungubwe Cultural Landscape beyond the confines of South Africa, and to highlight the archaeological importance of other sites (whose affiliation is sometimes acknowledged but without any research backing) to that landscape. This could go a long way toward showing how people are not limited by the visible borders imposed upon them by state-level political systems. Previous work will be used where appropriate as baseline data. More importantly, data on the past ecological dynamics of the region (Smith, 2005) and the resilient landscapes on the Zimbabwean side of the Basin (Manyanga, 2006), both dealing with the agro-pastoral economies of the Basin, will prove extremely valuable. Lindholm's (2006) study of the spatial distribution of wells in the landscape of the Namibian desert as useful indicators of how humans can continue to live in a hostile environment will be used for comparative purposes.

4.3. Fieldwork Research Survey

This section looks at the fieldwork research survey that was conducted from May to October 2005 in Botswana. The fieldwork was preceded by a number of field visits undertaken between 1998 and 2002, and the results of the latter are presented in Chapter 5. This survey was more comprehensive but focussed largely at the confluence of the Shashe–Limpopo Basin, owing to time and financial constraints as outlined on Section 4.4 on the research. The study area is in a game reserve, and therefore, it was not always practical to do foot survey covering large areas. This also resulted in the oral interviews being conducted in the villages outside the reserve as the current occupants of the area are working migrants some of whom are foreigners from neighbouring countries and elsewhere. By implication therefore these recent immigrants have limited knowledge of the area and its past occupation. Random and systematic survey strategies were employed. The general survey was done in vehicles using pre-field desktop analysis information, established cut-lines and fire-breakers as boundaries, and aspects of the landscape, trees, roads and stream intersections marked as reference points using a handheld GPS. The research survey team comprised the research director (the author), GIS and field archaeology specialists from the University of Botswana archaeology unit, Modisa Sedimo and Pena Monageng, respectively, and five research assistants. The research assistants were current and former archaeology students from the University and during their time at the University had been involved in the initial surveys undertaken in the study area. This latter factor was considered important as they understood the hostility of the research environment, and this would minimise the kinds of delays that had been experienced during the previous field seasons.

4.3.1. Landscape Analysis

The primary source of data for the landscape aspect was essentially obtained through the application of remote sensing — in this case the use of aerial photographs and to a lesser extent satellite images — as well as from topographic, soil and vegetation maps. The existing archaeological data from previous surveys was useful in identifying known sites from aerial photos.

Aerial photography is a tool conceived and developed during the First World War, and has grown phenomenally as an important tool for archaeological fieldwork. This has been attributed to the fact that the processes and conditions responsible for good results are now better understood and expertise in interpretation has developed (Lock, 2003). Use of aerial photographs in archaeology has grown to such an extent that it is inconceivable that any major archaeological undertaking involving sites and landscapes could proceed without recourse to its utilisation (Lock, 2003:17). Archaeologists find aerial photographs instrumental in placing known sites within a wider context, as well as in locating and discovering new sites. Aerial photographs can provide profound insights into the spatial relationships between archaeological data and landscape features (Connolly and Lake, 2006). They reveal repetitive patterns that are useful in characterising certain attributes depicting human modification of the landscape. Interpretation of the photographs is based on visible landscape features, some of which could be humanly modified or just natural but important for human exploitation. In his study on pastoral land-use, Lindholm (2006) showed how the perception of the Kalahari as an inhospitable environment, unlikely to support occupation by pastoral societies, was not only false but ill-conceived. He successfully showed how livestock herders procured dry season resources and had a long and well-established system of digging wells. These past land-use systems are not readily visible in site location exercises and they are often missed. In aerial photographs these features are generally visible and can be used to track and reconstruct a pastoral land-use system in the Kalahari. It is usually possible to recognise signatures in the form of ancient roads, pathways, track ways, and hollow-ways criss-crossing the landscape to these points of crucial resources (Ur, 2003) like Lindholm's wells. Usually, where rivers and streams intersect or converge is a likely place to find a well (Lindholm, *pers. comm.*), an observation also made at a cattle-post at the intersection of Manake and Selepswe Rivers near the village of Mathathane.

4.3.1.1. Desktop Assessment

Prior to the field survey, a desktop study was conducted, which comprised mainly the digital acquisition of base maps. Digitisation of maps is the transferring of analogue information from a paper to a digital format in order to generate a spatial framework for archaeological investigation. The digitisation process involved scanning, rectifying and georeferencing mosaics of aerial photographs and topographical maps of the same scale (1:50 000) and displaying them on computer screen, in order to permit the identification of known features and areas with potential archaeological sites, within the Environmental Systems Research Institute (ESRI)'s ArcGIS environment. The steps followed for digitisation are as described by Connolly and Lake (2006:81) and shown on

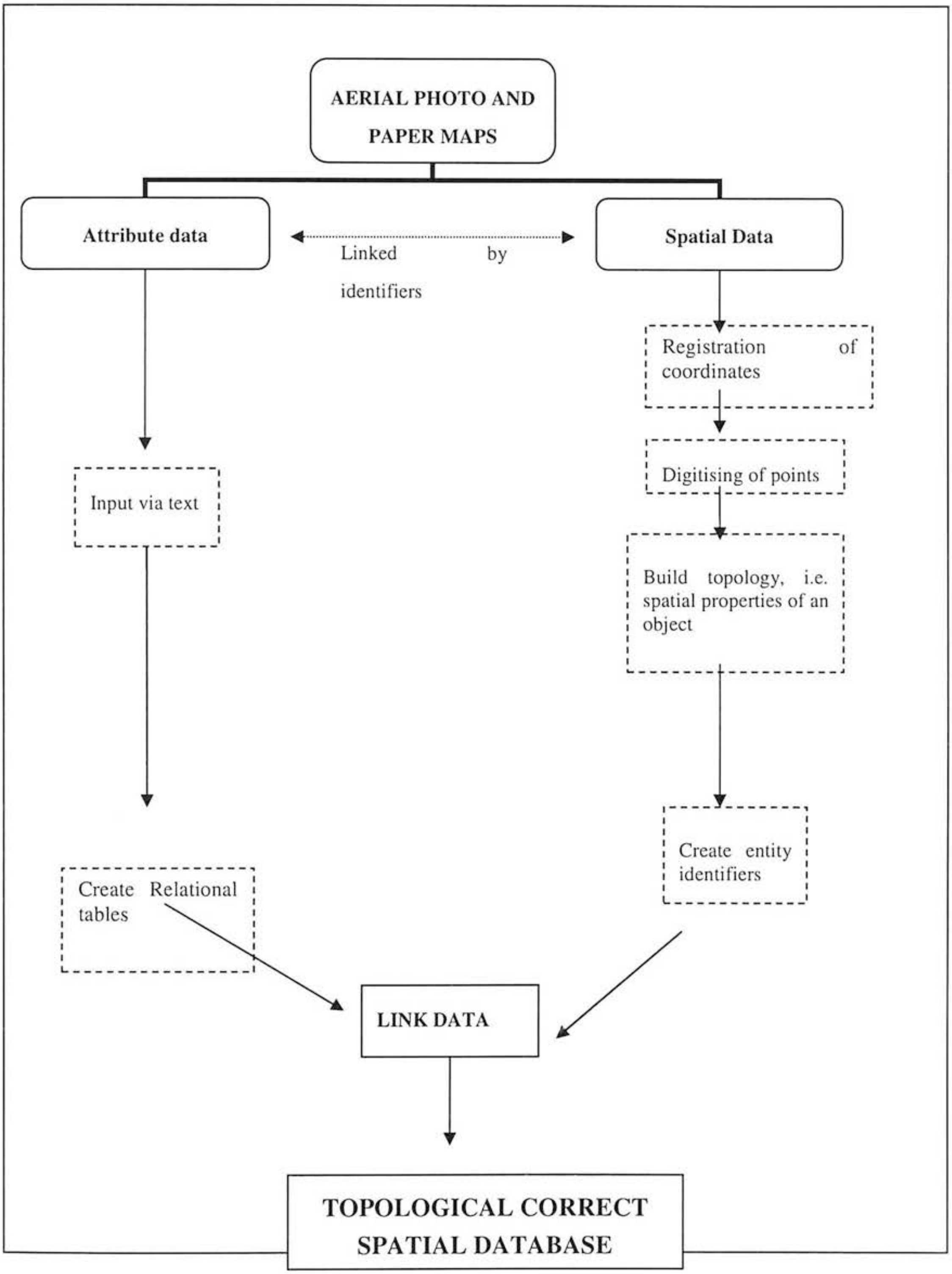

Figure 4.1 Steps in digitising map data (after Connolly and Lake (2006), fig 5.6)

Figure 4.1. Since the data were from multiple sources and had to be combined, maps needed to be projected. The topographic map used was produced by the Botswana Government's Department of Surveys and Mapping in 1985 and constructed with a mathematical error of 10^6 false northing using a World Geodetic System (WGS) 1972, as its datum coordinate reference. This information is printed bottom left hand corner of the 1:50 000 topographic map. In the GIS environment, in order to rectify and georeference, a number of locations with known coordinates were identified on the map image and used as ground control points (GCPs) that correspond to locations on the target map, thereby defining spatial coordinates for the new map. These included features such as road intersections, streams or buildings. In this exercise the new map was geo-rectified with an average spatial error or RMS (root mean square) of ±8m, an error resulting from the combination of aerial photographs and topographic maps which would have undergone processing, transformation and interpretation and inevitably contain spatial errors. For accurate placement of archaeological information within the landscape, it is recommended that RMS error be established particularly for map scales of this size, as it provides a measure of how accurately spatial information has been translated to a new coordinate system (Connolly and Lake, 2006:42 and 88).

Data for sites located from previous field surveys were integrated onto this analytical environment by retrieving it from a relational database (i.e. a database made up of separate tables where all records in a given table have all the attributes appearing as fields in that table) in the form of a Microsoft Excel® spreadsheet and incorporated into the digital spatial framework created. In this digital display different components were organised into different thematic layers and elements were individually queried, modified and edited by switching on and off the layers within the same map. The landscape approach was also used to delineate certain environmental variables in order to recognise and identify certain repetitive but distinctive aspects of the cultural landscape from aerial photographs, which became instrumental in predicting areas with potential sites.

This desktop study was in preparation for ground control of the aerial photographs during the field survey and to confirm the site locations, and to fix them with the aid of a handheld GPS so that they could become part of a geographical database in the form of the GIS. Other aspects of the landscape derived from these remote sensing resources, in particular vegetation distribution, were used to complement and provide clues to archaeological site distribution in relation to the environment, especially that of *Cenchrus ciliaris* and *Colophospernum mopane* which have been previously observed to indicate nutrient-loaded sites resulting from anthropogenic activity. However, vegetation mapping was placed within a broader geomorphological and soil systems framework. The main objective was to try to understand whether variation in the environment at micro- or macro-levels had any significance for Late Iron Age use of the Basin. This approach was considered necessary as it would complement the existing forms of research, especially excavation.

4.3.1.2. Survey and Sampling Techniques

Field survey in 2005 was conducted between May and October. Hard copies of topographic maps were used for orientation and confirmation of terrain features as identified during the desktop study. Sites and features were located and positioned using a handheld GPS and the Universal Transverse Mercator (UTM) coordinate system.

Therefore, the fieldwork research survey included, but was not limited to, the following:

- Ground control of the air photograph maps, which took the form of normal basic sample survey of identified areas from the desktop study. Any sites located were then fixed using GPS and plotted on the aerial photographs. Sites of potential archaeological interest identified on the aerial photographs were looked for in the ground survey and, if confirmed, were also fixed.
- Ground control of the vegetation, description of species, and their association with the sites.

- As an offsite approach, a random selection of areas with and without material culture but appearing as anthropogenically-influenced landscapes from the aerial photographs were investigated and test-excavated, soil samples taken for further analysis, and then mapped within the broader landscape context.

4.3.1.3. Post-field Landscape Analysis

At the time of the fieldwork, the Botswana Government's Department of Surveys and Mapping (DSM) had started a nation-wide project to produce digitally formatted ortho-rectified aerial photographs, and the Shashe–Limpopo Basin was one of the few areas already covered. The images were bought and ten (10) compact discs (CDs) were cut at a cost of P1800 (£180) and imported into the GIS program. Since these images were already rectified, they had UTM references incorporated and the only task undertaken was to georeference them by re-projecting them to a compatible coordinate system, which is datum WGS 84 and UTM35N for the study area. The extensive attribute fieldwork data acquired using a handheld GPS were entered into a separate relational database using a Microsoft Excel® spreadsheet together with their spatial entity identifiers (ids). These data were then linked to the generated remote sensing and topographical GIS spatial database by projecting them to the same reference system (WGS84, UTM35N), thereby creating a thematic layer. The aim was to organise, manipulate and manage the data in such a way that layers for each dataset could be viewed individually or collectively in space. The expected outcome is that these map layers or subsets of each layer can be combined to produce new maps which can be helpful in providing insights into relationships of elements useful in understanding human behaviour and decision making over the Shashe–Limpopo Basin landscape.

4.3.2. Geochemical Analysis

An evaluation of the geochemical content of soils is used as an archaeological investigative technique at an identified site within the research area, Tuli Circle 2. It is intended to show the distinction between certain elements, which could be associated with locations of various past human activities across the selected area. This technique is germane to this study as this landscape is believed to have harboured a community that was socio-economically dynamic. Previous studies in the Shashe–Limpopo Basin have through excavations determined the range of materials employed in the activities performed therein but specific areas related to such activities have not been identified. This is partly because the artefacts recovered have been moved to secondary locations, which is where we discover them and develop inferences about the relationship between these activities and the political development of the sites. I have not yet come across any published information discussing the use of geochemical techniques in the area or even on sites in the surrounding region. However, in this study it will be used at a micro-scale, notably at the sites already located from previous field undertakings as well as those found using the aerial photographs and satellite images as described above. The objective in doing this is to try to recognise the varied activities which could have been undertaken at those sites, with a view to broadly understand the dynamic land-use of the study area. The analytical techniques used have been borrowed from agronomical sciences but developed for archaeological purposes.

4.3.2.1. Soil Phosphate Analysis

Chemical analyses, in particular phosphate analysis of archaeological sites, have become important and powerful tools in the study of prehistoric land use patterns. Use of phosphate analysis in soils is a technique, like resistivity survey, magnetic susceptibility, or trace element analysis, which allows features of an archaeological landscape that were hitherto invisible to be revealed. Phosphorus (P) is an essential element in all living cells and it is also a fundamental energy provider for biochemical processes (Isendahl, 2002). Over time Soil P undergoes a cyclic process of extraction, deposition of organic, inorganic and soil solution forms. During this cyclic process of P, plants assimilate soluble P that humans and animals consume as food and absorb into their bones, whilst during the decomposition process the organic P is released and fixed within the mineral structures of soils to form insoluble compounds with other elements such as aluminium, calcium and iron, called phosphates. Phosphates can therefore remain bound to the original deposition site with negligible lateral and vertical migration and can remain detectable for 100s to 1000s of years afterwards (Wells *et al.*, 2000). Human activities related to subsistence cause changes in the chemical content of soil on which they take place. That is, in an ecosystem without humans, according to Isendahl (2002), there is theoretically a P stable system as human deplete as well as accrue soil P. The activities could range from food procurement needs, waste disposal, and social activities like human burials. Hence, the analysis of phosphates can provide valuable insights into the nature and origins of contexts on archaeological sites and most importantly, for this particular study, spatial patterns of human activity across a site. Quantitative analysis of phosphate levels over space can be useful in interpreting how humans conducted their activities to produce the observed patterns in phosphate distribution. Since the study area is within a nature reserve, it has to be taken into consideration that low levels in phosphates are expected as excrements especially animal urine which are known to produce minor or no amounts at all (Isendahl, 2002). Isendahl (2002) also cautions that zero or low levels of phosphates do not necessarily mean that human activities did not take place as the amount of PO_4^{3-} in soil is also dependent on quantity and time-depth of deposition. The soils of Botswana do not generally have significant quantities of phosphates (Mosekiemang, *pers. comm.*, 2006).

In this study samples were collected on a regular grid and along straight transect lines to try to understand the spatial patterning of the site activities. Samples were collected randomly without using any visible archaeological remains as a determining criterion. This would in my view reduce bias and as a result inclusiveness for a site which would have been hitherto regarded as not worthy due to absence material remains. This hidden archaeology could enhance, in addition to aerial photography, our understanding of the general area under study. It could also be helpful in devising selective excavation strategies and save on costs and time. Thus, soil phosphate analysis is also a useful reconnaissance tool for pre-excavation assessment of sites and can be extremely useful in Cultural Resource Management.

OBJECTIVES

The primary objectives for analysing the soils from the Shashe–Limpopo Basin (Tuli Circle 2) were as follows:

- To use data obtained from concentrations of phosphates to assist in our interpretation of the spatial activities of the study area represented by white patches in the landscape sometimes associated with specific grass species (Denbow, 1979).

- To use the results and associated observable archaeological remains to map the corresponding activity loci over the landscape using GIS datasets,

- To determine their boundaries and attempt to interpret the activities as observed and documented from the field survey analysis.

- To extrapolate the results and make recommendations for future archaeological investigation and selective excavation in the study area and beyond

These sites range from artefact scatters and clusters of pottery, stone cairns and *dhaka* floors to heaps of middens of considerable size, located on opportunistically selected areas but limited to high rise segments overlooking both the Shashe and Limpopo rivers. During the fieldwork, excavations were conducted mainly at Tuli Circle 2, a site discovered using the aerial photographic technique and chosen primarily for its relatively extensive coverage of both the low-lying and elevated areas. The assumption was that because of its size it would provide a relatively significant representation and variability, if any, of spatial activities of the area. As a sampled area, the Tuli Circle 2 field assessment would represent the confluence area where the specific aim is to understand the range of activities carried out by the Iron Age communities of the Basin.

This was in addition to the previous work undertaken at Megwe Hill, which is located less than 5 km east of Tuli circle 2.

Sampling Survey

The survey method was to run transects covering areas with and without visible artifactual remains. The geochemical testing of phosphates and pH were conducted at the University of Botswana, Department of Environmental Sciences. The objective was to delimit the extent of the sites and deduce their use from what Denbow (1979) observed as areas indicative of cultural loading.

Sampling Procedures

Collect soil samples from all excavation contexts
Collect soils opportunistically between sampling points at about 10m intervals
Run uniform transects approximately 10–15m apart on a regular x/y grid for Tuli Circle 2 and use another site as a control
Use an auger to collect samples.
Record the coordinates of every sample collected using a handheld GPS and make note of any observation that could help in the later interpretation of the sample.

For each sample we collected approximately 0.5kg of soil and where necessary cleaned the auger with water between sample collections and wiped it dry.

4.3.2.2. Post-field laboratory analysis for phosphates

Method background and application

The procedure employed was to determine inorganic phosphates as opposed to total phosphates. The preference for this approach was because the samples collected were relatively large and this application has been found useful for spatial surveys covering large samples as it is also relatively inexpensive to undertake (Crowther, 1997). It has also been observed that there is no significant variation between inorganic and total phosphate if analysis is performed on a single site (Crowther, 1997; Wells *et al.*, 2000) as in this case, Tuli Circle 2. The method of analysis adopted was that of Olsen *et al.* (1954) which was chosen because the basic test showed the study area soils to be highly alkaline with an average pH of 8.8 (see Appendix C). This method employs a strong base which is capable of extracting a very high proportion of available phosphate (and probably all of the archaeological phosphate), thereby providing a direct measure of the archaeological phosphate present (Crowther, 1997). As laboratory procedures require specialist competence, the analysis was undertaken in a controlled analytical laboratory environment at the Department of Environmental Sciences, University of Botswana, under the supervision of a senior laboratory technician, Tlou Mosekiemang. The apparatus used comprised Spectrophotometer (with 10mm curvette), polythene shaking bottles, and reciprocating shaking machine.

Analytical Procedure

Samples were weighed (not exceeding 25g each) and then sieved through a 2mm stainless steel mesh. The extracting solution was prepared following Olsen *et al.*'s (1954) method; the Olsen P extracting solution is 0.5M $NaHCO_3$ at pH 8.5. The following analytical procedure was followed:

Place 5g of soil into a 250ml polythene shaking bottle, include 2 blanks and a reference sample.

Add 100ml of the extracting solution

Shake for 30 minutes

Filter through a hardened filter paper

Pipette into test-tubes 3ml of the standard series, the blanks and the sample extracts.

Slowly add 3ml of the mixed reagents by pipette and swirl (CO_2 evolution)

Allow the solution to stand for at least 1 hour for the blue colour to develop

Measure the absorbance on a spectrophotometer at 882nm and plot graphs

For each sample the concentration of P was calculated as:

P (mg/kg soil sample) = (a-b)x100/1000 x1000/s x mcf

= (a-b) x 100/s x mcf

where	a	=	mg/1P in sample extract
	b	=	mg/l P in blank
	s	=	sample weight in grams
	mcf	=	moisture correction factor

Conversion factor: $P_2O_5 = 2.31xP$

The sample coordinates from the field acquired with the aid of handheld GPS were imported from a database file (Microsoft Excel spread sheet) and phosphate results were input alongside their respective coordinates for each sample analysed, then buffered against the aerial photographs and topographic land-systems map, using the ARCGIS9 Arccatalog tool. The phosphate indices for the 100 x 100m^2 grid were interpolated into a thematic map using a spline technique within the ArcGIS database application system.

4.3.3. X-Ray Diffraction Analysis of Pottery Remains

4.3.3.1. Background and Application

The last 2000 years saw the introduction of the Bantu societies to the region. Their arrival was accompanied by food production which included amongst other things herding and farming, metalworking, the rise of urban centres and changes in social structure including the beginning of sacred leadership (Jacobson *et al.*, 1995). The evidence for this movement and societal change is discussed in Chapter 3, where it was noted that the analysis of ceramics, languages and social organisation in particular has provided insights into the temporal and spatial patterning of the occupation of the Basin. Ceramics are the most abundant of all the artefacts recovered and they display a range of decorative and formal variation which has been used to divide the prehistoric occupation of the region and that of the Basin in particular, into cultural phases. Like all archaeological cultural phases, those of the Shashe–Limpopo Basin, divide a temporal and spatial continuum into discrete cultural packages. The division is done by visual analysis of vessel form and its intricate decoration to define stylistic types (see Fig 1.2). Through ceramic decorative similarities (and/or dissimilarities) the changes in exchange and interaction over centuries or millennia is assessed and divided into types. This classification is perceived as representing cultures, cultural traditions and/or cultural phases indicative of lines of descent within the region. Hitherto it was believed that the ceramic attributes could be traced through successive generations (Hall, 1987), and interactions within and between sites from different cultures, whether social or economic, could be determined from the presence of sherds of different ceramic traditions. The reasoning was that ceramic modes which persisted through time or disappeared from the record were a clear indication of the cessation of one phase and the beginning of its successor (Hall, 1984). These approaches, which have been used extensively for archaeological interpretation in the region, suggest modest levels of interaction and movement of materials throughout prehistory. There is currently little or no evidence of craft specialisation associated with pottery production in the study area. Although pottery has played a role in discussions of ancient economy, trade and lifestyle have not been explored, in spite of the fact that pottery is generally recognized as an important material for understanding prehistoric societies. Interactions within and between sites of the same (or a different) ceramic tradition will be difficult if not impossible to determine from stylistic analysis alone. It is in recognition of this fact that the present study seeks to explore the potential of mineralogical (phase) composition analysis in characterising pottery sources in order to show that even though pottery vessels or sherds may differ stylistically, they may not necessarily be from different clay sources. The rationale behind this approach is that different clay sources have specific elemental compositions of minerals, and pottery remains made of these clays can be distinctive. Theoretically, every vessel should carry a chemical compositional signature or 'fingerprint' identical to the clay from which it was made. The hypothesis to be tested here is that there is no significant relationship between ceramic typology and clay source. The alternative hypothesis is that the classes created do not necessarily represent the prehistoric people and their cultures, because ceramics are movable items and could have reached the region from elsewhere as trade or exchange items. It is also argued that if indeed the area was occupied by different cultural groups at different times as evidenced by the different pottery designs, then it is possible that (1) they could have brought with them their specially designed ceramic products, or (2) they produced them locally by sourcing clay where their predecessors did. If the former is the case, then we expect the mineralogical composition to be different from the latter case. The identification of clay sources and comparison with the geochemistry of the ceramic remains can be critical in identifying their origin. This is considered useful as it may be possible to establish the pattern of circulation of the ceramic products and the level of human interaction through trade and exchange networks, if any. Furthermore, it is anticipated that once the mineralogical components of clays are defined and established, we will be able to look for patterned similarities and distinctions within and between the typological groups established by previous studies. Indeed this would be a starting point from which to investigate the authorship ceramic traditions of the Basin, as well as the socio-economic dynamics of its occupants and beyond.

This study will only assess the mineralogical composition of the ceramic remains collected at the sites in the research area. It was not possible to identify clay sources in order to collect samples, as the present inhabitants of the area have no information to this effect and geologically there are no known clay deposits within the area. The only clay quarry located was about 62km outside the Game Reserve, near the village of Mathathane, where samples were collected for analysis, and this was used as a control site. The quarry is no longer in use and was brought to our attention by one of the villagers we interviewed whose great grandmother was a potter. This was one of two individuals we interviewed about the processes involved in pottery and pot making. They were not potters themselves but at some point had a relative as a potter. The purpose of the interviews was to gather ethnographic data on what is involved in the manufacture and production of ceramics, in order to better understand the mineralogical composition of the samples.

The phenomenon of X-Ray Diffraction takes place when x-ray radiation passes through a crystalline substance and the rays are scattered and a pattern is created. Ninety-five percent (95%) of all solid materials are crystalline, and since every crystalline substance produces a pattern, the same substance, for example quartz, gives the same pattern and if it is present in a mixture of substances like a ceramic sherd, each substance present will produce its own pattern independently from another (http://epswww.unm.edu/xrd/xrdbasics.pdf (accessed 02/06/06). Therefore with a diffraction pattern it is possible to identify any unknown mineral from the powdered samples of potsherds from the angle and intensity of a set of peaks that are unique to the structure of the substance being examined. This is done by using the powder diffraction method to identify components in a sample by a search and match procedure using X'Pert software to produce graphs. The areas under the peaks of the graph are related to the amount of each substance present in the sample. Hence the XRPD technique is valuable for 'fingerprinting' identification of various solid materials and in that way is instrumental in helping to achieve a better understanding of their provenance.

4.3.3.2. Sampling and Analytical procedure

A total of 73 pottery samples were sent for analysis of their mineralogical phase content. The samples were first photographed, drawn and described following the standard practice of pottery analysis (Dillon, 1985; Rice, 1987) and the southern African nomenclature proposed by Loubser (1991). The XRPD technique was used to provide information on the mineral composition of the pottery samples, under the supervision of Dr Georges Ekosse, chief laboratory technician at the Department of Geology, University of Botswana, who has also worked extensively on clays from Botswana (Ekosse, 2005b, 2005a). In XRPD, diffraction peaks occur when the path of the diffracted X-rays of known wavelength is focused on a powdered sample and is equal to an integer multiple of the path difference expressed according to Bragg's law as:

$$n \lambda = 2d\sin\theta$$

where **n** is an integer, λ is the wavelength, **d** is the interatomic spacing, and θ is the diffraction angle.

The samples were characterised by means of a Phillips 3710 diffractometer system, which was operated at 40kV and 45 mA, having a Cu-$K_{á}$ radiation (λ=1.54056) and a graphite monochromator. A PW 1877 Automated Powder Diffraction, X'PERT Data Collector software package was employed to capture raw data, and perform peak searches for elements suspected to be present in the sample. Following an X'PERT organized computer program, x-ray graph scans are imported and analysed using the Philips X'PERT Graphics & Identify software package for qualitative identification of the minerals from both the data and patterns obtained by scanning at a speed of $1^{o}2\theta$/min. Samples were scanned from $2^{o}2\theta$ to $40^{o}2\theta$ and their diffractograms recorded. The interpreted results were compared with data and patterns available in the mineral Powder Diffraction File (PDF) data book and the search manual issued by the International Center for Powder Diffraction Data (ICPDD) (2001) database for confirmation.

It should be appreciated that, in practice, linking pots to clays through their mineralogical composition is not straightforward. There is the possibility that the original chemical 'fingerprint' has been altered due to the addition of temper to the original clay or contamination during its life and use (Jacobsen, 1995). In this case, other techniques useful in clay chemical analysis, such as Fourier Infrared Transform Spectrophotometry (Ekosse, 2005a) and X-Ray Fluorescence (XRF) can be employed to circumvent the problems. However, the XRPD analyses will provide the basis for further studies using these other techniques at a later stage.

4.4. Limitations

The present study has a number of limitations which need to be discussed. These affected it both directly and indirectly at different levels, from research fieldwork through to scholarly discourse and discussion. An attempt is made here to outline the problems encountered and show how they were mitigated to minimise their impact on the quality of the work presented.

Firstly, conducting research at the confluence was not an easy task. Its current land-use as a freehold nature reserve makes access very difficult. The land is owned by different stakeholders, and acquiring a research permit can be a lengthy process that involves a considerable amount of consultation, and a sustainable rapport needs to be forged in the interests of continuity. It is not unusual to be stopped and asked to identify oneself by some of the owners who have the absolute authority to evict you or refuse you permission to stay in their lodges. Archaeological sites, however, according to Botswana laws belong to the state and, if located within private property as in this case, they can be accessed after consultation with the owner and obtaining a research permit from the relevant government ministry.

Figure 4.2 Mashatu Game Reserve, Shashe–Limpopo Confluence elephants (pic. Haenen, 2007)

As a nature reserve, this area is home to large and small wild faunas. It has the second largest elephant population in the country (Mainah, 2005). The elephants here are notorious for being human unfriendly, and have killed more people than anywhere else in Botswana. This makes research, especially field survey and excavations, extremely difficult. Other animals which make the area unsafe include lions, leopards, hyenas and wild dogs, but these pose less danger than elephants as they are generally not visible during the day. As a requirement and for safety reasons, researchers and research assistants have to stay in secure accommodation. By virtue of its status as a wildlife nature reserve, it is one of the world's most popular tourist destinations. Even though the tourists do not directly create problems for archaeological research, researchers have to compete with them for accommodation and lodging. The game reserve is a private enterprise, therefore there is little or no government control of the rates that may be charged. Also the government subsidies or concessions enjoyed at other similar game reserves are not available. Tourism peaks coincide with the best times to conduct fieldwork, that is, when it is dry and cool. This affects both the duration and timing of the fieldwork, as there are problems in securing accommodation since the lodges and chalets are heavily booked and at above-average rates. To circumvent these problems the research team has to be large enough so that a substantial amount of work is done in a short period of time. Accommodation is very costly and takes over 75% of the research budget.

Even though excavation was not intended to be the main form of data recovery, there were situations where test-excavations produced results which could only be understood by conducting larger and more extensive excavations. This has a direct bearing on the quality of the results expected. A PhD research study has to be completed within a specified time period, but this particular research project really requires more time to be devoted to it. However, as the present study fell within the confines of a larger research project, it was considered appropriate to use data collected from previous field undertakings as a base on which to build. By the same token, the present study will also open up avenues for future research.

Another major limitation is of scholarly nature. As this part of Botswana has not been fully studied before, to some extent it is necessary to rely on the studies conducted in other areas and especially the neighbouring countries. As Lane *et al.* (1998) argue even though Botswana sites should not be investigated in isolation by excluding sites outside its borders, the borrowing of external interpretations forces researchers to adopt constructs and notions that hinder them from appreciating the unique qualities of the local archaeological record. These qualities could be distinctive and can help recognise elements that connect the record with those of the neighbouring countries. Indeed, the Botswana side of the confluence is considered to possess such unique and integral qualities, which contributed to the existence of the Shashe–Limpopo Basin populations for centuries.

5. RESULTS AND DISCUSSION

This chapter presents and discusses the results in two stages, as follows:

- A brief presentation and discussion of the results arising from a preliminary reconnaissance survey (chapter 1.1) conducted intermittently between 2000 and 2003 within the framework of the SIDA/SAREC-funded regional study on *Human Responses and Contributions to Environmental Change* (HREC). This was the work that led to the conception of this PhD thesis, and

- The results and discussion of the present study using the methods outlined in chapter 4.

5.1. PRELIMINARY RECONNAISSANCE SURVEY AND PATTERNS OF SITES

The following were observed during the preliminary investigations of the study area:

a. Landscape comprising hilly outcrops interspaced by valleys or channels, with remnant settlements located on their summits. Completely isolated from fluvial activity these elevated sites had considerable quantities of cultural remains on the surface. The most abundant were pottery scatters even though further investigations, which involved test excavations, recovered human and faunal remains, lithics, animal dung, and iron slag. The ceramic analysis of styles and motifs enabled the finds to be placed within the established chronology of the area. They ranged in age from the earliest, Zhizo, to recent, Sotho-Tswana, cultural types. Test-excavation on raised terrain below Megwe revealed a complete human burial interred with intact ceramic vessels of varying sizes and function. It was situated on relatively high ground free from possible direct fluvial action. The burial was found at a shallow depth, possibly as a result of being exposed to erosion for a long time. Through AMS dating of the skeleton's tooth, a date of *ca.*AD 1049±50 was obtained, making it contemporaneous with Zhizo cultural population at Schroda.

Figure 5.1 Test-excavation revealed a burial on a relatively high ground just beneath Megwe hill

b. In the low-lying areas and floodplains, sporadic occurrences of surface scatters were observed, but in general there was poor visibility of sites. There are a number of possible reasons for the apparent lack of sites on the surface, as was also the case on the hill outcrops and raised grounds. Not in any particular order of importance, these are:

- **Selective and/or preferential preservation** in terrain that was subject to high rates of erosion. The differential visibility could be an effect of accumulation/removal of deposits,
- **Response to risk assessment** in areas that were susceptible to flooding, and a strategic preference for elevated areas, possibly exercised on a long term basis,
- **Economic potential** as these areas have heavier textured soils (Bawden and Stobbs, 1963) suitable for both crop cultivation and pasturage. The FAO (1990) soil classification indicates it to have a high potential dependable yield for, amongst other crops, sorghum, millet, and cowpeas. According to Huffman (1996), sorghum and millet need a minimum of only 350mm/year of rain in the summer growing season, which is a typical average for this area today (Smith 2005; O'Connor and Kiker, 2004). Smith's (2005) recent work shows

this to be approximately the annual rainfall prevailing at the time of the Schroda occupation.

c. A common feature of these low-lying areas is patches clear of trees and often associated with *Cenchrus ciliaris* or other grass species. In the past *Cenchrus ciliaris* has been observed to be predominant on LIA sites and it was used as an indicator to locate sites associated with livestock enclosures, particularly cattle pounds (Denbow 1979).

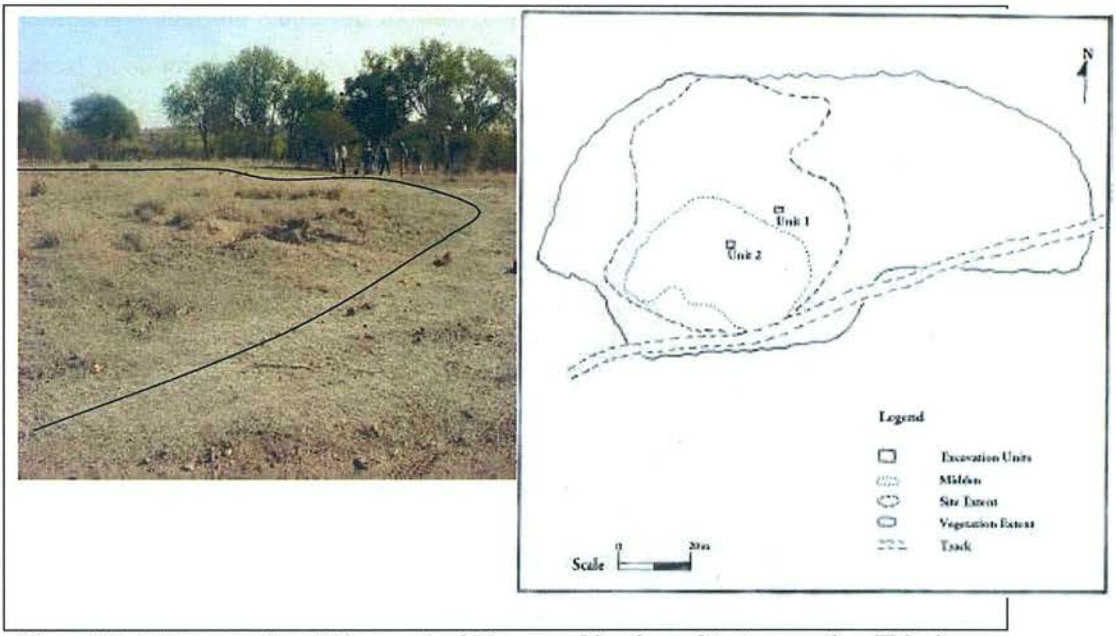

Figure 5.2 A site on a valley 1½ km south of Megwe and its planned test-excavation. This site was identified as a white patch on the aerial photograph. The patch of grass is surrounded by predominantly C. mopane trees (insert the planned midden).

d. A land-use planning strategy was in place. Confronted by temporal variations in climate, the confluence inhabitants had to strategise their use of the landscape by locating their homesteads along the Shashe River, rather than the flood-prone Limpopo, over an area averaging approximately 350km^2. These sites are on average approximately 15km apart. It is assumed that this reflects not just a chance occurrence, but a management strategy where land had to be available for purposes of grazing, cultivation, hunting and gathering, trading, and other specific cultural and ritual activities such as burial practices, as is common among contemporary societies. The floodplain and drainage channels also have pockets of good soils that maintain palatable vegetation for grazers and browsers.

5.2. LANDSCAPE ANALYSIS: INTERPRETATION FROM AERIAL PHOTOGRAPHS AND GIS DATA SETS

5.2.1. Introduction: Sites and their Setting

Landscape analysis employed the use of remote sensing techniques in the form of aerial photography and to a lesser extent satellite imagery. Desktop assessment of mosaics of aerial photographs identified repetitive patterns of certain features of the landscape known to possess or to have potential to possess archaeological features.

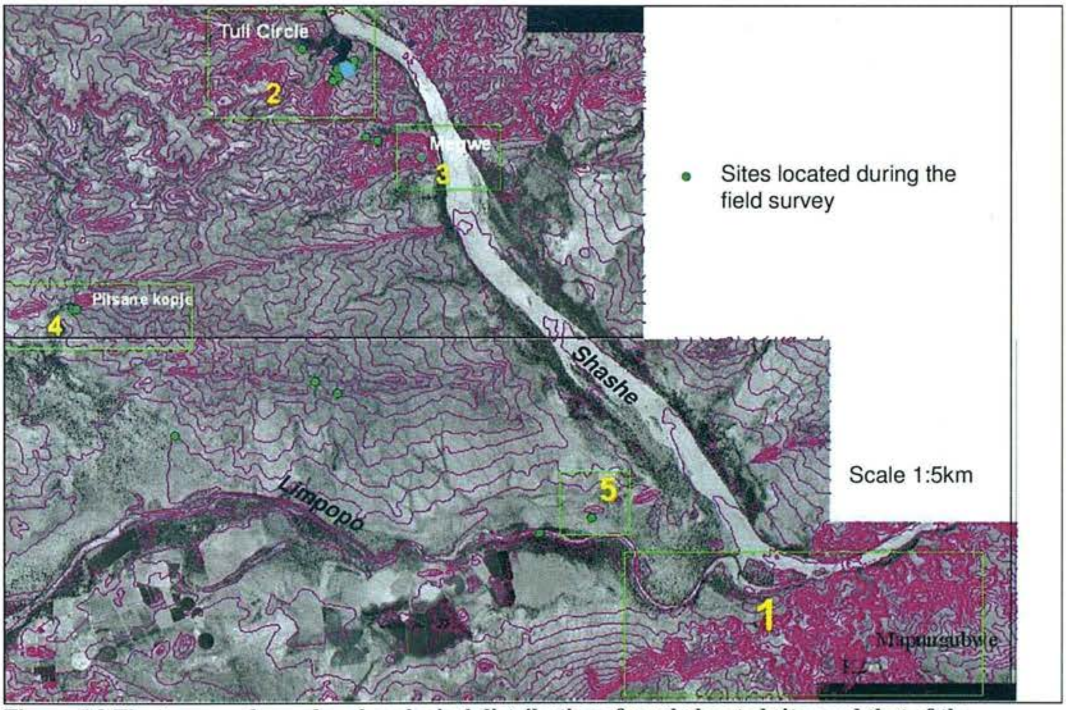

Figure 5.3 The topography and archaeological distribution of newly located sites and that of the of the research area and the known archaeology where 1=Mapungubwe (and Island sites of Botswana), 2=Tuli Circle, 3=Megwe, 4=Pitsane Kopje and 5=Chaile Kopje

Using ARCGIS these aerial photographs were rectified and georeferenced before sites were confirmed on the ground where they were fixed using a handheld GPS. Additional sites not previously identified but located during the fieldwork were recorded and added to the database.

After the field survey the data collected were analysed, manipulated and managed in an ARCGIS environment as outlined in chapter 4, in order to assess the features that make the landscape under investigation archaeologically unique.

As in the preliminary survey the sites identified from aerial photographs were almost exclusively situated on hill-tops and lower-lying, but relatively high, ground above the valley floors. Even the desktop assessment of aerial photographs did not identify any sites on the floodplains. Valley site 1 already known and discussed above, could not be identified either. The sites (Appendix A) that were identified and subsequently confirmed on the ground are presented and shown within their landscape context on Figure 5.3 above and are discussed individually below. They are presented here not on an individual basis but as components of the landscape, as discussed in chapter 4 and they are looked at in terms of their geomorphic settings. These settings are not viewed as site boundaries but appreciated as units of the landscape with dimensions that can be used in mapping human activities. This has been termed an off-site archaeological approach (Foley, 1981a; Foley, 1981b)

As outlined in the methodology chapter, a remote sensing approach was employed in this study to situate known sites within a wider context as well as to locate and discover new sites. This technique produced repetitive patterns typifying certain attributes depicting human modification of the landscape and indeed a significant number of sites were located through this approach. Interpretation of the images is based on visible landscape features, some of which are humanly modified whilst others are natural, but all are considered to have directly or indirectly informed the past occupants on the utilisation of the landscape. The use of aerial photographs was employed mainly as compared to satellite images. After the field survey aerial photographs were found readily available in digitised format from the Department of Surveys and Mapping, in Botswana. They were rectified and geo-referenced and therefore had less error than could have been achieved from the desktop aerial mosaics which were in paper format. Digitised topographic data were also obtained and incorporated. Features were spatially integrated as layers in the geo-spatial database in an ArcGIS environment. Satellite images acquired from Google Earth[2007] were found useful in recognising geomorphological features such as vegetation, rivers and modern land use, but the resolution of the satellite imagery for this part of Botswana is still too low to be able to successfully identify landscape features with archaeological potential.

As expected almost all reflective 'white' patches observed from the desktop were confirmed to be sites during the ground survey. On the ground, however, these white patches appeared bare and did not have any grass cover as observed at other sites previously located using the same technique. For example, Denbow's (1979) reconnaissance survey of eastern Botswana located sites on hill-tops and these were exclusively covered by *C. ciliaris* (or buffalo-grass) type of vegetation. By contrast, in this study the white patches with no grass cover were often limited to hilltops and those colonised with *C. ciliaris* and other grass species proved to be middens on low-lying valley sites, which were not identifiable from the desktop survey. On the ground they existed as "bald spots" surrounded by *C. mopane, C. terminalia* and *acacia* species. The vegetation surrounding the sites is probably influenced by the types of soil in those localities and would tend to differ. Similar observations were made at sites on the South African and Zimbabwean side of the Limpopo River. In South Africa such sites are sometimes called 'secondary' sites, to distinguish them from the large and cultural-material-rich sites, such as Mapungubwe, K2 and Schroda (Bernartt, 2005, pers. comm.)(Figure 5.4).

Figure 5.4 Sites covered by grass species and surrounded by woodland vegetation a) Botswana (June 2002) and b) South Africa (August 2005).

The exclusive appearance of the 'white patches' observed on hill terrain in this study, with and without material remains, is considered to have some implications over and above those that have been raised before. Firstly, the signatures that appear as white patches on the aerial and satellite images are not necessarily the typical *C. ciliaris* grass species observed in previous surveys such as that of Toutswe (see Chapter 2, Figure 2.5). Most of them do not possess grass at all even though this could also depend on the time of the year the photograph was taken and when the sites were field surveyed. Reid and Segobye (2000) have also suggested that the underlying geology could be responsible for the reflective, white, signatures on the aerial photographs and satellite images and not necessarily the grass species. However, they did not elaborate on which rock types might cause this, but the implication is that since the signatures can be identified in areas where the typical grass species or no grass at all is present, then certainly it is not the grass that influences the white appearance on the photograph. Therefore, those without grass do not necessarily indicate former cattle enclosures and middens of Late Iron Age farmers as Denbow (1979) has postulated. Notwithstanding these observations, Smith's (2005) study found a strong correlation between the Strontium isotope signatures of the *Bos taurus* and *ovis/capri* remains and the geology of that area. She interpreted these results as showing a potential for pasturage in the area, which was on the periphery of the centres and most likely to have been used as cattle posts to ease carrying capacity pressures from these centres. However, this was not related to whether the grass species available were palatable to grazing cattle. At a symposium held recently on research in the Shashe-Limpopo Basin, Hanisch argued that the grass species at the confluence were unsuitable for grazing cattle and this could be a reason why there is no evidence of large accumulations of cattle dung and middens as observed in eastern Botswana and on the margins of the Kalahari Desert (Hanisch, 2007). Probably, this is where the cattle posts were and the exclusive predominance and association of such sites with *C. ciliaris*.

Secondly, this study has revealed a larger number of white patches over a relatively small area (less than 350 square kilometres) than anywhere else known. This could be attributed to the higher resolution of the technique used compared to the reconnaissance surveys of the late 1970s, and the ability to manage and manipulate data within an ArcGIS environment has enhanced the degree of certainty on the location and specificity of sites being investigated. After the fieldwork study, when these images were shown to T.N. Huffman (pers. comm., June 2006) and R.W. Payton (pers. comm. May 2006), their immediate response was that they were cattle enclosures (byres) and savanna glades, respectively. However, they both concurred that it was the first time they had seen such enclosures so concentrated in one area like at Tuli Circle 2 (also selected for geochemical analysis in section 5.42). Among contemporary societies, it is not common to have numerous kraals in one place. In the field and through test-excavation it could not be confirmed that these were cattle or livestock enclosures. Lastly, as already indicated, sites with grass species, some of which were confirmed to be *C. ciliaris*, were located on low-lying terrains by fieldwalking. These sites were not picked out on the aerial photographs. In spite of their smaller size, when compared to large sites like Toutswe and Lose (Figure 5.5), they tend to be similar in terms of the type and extent of the vegetation and the presence of middens. The latter sites were, however, located on hilltops in the late 1970s through aerial reconnaissance survey by Denbow (1979, 1983).

Figure 5.5 Lose Iron Age site situated on the summit of Lose hill in eastern Botswana (photo: L. Kgobe)

From these observations it became increasingly evident that we were confronted by a dynamic land-use enigma that could not be investigated by traditional methods of data collection like excavation alone. There was a need to investigate and/or interrogate the landscape for signatures that would help us understand the choices and use of resources offered by the landscape to its inhabitants. If we could identify the types of activities, then we could understand how the landscape acted as a medium for land-use diversification, resource utilisation, and human behaviour. It is evident that preliminary survey and landscape data from aerial photographs are in close agreement in facilitating a framework that could show the influence that a geomorphologic setting of the area had on settlement decision making and the resultant characterisation of varying types of activities. Since the relationship between geomorphologic units and site location is our main hypothesis, the study of the landscape was viewed as having two broad distinctive units suitable for analysis: a) the hilly-outcrop and the low-lying valleys but situated on the high-ground, and b) the floodplain terrain. The results presented and discussed in the following sections are of sites located using aerial photography as a reconnaissance technique for identification of sites with archaeological potential. An assessment of their spatial variation as a dependent of terrain was undertaken using geochemical analytical procedures, and the results are discussed in section 5.4.2.2.

5.2.2. The Hilly Terrain

The hilly terrain contains sites located on hill outcrops. These hills are not particularly high. The highest point with a beacon is 580m, which did not have any archaeological remains. All those with some archaeological remains do not exceed 560m and they tend to have a flat top. The hilly terrain sites are Megwe (550m), Tuli Circle (549–551m), Pitsane Kopje (558m), Chaile Kopje (517m) and the Confluence Island (Figure 5.3) within an area covering 20 x 30 square kilometres. Due to time and financial constraints, the Tuli Circle, Megwe and Island sites were test-excavated, whilst Pitsane and Chaile kopjes were only field-walked. These sites are generally in open terrain and were relatively safer to explore, taking into consideration the hostility of the area due to wildlife. Chaile Kopje is a stand-alone low relief rock outcrop in the floodplain overlooking the confluence and about a kilometre away from the Limpopo River to the east. Pitsane Kopje on the other hand is part of the rugged hill terrain that stretches from the floodplain toward the north, which is cut through by the Shashe River to the north. It is situated further away from either of these two major rivers. It is however, flanked by the floodplains of the Limpopo and its tributaries. The following discussion is mainly based on the field and post-field results from Megwe and Tuli Circle as sites that were extensively covered, whilst other sites will be used where relevant to elaborate and augment the data and interpretation.

5.2.3. Megwe Hill and Valley Site 2 Archaeology and its Implication

The Megwe site was first investigated in 2000 within the context of the broader framework of the research project, *Human Responses and Contributions to Environmental Change* (HRAC) discussed above. As a prominent site and easily noticeable, Megwe was one of the known sites used in the aerial images to assist in the identification of patterns characteristic of archaeological sites during the desktop analysis. It is a rugged basaltic-granite hill outcrop situated 550m above sea-level and it overlooks the Shashe River to the north (Figure 5.6). Like most of the habitation hill sites, Megwe has a flat summit with an area covering approximately 30,000 square metres. It had a significant accumulation of cultural materials concentrated on one side of the site and this is the area where test-excavations were conducted. Access to the hill top was easy from the south-western side through a steep and rocky trail that was also littered with archaeological materials, which have been washed down from the top, and this part of the hill is taken to be part of the site. It is likely that this track, even though it is not visible on the aerial photographs, was used in the past to access the site as access from the other sides of the hill is difficult because of the steepness of the terrain.

The site of Megwe and the valleys around it were field surveyed in 2000 and 2002. Valley site 2 is located immediately beneath Megwe hill but on relatively high ground, and for the purposes of the present study it was considered as part of the main site. During 2000, test excavations were focussed on sites located on the hilltop. Five (5) test-pits ranging in size from 1 x 1m to 2 x 2m and trenches of 2 x

3m were dug. A considerable quantity of materials — largely ceramics, bone fragments, beads and metal remains — were unearthed.

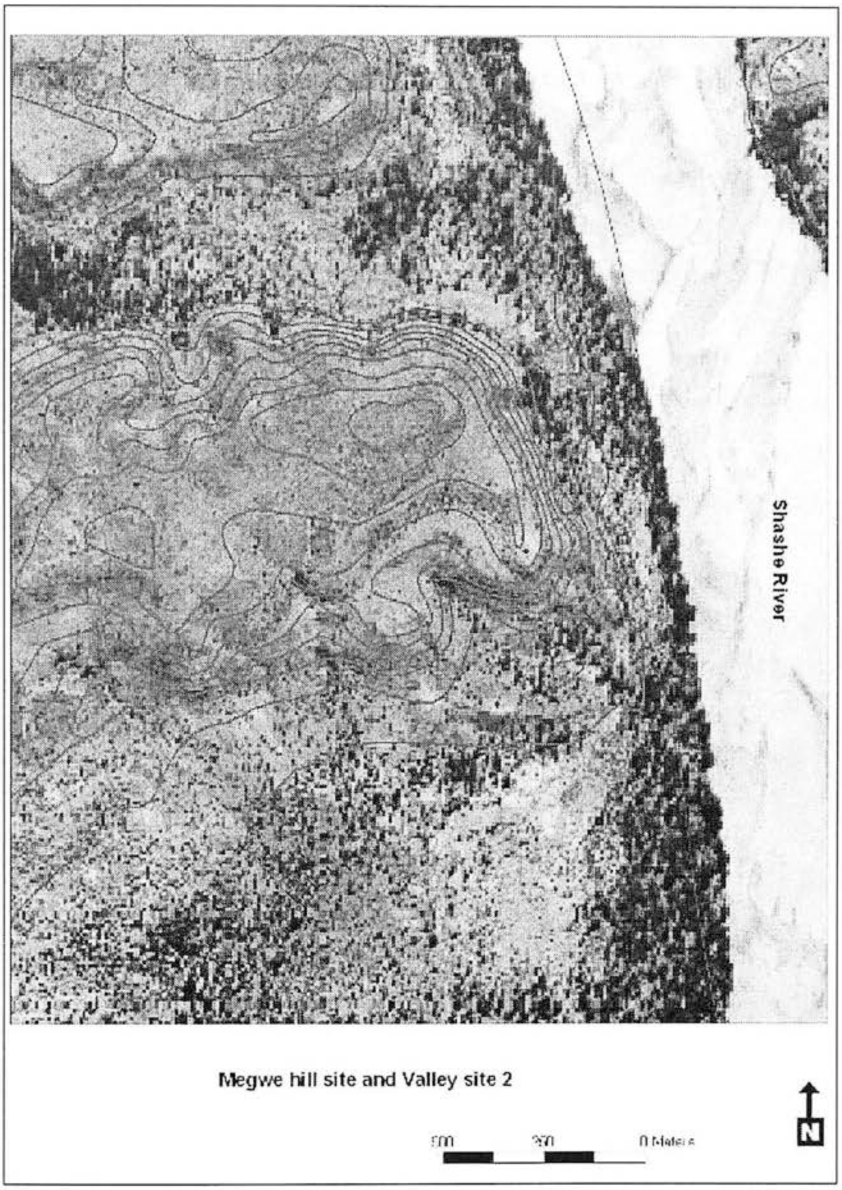

Figure 5.6 Aerial photograph showing Megwe hill site and valley site 2 below (see figure 5.1 above)

Since the remote sensing technique was designed to generate spatial data, the materials recovered were not assessed for their chronostratigraphical information. The established database on chronology of the Basin and the wider region will be used in the discussion and interpretation of this data. Some of the materials (objects) recovered are shown on plate A from Megwe hill site. Of the excavations conducted, square A (2 x 2 m^2) was dug to level 10 (90–100cm) before reaching the bedrock. The deposits were loose and dry, making it difficult to assess and define the profile. This further made it difficult to differentiate and account for any lateral movement and vertical displacement of material, especially as cultural materials were recovered from every layer. A large quantity of archaeological materials were recovered from square A, and because of their fragmentary nature and the wide variation in materials, it was interpreted as a midden deposit which was also highly disturbed due to the burrowing activities of small animals.

These animals tend to bring to the surface materials of early occupation periods because on the surface ceramic fragments, with distinct and typologically known stylistic variants could be identified. Figure 5.7 (below) shows a grinding stone filled with potsherds by tourists.

Figure 5.7 Characteristic sherds from the surface of Megwe hill with chronological known styles (see figure 1.3)

From the decorative motifs they can be identified and chronologically affiliated as ranging in age from the Zhizo period to historic times. Samples from this test-excavation have been analysed for their mineralogical composition using x-ray powder diffraction (discussed in Section 5.4.5) to assess if there is any difference in the clays used for the production and manufacturing of the ceramics vessels.

From the evidence of this study it is apparent that Megwe as a hilltop settlement site was strategically located both for defence from both human and animals and of course for its spectacular view of the magnificent Shashe River. Most significantly, as a habitation site Megwe was away from the risk of flooding from the nearby

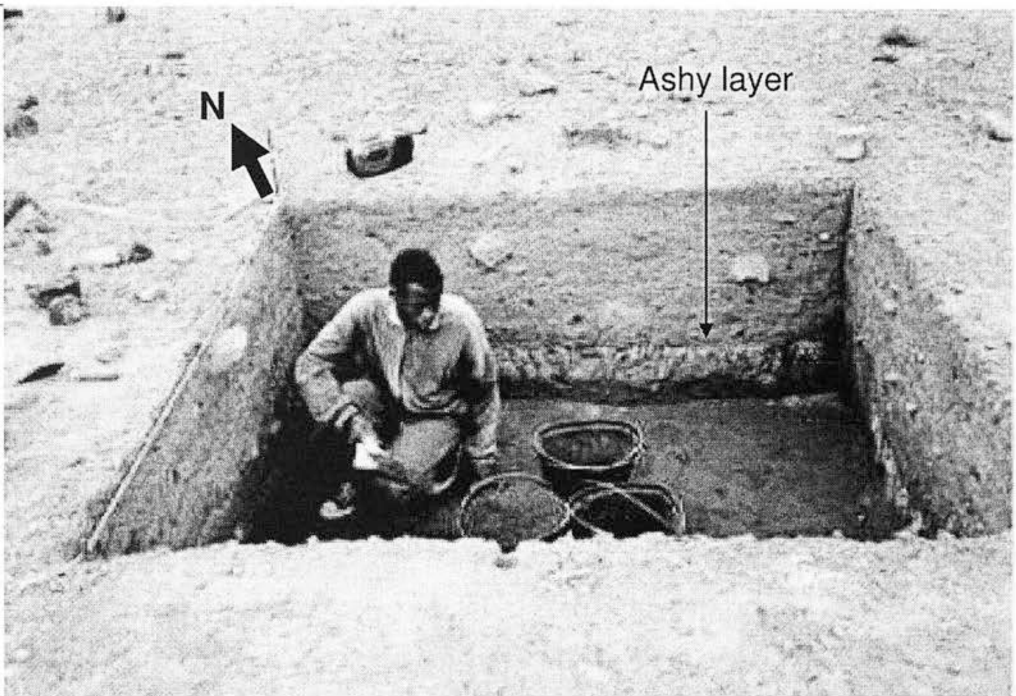

Figure 5.8 An excavation on top of Megwe hill produced a white ashy layer separating cultural materials

Shashe River whose waters at full capacity cover most of the bottom part of the hill and its surroundings. All the units excavated produced a considerable quantity of archaeological materials not covered within the scope of this study. The test-excavation unit that will be discussed here is that of Megwe square E (M2KE, which is located 10m north-east of square A mentioned above. This test excavation unit is considered important to discuss because, in spite of not producing a particularly large quantity of materials and not exceeding 0.8m in depth, it presented a profile that is critical for understanding the use of space among settled environments (Figure 5.8). The first few levels of the excavation produced different types of materials which, like the other units, comprised mainly potsherds with a few fragments of bones, lithics and beads. At level 5 (40–50cm), a compacted layer lacking cultural remains was encountered. This material was dry and ashy and continued vertically for 20cm. After level 7 (60–70cm), there was a reappearance of cultural materials, which continued until the bedrock was reached at 80cm depth.

This excavation proved interesting and revealing about the kinds of activities that were undertaken on that particular landscape unit. The cultural materials recovered above and below the ashy layer are indicative of human use of the immediate surroundings over a period of time. It is not apparent what types of activities were undertaken, but it is probable that it was a midden as the materials recovered compare well with those from other excavated units in the site, especially square A. The ashy layer, however, suggests a different use. The consistent presence of a uniform deposit with no inclusions of cultural materials implies an exclusive use of the site for a specific purpose. The thickness of the layer can further be interpreted as an indication of continuous use for that specific type of activity for a significant amount of time. From close visual inspection of the material it was interpreted as livestock dung. It is not clear what type of livestock produced the dung, as no tests were performed and no chronological information was gathered to ascertain when it was deposited. However, following the principle of superposition, it may be suggested that the cultural materials found below this layer were deposited first and those above it are later, implying continual use of the space over time but for different types of activities. This evidence is critical in the sense that it provides us with vital information on how the occupants of the site perceived and managed space.

Further evidence for long-term use of the site comes from ceramic typology and environmental data, which can be used to understand the dynamics of Megwe and the surrounding plain. The ceramic designs (Figure 5.7) from this site show that it was continuously occupied from the earliest period to the historic times of the Mapungubwe Cultural Landscape occupation. An excursion made to the site in the company of some of the pottery specialists during the Pan African Archaeological Congress in 2005 confirmed the presence of Zhizo, K2, Mapungubwe and later pottery styles among the surface scatters. A secure date from the Valley site 2 burial suggests Megwe to have been settled already at the time of the K2 occupation, and the Central Cattle Pattern (CPP) at K2 has been interpreted as showing the reliance of the people on livestock in these settlements (Smith, 2005). It has also been suggested that the peripheral sites could have been used to ease pressure on those major sites and the hinterland such as Megwe and the outlying sites are likely to have been areas with a potential for grazing as suggested by Smith (2005) whose Strontium analysis study strongly indicate the area to have been used for pasturage. There are floodplains nearby, as well as valleys in between the hills with soils that have good moisture retention capacities. These serve as micro-environments with good soils and vegetation that are exploitable for human and livestock use. This thesis is further explored in Section 5.2.4 which discusses the archaeological potential of the floodplain.

The past environmental models of the Shashe–Limpopo Basin discussed in Chapter 2, present changing climatic conditions through out the time of the occupation. The Basin was characterised by dry and wet episodes. These changing conditions had both positive and negative impacts on the use of the landscape. The appearance of white patches (or savanna glades) on aerial photographs has also been used to suggest that the hilly terrain of the confluence zone could have been utilised for livestock herding management to ease pressure on the capital of K2 and Mapungubwe. It is suggested that during wet periods the valleys and floodplain terrains may have been unsuitable for livestock enclosures. In particular, small stock, *Ovis/Capra*, does not normally prefer waterlogged environments and it would have been difficult to construct their pens in the surrounding valleys and floodplains during wetter climatic periods. Hence, it would have been more practical to have their enclosures on elevated areas such as hill-tops. It is also likely that the presence of savanna glades on these site and those at Tuli Circle 2, are indicative of a land-use management strategy where small stock enclosures were used in rotation in order to meet the immediate needs of the occupants. It is common among Tswana-Sotho contemporary societies to have small stock within and around their homesteads, as observed at the confluence of the Selepswe and Manake Rivers (Plate B) near Mathathane. It is locally called *Dikgatlhong* (see Figure 1.3 for its location) which translates into the confluence of rivers. There is a series of small stock enclosures; some are no longer in use and have thick accumulations of dung, while others that are still in use have livestock rotated around them. For example, there were three active small enclosures for just one family, comprising husband, wife and granddaughter. When asked why that was the case, Mr Makwati[1], the head of the family, said this was because at night they separate the young animals from their mothers. At other times they also separate lactating mothers from the rest of the flock to avoid inbreeding and loss of milk, since one reason for having the animals around was to provide the family with milk.

With the number of savanna glades that are highly pronounced in the study area coupled with some of this ethnographic data, as already suggested these features could have been for small stock rather than cattle enclosures. The shorter reproductive cycle of these small ruminants gives them a comparative advantage in terms of recovery following disease or drought and they can be acquired in significant numbers. Livestock diseases such as *trypanosomiasis* (also known as nagana or sleeping-sickness), caused by tsetse-fly, have been cited as having been endemic in the 19th century, with some authors suggesting that this could have been a possible reason why the area could not sustain permanent populations (Tsheboeng, 2001). This disease is prevalent near watery environments and it was also associated with movement of the Bantu people from the Zambezi catchment area during the first century AD (Plug, 1997; Pwiti, 2005). If it was a common occurrence as suggested and the climatic conditions were favourable (wet) then the frequent outbreaks of the disease could provide the answer to Hanisch's (2007) question and explain the high concentration of savanna glades in the research area.

[1] Mr Markwati, 80 years old resident of Bobonong with a cattle-post at the confluence of Manake and Selepswe Rivers.

Below Megwe hill on the valley and mainly on high-ground are sites that are loosely referred to as valley sites, in order to distinguish them from the hill-top sites. Three sites have been test excavated. These are generally referred to as Valley Sites 1, 2 and 3. Valley Sites 2 and 3 are in the vicinity of the hill, whilst Valley Site 1 is situated $1^1/_2$ kilometres away on flat terrain. The significance of the latter is discussed in Section 5.1 under the reconnaissance survey. This type of research was not included in the work conducted at valley site 3 in 2004 by the archaeology team from the University of Botswana. However, access to the materials from the field was permitted and even though the data are not discussed within the context of the research results, some samples from this site were included for consideration in the geochemical and XRPD analysis for comparative purposes. It is Valley Site 2, situated just over 300m below Megwe hill (see Figure 5.1 and Figure 5.9 below) that is of relevance. It was test-excavated during the 2002 field season. It is an open site situated on high ground and flanked by the valleys and streams sloping toward the Shashe River. Compared to Megwe located on the hill summit, Valley Site 2 had few scatters of potsherds visible on the surface and round about. Even though it is possible that it was more exposed to weathering and erosion, it had the characteristics that were used to identify sites. Its open nature and the way the vegetation was limited to its margins is typical of a humanly induced micro-ecological zone, as employed in site recognition in the area. It was not surprising when it appeared as distinct on the aerial photograph during desktop analysis. Two 1 x 1 test-pits were opened. The first test-pit produced a few cultural materials but only recovered from the upper part of Level 1 and excavation was abandoned at the end of this level as only stone rubble was being recovered. The second test-pit, located 10m south of the first, had very little archaeological material on the surface and at about 5cm depth human remains were exposed. It appeared that the test-pit had intersected the middle of a burial. It was therefore considered appropriate to widen the excavation by a metre in each direction thereby converting it into a 2 x 2 metre trench. As the digging progressed both laterally and vertically, a skeleton surrounded by cracked and very distinctive ceramic vessels emerged.

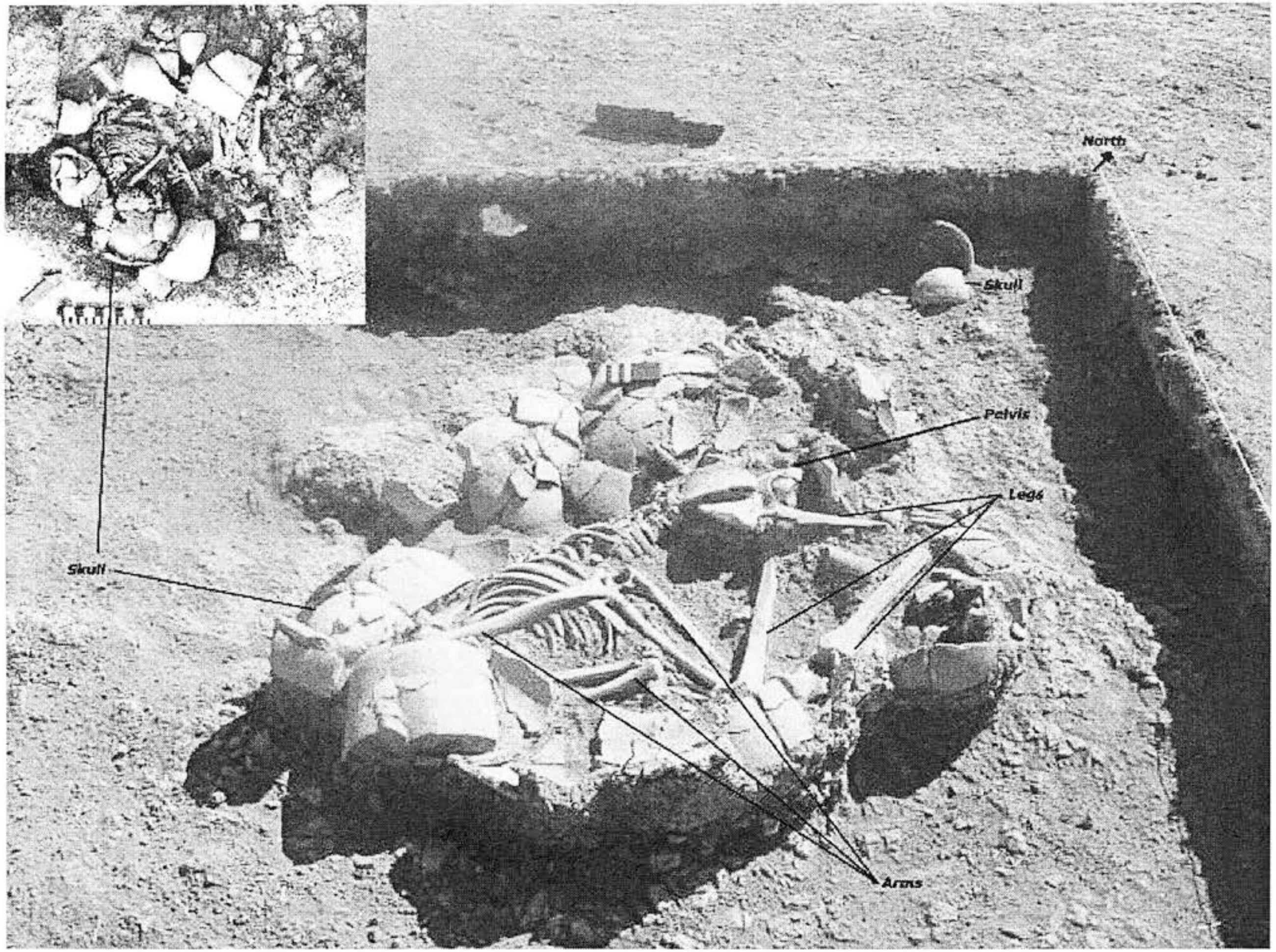

Figure 5.9 A burial excavated during a test-excavation at Valley site 2 below Megwe Hill. Similar burial practices with vessels accompanying the dead have been observed at K2 burial sites (insert)

By the end of Level 2 (20–30cm) the whole body was exposed. It had been buried in a crouched position facing west. The wrists, ankles, waist and neck were surrounded by blue glass beads which appeared to have been worn around these joints at the time of burial. Even though the gender of the individual was not formally established, it is very likely (for reasons discussed in Section 5.4.1) that this was a female burial. This gender identification is also influenced by the quantity of ceramic vessels surrounding the body. In this unit further to the north, more human-like bone remains were visible in the trench wall and on the surface. The excavation could not continue, however, as this was a test and the area was earmarked for future excavation which needs to be systematic and more tightly focussed on recovering chronostratigraphic and socio-cultural information. The burial, however, was extremely shallow and it is not clear whether this is due to surface erosion since the time of burial, or if the corpse was deliberately buried in a shallow grave. It is worth noting that the K2 burial was also very shallow, and it is possible that the preferred burial locations were difficult to dig as the soil was hardened by calcareous accumulation in the upper horizons.

Bone samples were collected and sent for radiocarbon dating to the Centre for Quaternary Research at the Council for Scientific and Industrial Research (CSIR) in Pretoria. The ^{14}C age was confirmed as ca. AD 1049±50. This date suggests that the occupation of the site coincided with the earliest occupation of the Basin by the Zhizo agro-pastoralists (see Chapter 2, fig. 2.7) and/or the K2 period. The beads associated with the burial were all similar in size and colour. They were small (0.5mm in diameter), cylindrical in shape, and generally transparent to translucent, turquoise to blue-green in colour. This description interestingly is similar to that provided by Wood (2000) for Zhizo-type beads. A similar burial practice of ceramic vessels accompanying the dead in large quantities was common among the K2 burial sites (Tiley, 2004) as shown in Figure 5.9 (insert) where a burial of a child at K2 revealed similar types of ceramic vessels. As discussed in Section 5.4.1, below, comparison of the burial with that from Tuli Circle 2, suggests there could be some form of ritual significance in the mortuary practice followed, related perhaps to belief in an after-life where ceramic vessels would be needed by the deceased.

From the perspective of this study, with its emphasis on spatial use, the functions of Tuli Circle 2 and the hill-top Megwe site seem to be significantly different. From the type of materials recovered at both sites, it can be concluded that the Megwe site was predominantly a habitation site which, judging by the thickness of the deposits, was occupied for over a long period of time. Test excavations on the hill were many and close to one another and, yet, none of the test-excavations on Megwe produced any human remains. Megwe was also littered with surface cultural remains. On the other hand Valley site 2 just below the hill, had few cultural materials visible on the surface, and the second test excavation produced burial remains. It is suggested that it had a specific use, as a cemetery or graveyard. From the perspective of the present study, this appears to be a classic illustration of people's perception of the landscape. The valley 2 site is on an elevated surface, free from flooding and yet not far from the main habitation site. As already suggested, the period of occupation coincides with a wet climatic phase in the Basin and, if the situation presented by occasional wet periods in the contemporary Shashe–Limpopo confluence is anything to go by, it would have been extremely difficult to find suitable places to bury the dead in this landscape during such wet phases. Another aspect to this choice of location lies with the cosmology and worldview of death and the sun. It is often believed that the sun has set on the dead and since they will never see it again they should be buried in the eastern side of the settled areas. This burial is located to the east of Megwe hill, which means the sun sets early on the site.

It also has to be appreciated that the Shashe and Limpopo Rivers and climatic changes in the watershed of their tributaries created a dynamic landscape and therefore a variety of cultural responses. The inaccessibility of the main centres during wet seasons could have had negative impacts; socially, culturally and economically. If Valley site 2 was a graveyard, it is possible that it may also have been utilised by the occupants from Tuli Circle, with Pitsane Kopje as another alternative burial site (see an unpublished report by Hanisch (not dated)). It is hoped that further work on the site will provide information that will enable us to further develop these ideas on the riverine dynamics and land-use management strategies.

5.2.4. The Floodplain Terrain

The floodplain in this study is a flat, low-lying terrain between the confluence and the Shashe and Limpopo Rivers with an altitude not exceeding 527m above sea level. Its limit is defined by the start of *C. mopane* woodland and the rocky terrain. Owing to the complex physical character of the Basin, with the confluence being the point of minimum altitude, this area periodically suffers from major flooding resulting in removal and accumulation of sediments. Ethnographic data in the form of oral interviews with some of the residents confirm the flooding phenomenon as the main reason why the Limpopo floodplain was deemed unsuitable for long-term human occupation by Chimangane (2005, *per.comm*)[2]. This observation was also recently brought up by Huffman (2005) who purports that "when the Shashe occasionally floods, it acts as a dam wall and backs up the Limpopo for several kilometres (Huffman, 2005:8). Chimangane graphically described how the Limpopo has nowhere to flow if the Shashe is full, but has to empty its waters over the floodplains. In terms of the flow regime, both the Shashe and Limpopo rivers flood from time to time, as was the case in the year 2000 as a consequence of the unusual climatic condition associated with the El Niño event. The area witnessed massive floods, which created alluvial terraces later cut through by streams eroding away sediments and pediments.

These terraces characterise the floodplain, which is quite distinct from the immediate Karoo sandstone escarpment to the west and towards Tuli Circle. The vegetation is predominately evergreen woodland with species such as *Boscia albitrunca* (Motopi), *B. foetida* (Mopipi) and *Xanthocercis zambesiaca* (Mashatu). The Mashatu tree occurs in the alluvial soils along the watercourses and most of them are reported to range in age from 300 to 600 years and the tree can reach a height of 30m (Palgrave, 1983). Acacia species are also visible especially in areas that were presumably cultivated and in depressions. No *C .mopane* is visible in this landscape. This landscape unit is scarred by gullies and traces of ancient trackways, pathways and depressions transformed by erosion and aggradation.

[2] Chimangane is 85 years old and has lived continuously in the area since the 1920s working as a farm labourer. He was interviewed 25 August, 2005

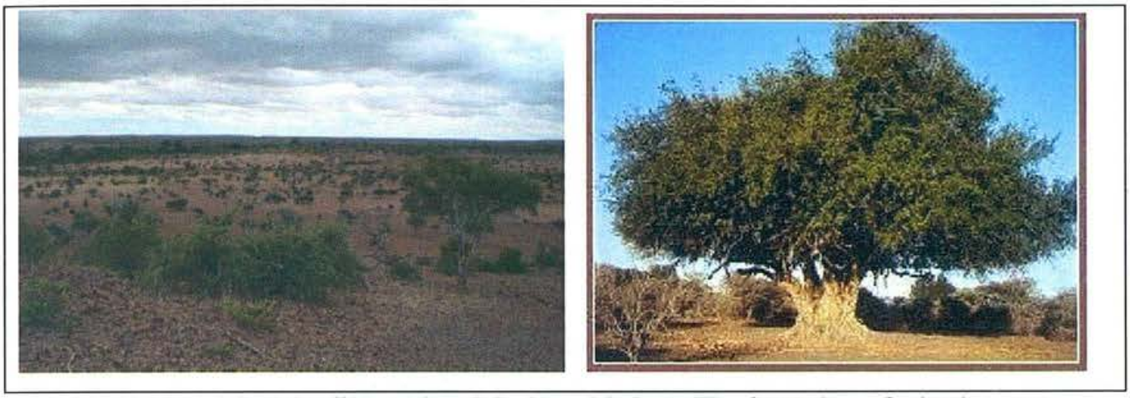

Figure 5.10 Motopi (*Boscia albitrunca*) and the large Mashatu (*Xanthocercis zambesiaca*) trees are typical woodland vegetation of the floodplain (Source: www.tulileopard.co.za (accessed 30/10/2007)

The results presented in this section largely relate to the area at the confluence of the two rivers, where there is an immediate and sudden drop in altitude, producing an open flat terrain with escarpments, 8–15km away from the Limpopo river. The weathering of the basaltic-granitic rocks that characterise the solid geology of the confluence have a bearing on the types of soils in the floodplain, valleys and depressions in between the hills, as discussed below.

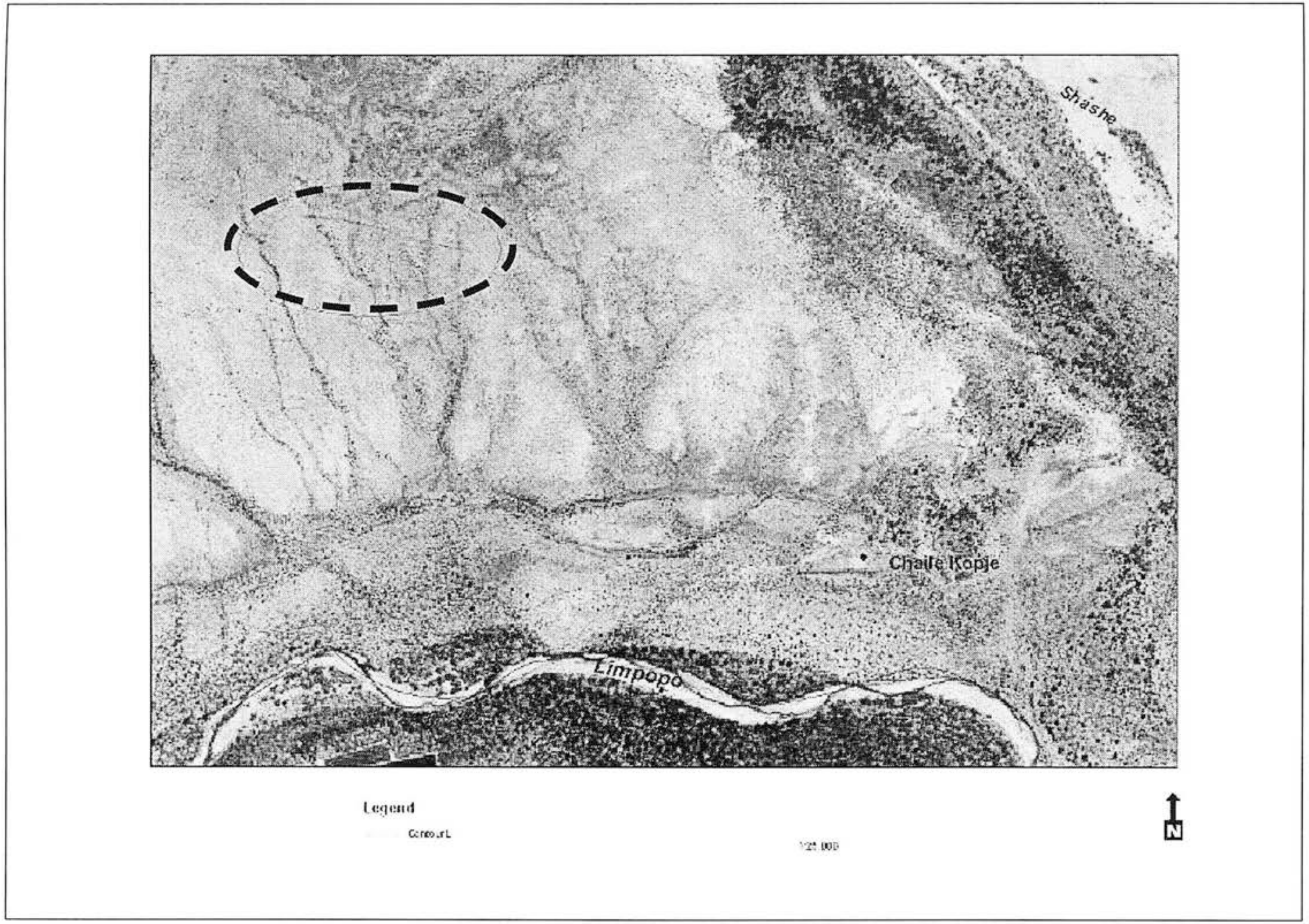

Figure 5.11 A dissected floodplain showing pediments and gully erosional surfaces as an indication of an active landscape in the past

5.2.5. Archaeological Implication of the Floodplain Terrain

Analysis from aerial photographs of this landscape unit showed pediments sloping toward the rivers and extensive gulley erosion (Figure 5.11). Pediments are erosional surfaces of low relief, partly covered by a thin layer of alluvium, that slope away from the bases of escarpments; they are a common feature of arid and semiarid environments (Thomas, 1989). The pediments are dotted with isolated hills, for example Chaile Kopje (Plate C) as well as ridges, elevated areas (see Plate D) for sites around Pitsane Kopje) and stream channels with well developed alluvial soils that were often attractive for human habitation and agricultural exploitation. The alluvial deposits overlie the inclined bedrock surfaces of the lower pediments, and reach considerable depths where the pediment meets the boundary of the hilly terrain. The pediments in the floodplain form sequences of terraces along rivers and their tributaries (Bawden and Stobbs, 1963). Where there are abrupt breaks-of-slope pockets of soil occur which could retain moisture for a significant amount of time. In addition to retaining moisture that can be exploitable throughout the year following adequate rainfall, they can be useful as passage routes for both vehicular and foot travel by humans and by animals as they are on high ground away from flood Basin floors. Chaile Kopje is a raised isolated hill in the middle of the plain and on its summit there is evidence that it was settled for brief periods of time. These could have been at times when the surrounding landscape was cultivated as most of the material remains observed was related to arable farming practices. These include grinding stones and stone features which fit the description of grain bin stands as noted in the vicinity of Pitsane kopje (Plate D). From aerial photographs pediments are identified by surfaces that are not too deeply or intricately dissected by drainage channels (and gullies). In some instances these surfaces are covered by calcareous gravel, whilst in other instances owing to weak structure the soil is easily removed from the pediment during a significant flood event. As outlined in Chapter 2 summer storms can dump large amounts of precipitation in short periods of time and they are important erosional and depositional forces which result in the area being highly dissected, as shown in Figure 5.11.

Visible also on aerial photographs are deep gullies which tend to characterise the entire terrain. The geomorphic processes operating within the Basin were critical for how the region was inhabited from prehistoric times up to the present day. The washing away of sediments producing the gullies is a consequence of land use practices, coinciding with the first clearance of the savanna woodland in the area. There are areas within the floodplain terrain with pockets and levees of waterlogged clay soils as described by Bawden and Stobbs (1963) and described in chapter 2 which can be difficult to access during rainy periods, however with time they become physically manageable as they retain water and can easily be exploited for cultivation during dry periods and when rains fail (Manyanga, 2006). The floodplain soils are classified by FAO as Luvisols (Lk4-2ab). This means that they are products of moister conditions, with a low cation exchange regime and high agricultural potential as they are cultivable even though they are not highly productive (Payton, pers. comm. 2006). Because of these properties it is no coincidence that the area was considered for commercial farming in the early 1900s by the colonial administrators; the project however proved unsuccessful. This could further explain why the area was continuously occupied from prehistoric to recent times

In addition to the pediments and sediments on the floodplain, distinctive on aerial photographs are track- or pathways leading to and from the river channels (some of these track-ways terminate without connecting to others and may therefore link isolated activity areas — see circled area on Figure 5.11, above). Studies in more arid environmental settings, such as that by Ur (2003) in north-eastern Syria, concluded that such tracks were used by both humans and animals en route to and from water sources, fields and pasture. Even though their studies are based on a broad regional landscape compared to the one investigated for the present study, the findings are useful as indicators of how the presumed densely populated and complex Mapungubwe society, which was involved in agro-pastoral and diverse socio-economic practices, could have used its surroundings. For example, as a wetland environment, the floodplains possess attributes which today, as in the past, make it vulnerable to extensive degradation and destruction by land-use practices through over-gazing, water abstraction (e.g. the Dam constructed at the confluence for the Venetia diamond mine in South Africa), and invasive vegetation and wild animals (Tooth and Mccarthy, 2007:31). The Shashe–Limpopo confluence floodplain in this sense represented the only reliable source of water in an otherwise dry-land setting, and hence its importance cannot be underplayed. Usually the points where rivers, streams and their tributaries meet tend to be opportunistic areas for digging wells (Lindholm, pers. comm., 2006), which can sustain the community through the dry season. These are important focal points that potentially could yield important archaeological records of past human activity.

5.3. SUMMARRY OF THE ARCHAEOLOGICAL AND ENVIRONMENTAL CONTEXT OF THE LANDSCAPE ANALYSIS

Previous studies have demonstrated that aerial photography can be employed effectively to locate archaeological sites (Denbow, 1979; Maggs, 1976; Mason, 1968; Payton, 2005). In southern Africa they have been used successfully to locate and identify Iron Age sites, a) with stone-walling as in the case of Mason (1968); and Maggs (1976) at some sites in South Africa and b) as indicated by white patches of grass, later confirmed to be cattle/livestock enclosures in Botswana by Denbow (1979, 1984). In Denbow's work the grassy white patches were also found in association with considerable numbers of dung middens. Some studies have argued that these middens are not necessarily related to cattle since no analyses have been performed (Peter, 1999; Reid and Segobye, 2000). Reid and Segobye (2000) also noted that the faunal analysis from Denbow's sites show small stock, sheep and goat, to be as equally represented as cattle. In East Africa, too, the patches phenomena have been observed; they are commonly referred to as savanna glades and are attributed to settlement sites of former pastoralists. Payton (2005) describes these as features that:

> "... represent nutrient-enriched patches related to abandoned cattle enclosures that become dominated by nutrient-rich grass species that are particularly palatable to wild grazing ungulates such as eland and impala. They are

> then perpetuated in the landscape by browsing and grazing activities that act to suppress the invasion of trees and shrubby seedlings." ((Payton, 2005:49)

Many of the sites under study lack the nutrient rich grass species described above but they are frequented by ungulates which could be responsible for the suppression of the vegetation. There is no evidence either to suggest that they could be cattle enclosures.

However, the results from this study and especially the large concentration of white patches in one area call for other explanations. Comparisons with contemporary societies do not provide support for cattle enclosures being in such close proximity. Peter (1999) has argued that vitrified dung found in areas identified on aerial photographs and interpreted as cattle enclosures does not necessarily represent cattle middens. He suggested they were related to the keeping of small stock. This is a plausible suggestion considering that small stock can be kept in small areas, and the herding practices require a few enclosures or pens in order to separate livestock for different purposes. For example, goats and sheep are normally kept separate from one another, and it is also common for the young animals to be kept separate. This could result in a series of kraals in a limited area but belonging to one family or homestead. The middens on low-lying areas had stubs of grasses which could not be independently identified as *C. ciliaris* species but were surrounded by woody vegetation as shown in Figure 5.4.

The basis for the desktop assessment followed the technique employed previously by Denbow (1979) on aerial photographs. In his reconnaissance survey he observed white patches which, when confirmed by fieldwork, were found to be associated with *C. ciliaris*. They were later interpreted as LIA archaeological sites with cattle enclosures. Denbow used this method to successfully locate a considerable number of farming sites in eastern Botswana. A similarity to Denbow's observation in this study is that the white patches occur frequently on hilltops. However, no extensive middens as recorded in

Denbow's work were immediately visible, nor was there any extensive grass cover as at Toutswe and related sites.

As the confluence area is a nature reserve these sites are frequented by ungulates especially antelopes and other large browsers such as elephants, giraffes and wildebeest, hence Payton's (2005) assertion above. This could have also had an influence on Smith's (2005) Strontium analysis results as pertaining to herd pasturage. The presence of archaeological deposits attests to cultural activities also taking place and they date to the earliest occupation of the Basin. As outlined in the aims and objectives for using this technique, these are landscape signatures indicative of the diverse spatial use by past communities in the confluence area.

It can therefore be concluded that by using the landscape analytical technique of aerial photograph interpretation it has been possible to appreciate the effect of the geomorphologic setting on the settlement patterns of the confluence area. It is evident that the inhabitants employed a land-use management strategy that was influenced by the geomorphology, including the placement of their habitation sites and the overall utilisation of resources within the Basin landscape. Settlements were situated on hill-tops and elevated areas as has also been observed in neighbouring Zimbabwe and in particular South Africa where the well-known sites of Mapungubwe, K2 and Schroda are all on hill summits away from the floodplain (Figure 5.3). From the site distribution map and the land units of Botswana presented in Figure 2.1, more than three quarters of the contemporary population resides in the eastern part or hardveld, an environmental and land-use setting that matches the distribution of archaeological sites especially those associated with farming communities. The dearth of sites in the research area was further attributed to a lack of interest in the area due to a common perception that its environmental backdrop offers limited potential for human settlement because of the predominantly low-lying terrain as well as the present climatic conditions of low rainfall and excessively hot summer temperatures (Tsheboeng, 2001). As has been shown by, for example, Reid and Segobye (2000), settlements especially those with high population densities and great political significance do not exist in isolation. Unlike Reid and Segobye (2000) who tend to look further into Botswana for that interaction, using the mechanics of frontiers, the sites in the present study are in the immediate vicinity of such settlements and because of their low status material culture and the poor visibility of the sites they have remained unexplored. The methods of analysis applied in the present study have demonstrated a landscape with archaeological sites which were used for habitation, with possible animal enclosures such as at Megwe, and from ethnographical observations at the confluence of Manake and Selepswe (Figure 5.12).

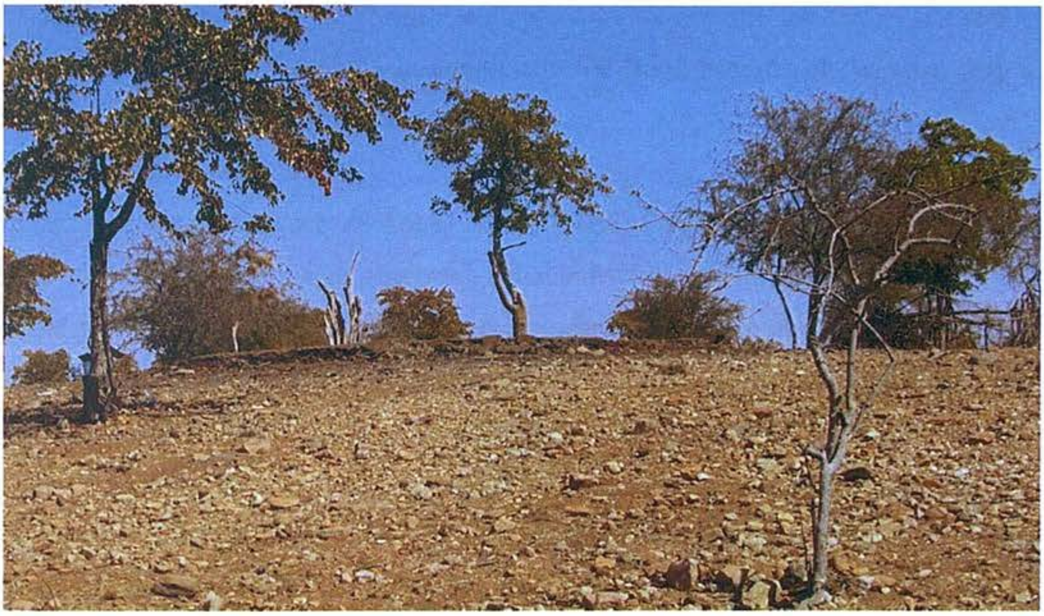

Figure 5.12 Remains of a disused small stock enclosure at Dikgatlhong, Manake and Selepswe confluence, situated on a high raised ground. Note: to the right is a new enclosure that is used for young animals (see Plate B).

they are assumed to be for small stock which are usually inferred to have dominated the occupants' subsistence diet (see Plug, 2000).

In the past this terrain was extremely busy, traversed by both humans and animals going to and from the rivers to exploit the resources available on the floodplains for agro-pastoral and other social and economic activities. Supporting the evidence that can be gleaned from aerial photographs, are test-excavations which suggest that these landscape units were activity specific in terms of the kinds of social and economic practices undertaken. Some sites were probably used as burial grounds (e.g. Valley site 2) while others could have been used for craft work (e.g. Tuli Circle 2, supported by heavy metal analysis) and seasonal occupation. Chaile Kopje, an isolated hill situated in the middle of the floodplain, could not have been used on long term basis, and with its surrounding plain subject to gully erosion it is possible that it was occupied mainly during the cultivation period. Hilltop location preference could also have been influenced by the presence of wild animals in this wetland. Trading in ivory from elephant tusks dates to the earliest occupation of the Basin and elephants were and still are the largest residents of this environment. Therefore, in addition to the flood hazards of the area, they also posed a serious danger to the inhabitants.

Indeed recent studies, such as that of Smith (2005), have identified some areas within the study area like Tuli Circle that were suitable for herd pasturage. This is suggested as a land-use management strategy employed to ease congestion and overstocking at K2, and this conforms with some of my assumptions and findings. Again, aerial photographs show what were confirmed as savanna glades in the study area and they were mainly confined to the hilly terrain, as was found to be the case in eastern Botswana (Denbow, 1979). Even though they are known to reflect enclosures frequented by livestock and ungulates among farming communities, the ones observed would have been managed from small groups of homesteads that were engaged in other small-scale activities similar to those undertaken at the core site of Mapungubwe. They would have supplied items of trade, farm produce and craft skills to the core. It has to be emphasised that even though excavation was not employed as a survey and data collection tool, the few test-excavations undertaken did not demonstrate the savanna glades to be cattle enclosures as had been expected and also suggested by previous reconnaissance surveys (see Denbow, 1979). However, they were found to contain abundant cultural remains, which show that they are indeed signatures of human antiquity. It can be concluded, as Denbow (1979) and others that used the technique for archaeological reconnaissance have done, that the white patches are indeed humanly-induced signatures, but it requires the use of other techniques of data recovery to arrive at a definitive interpretation. For example, it has been suggested that the underlying geology rather than *C. ciliaris* contributed to the lighter or white patches on the aerial photographs, as most of the sites did not possess any grass and, further, the sites with *C. ciliaris* were on low-lying ground and not visible on the aerial photographs. An alternative explanation for the savanna glades that have been used in the identification of ancient sites and landscape features in eastern Syria is that their higher reflectivity when seen from the air could be a result of better drainage of the sites' anthropogenically-modified soils and poorly developed soil structure, or the more developed soil structure, texture, mineralogy and water-retaining properties of the surrounding areas (Ur, 2003:105). This is plausible considering the varying intensity and nature of cultural deposits encountered within these features.

It has to be acknowledged that there are limitations to this method of inquiry. The aerial photographs used for this study were not specifically taken for archaeological reconnaissance purposes, as was the case in Denbow's (1979) study. They were taken advantage of in this study as an available resource at the Department of Mapping and Surveys in Gaborone, Botswana. They are part of a national database project and were taken for non-archaeological purposes. However, they have proven extremely useful as they had a higher and better resolution than the LANDSAT imagery, which was only good for the identification of topographical and geomorphological features on the landscape as shown in Chapter 2.

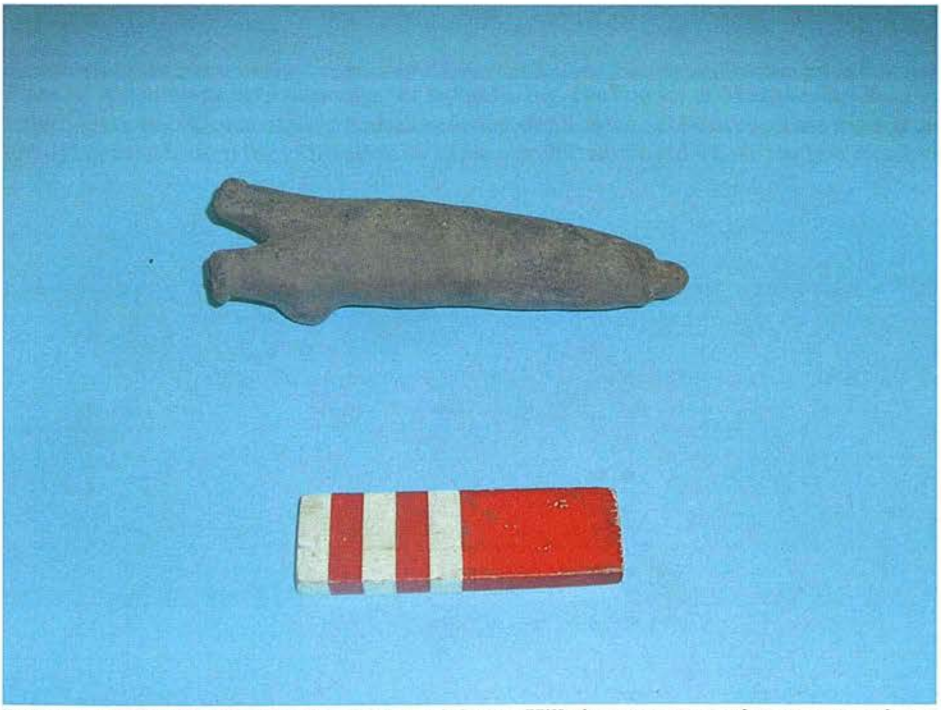

Plate A: Some recovered materials from Megwe Hill site test-excavations, a ceramic vessel (top)and an unidentified find (below) believed to be a ritual object but not confirmed

As a comparative analysis for the current land-use in similar settings as the Shashe-Limpopo confluence it was interesting to see how people organise themselves and to take advantage of good fertile soils for arable farming and situating the livestock and homesteads on the high ground as there are floods during rainy seasons. During dry they take advantage sandstone base river and have sunk pit-wells on the sandstone base rivers (A cattle post for Mr Makwati of Bobonong/Mathathane)

Plate B: A contemporary settlement at Dikgatlhong, confluence of Manake and Selepswe rivers, where there is evidence of used and abandoned small stock enclosures on the high ground whilst the low-lying area is used for cultivation. A sunken well is also used where the two rivers converge.

Plate C: Chaile Kopje showing the type of vegetation, a succulent plant: *Euphoria cooperi* (also known as Candelabra tree or *Nkodi-nkulu*) common in this type of dry, rocky environment (top) and how the site itself is like (below).

Plate D: Typical floodplain terrain with some pediments. Here is the Pitsane Kopje terrain showing some ridges/ elevated areas. There are grain bin stands in the vicinity as an indication of how the area was exploited for crop production.

5.4. FIELD SURVEY RESULTS AND TEST-EXCAVATIONS

For this study, the main excavation was conducted at Tuli Circle 2. Tuli Circle 2 is a site confirmed during fieldwork following its identification from desktop assessment of aerial photographs. This site proved to be extensive and rich in cultural material when compared to other sites. It is hereby referred to as Tuli Circle 2 because during the preliminary survey, a site named Tuli Circle was located 2 km away. Tuli Circle, is a semi-circular political boundary that separates Zimbabwe from Botswana. Tuli Circle 2 is a site extending over three ridges and surrounding low-lying areas, which overlooks the Shashe River to the north. The site appears to be part of a large settlement that covers an area over 20 kilometres in radius. Compared to the sites located previously as part of the current study, Tuli Circle 2 stood out as being extensive, and covering hilltops and low-lying areas. It was for this reason that it was chosen for transect soil sampling, test-excavation, and further analysis.

As mentioned in section 5.2, from the landscape analysis the Tuli Circle 2 site had the largest concentration of white patches assumed to reflect human activities. Data from the preliminary survey will be used to augment, compare and contrast these findings where relevant. Due to the extensiveness of Tuli Circle 2, test-excavations were also considered necessary for the interpretation of soil phosphates, heavy, elemental and trace metals especially that of iron, copper, nickel and zinc and traces of phosphorus. An XRPD data analysis of ceramic remains was also performed. For the XRPD analysis some of the sites from previous fieldwork were used as control data. It has to be emphasised that the excavations were not designed to provide chronological interpretations of the sites. Rather, these had already been established and are not contested by this study. The limitations outlined in section 4.4 warranted such an approach and since the objective of this study is to understand the use of space, it is believed that the techniques used will complement one another to elucidate the spatial aspects of the confluence. As an off-site approach, excavations were not guided by visibility or abundance of archaeological remains. However, there were instances where archaeological features were exposed, as will be discussed later, which led to more attention being paid in that direction.

In the field, in order to allow full coverage of the sampling, and for mapping of the area by Total station and electronic distance measure (EDM) equipment, Tuli Circle 2 was subdivided into 4 overlapping, but arbitrary, sectors, designated A, B, C and D. Test excavations were undertaken on site-subdivisions B and C, which were located on relatively high ground and accordingly described as hilly terrain units as they are on the summit of an outcrop. The reason for choosing these for test-excavation was largely for safety reasons. It was considered easier to work in elevated areas as they provide vantage points from which to look out for danger from wildlife, especially elephants, which frequent the nearby densely vegetated Shashe River. However, to avoid bias, sampling transects were run in contrasting terrain units — hilltops and low-lying areas.

5.4.1. Field Survey and Test-Excavation

5.4.1.1. Tuli Circle 2: Site Sub-Division B Test-Excavations

The arbitrary extent of site-subdivision B is shown on Figure 5.16 for phosphate analysis transects. This site comprises low-lying (or foothill) and the hilltop areas. The hilltop is completely barren, with saltbush and shrubs generally defining the extent of the site. The low-lying area is also open with some isolated instances of tree growth, particularly *Boscia albitrunca (motopi),* or *B. foetica (Mopipi)* commonly used for providing shelter or shade from the sun. A series of stone cairns, either in the form of small heaps or forming circular features with a stone in the centre, could be observed around the site. On the hill slopes and the summit are remains of pottery scattered all over the place. Some of the sherds on the slope had probably been washed off the top of the hill. Instances of complete or parts of vessels (burnished bowls and necked pots with rims protruding on the surface) could be observed. Other materials on the surface included glass and ostrich eggshell beads, lithics, and bone fragments. On excavation, complete and broken vessels were recovered. This part of the site was distinctive and appeared as a white 'bald' patch on the aerial photograph during the desktop analysis. It overlooks the Shashe River. It is an open site covering an area of about 200 by 150 metres. Finds observed on the surface also included bones, *dhaka*, and glass and ostrich eggshell beads. Three test pits were excavated and are described and discussed below:

Test-pit 1

This test pit measured 1 square metre. It had a considerable quantity of potsherds visible on the surface. After clearing the debris and grass, the rim of a large, complete pot appeared. The vessel was in-filled with soil material and was in the centre of the test pit. The first level (0-10cm) of the excavation consisted of a dark loamy soil with stony material aggregates. The west and south-western corners of the test pit had some white ashy material. The complete vessel was encountered at the base of Level 1 but appeared to be sitting on some kind of stand, warranting further investigation into Level 2 (10-20cm). A concentration of bone fragments was found around the vessel. Even though it was a complete vessel, it was fractured probably as a factor of length of time since it was discarded as well as due to trampling on the surface by people and animals. The vessel and bone fragments were the only materials recovered from this test-pit. This second level of excavation was characterised by small to increasingly medium stony soil and a decrease in the number of finds recovered. The parent material was reached at 14cm below the surface, but digging continued until about 16.5cm depth in the south-western corner of the unit.

Test-pit 2

On the surface, a skull was visible and was exposed in the first level. Very few potsherds were collected from the surface. The first level consisted of a light, ashy and powdery soil matrix and a visibly cracked and disintegrated human cranium was exposed at this level. The area of excavation was increased by a square metre on each side to make 2x2 metre square metre test pit. A human skeleton was exposed and finds included potsherds, a few bone fragments, and crumbs of cattle dung. The skeleton seemed to extend to the east. As the square was extended, other parts of the skeleton were exposed and two complete but badly broken ceramic vessels were recovered, placed on each side of the upper body. Among the other materials recovered were one ostrich eggshell bead and some potsherds. At the base of Level 1, the matrix continued to exhibit a greyish, powdery texture. Most finds were concentrated around the skeleton and it was considered possible that an association with the burial would be established once unit had been fully excavated. However, at around 7.5cm, the soil assumed a reddish-powdery colour until the base of the level. Finds were reduced in quantity with only a few sherds at the south-western corner of the unit. In the same vicinity were traces of burnt soil for just a few millimetres. Excavation of the next level (10-20cm) was preceded by photography, documentation and retrieval of the skeleton and associated 'vessels'. The soil was dry and powdery, making it difficult to describe the profile and it was difficult to discern any stratification. Burrowing by animals also made it difficult to ascertain whether the grave extended further than Level 2 or this impression was due to animal burrowing, which also made it difficult to trace the lateral extent of the grave.

The skeleton was in a crouched position on its right side with the head facing west. Most of the skull was missing, most likely as a result of animal trampling and burrowing by small animals, as some of the fragments of potsherds and bones were observed on the surface. It seemed the body was 'buried' together with two vessels. One vessel was placed directly behind the back (on the northern side of the body) whilst the other was placed in front of the torso. These vessels were mainly disintegrated, but it was likely they could be fitted back together in order to restore the vessels As the excavation continued, it became evident that the skeleton lay at about 15cm below the surface and that the vessels were higher up, just below the bottom of Level 1 (10cm), suggesting that they were initially placed on top of the grave not with the body. Both vessels were removed and packaged individually with their contents intact, and were taken for phosphate concentration sampling. The skeleton was also removed. Apart from the two vessels, no other finds were found associated with the burial. Compared to the Megwe site burial excavated in 2002 and situated 5km to the east, this burial had fewer mortuary remains interred with it. It had only two vessels which, as suggested, seem to have been placed on top of the grave after the body had been interred. At Megwe the body was surrounded by vessels of various forms, shapes and sizes and had beads on its wrists, ankles, waist and neck. However, both bodies were laid on their right hand side facing west and in a crouched position. The different mortuary practices could be interpreted as indicative of the following social practices.

A GENDER ROLES

The adornment, especially the blue imported beads, of the Megwe burial is suggestive of the burial of a woman. This interpretation is also supported by the number of complete vessels of varying forms, sizes and shapes, which are functional objects, probably provided for her use in her next life. On the other hand the Tuli Circle 2 burial could be interpreted as that of a male. In spite of the burial not having any materials accompanying it, its location on what seems to be a cattle kraal (byre) is reminiscent of men and power over cattle (see Hall, 1987; Huffman, 1986; Huffman, 1996). Ethnographically, male adults were buried inside the kraals.

B CHRONOLOGY

The tooth of the skeletal remains of the Megwe burial was securely AMS dated to *ca.* AD 1049 $\pm$ 50 by the Centre of Quaternary Research in Pretoria. This is the period when the Shashe-Limpopo Basin was occupied by Zhizo farmers and possibly K2. The burial practice, especially the surrounding of the body by ceramic vessels, compares well with that of a child at Mapungubwe (Huffman, 2005). Unfortunately, the Tuli Circle 2 burial was not dated, but from the observations made, the faunal remains were not as fragmented and powdery as those of Megwe. This could imply that the burial is later than that at Megwe. Until firm dates are obtained, it may be suggested that this burial was laid during the later occupation of the Basin, about three centuries ago, by the Sotho-Tswana Bantu-speaking people. It is even probable that it could date to historic times when the area was occupied by the Babirwa sub-group of the Sotho-Tswana cultural group. This group was relocated from the area in the early 20th century. If that is the case, the suggested gender-related burial practice is likely as it was common among the Sotho-Tswana to bury men inside cattle kraals. Hence, even though inconclusive, it is tempting to suggest that the time of burial has implications for the differences between these two burials.

Since only two burials were found at the time of the survey, and only one has been securely dated, it is inconclusive to base an interpretation on these test-excavations. It is likely that other burials will be identified in a full-scale excavation. Hanisch's (not dated) work at Pitsane Kopje reported burial excavations, but it was preliminary work which was not sufficiently detailed for comparison with the observations made in the present research work. Interestingly, however, Hanisch's burials date from the Zhizo to Mapungubwe periods of occupation.

Furthermore, since the Tuli Circle 2 burial was on a white patch detected during the landscape analysis, and since human remains are known to enrich soil PO_4^{3-} concentration levels, it was considered imperative to take soil samples for phosphate analysis. It was also deduced that since the burial was in what appears to be a kraal, the suspected dung material was not vitrified, providing inconclusive evidence of the length of time since the matter was buried even though there are thermodynamic factors which have to be taken into consideration before vitrification can take place. However, the soil phosphate concentration levels for the burial were surprisingly low at 2.9 *ppm*, relatively lower than samples without any faunal remains. Even the PO_4^{3-} concentration levels for the contents of the two pots placed on top of the burial were higher at 4.1 *ppm*. It is however, possible that the vessels could have contained foreign substances which enhanced the phosphate concentration.

Test-pit 3

The partial form of what appeared to be a beaker-like vessel was found on the surface when running the sampling transects for the soil phosphate analysis. It was not the intention of the survey to be guided by visible materials to conduct test excavations, but instances of this kind could not be avoided as they proved to be useful later in the interpretation of the chemical signatures of the site. Consequently, it was marked for test-excavation and a 1x1 metre square test pit was established. This test pit was 14m south of test pit 2 (burial), and on the periphery of the white patch which is interpreted as a kraal. It was littered with potsherds which generally covered the entire site surface. The soil in the first level was light brown in colour and easy to work on compared to test pit 1. However, at around 4.5cm into the level, the soil became more compact, although the colour did not change. At the bottom of level 1, the compact soil formed a horizontal layer across the entire test pit. The beaker-like vessel was planned and photographed. Within the test-pit towards the south of the beaker there was a pot-like object, more or less similar in its placement to the ones excavated in the burial at test pit 2. It appeared to be on a 'stand'. To the east of the beaker, about 14cm away, a broken bone protruded from the edge of the test pit. It was at this point that it was realised there could be more burials on the site. The aim of this survey was not to do extensive excavation, given time limitations and funding constraints. After planning, the beaker and the pot-like feature were removed at this level, complete with their contents, but the bone was left *in situ*.

The site-subdivision B test-excavation results and the cultural materials recovered are inconclusive at this level of study. However, it became increasingly clear that this could be a burial site. The large concentration of pottery remains on the surface could reflect vessels placed on top of burials, a common and known practice amongst Bantu people even in the historic times. Soil phosphate analysis was limited to the transect to give a fairly accurate picture of the activity, but the elevated values for transect $26_{q\text{-}x}$ and transect *r* (which are discussed later) are taken as good indication of differences in the use of space by the site's occupants. As this was limited by the methodological approach and time frame, it is recommended that future work in the area take these observations into consideration in order to establish the extent of the site as this could tell us more on the use of this site sub-division and its relation to the other sites.

5.4.1.2. Tuli Circle 2: Site Sub-Division C Test-Excavations

Site sub-division C overlaps with site-subdivisions A and B; it covers an area of 200 x 300m and had a lower concentration of materials especially potsherds visible on the surface compared to site sub-division B. However, it had *dhaka* features, appearing mainly as compact materials on the surface and at other times as a few scatters possibly due to trampling by animals. Two test excavations were conducted on randomly selected areas of the site-subdivision and these are as described and discussed below.

Test pit 1

This test pit was positioned in the north-western part of site-subdivision C (22° 04□ 25.78□) with a stone feature visible on the south west corner of the site-subdivision. On the surface *dhaka* features were visible as rubble but most of them were compacted.

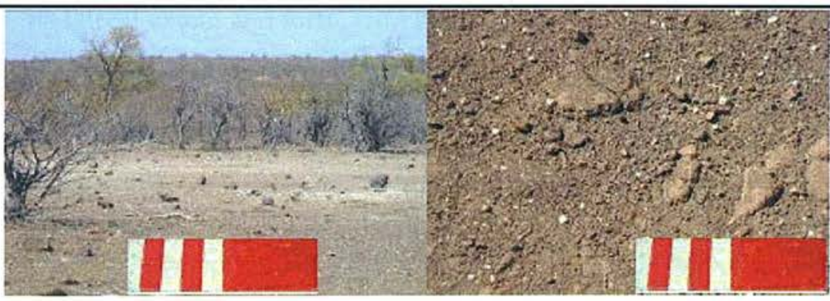

Figure 5.13 Site sub-division C showing how the general area is a white patch (left) and a closer snapshot of the surface before test-excavation was conducted

These were exposed during excavation at level 1 (0-10cm) onwards. The *dhaka* appeared burnt and reddish in colour. There were no other surface finds associated with the feature.

The first level of the test-excavation revealed a dark-brown soil matrix with a coarse texture. The feature seemed to be circular in shape with only half of the circle being exposed in this level. An extension of the excavation was made to the east in an effort to expose the entire feature. All these test-pits were increased by 1x1 square metre until the whole feature was exposed on a 2x2 square metre trench The feature proved to be circular in plan, and it was observed that the soil matrix had the same coarse texture but with a burnt reddish colour. It contained a few potsherds and common loose *dhaka*. A rubble feature was also observed to extend into the western side of first excavated metre square. Since it was not immediately clear whether this may have resulted from the collapse of the main feature, it was considered important to set up a 1x1 metre square in order to find out how far it would extend. It was hoped that this investigation would result in a more comprehensive picture and guide further investigation of the feature. A further 10cm was dug (level 2, 10-20cm) in order to determine the vertical extent of the feature. The feature itself was being investigated further in the hope of determining:

- its lateral extent and form,
- the types of material used in its construction, apart from the visible *dhaka*,
- whether it had collapsed inward or what has been exposed was actually its floor and therefore try to establish what could have happened to other construction material(s).
- its function

Figure 5.14 Test-pit 1 test-excavation showing a semi-circular *dhaka* feature with rubble to the northeast, and after removal of test-pit 2 from one metre square to expose the base of the feature.

The rubble feature to the northeast, upon further investigation appeared to have fallen from the main feature rather than being an extension of it. After further excavation to determine the vertical extent of the feature and the rubble material, it became evident that they did not go beyond 12 cm below the ground surface. No other cultural materials were observed in this test-excavation except for the *dhaka.* A *dhaka* block was removed from the centre of the feature to establish how far the feature extended and to obtain a sample of the material for analysis. The block was removed and soil samples from beneath the block were also taken for analysis. The *dhaka* block had a smooth upper surface and a rough lower surface. The test excavation extended to a depth of 20cm and no materials were recovered. The burnt *dhaka* was loose on top of the block (floor). The floor maintained a reddish colour and had no burn marks. The floor pieces have irregular shapes. This suggests that it may have been a complete floor, which was cracked by natural agents over time or trampled by animals.

This structure was initially interpreted as the remains of a furnace or hearth. There was evidence of burning or heating caused by fire, but no clear evidence of iron smelting in the form of slag. The only link to iron working could be implied from tuyeres-like material around the feature and thought to have been used for forcing air into a blast furnace or forge to facilitate combustion when making or shaping iron implements. Samples were collected for phosphate, and elemental and heavy metal analysis and will be discussed in sections 5.43 and 5.4.3, respectively.

Test Pit 2

This test pit ((22° 04′ 26.67″) was set up as a 2 x 2 metre square in order to expose a circular stone feature that was observed at the surface and was situated 12m to the south-east of test pit 1, in an area where features like those observed in test pit 1. The first excavation level exposed a dark-brown, coarse textured soil matrix that was difficult to dig using a trowel. At the end of the first level, a semi-circular stone feature was exposed. The stones are densely packed and tightly fitted. The finds included *dhaka* remains, potsherds and bone fragments. At all corners of the test pit, there were undisturbed as well as intact pottery vessels. The few potsherds recovered were not confined to the stone feature.

The test pit was extended to the east by a metre, in order to establish the spatial extent of the stone feature. The soil matrix was dark greyish and coarse and difficult to excavate. The excavation exposed a stone feature that was semi-circular or arc shaped. Associated with it were ceramic vessels and remains of disintegrated pots. The vessels and potsherds were decorated and judging from the styles and morphological designs they conformed to the established K2 and Mapungubwe ceramic repertoire.

The stone structure and the ceramic vessels and potsherds were photographed *in situ* (Figure 5.15). The undisturbed vessels were removed together with their contents for further analysis. Potsherds were also taken for XRPD analysis. Investigation of the stone features showed that the surfaces of stones differed depending on where they were placed. The stones in the interior had a smooth surface, as if they had been worked on, possibly used for patterning, shaping and/or sharpening of iron or metal implements.

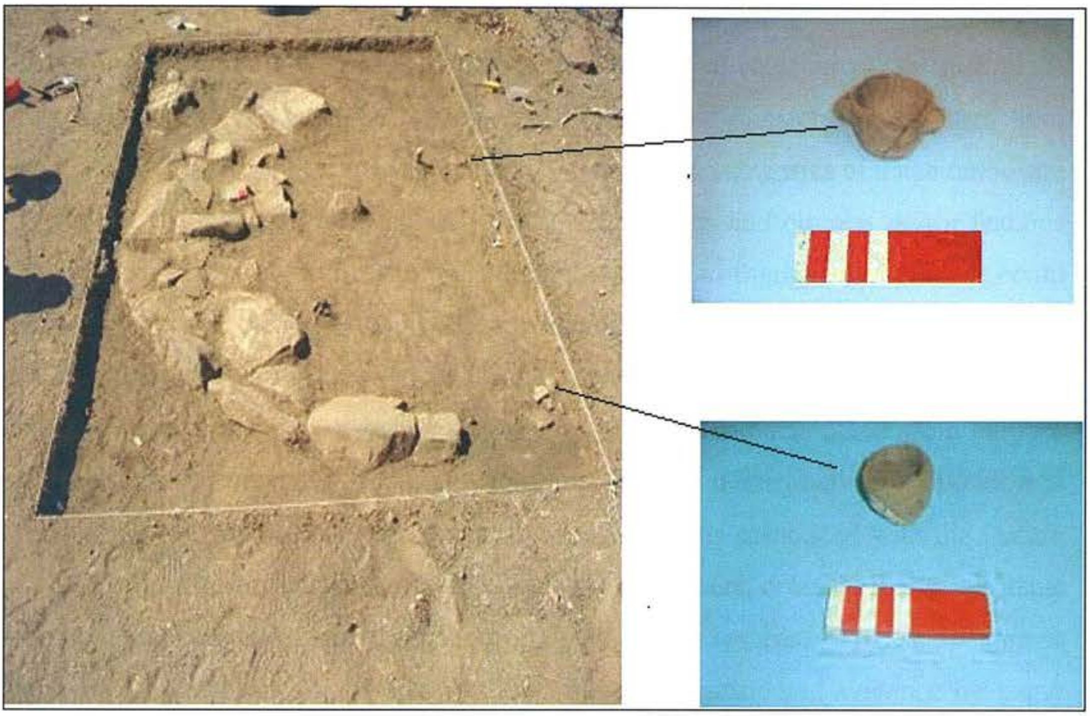

Figure 5.15 Test pit 2 excavation and some of the vessels recovered *in situ*

There were no cultural materials observed within the stone structure. In order to establish how deep the stone feature went and also to search for more materials, a second level (10-20cm) was dug. More fragments of complete vessels were exposed, especially in the western corner of the test pit. This seemed more extensive than originally anticipated and more time would have been required to establish the full extent and possible use of the structure. As already mentioned, it was not the intention of this fieldwork to excavate beyond the test pit scale and it is hoped to conduct further research on the site in future. However, samples were collected for phosphate, and elemental and heavy metal analysis. Pottery fragments were also collected for x-ray powder diffraction analysis.

Tuli Circle 2 site sub-division C activities seemed to differ from those of site sub-division B. The absence of pottery scatters on the surface and the concentration of *dhaka* remains on this site made the difference between the two sites more pronounced. The test-excavations also produced totally different materials. This is interesting because on the aerial photographs the two sites appear as white patches and when investigated they seem to have been used differently, counteracting the animal enclosure or savanna glade theoretical concept discussed in section 5.2. With site sub-division B thought to have been a burial site, site sub-division C tends to fit within the categories of a habitation site with stone structures that were possibly house foundations and circular *dhaka* features likely to be fire places and hearths. At the time it was also thought that this site could have been a special activity site, probably specialising in iron working. However, it was not clear what stage of iron working it could have been, whether smelting, forging or smithing. Most of the stones surrounding the feature were retouched and seem purpose specific as if they were used for sharpening iron tools or related activity. This view is supported by the presence of other culturally-specific items associated with the feature such as medium-sized pots probably used as water containers, crucible-like small items for storing and carrying materials such as oils, lipids or waxes used in the sharpening or shaping of implements. The tuyeres on the surface were considered evidence for metal working on the site. Also close to the feature were apparent furnaces/hearths similar to test pit 1 and assumed to have been used for heating metal tools. Therefore, the stone features located in close proximity to these would-be furnaces were receiving points for patterning and shaping of the iron and metal tools. This thinking was reinforced by the presence of what appeared to be heaps of ash deposits/middens in close proximity, which could have been the ash from burning firewood in the furnaces before metal tools were reworked into implements on the stone features.

However, the evidence used to support these suggestions is insubstantial. Presence of slag on the site was extremely limited and iron or metal tools were not recovered. Soil samples from the test-pits and pottery vessels were collected for phosphate, elemental and heavy metal analyses. Furthermore, comparative analysis of ethnographic iron working or related activities was considered to be useful for understanding the possible use of this site.

5.4.2. Geochemical Analysis

With regard to spatial dynamics, chemical analysis in the form of soil phosphate, pH, and heavy, elemental and trace metal analysis can provide information on the different activities undertaken at a site and its locality, as well as the production and circulation of pottery. The results presented here relate to soil phosphates samples collected from transects at Tuli Circle 2, previous excavations at Megwe, and heavy metal analysis from the Tuli Circle 2, Megwe and Manake sites. Soil phosphate is an established indicator of past human activities which accumulate as a result of social and cultural processes (see Clark, 1990; Eidt, 1973). By analysing the relative phosphate concentrations of these samples over space, anomalies that signify locations where people engaged in certain types of activities could emerge.

5.4.2.1. Soil Phosphate concentration levels and their implications

Determination of soil phosphate concentration as an analytical technique was employed in the current study to determine whether activities undertaken in and/or around the white patches, which are thought to represent animal enclosures, varied. Rather than rely on surface material remains to guide where to collect samples, systematic transects were made and samples collected at 10m intervals. In order to investigate spatial variation at a larger scale, a 100m by 100m grid was also sampled. The grid method was considered important as it might reveal for a particular use, for example a kraal, if the phosphate concentrations show any variation over space. The 10m interval was deemed appropriate for this analysis as the area covered is not particularly large, hence the close spacing between transects would increase the probability of detection in variation as well as the representation of features.

Sampling transects were run through each of the site-subdivisions at regular intervals of 10m; where the bedrock proved impervious no samples were collected. A simplified layout of the area covered and the sampling transect x-y coordinates are shown in Figure 5.16, below.

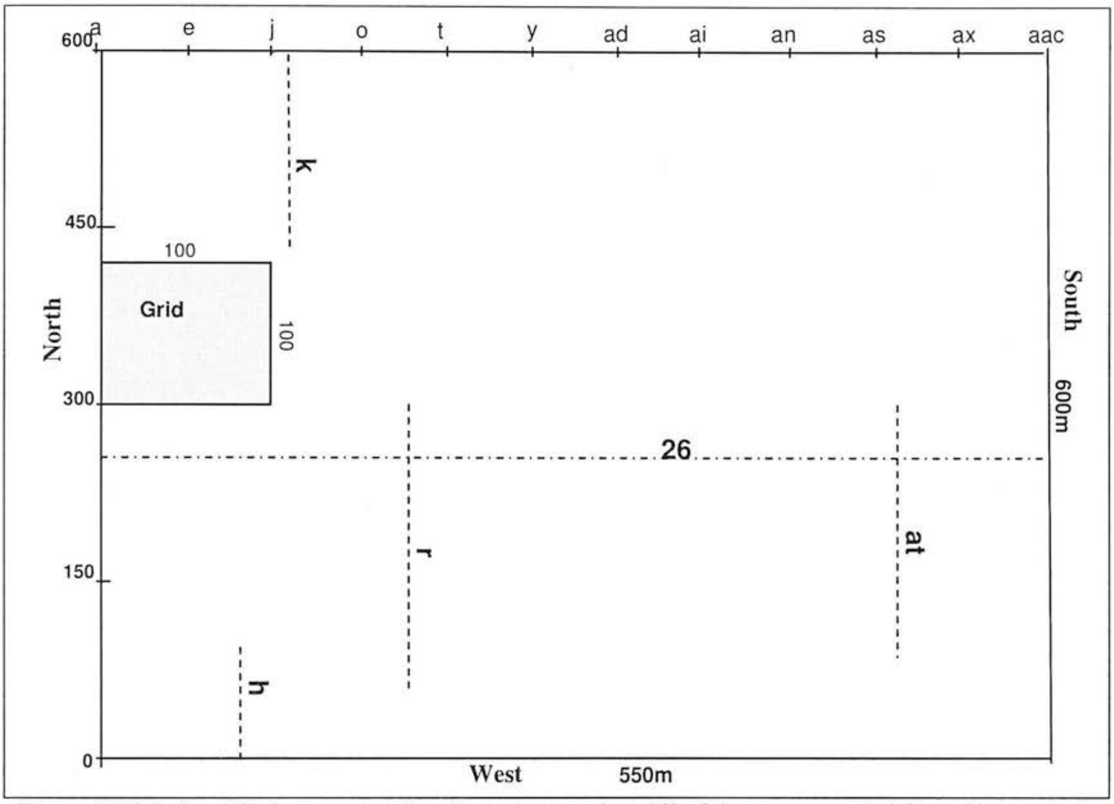

Figure 5.16 A simplified representation (in metres, scale 1:20) of the area sampled for soil phosphate analysis showing the sampling transects at Tuli Circle 2 and how they were labeled on an x-y coordinate system

The GPS points for all the samples collected and accompanying notes for the samples are given in Appendix B. A 100 x 100 metre grid was also sampled at site-subdivision B on the foothill and low-lying area adjacent to D and it is interpolated using GIS to graphically assess spatial distribution of the PO_4^{3-} in that randomly chosen localised area (Figure 5.17). The phosphate results for each transect are considered according to the terrain unit in which they occur. For comparison, and to account for any differences in types of activities undertaken, an inferential analysis, Mann-Whitney U-test was performed. The average pH for all soil samples was 9 and this was the basis for using Olsen's (1954) method for phosphate analysis described in section 4.3.2. The concentration levels were obtained using a UV-spectrophotometer.

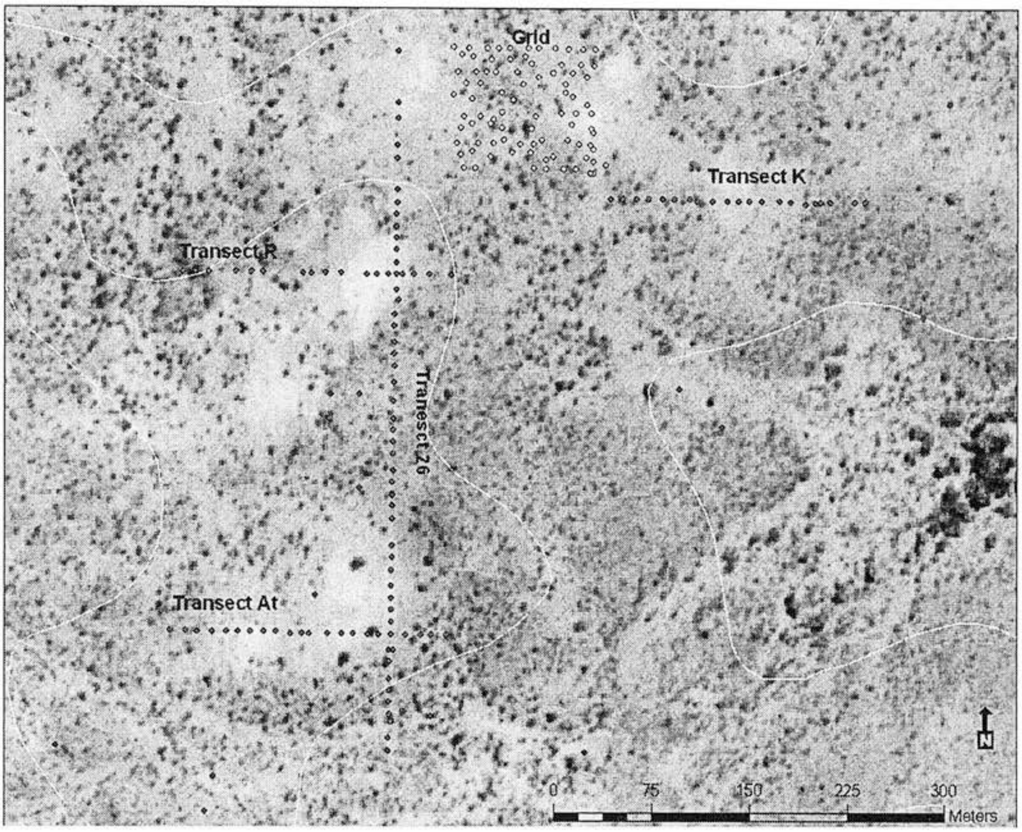

Figure 5.17 An aerial photograph showing the transects (except transect H) of soil sampling points running through Tuli Circle 2 subdivisions A, B, C and D and their phosphate variation discussed in detail in 5.4.2.2.

The assumption was that since there seemed to be a significant number of white patches on aerial photographs and their subsequent confirmation on the ground survey that they are archaeological sites even though they did not possess *C.ciliaris*, and are therefore indicative of human activities. These activities appeared to be related to the terrain unit in which the samples were collected. That is, there seems to be a relationship between the type of terrain unit where the samples are collected and the level of phosphate concentration. Thus, it may be assumed that there is variation in the concentration levels of phosphates on sites according to whether they are located on hill-tops or high-ground, low-lying or sloping ground as in valley or stream-gouged locations due to different types of activities undertaken at Tuli Circle 2. The control site of Manake, a disused clay quarry, has very low concentrations of phosphates. This site is located 60km out of the sampled area.

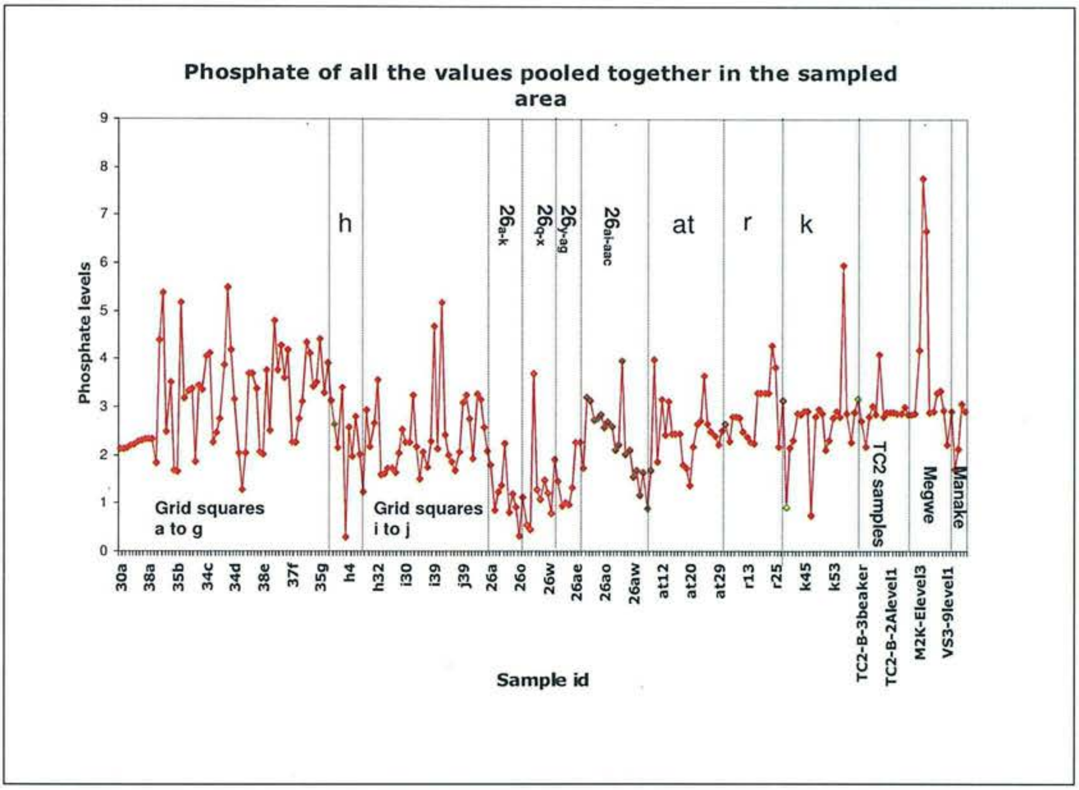

Figure 5.18 Phosphate variation for the sampled area showing all values pooled together and the transects as described in the text.

The relationship between the type of terrain and the concentration levels of phosphates is more pronounced when all the values for the sampled area were pooled together and presented on a graph as in Figure 5.18 above. From the resultant graph it can be hypothesised that:

I. there is variation in PO_4^{3-} concentration levels on sites situated on hilltop and high-ground. The same applies to samples collected from the Megwe sites.

II. the low-lying and valley samples have generally low PO_4^{3-} levels compared to sites situated on hilltops and high-ground

III. the contents of pottery containers recovered from test pits have lower PO_4^{3-} than the sampled soils.

However, when separated and analysed for each transect, variation in concentration levels persisted but with less noise compared to the group data. It is suggested that even at that small scale of coverage, the landscape units seemed to influence the levels of the phosphate concentrations, and therefore could be indicative of different spatial activities at Tuli Circle 2 as part of a wider landscape. Samples collected from test-excavations on site-subdivisions B and C were also analysed for their phosphate concentrations and are discussed separately.

To account for variation in PO_4^{3-} levels as an indicator of variability in the use of space from different terrain unit and to find out if this pattern really exists, a non-parametric inferential statistical analysis was performed. It is assumed that we are dealing with data from two contrasting aspects of the landscape: - the hilly and low-lying, and the aim is to compare the phosphate concentrations of transects on these terrains and demonstrate that they are different. With inferential analysis it can be ascertained if there were any other aspects of the landscape which could have influenced the observed variation in the data. In this analysis Mann-Whitney (U) test of significance is used. The statistical values and their significance were obtained following a free interactive statistics textbook from *VassarStats: Web Site for Statistical Computation* compiled by Lowry (2008). This test is deemed appropriate as it can tell us whether the differences between the two sets of sample data from the different transects, are significantly influenced by landscape unit or it is just a chance occurrence. Using this statistical technique, the test is carried out through the use of the rank measurements and not the original measurements. This is deemed appropriate as the intention is to compare the average performance of terrain units on PO_4^{3-} levels and assess if the differences are an indication of differences in use of space, without prior assumption of normal distribution about the population means

Site-subdivision A

There were no test-excavations conducted on this site. Samples for soil phosphate analysis which fall within the perimeter of the site are those collected from transect H. This transect ran in a westerly direction descending down through a valley or stream before ascending up the raised outcrop towards site sub-division B. It tends to overlap with transect R which originates from site-subdivision B. The results presented are for transects H and R and their means are compared using Mann-Whitney U-test analysis.

The space between sample collections was maintained at 10m. Sample h0 was collected on top of site A as the first sample on the transect and along a line marking the western extent of the area for sampling as shown on Figure 5.16 and Figure 5.17. The next three samples (h1-h5) were collected as one descends the hill outcrop. On site-subdivision B, sample r28 was the first sample on the transect and samples were collected in a westerly direction towards site-subdivision A. A straight line transect was maintained using the handheld GPS and the coordinates for samples varied minimally with the distance. Samples h6 and r6 (29°14□42.5□E), h7 and r7 (29°14□42.8□E), h8 and r8 (29°14□43.2□E) and h9 to r9 (29°14□43.5□E) were collected within a valley that separated the two sites. The latitude (eastings) varied with every 10m of sample collection whilst the longitude (northings) remained constant at 22°04□13.9□S and 22°04□17.1□S for transect H and R, respectively. Therefore, the samples for these two transects overlapped here. The terrain in which they were collected was that of a sloping valley-like stream running through the two site-subdivisions. As expected the phosphate values do not seem to vary significantly in these samples even though samples h8 and r8 differ. The explanation could be that whilst h8 is at the lowest point of site-subdivision A, r8 is when you begin to ascend site-subdivision B resulting in h8 being susceptible to erosion and phosphates leached off down the slope.

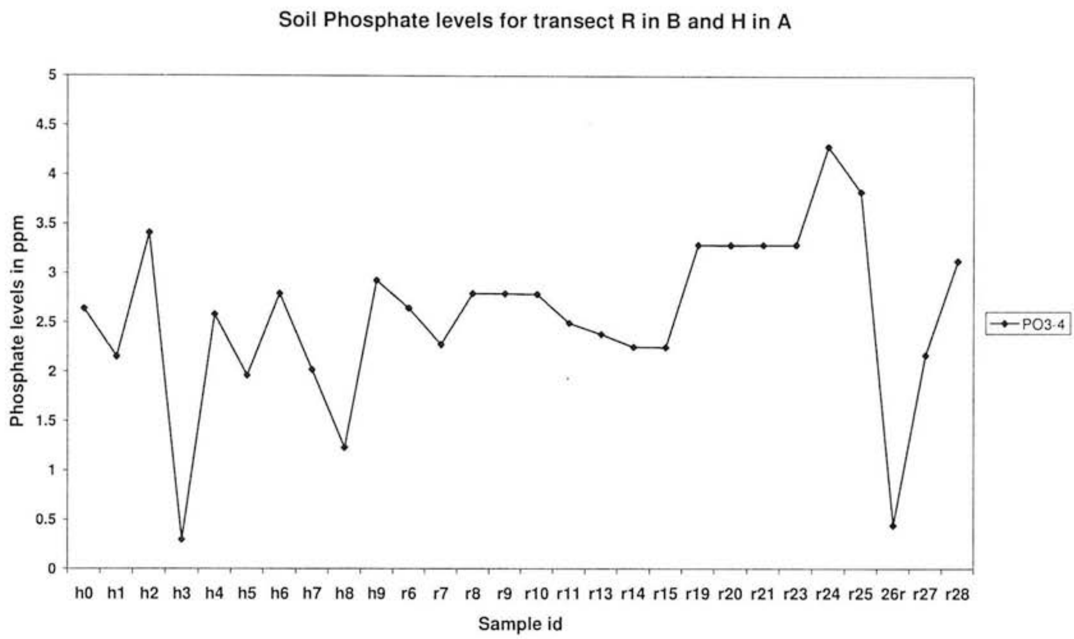

Figure 5.19 Soil Phosphate Levels for transect R of site-subdivision B as compared to that of H from site-subdivision A

The U-test analysis results for these two transects is 126 (P (two-tailed)=0.089, n1=10 and n2=18).This implies that two the samples are not significantly different at a probability more than P=0.05 (or 95 confidence level). Evidently more samples were collected on the hilltop of B than on A and could account for the skewed presentation towards B. Notwithstanding that, the above graph shows the phosphate concentrations for samples collected on transect R to be on average higher than those of site-subdivision A, and it was observed during the field survey that site-subdivision A had few pottery scatters than site-subdivision B. With the elevated phosphate concentrations of site-subdivision B as well as the results from the test-excavations, it is increasingly apparent that it could have been used as an animal enclosure where at times burial practices were also undertaken. Human burials as well as manure are known to elevate phosphate levels (Wells *et al.*, 2000) and, ethnographically, men were buried inside kraals as mentioned above. It is, however, not certain whether these could have been cattle enclosures. Test-excavations were not undertaken on site-subdivision A for comparison and determination of possible use.

When transect *h* was compared with transect *at* on site C and transect *k* on site D there was no significant difference in the phosphate concentrations. There was also no significant difference in the means of the phosphate levels of these two transects when compared with that of *r*. This does not necessarily imply that the activities undertaken on these site-subdivisions (A, C, and D) were similar but it is on the other hand interesting to observe that they appear different from the activities undertaken on site B.

Site-subdivisions B and C: Description of Sampling Transects

The 100x100m metre grid and three of the main transects covered site-subdivision B. This site rises from an average height of 540m above sea level (asl) to no more than 560m asl in the direction of site-subdivision C. A simplified graphical representation of the transects is shown in Figure 5.16 and they are fixed geographically using an ESRI ArcGIS analytical environment on Figure 5.17. The longest transect of 540m (Transect ***26***) commences 40m west of the edge of the grid and runs parallel to it. It begins below site-sub division B, then ascends the hill outcrop, and terminates on the southern side of site sub-division C. This transect has been sub-divided into several sections according to the type of terrain it runs through as observed during the survey. There are two other transects that run perpendicular to transect ***26*** (transect ***r*** in site-subdivision B and transect ***at*** in C). Transects for site-subdivision B and C are described as follows:

- Transect $26_{a\text{-}k}$ runs from bottom of site-subdivision B at an elevation of 543m asl and terminates as you begin to ascend the hill due to the impervious rock. It is on relatively low terrain that is susceptible to water erosion and it is dissected by small channels flowing in the direction of the River Shashe to the north of the site. It is assumed that the activities undertaken would have been suitable for that type of landscape unit. Visible on the surface are cultural materials such as lithics, potsherds and beads, as well as stone features, in the form of cairns and possibly grain bin stands.

- Transect $26_{q\text{-}x}$ is situated right on top of site sub-division B, in relatively flat terrain at an elevation of 550m asl. It is extensively covered by numerous potsherds of varying sizes scattered all over the place.

Figure 5.20 Test pit 3 revealed a beaker and at level 2 a bone was also observed protruding from the northern-eastern side of test-pit. A complete beaker was recovered (right).

There are vessel parts such as rims protruding from the surface exhibiting the outlines of necked pots, burnished bowls and beakers. This transect is 6m from Test pit 2, the burial excavation discussed in section 5.4.1.1 above. It also passes close to Test pit 3 situated 14m south of Test pit 2 where an excavation recovered a complete pottery vessel and bones were observed during excavation. The vessel recovered is shown in Figure 5.20. The phosphate values of the contents of the vessels were measured and were observed to be significantly lower, that they were even less than 3ppm which is the average range in that transect.

- Transect $26_{y\text{-}ah}$ passes through a low-lying area between transect $26_{q\text{-}x}$ and $26_{ai\text{-}aac}$ (in C). An incised stream runs through the area and on its channel sediments secondarily deposited materials are visible. The materials included fragments of bones and potsherds, probably washed from the top of the site by running water.

- Transect *26$_{ai\text{-}aac}$*, is situated on a flat hill outcrop in site-subdivision C at an elevation of 570m asl. It terminates at a stream on the southern side of the site.

- Transect ***r***, situated on the hilltop of site-subdivision B, runs perpendicular to transect ***26*** in a westerly direction. Transect ***r*** passes through a large concentration of surface pottery scatters, which appeared as a mound-like feature that had been severely disturbed by burrowing of animals, bringing to the surface potsherds and bone fragments. This transect has been discussed in the section above, where its phosphate is compared to that of transect ***h*** of site sub-division A. The two transects also overlap in a valley that runs through A and B.

- Transect ***at*** runs perpendicular to ***26***$_{ai\text{-}aac}$ and had *dhaka* remains on the surface with relatively little or no pottery sherds readily visible and a relatively low quantity recovered from test excavations. It is situated in site sub-division C.

- Transect ***k*** commences 10m from the edge of transect 40 of the grid and it runs eastwards in the opposite direction. Some of its sampling points overlap with those of sites B and D.

5.4.2.2. Evaluation of soil phosphate variation in relation to terrain units using the Mann-Witney (U)-test analysis

Since these transects are divided in relation to their terrain characteristics, they are assessed through comparison with other transects along the long continuous transect 26 which passes through site B and C as shown below in Figure 5.21. A comparison of results is also established within and between samples from transects in other site-subdivisions using U-test statistical analysis, and their collective or individual significance is discussed. Where there is a statistically significance difference observed between the means of the PO_4^{3-} concentrations level in relation to the terrain unit, a graphical representation will be provided and discussed. Otherwise, for transects which favour the null hypothesis only possible implications will be discussed.

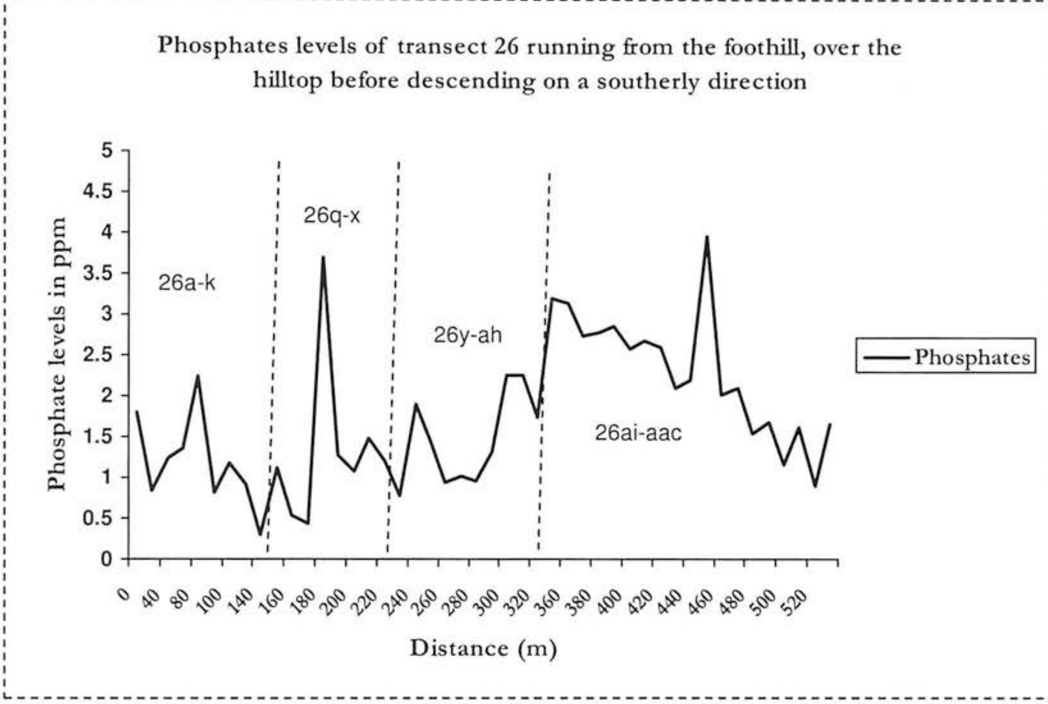

Figure 5.21 The phosphate levels of transect 26 running from bottom of site-subdivision B to the lower end of site-subdivision C.

A Transect $26_{a\text{-}k}$ and Transect $26_{q\text{-}x}$

Comparison of the mean ranks of these two transects produced a U value of 35 (n1=8, n2=7) and p(two-tailed)=0.46 (z = 0.9). Since p>0.05 this implies that there is no significant difference between the means of PO_4^{3-} levels as a result of terrain differences and we are over 95% confident that such difference does not exist. Social activities undertaken immediately below the hill did not involve processing of products which could elevate phosphates.

B Transect $26_{a\text{-}k}$ and Transect $26_{y\text{-}ah}$

The U-test results showed no significant difference between the means of PO_4^{3-} concentration levels of the two transects according to their terrain at the 95% confidence level. Transect 26_{y-ah} is a low-lying area between site-subdivisions B and C; it was incised and secondary deposition of faunal and cultural materials was highly visible in its matrix. It was expected that these would show a significant difference in phosphate levels. It is, however, possible that this is a stream running down from the main site and no major activities may have taken place there. Alternatively, the low phosphate concentration values could be due to leaching.

C Transect 26_{a-k} to 26_{ai-aac}

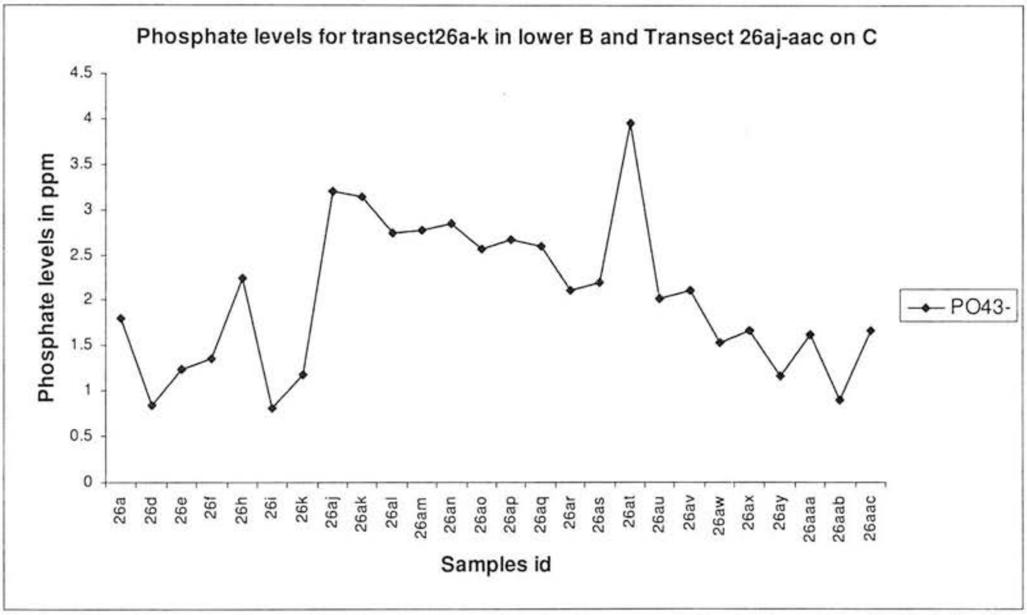

Figure 5.22 A graph comparing the phosphate levels of transect 26_{a-k} below site sub-division B and transect 26_{ai-aac} on top of site-subdivision C

Tests performed on these transects presented a significant difference ($p<0.01$, (two-tailed) in the phosphate concentration between the two terrain units. This variation is also shown by the z-value (measure of the distance in standard variations from the means) that at confidence level of more than 99%, the activities undertaken in the two terrains were different. Figure 5.22 above captures this variation very well and the computed results are shown below in Table 5.1.

Table 5.1 The statistical variation of the Transect26a-k and Transect26ai-aac

n_1	n_2	U	P(two-tailed)	P(one-tailed)	z-value
19	7	111	0.0085	0.0042	2.57

Transect $26_{a\text{-}k}$ is in low-lying terrain whilst most of transect $26_{ai\text{-}aac}$ lies on top of site sub-division C before sloping down to the south. The kinds of activities undertaken in the two terrains were different even though it is not immediately evident what types of activities were undertaken. Transect $26_{a\text{-}k}$ lies 40m west of the grid. It was generally open and characterised by a substantial amount of cultural materials in the form of potsherds and stone features resembling grain bins and cairns. On the other hand, transect $26_{ai\text{-}aac}$ is located on a hilltop with a less dense concentration of material remains in the form of artifacts observed on the surface. It was also characterised by the white patch as picked from aerial photographs and *dhaka* features were visible on the surface. As typical sites commonly associated with savanna glades and animal enclosures, it was expected that there would be no significant difference as they would have been used for similar activities. It has to be noted that these sites are over 200m apart and that is a considerable space to warrant a different type of activity to be undertaken.

D Transect $26_{q\text{-}x}$ to transect $26_{y\text{-}ah}$

There is no significant difference (p (two-tailed)=0.24, n1=9, n2=8 and U=49) in the phosphate concentrations of the samples in relation to terrain. It must be appreciated that transect $26_{y\text{-}ah}$ is a continuation of transect $26_{q\text{-}x}$, and therefore it is likely that the boundaries of the types of activities overlapped.

E Transects $26_{q\text{-}x}$ and $26_{ai\text{-}aac}$

There is a significant difference between the means of the phosphate concentrations related to terrain at the 99% confidence level ((p(two-tailed)<0.01).

Table 5.2 The statistical variation of the Transect26q-x and Transect26ai-aac

n_1	n_2	U	P(two-tailed)	P(one-tailed)	z-value
19	8	127	0.0054	0.0027	2.71

It has to be emphasised that the two transects on site subdivision B (26_{q-x} and $26a_{a-k}$) showed no significant difference in the types of activities undertaken but when they were both each compared to transect 26_{aj-aac} on site sub-division C there was a significant difference ($p<0.01$). What can be deduced from these results is that site-subdivision C appears to have had some activities quite distinctive from those of site sub-division B as shown on Figure 5.23 below.

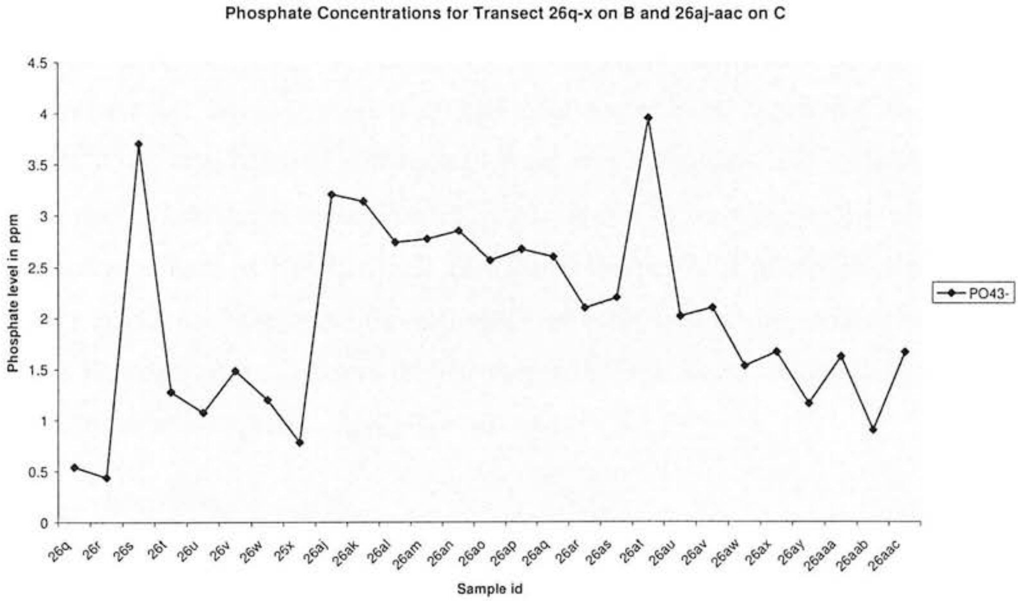

Figure 5.23 Graph showing the concentration levels of transect 26_{q-x} on top of B and transect 26_{aj-aac} on C

When test-excavations as described and discussed above were conducted on site sub-division C, circular *dhaka* and semi-circular stone features were exposed in close proximity to one another, which suggests that the site was exclusive, perhaps used for processing particular products which were significantly different from those undertaken on other sites or an exclusive habitation site in the form of a homestead.. This suggestion is also strengthened because comparison of transects $26_{ai\text{-}aac}$ and *at* which are both in C and transects *h* (in site A), *k* (in site D) and those in B also show that a significant difference still existed between the means of the phosphate concentrations on these terrain units.

F Transect26y-ah and transect26ai-aac

Table 5.3 The statistical variation of Transect26y-ah and Transect26ai-aac

n_1	n_2	U	P(two-tailed)	P(one-tailed)	z-value
19	9	132	0.022	0.011	2.29

The mean phosphate levels of transect $26_{y\text{-}ah}$ were significantly different (p=0.022) from those of transect $26_{y\text{-}ah}$ at more than 95% confidence level. It can still be argued that transect $26_{y\text{-}ah}$ has suffered consistently from stream erosion and therefore produced biased results but at the same time $26_{y\text{-}ah}$ has shown to be significantly different from other assessed sites at Tuli Circle 2. This shows the potential of the hill-top location of transect $26_{ai\text{-}aac}$ to have been a useful space as compared to the eroded transect $26_{y\text{-}ah}$ terrain. However, if we compare these results with those discussed above, this transect at site C still stands out as an activity-specific entity

From the results obtained of the phosphate analysis in relation to samples collected along transects in different terrain units, it can be summarised that most of the transects showed no significant difference in the level of phosphates in relation to terrain when tested at the 95% confidence level. This does not necessarily imply that similar social processes were practised. It is possible that the processes did not result in the accumulation of phosphates that could be detected in high levels. Notwithstanding this observation, however, site sub-division C stands out as an exclusive site with specific use. At this level of investigation it is not clear what kind of activities could have been undertaken on this particular site. Test-excavations recovered structures and archaeological features which, with further work, can be analysed to ascertain use.

There was no significant variations in the concentration of phosphate observed in transect *at* situated in site C, transect *r* in site B and transect *k* in site D. This is in spite of other transects in B having been consistently different to C. Both transects *at* and *r* are over 200m long and run in a westerly direction perpendicular to the 540m long transect *26* whilst also over 200m transect *k* runs in an easterly direction. It is difficult at this stage to speculate about the lack of significant differences in the means of the phosphate levels in relation to the terrain. Since they all had relatively elevated levels and various surface scatters, it is probable that they had different types of activities which cannot be separated individually at this level of research.

It is evident from these preliminary phosphate results that the 'savanna glades' are socio-cultural-loaded signatures of anthropogenic activities which varied at the local level. Furthermore, based on these findings, it is not necessarily justifiable to assume that they were cattle enclosures, as suggested in previous studies. The phosphate concentrations varied within these white features which could be taken to mean differing uses, or perhaps differing intensities of use. Their white appearance is probably influenced more by the underlying geology than the presence of *C.ciliaris,* which of course has the potential for enhancing this appearance on aerial photographs. However, more work needs to be done to account for their extent and the differing types of activities undertaken, and thereby arrive at a conclusive interpretation.

Results from the Sampled Grid

The randomly selected 100x100 metre grid was systematically sampled. To ensure that the entire grid was represented, and to account for variability, samples were also randomly collected within each and every 10x10m square and the coordinates were recorded and later imported into the ArcGIS environment for spatial analysis. Accordingly 100 samples would have been collected but there were instances where samples could not be collected because of the impenetrable rocky surface. In total 95% of the area was sampled and analysed, and this is believed to be a representative sample of the entire grid. There were 10 transects altogether and they are labelled in such a way that they denote the x and y axis where the numerals denote the x-axis and the letters denoted the y-axis Figure 5.24. For example, sample *37h* represents a sample collected randomly within square *h* along transect *37*. The soil phosphate and pH results presented are for transect 30 to 40 and sampling points a to j.

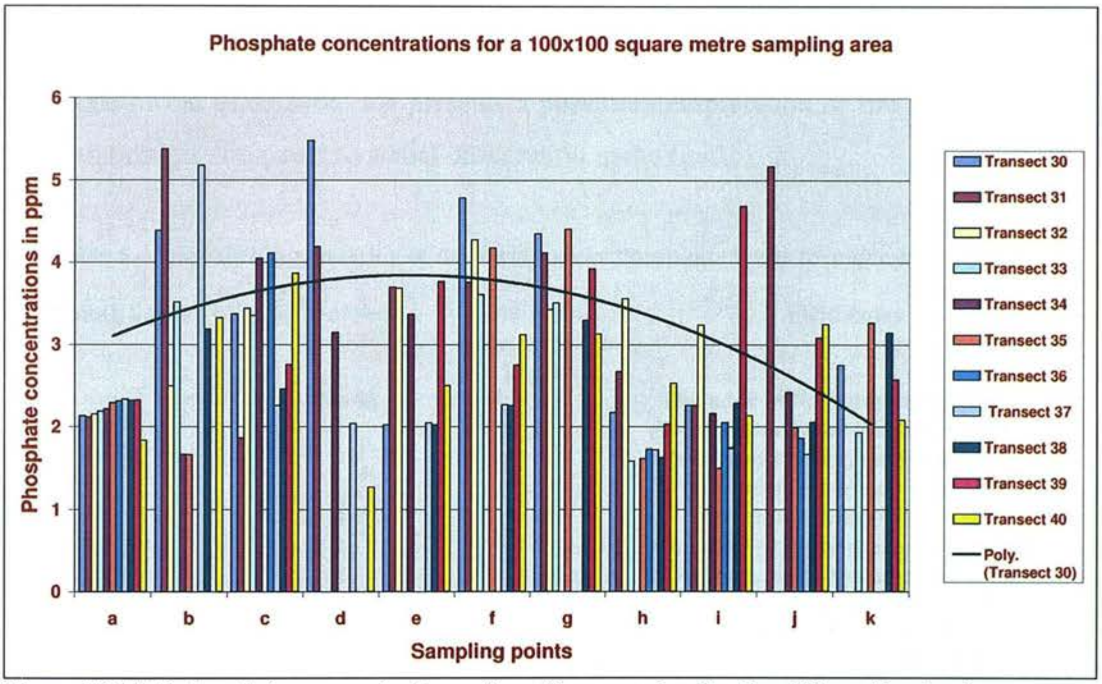

Figure 5.24 Soil phosphates concentrations of a grid square showing the different levels of phosphates to indicate possible different cultural activities on the site.

Any significant observations were noted during the sampling for post-field analysis comparison. This was to help in explaining any anomalies in the results. The phosphate levels are generally low and this is as expected because soils in Botswana are generally low in phosphates (Mosekiemang, *pers. comm., 2006.*) and in the study area the high pH and the coarse-grained nature of these soils make phosphate fixation less powerful, hence the values are even lower. However, the results offer an opportunity for discussion since a pattern emerges from the grid survey. It is also useful to compare the field notes with the results to be able to see if the observations made were of any value.

For all transects of sampling point *a*, the phosphate concentration levels appear to be very low (<2.5ppm). Sampling point *a*, is largely on the edge of the sampling grid and sloping towards the Shashe river. The concentration levels then vary within the grid with instances of low and high levels of phosphates. It is difficult to discern the actual activity that took place within the grid but an attempt is made here in reference to the data presented in the graph. As the trend seems to represent a normal distribution, it should be noted that sampling was random and the concentration levels would have varied on either side of the grid. Table 5.4 presents a possible interpretation of the low and high concentrations as compared to actual observation in the field.

Table 5.4 Possible interpretation of the variations in Phosphate levels throughout the grid

Sampling Square	Transect	Phosphate concentration in ppm	Field notes
a	30-40	<2.5	The edge of the sampling grid and slopes towards the Shashe river and the nearby valley. Probably $PO4^{3-}$ have been removed by erosion
b	34 and 35	<2	A stream running across the sampling point and hence problems of erosion. Samples collected from a
	30,31,33,37-40	>3	white ashy deposits with visible scatters of pottery, probable cause of elevated levels of phosphate.
c	31	<2	Sample collected from a grain-bin like stone feature
d	30 and 31	>4	Samples collected from an ashy deposit
f	30	>4	Sample collected from the edge of a midden
h	33-40	Average<2	This transect runs across a depression with a stream that slopes in the direction of the Shashe river

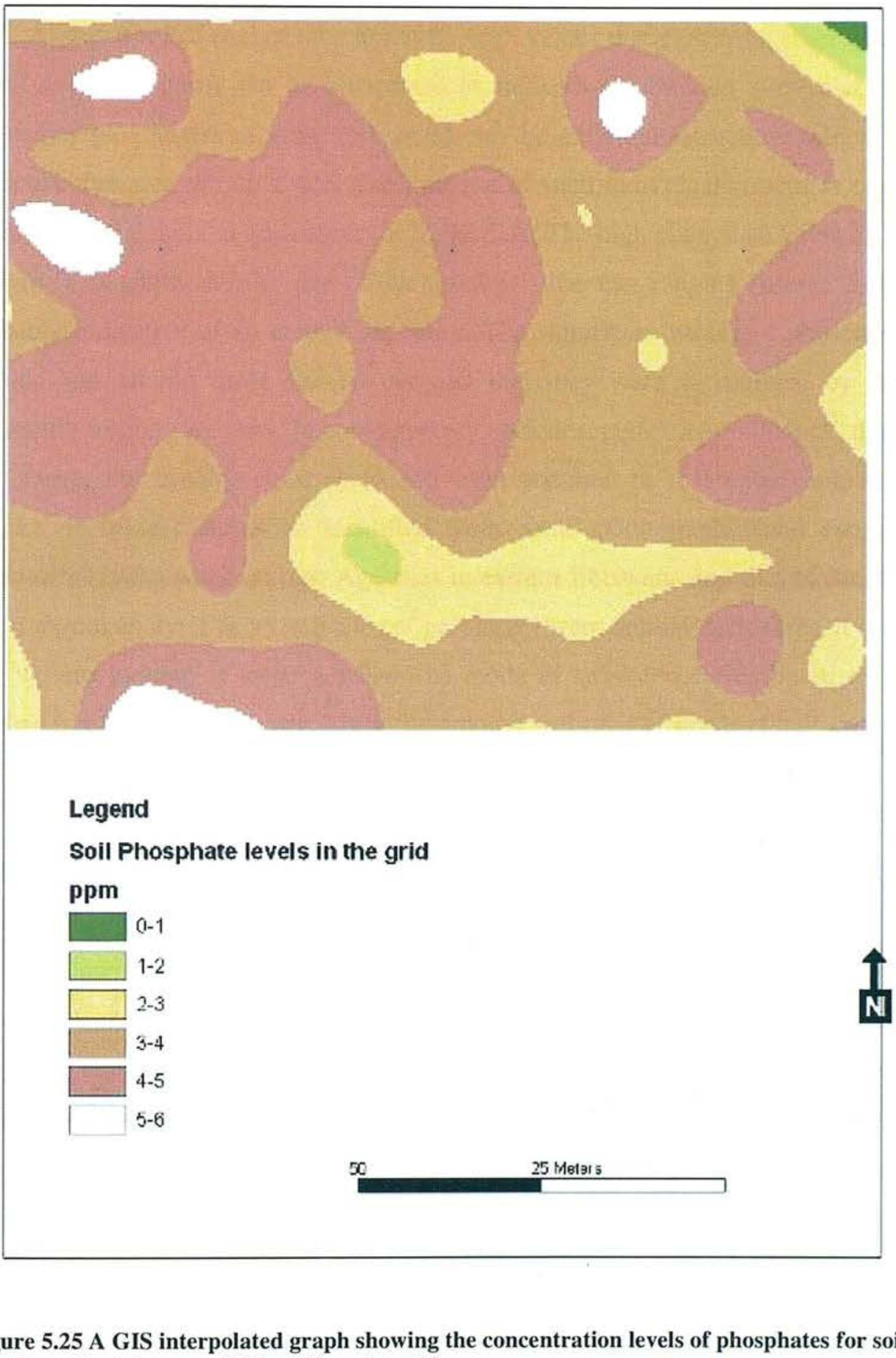

Figure 5.25 A GIS interpolated graph showing the concentration levels of phosphates for soil samples collected over a 100 by 100 metre grid.

A distribution map of phosphate clusters is produced using GIS and presented in Figure 5.25. At this level of analysis the relatively high values that cluster together and cover a broad area (3-5 ppm) can be interpreted as indicating habitation sites, and the well-defined single clusters in white (5-6 ppm) may be individual structures which served a particular function within a site. The function of such individual structures could have been residential, animal enclosures, or for burials. The high phosphate value on the map appearing as white and the size of the structure (diameter ranging from *c*. 5–10m) are probably indicative of an animal enclosure. The significant values of phosphate found outside and around these features suggest that they were surrounded by structures constantly used by humans. In contemporary societies, pens for small stock, that is goat and sheep, are usually constructed and even attached to residential homes. In this respect, if these features as identified from aerial photographs (and supported by Denbow's (1979) work on Iron Age sites in eastern Botswana and that of Smith (2005) on strontium analysis as an indicator of pasturage) were animal enclosures, it is possible that we are looking at an area where the mode of subsistence was based on farming particularly animal husbandry. From the amount and type of material culture recovered at Tuli Circle 2, it is evident that the occupants there were of a lesser status than those at the Mapungubwe capital. It is possible that they may have been there to take advantage of the land for pasture, which was important for the breeding and upkeep of the livestock for the Mapungubwe community. If these were cattle-posts, it therefore makes sense to have the low levels of phosphates.. This could suggest that in terms of settlement, the population size was too small and may have been seasonally used. It has also been suggested that the abundance of animal enclosures could imply that animals were rotated around the landscape on seasonal basis, especially as this site is right on the bank of the Shashe River and so susceptible to flooding. Sheep and goats usually do not like waterlogged environments for their sheds, and so their occupation is often rotated. Samples from transects, especially those of site-subdivision C, also point to a society with some sort of craft specialisation and, as hypothesised earlier, these could have been sites which were the driving force for the successful economic growth of that class-based state.

It is however too early to draw firm conclusions from these results, as more work needs to be done and the sampling coverage increased. It is also important in future research to do the analyses on the known and documented features, such as burials, and systematically within a single structure from Mapungubwe and other sites for comparison and confirmation purposes. Where there are no structures visible as in this study, high density sampling could help by drawing up the boundaries of activity areas, which is often not possible from artifact distributions alone. Having said that, based on these results the usefulness of phosphate analysis cannot be understated and its application can serve as a valuable tool in archaeological research, on its own or as a complement to other data collection techniques.

5.4.3. Summary of Geochemical Analysis in the Archaeology of the Study Area

In addition to aerial photographs used in identifying archaeological sites, the primary aim of employing geochemical analysis at Tuli Circle 2 was to attempt to develop a methodological framework that might be applied on other sites in the future in order to determine their use. As far as this present study is concerned, there is no known work that has used this technique in Botswana and at any sites in the Basin to characterise the nature of phosphate level variations as a consequence of particular identified activities. The test-excavation results have in a way delimited the savanna glades observed from aerial photographs by identifying social and cultural signatures that could be associated with such activities. The large number of the white patches recognised in such a small area it does not immediately imply cattle enclosures. It has been suggested that it is possible that small stock, *ovis/capra*, could have been rotated around the area on a seasonal basis. Animal manure is known to elevate phosphate levels and from the sampled grid the concentration levels of 5-6 ppm could well be representative of such enclosures with diameters ranging between 5m to 10m.

It has been cited elsewhere, at sites which are considered to be cattle enclosures and possess vitrified dung, such as Toutswe, that within their vicinity there are *dhaka* materials which have slag deposits probably formed in the process of heating and as a result producing the same material as iron slag (Peter, 1999) . The heavy metal analysis results have not convincingly demonstrated that the iron-like slag deposits observed on the surface have any iron in them to qualify as such. As there is *dhaka* debris on the surface, it is possible that these could be the products of such a process. The heating could have prolonged natural heat energy from the sun over a long period of time and also heating could have come from lighting. However, as the results also suggests to structures found in the vicinity such as Test-pit 2 to have been habitation sites, it is also possible that the heat could have been produced locally using bricks/*dhaka* materials as fireplace bases and pot stands.

The primary aim of this section of the thesis was to test certain methodological aspects in geochemical analysis, which included sample collection, sampling intervals, and analysis of soil samples. It must be acknowledged that since no attempts have been made in past studies of the Basin, this study is essentially on a trial and error basis and it is by and large an experiment designed to assess geochemical testing as a potential technique for understanding the broader landscape of the Shashe-Limpopo Basin in the past. It has indeed produced interesting results as far as the location and extent of activities at the Shashe-Limpopo Basin site of Tuli circle 2 are concerned. Within the grid (Figure 5.25) it can also be seen how useful a tool phosphate analysis can be in the interpretation of intra-site relationships, which definitely varied as demonstrated by the transect analysis using Mann-Whitney U-test non-parametric statistical analysis. However, more work with greater spatial coverage and a broader spectrum of elements and traces to be tested needs to be undertaken in order to fine-tune these findings and to allow for comparisons to be made over a large area. This will aid our understanding of their potential uses as indicators of certain types of activities such as cooking, kraals, burials and metal working. It is believed that research of this nature is critical for archaeologists in helping to appreciate the potential of geochemical analysis as an interpretative tool that can permit us to examine the function of individual structures as well as the use of space within habitation sites and beyond. In that way we can incorporate in our interpretations the diverse approaches that humans can employ for optimum use of their surrounding landscape.

Secondly soil phosphate determination can also be useful in pre-development archaeological surveys. The Botswana Monuments and Relics Act (1970) interprets all historical and prehistoric archaeological remains as national assets that should not be disturbed by construction work without impact assessments being conducted. Soil phosphate survey can become extremely useful under such circumstances where the method can be used both for finding sites and for guiding where excavations should be conducted within a reasonable time and budget, and with minimum damage being inflicted on sites. In light of the tri-partite Trans Frontier Park envisaged for the area, this technique will be crucial for the location and documentation of sites especially on the Botswana side of the Basin where most of the sites are located and access is difficult because of the wildlife. Phosphate survey has an advantage in that it is a rapid, relatively inexpensive, survey method capable of producing much useful data.

5.4.4. X-Ray Powder Diffraction analysis of Ceramics

5.4.4.1. Introduction

The use of this technique was preferred for its ability to differentiate individual phase components of minerals from the crystalline matrix containing them. Following the computer-aided method described in Chapter 4, x-ray graph scans were imported and analysed, and qualitatively and quantitatively used to identify a range of minerals present in the samples. The printed output data from the XRPD analysis consists of **x,y** paired data where **x** is the 2-Theta angle of diffraction and **y** is the intensity of the diffracted beam, and these data are represented as a graph of intensity in counts per second *versus* 2-Theta angle. The graph shows the mineralogical characteristic of the sample being analysed as presented in Appendix D and selected examples in the section below. This is called a 'Graphics and Identity' feature of the XRPD analysis program and it allows for the identification of an unknown by comparing it to the XRPD pattern and a series of known patterns using a list of peak positions. Observed peak positions are matched against the data and patterns available in the Mineral Powder Diffraction File data book and the search manual issued by the Joint Committee on Powder Diffraction Standards (JCPDS) from the International Center for Powder Diffraction Data (ICPDD) (2001) database, and the interpretation made (the manuals were available in the Geology Department, University of Botswana). This is done by using the printout of the x-ray data file (diffractogram) and a plot of the pattern for the unknown mineral by:

a. identifying the three most intense peaks and noting down their d-spacing;
b. identifying the section with d-spacing for the sample with the most intense peak;
c. within the same section scanning down the column with the second most intense peak;
d. comparing the values for the 3 most intense peaks with those minerals listed in the immediate vicinity.

Two or three minerals usually emerge as most likely candidates.

5.4.4.2. Mineral Phase Composition on Ceramic Samples and their Implications

The recorded diffractograms of all ceramic samples analysed are presented in Appendix D, whilst a qualitative and at best semi-quantitative representation of mineral phases is as presented on Table 5.5. All samples analysed were found to contain quartz. Albite (alkali feldspar) and anorthite (a plagioclase) are formed by a low temperature reaction between aluminium-rich silicates and calcites and they are the most prevalent in the samples after quartz. There are a few instances where they occur together in some samples. The results show anorthite to be common amongst decorated sherds, whilst albite is common in undecorated sherds, even though there are a few exceptions where they occur on either decorated or undecorated samples. Anorthite, albite and quartz have been reported as the main mineral components in the types of soils found in the region, such as at Selebi-Phikwe (Ekosse, 2005: 63).

Where albite or anorthite is not significantly present, the phases of the potassium and sodium feldspar in the form of sanidine, microcline and orthoclase are observed and they tend to occur independently. Two samples, one from Megwe (level 10, or 90–100cm) and the other from Tuli Circle 2 (surface collection), and both undecorated ceramic sherds had tridymite with sanidine and tridymite with orthoclase, respectively. Tridymite is a high temperature silica polymorph. Polymorphs are specific crystalline forms of a compound that can crystallize in different forms and they exist when there is more than one way for the particles of a particular substance to arrange themselves into a crystalline array. Orthoclase and sanidine on the other hand are potassium feldspars that are principal constituents of acidic igneous rocks. Significant about the results is that quartz predominates as the major component of samples, probably from the weathering of the granitic bedrock in the area and the phases which occur independently (and or together in some instances) could well be from different sources whereby they could denote inclusions (tempers) introduced into the clay raw materials for purposes of boosting quality and durability of the pots.

Table 5.5 X-Ray Powder Difraction Mineralogical Composition of Ceramic Samples

Sample id	Site	Unit:level:Sample#	Description	Quartz	Albite	Anthornite	Tridymite	Sanidine	Microcline	Orthoclase
Manake Clay	Manake		Clay samples collected from Manake site	X	X			X		
MVA-1/1	Megwe Hill	A:1:1	Sample from Megwe hill, Square/unit A level 1 sample 1	X	X					
MVA-1/2	Megwe Hill	A:1:2	Sample from Megwe hill, Square/unit A level 1 sample 2	X	X					
MVA-1/3	Megwe Hill	A:1:3	Sample from Megwe hill, Square/unit A level 1 sample 3	X					X	
MVA-10/1	Megwe Hill	A:10:1	Sample from Megwe hill, Square/unit A level 10 sample 1	X		X			X	
MVA-10/2	Megwe Hill	A:10:2	Sample from Megwe hill, Square/unit A level 10 sample 2	X			X	X		
MVA-10/3	Megwe Hill	A:10:3	Sample from Megwe hill, Square/unit A level 10 sample 3	X	X			X		
MVA-10/4	Megwe Hill	A:10:4	Sample from Megwe hill, Square/unit A level 10 sample 4	X					X	
MVA-10/5	Megwe Hill	A:10:5	Sample from Megwe hill, Square/unit A level 10 sample 5	X	X					
MVA-5/1	Megwe Hill	A:5:1	Sample from Megwe hill, Square/unit A level 5 sample 1	X					X	
MVA-5/2	Megwe Hill	A:5:2	Sample from Megwe hill, Square/unit A level 5 sample 2	X	X					
MVA-5/3	Megwe Hill	A:5:3	Sample from Megwe hill, Square/unit A level 5 sample 3	X	X					
MVA-5/8	Megwe Hill	A:5:8	Sample from Megwe hill, Square/unit A level 5 sample 8	X	X					
MVA-5/9	Megwe Hill	A:5:9	Sample from Megwe hill, Square/unit A level 5 sample 9	X	X					
TC2B-0/1	TC2/B	Surface collection1	Samples from surface of Site subdivision B, sample1	X		X				
TC2B-0/2	TC2/B	Surface collection2	Samples from surface of Site subdivision B, sample2	X		X				
TC2B-0/3	TC2/B	Surface collection3	Samples from surface of Site subdivision B, sample3	X		X				
TC2B-0/4	TC2/B	Surface collection4	Samples from surface of Site subdivision B, sample4	X						
TC2B-0/5	TC2/B	Surface collection5	Samples from surface of Site subdivision B, sample5	X	X					X
TC2B-0/6	TC2/B	Surface collection6	Samples from surface of Site subdivision B, sample6	X			X			X
TC2B-0/7	TC2/B	Surface collection7	Samples from surface of Site subdivision B, sample7	X						
TC2B-0/8	TC2/B	Surface collection8	Samples from surface of Site subdivision B, sample8	X		X				
TC2B-0/9	TC2/B	Surface collection9	Samples from surface of Site subdivision B, sample9	X	X					
TC2B-0/10	TC2/B	Surfacecollection10	Samples from surface of Site subdivision B, sample10	X	X	X				
TC2B-2C-2/1	TC2/B	2C:2:1	Sample from site subdivision B, unit 2 quadrant C level2, sample 1	X	X					
TC2B-2C-2/2	TC2/B	2C:2:2	Sample from site subdivision B, unit 2 quadrant C level2, sample 2	X	X	X				
TC2B-2C-2/3	TC2/B	2C:2:3	Sample from site subdivision B, unit 2 quadrant C level2, sample 3	X	X					
TC2B-2C-2/4	TC2/B	2C:2:4	Sample from site subdivision B, unit 2 quadrant C level2,	X	X					

			sample 4							
TC2B-2C-2/5	TC2/B	2C:2:5	Sample from site subdivision B, unit 2 quadrant C level2, sample 5	X	X					
TC2B-3-1/1	TC2/B	3;1:1	Sample from site subdivision B, unit 3 level 1, sample 1	X	X					
TC2B-3-1/2	TC2/B	3;1:2	Sample from site subdivision B, unit 3 level 1, sample 2	X						
TC2B-3-1/3	TC2/B	3;1:3	Sample from site subdivision B, unit 3 level 1, sample 3	X		X				
TC2B-3-1/4	TC2/B	3;1:4	Sample from site subdivision B, unit 3 level 1, sample 4	X						
TC2B-3-1/5	TC2/B	3;1:5	Sample from site subdivision B, unit 3 level 1, sample 5	X						
TC2B-3-1/6	TC2/B	3;1:6	Sample from site subdivision B, unit 3 level 1, sample 6	X	X					
TC2B-3-1/7	TC2/B	3;1:7	Sample from site subdivision B, unit 3 level 1, sample 7	X	X					
TC2B-3-1/8	TC2/B	3;1:8	Sample from site subdivision B, unit 3 level 1, sample 8	X		X				
TC2B-3-1/9	TC2/B	3;1:9	Sample from site subdivision B, unit 3 level 1, sample 9	X	X					
TC2C-2-2bea	TC2/B	3:2bea	Sample from site subdivision C, unit 2 level 1, contents of a beaker	X		X				
TC2C-2-2cru	TC2/C	2:2cru	Sample from site subdivision C, unit 2 level 2, contents of a crucible-like object	X	X					
TC2C-2-2cup	TC2/C	2:2cup	Sample from site subdivision C, unit 2 level 2, contents of a cup-like object	X	X	X				
TC2C-2B-2/1	TC2/C		Sample from site subdivision B, unit 2 quadrant B level2, sample 1	X	X				X	
TC2C-2B-2/2	TC2/C		Sample from site subdivision B, unit 2quadrant B level2, sample 2	X	X					
TC2C-2B-2/3	TC2/C		Sample from site subdivision B, unit 2quadrant B level2, sample 3	X	X					
TC2C-2B-2/4	TC2/C		Sample from site subdivision B, unit 2 quadrant B level2, sample 4	X	X					
TC2C-2B-2/5	TC2/C		Sample from site subdivision B, unit 2 quadrant B level2, sample 5	X	X					
TC2C-2NW-1/1	TC2/C		Sample from site subdivision C northwest corner of unit 2 level 1, sample 1	X		X				
TC2C-2NW-1/2	TC2/C		Sample from site subdivision C northwest corner of unit 2 level 1, sample 2	X	X			X		
TC2C-2NW-1/3	TC2/C		Sample from site subdivision C northwest corner of unit 2 level 1, sample 3	X	X					
TC2C-2NW-1/4	TC2/C		Sample from site subdivision C northwest corner of unit 2 level 1, sample 4	X		X				
TC2C-2NW-1/5	TC2/C		Sample from site subdivision C northwest corner of unit 2 level 1, sample 5	X		X				
TC2C-2SW-1/1	TC2/C		Sample from site subdivision C southwest corner of unit 2 level 1, sample 1	X		X				

TC2C-2SW-1/2	TC2/C		Sample from site subdivision C southwest corner of unit 2 level 1, sample 2	X		X				
TC2C-2SW-1/3	TC2/C		Sample from site subdivision C southwest corner of unit 2 level 1, sample 3	X		X				
TC2C-2SW-1/4	TC2/C		Sample from site subdivision C southwest corner of unit 2 level 1, sample 4	X	X					
TC2C-2SW-1/5	TC2/C		Sample from site subdivision C southwest corner of unit 2 level 1, sample 5	X		X				
TC2C-2SW-1/6	TC2/C		Sample from site subdivision C southwest corner of unit 2 level 1, sample 6	X	X					
TC2C-2SW-1/7	TC2/C		Sample from site subdivision C southwest corner of unit 2 level 1, sample 7	X	X					
TC2C-2SW-1/8	TC2/C		Sample from site subdivision C southwest corner of unit 2 level 1, sample 8	X	X					
TC2C-2SW-1/9	TC2/C		Sample from site subdivision C southwest corner of unit 2 level 1, sample 9	X	X					
TC2C-2W-2/1	TC2/C		Sample from site subdivision C west corner of unit 2 level 2, sample 1	X	X					
TC2C-2W-2/2	TC2/C		Sample from site subdivision C west corner of unit 2 level 2, sample 2	X	X					X
TC2C-2W-2/3	TC2/C		Sample from site subdivision C west corner of unit 2 level 2, sample 3	X	X					X
TC2C-2W-2/4	TC2/C		Sample from site subdivision C west corner of unit 2 level 2, sample 4	X	X					
TC2C-2W-2/5	TC2/C		Sample from site subdivision C west corner of unit 2 level 2, sample 5	X		X				
TC2C-2W-2/6	TC2/C		Sample from site subdivision C west corner of unit 2 level 2, sample 6	X	X					
TC2D-0/1	TC2/D		Samples from surface of Site subdivision D, sample 1	X	X	X				
TC2D-0/2	TC2/D		Samples from surface of Site subdivision D, sample 2	X		X				
TC2D-0/3	TC2/D		Samples from surface of Site subdivision D, sample 3	X		X				
TC2D-0/4	TC2/D		Samples from surface of Site subdivision D, sample 4	X	X	X				
TC2D-0/5	TC2/D		Samples from surface of Site subdivision D, sample 5	X		X				
TC2D-0/6	TC2/D		Samples from surface of Site subdivision D, sample 6	X	X					
TC2D-0/7	TC2/D		Samples from surface of Site subdivision, sample 7	X	X					
TC2D-0/8	TC2/D		Samples from surface of Site subdivision D, sample 8	X		X				

In the Figures below are selected examples of the samples from Manake Clay, Tuli Circle 2 and Megwe Hill site which are used to illustrate the method of analysis and the results obtained as qualitatively presented in Table 5.6 above and quantitatively by the diffractograms on Appendix D. As indicated the only clay sample was that of Manake about 60km away from the confluence, which was also used as a control site. It was the only clay source ethnographically identified in the study area.

Manake Clay Sample

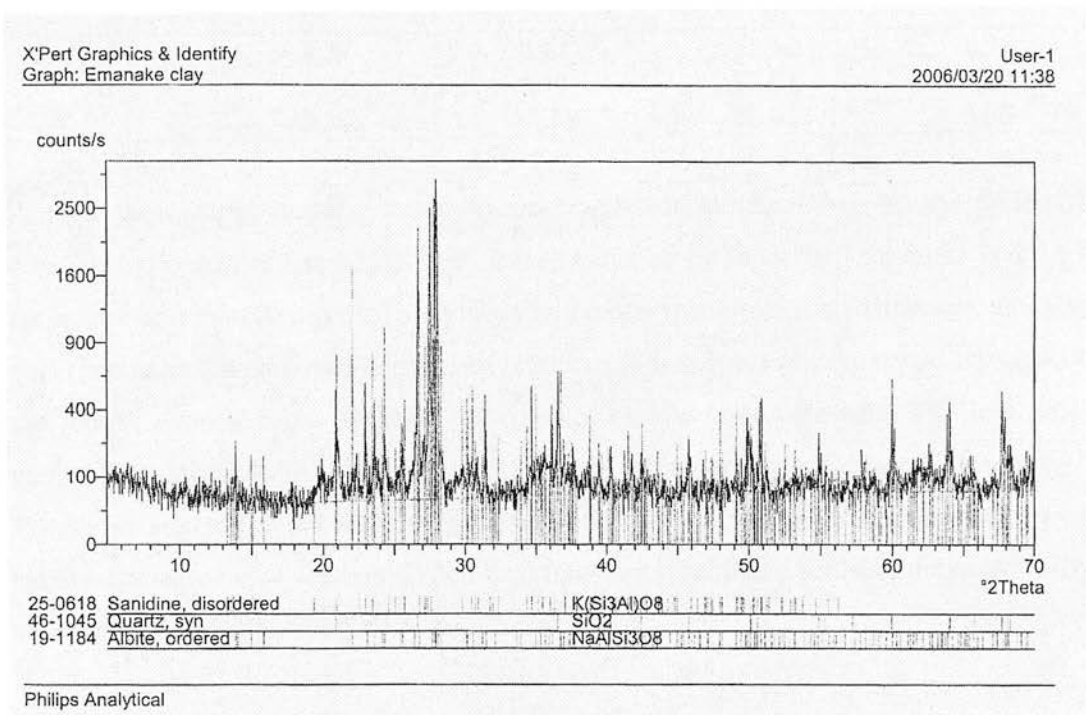

Figure 5.26 X-ray diffractogram of whole clay sample from Manake disused clay quarry

Using the printout of the x-ray data file or diffractogram and a plot of the pattern for a sample of clay collected from an identified old and disused clay quarry at Manake (Figure 5.28), it was found that the sample contained alkali feldspars of sanidine (d-spacing = 4.47, 3.24, 3.21Å) and albite (d = 3.77, 3.19, 3.18 Å) as the main constituent phases, with comparatively small amounts of quartz (d = 4.24, 3.34, 1.37 Å). The results are summarised in Table 5.6.

Table 5.6 The mineral phases of Manake Clay

Mineral phase	d-spacing (Å)	Relative intensity	Angle (2 ° Theta)	Significance
Quartz	**4.24**	**12.16**	**20.90**	**1.09**
	3.34	**75.37**	**26.65**	**6.13**
	1.38	**16.16**	**67.7**	**2.14**
Sanidine	**4.47**	**2.11**	**19.83**	**1.21**
	3.24	**85.49**	**27.49**	**7.40**
	3.21	**89.50**	**27.79**	**19.54**
Albite	**3.77**	**8.81**	**23.59**	**1.94**
	3.19	**100**	**27.91**	**9.19**
	3.18	**79.38**	**28.01**	**3.05**

Among these three choices, it can be observed that sanidine may be the preferred constituent because it has a high significance value of 19.54 *vs* 9.19 for albite and 6.13 for quartz and therefore contributed more to the total peak intensity. However, albite is also present as the preferred constituent (100%) and it is consistently present throughout the matrix even though at times it is present at low concentrations. The low peak intensity for quartz is an indication of its presence in the sample at lower concentrations. The likely source for the feldspar is the granitic rocks which dominate the geology of eastern Botswana (see Chapter 2) and therefore occur as altered feldspar deposits which are also Al-rich (Ekosse, 2005).

Tuli Circle 2 Samples

The Tuli Circle 2 site had more samples collected for analysis as it was extensively investigated during the field survey. Samples were collected from the surface and test-excavations. Also, a few samples were analysed from the contents of certain artifacts recovered from the test excavation. Most of the mineralogical phases observed in samples from this site had quartz, albite and anorthite as the principal components.

However, there were a few incidences where quartz was present with albite and orthoclase (TC2B-0/5) and with tridymite and orthoclase (TC2B-0/6) in the samples collected from the surface. This is the only instance where this particular component combination is observed in the phase compositional analysis of samples in the study. As the presence of most mineral constituents and their implications are dealt with in the discussion of the other two sites, the results and discussion of the Tuli Circle 2 samples will focus only on these unique cases.

Sample TC2B-0/5 was a decorated potsherd collected from the surface of site sub-division B. Table 5.5 shows the phase composition of this sample to be quartz, albite and orthoclase. Both albite and orthoclase are present in significant quantities as evidenced by their peak intensities, while quartz appears as a minor constituent of the sample (Figure 5.27).

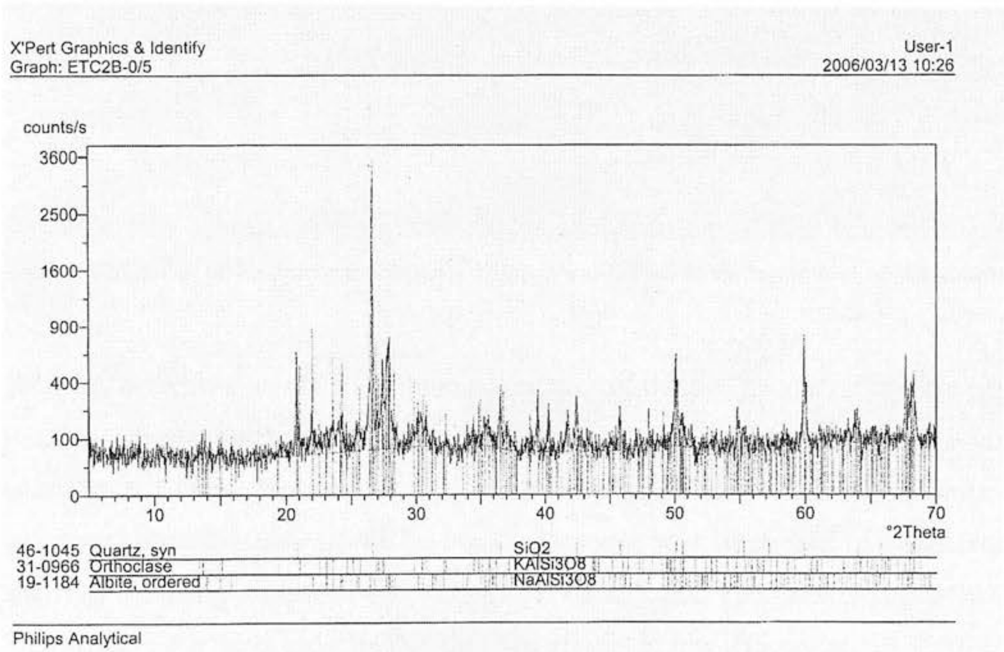

Figure 5.27 X-ray diffractogram of sample TC2B-0/5 collected from the surface of site subdivision B of Tuli Circle 2.

The presence of orthoclase ($KAlSi_3O_8$) in the sample is important. It is a product of potassium feldspar that is a principal constituent of acidic igneous rocks, and therefore it is not possible for it to originate from the weathering of rocks in the local area as they are basaltic granitic rocks (see Chapter 2). This implies that as most samples do not seem to have orthoclase in their mineral constituent, for example, the nearby Megwe

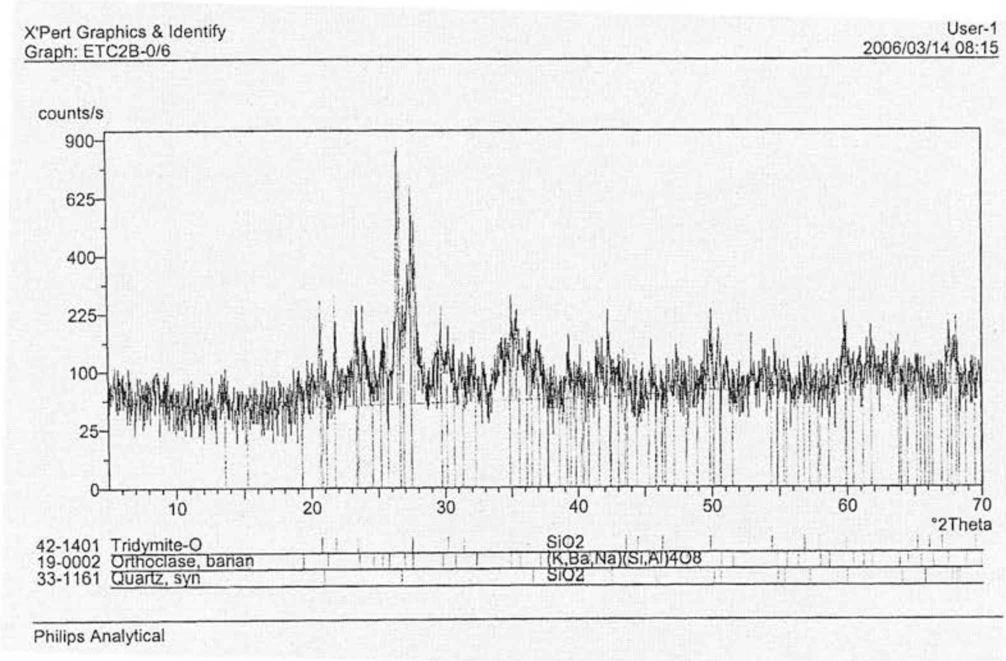

Figure 5.28 X-ray diffractogram of sample TC2B-0/6 collected from the surface of site subdivision B of Tuli Circle 2

Hill site, orthoclase is not a common occurrence of the soil geochemistry that produced most of the ceramic remains at the site. In other words, this mineral phase could be characteristic of pot remains that originated elsewhere. Sample TC2B-0/6, which is also a surface collection, also shows the high and intense peak intensities of orthoclase in the sherd as compared to quartz and tridymite (Figure 5.28). The weak and poorly defined intensities of the latter indicate that they are present in low concentrations. Orthoclase as a principal component is also observed in excavated samples. At site sub-division C, two undecorated sherds from level 2 (10–20 cm) of test pit 2 were analysed and had orthoclase with albite (Figure 5.29). Pots with this particular mineral phase seem to be a rare occurrence in the study area and as a principal constituent in those samples it could be assumed that it dominated in the geochemistry of the clay used in the production of those pots.

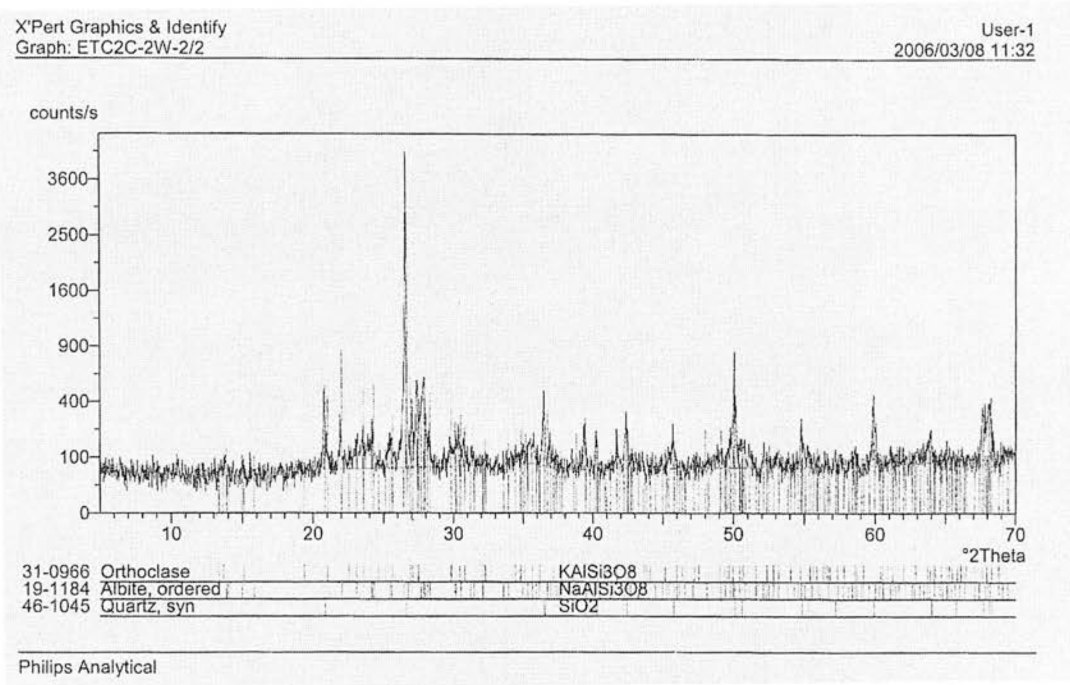

Figure 5.29 X-ray diffractogram of sample TC2C-2W-2/2 from the level 2 of the west corner of test-pit 2 on site subdivision C of Tuli Circle 2

Thus, the results suggest that these particular ceramic sherds are not local to the area and could have reached the site by other means, such as trade and exchange, and/or inter-community/society marriage. Since it is also present in the lower levels of the stratigraphy, it can further be suggested that the occupants of the site had an established relationship which existed over a period of time.

Megwe Hill Samples

At the Megwe site a total of 17 (4 discarded) pottery samples were collected and analysed and the mineralogical phases present are shown in Table 5.6. All these samples came from one test-pit (square A) but different excavation levels; A: 1, A: 5 and A:

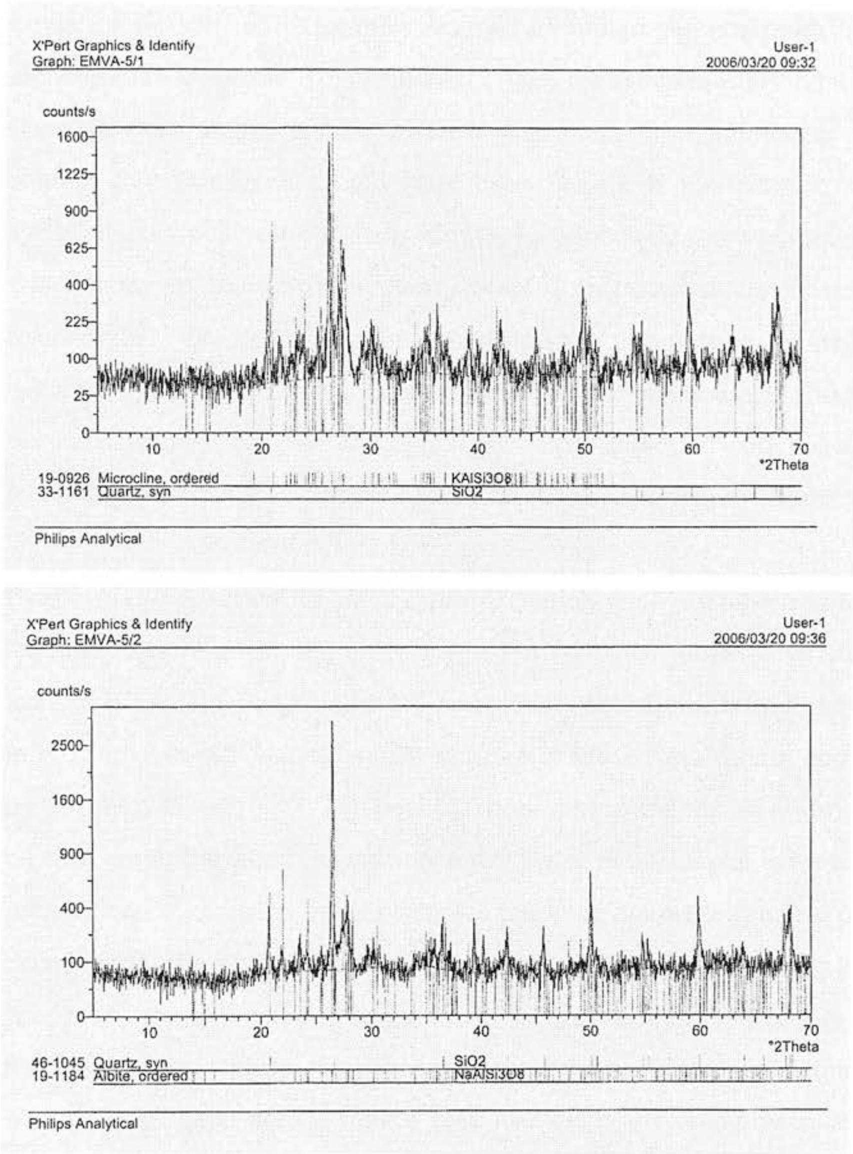

Figure 5.30 X-ray diffractogram of samples 1 and 2 of test-pit A level 5 (A: 5) of Megwe Hill site

10. As discussed in Section 5.2.3, this test-pit produced a considerable amount of loose, dry sediment on poorly defined profile, hence there is a possibility of it being a midden. Therefore the purpose in analysing its pottery remains was to establish if the mineralogical composition would show any significant variation at different levels of excavation as a possible indication of variation in occupation of the site or clay sources.

Level 1 (0–10cm, A: 1) samples were all decorated and comprised albite and quartz as the major constituents. This could imply that the samples analysed were sherds from the same ceramic utensil and/or different pots made from the same or a geochemically similar clay source. It would have been helpful if the decorative motifs had been systematically analysed and their affinity identified prior to x-ray analysis. Nevertheless, what seems to emerge from these results is that similar clay materials were used to manufacture the ceramics remains observed, irrespective of style. Assuming the decorative motifs to have been different, this element of geochemistry therefore becomes critical as it highlights the limitations of documenting cultural and technological change in complex societies based on stylistic variations alone.

For level 5 (40–50cm or A: 5), nine samples were submitted for analysis, however results were obtained for only five (5) samples as some were damaged during the analytical process. Samples A: 5:1-3, were all decorated sherds. Sample 1 has quartz and microcline mineral phases, whilst samples 2 and 3 have quartz and albite as the main constituents Figure 5.30. The peaks of both quartz and the alkali feldspars are high and narrow, implying good crystalline state. From these results, as already discussed, the predominance of quartz in the samples could be from the granitic primary rock which characterises the geology of the study area. However, the potassium and sodium feldspar phases in the samples point to the fact that, even though the samples are from same site and level of excavation, the geochemistry of the two sherds is distinctly different. They may be associated with different clay raw materials or tempers, and this could have critical implications for provenance determination.

Level 10 (90–100cm, A: 10) had five pottery samples analysed. They were all undecorated sherds and peaks of quartz were distinct, indicating a good crystal phase with quartz as a major constituent of the sample. In addition to quartz, sample 1 had anorthite and microcline, sample 2 had tridymite and sanidine, sample 3 had albite and sanidine, sample 4 had microcline, and sample 5 had only albite. Diffractograms of quartz and microcline have been shown and discussed above, therefore here the discussion is on the implication of anorthite, sanidine and tridymite as phase compositions.

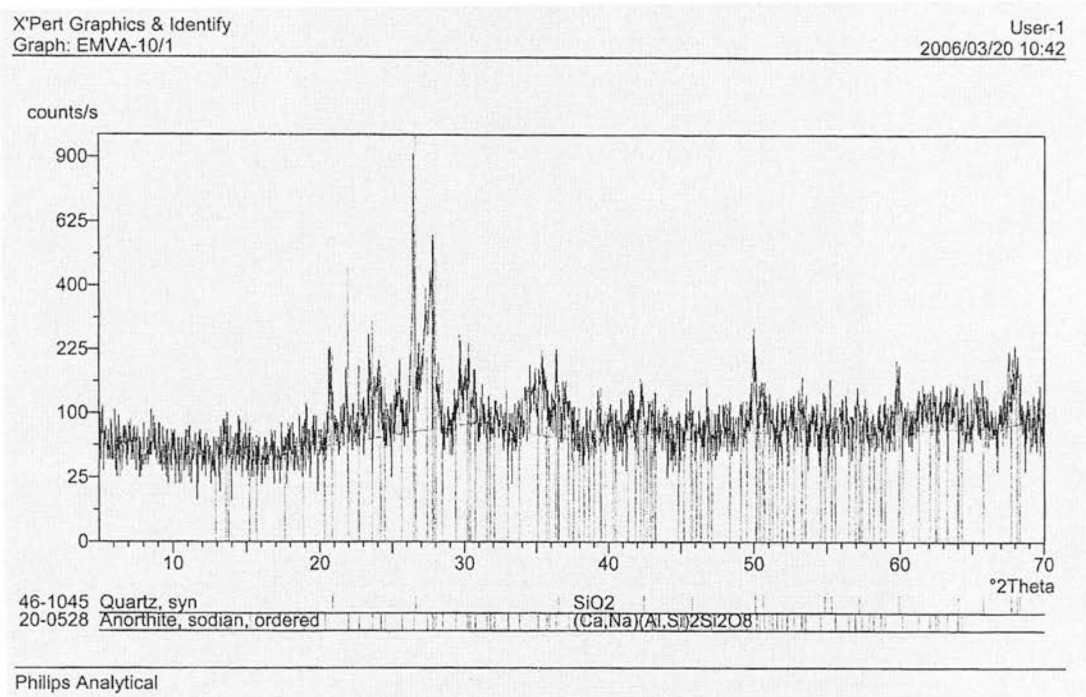

Figure 5.31 X-ray diffractogram of a ceramic sherd from test-pit A level 10 sample number 1from Megwe Hill site

Figure 5.31 shows the mineralogical phases of sample 1. Anorthite and quartz are both present at significant quantities in the sample as shown by the high peak intensities. Anorthite is alkali feldspar that is formed by a low temperature reaction between aluminium-rich silicates and calcites. The presence of calcite ($CaCO_3$) is interesting as this could be a reflection of relative mineral concentrations in the parent material, where the pottery was made and modified by addition of calcium-rich tempering. What is significant about this result is that the mineralogical composition is different from that of levels 1 and 5 discussed above. This is an indication that the geochemistry of the sherds differs between and within the levels of the same site.

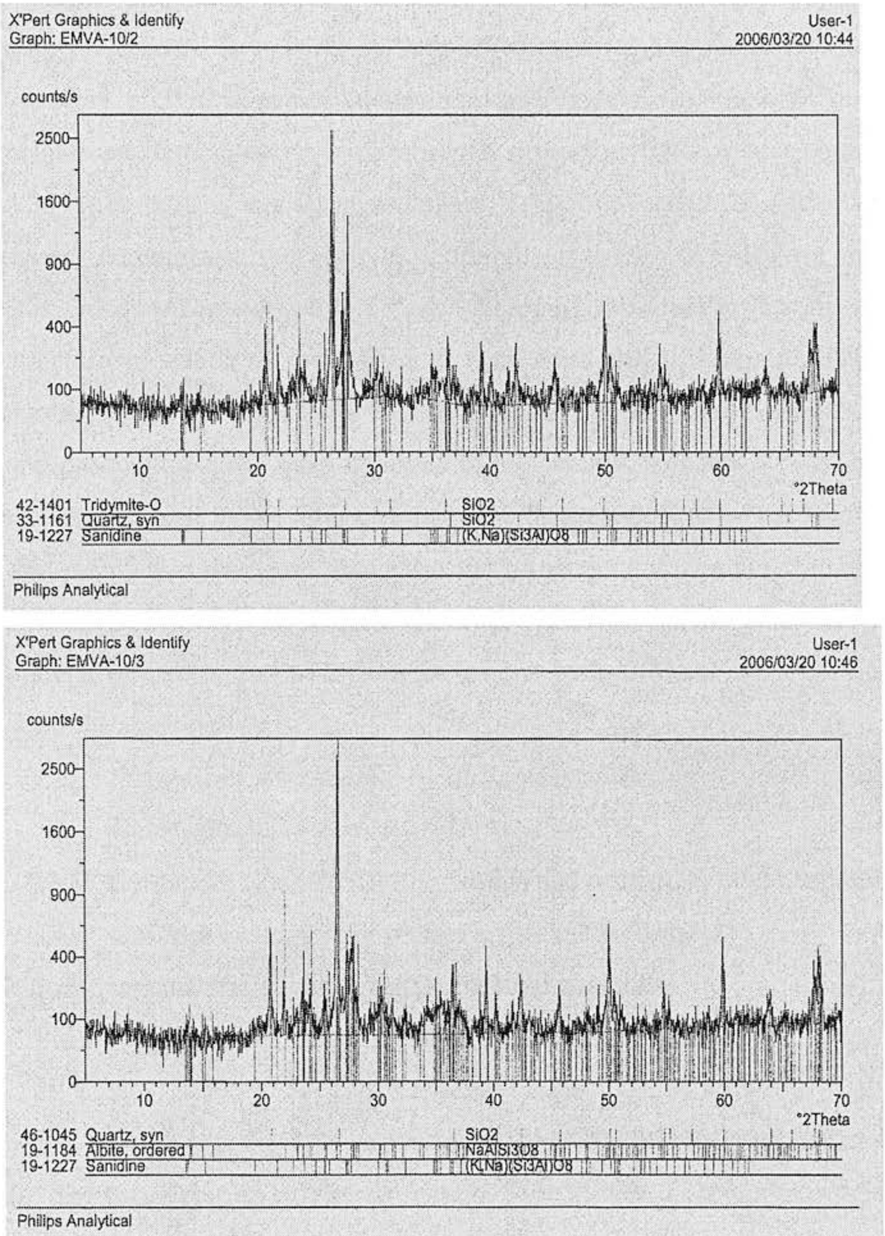

Figure 5.32 X-ray diffractogram from Megwe Hill site test-pit A level 10 samples 2 and 3

Samples 2 and 3 from level 10 both have sanidine observed at low peak intensities and therefore present in minor concentrations (Figure 5.32). In both samples quartz peak heights are distinct and it is significantly present at 100% relative intensity (d-spacing = 3.36 Å), indicating a good crystal phase. Tridymite (sample 2) and albite (sample 3) also appear dominant in the samples. Tridymite is a high temperature silica polymorph. It was probably formed due to ceramic materials subjected to heating which changed the structure of quartz to crystallize in a different form, tridymite. The presence of this mineral phase in this level is therefore distinctive, as it also points to the manufacturing and production techniques involved in the ceramic technology. As the deepest level in the stratigraphy, this level is considered to be the oldest of all the levels discussed above. The results for this level show that the mineralogical composition of ceramic samples differs within the level, as well as between the levels of the same test-pit indicating that pottery was made from clays or inclusions with different chemical compositions. This could be attributed to:

- changes in occupation by different cultures over time, bringing with them pottery products from elsewhere
- movement of pottery through trade and exchange; inter-community marriage
- seasonal movement of people across the landscape
- raw materials outsourced at different locations
- inclusions and tempers gathered from different sources

It has been shown that the ceramic remains at Megwe Hill and Valley site 2, supported by dateable deposits of human remains (see Figure 5.7), are typologically distinct and possess known stylistic motifs of the different occupations of the Basin. Even though the qualitative analysis of the results seemed to suggest an association of anorthite and albite with decorated and undecorated sherds, respectively, it not immediately clear if these phases could have been used for decoration purpose. This is because this level had both phases in the sample and yet the analysed sherds were all not decorated. It can also be argued that if the different pottery styles are an indication of group or ethnic identity, as advocated by some scholars, for example Huffman (2007) then the above results, could be interpreted as telling us that either different people were residing together, or the occupants gathered clay from the same quartz-rich deposits and added different inclusions as tempers. This could have a critical impact on the archaeological knowledge base of the Basin where different times of occupation are explained by the changes in the typological sequences of ceramic design.

5.4.5 Summary Remarks of the X-ray Diffraction Analysis in Ceramic Studies

It must be acknowledged that this is a preliminary attempt at a qualitative and quantitative analysis of the pottery remains using x-ray diffraction techniques. As can be seen from the above data analysis and discussion, diffraction patterns do provide valuable information on the crystalline phases/substances in the ceramic tempers, clays, and their derivatives. The fundamental finding is that pottery remains within and between the levels, sites and settlements can differ in their mineralogical compositions. This may be due to a number of factors, amongst which is movement of people, pots and/or raw materials. This study refers to x-ray powder diffraction analysis of pottery samples and no attempt is made at grouping them according to their relative concentrations of minerals. It is therefore suggestive of further work to be undertaken in order to relate the pottery remains to their sources.

The challenges that seem to arise from this methodological approach is in relating culturally-modified materials (artifacts) or sherds, to clay sources and other natural sources of temper. This can be addressed by grouping pottery through its mineralogical composition or phases according to affinities in time, space and culture. It will also be important to establish mineral phases that are most effective in distinguishing groups of ceramic pots. The advantage of this approach is that categorisation of pottery into groups will be related to established classifications and therefore it will be easier to support or refute existing models. A principal feldspar group in the samples is instrumental as its identification could be critical for provenance determination. XRPD is a standard method by which crystalline phases of materials can be detected and differentiated and therefore its application is limited. The determination of provenances could be undertaken by using more robust analytical techniques such as ICP-AES and by petrographic examination and characterisation of production sites. Insights could be gathered into whether pot-making techniques can change sufficiently in time, and also if pots made at a local scale can vary significantly in their mineral profiles. It could also shed light on the extent of geographical separation necessary to see a significant difference in the archaeological record. It is hoped that with more pottery samples analysed, more meaningful patterns will emerge. Furthermore, other analytical methods could be useful in providing additional insights into pottery sources, production, and circulation.

6. CONCLUSIONS AND RECOMMENDATIONS

The original survey of the confluence zone, unlike normal archaeological surveys, was not informed by the presence of archaeological data in the area. It was rather necessitated by a broad regional research interest in the dynamics of interaction between the past societies and their environment. The environmental setting of the study area was assessed and the results suggested that it was likely to have been a major factor in past human exploitation. The reconnaissance survey, which was undertaken to assess the archaeological potential of the area, revealed significant gaps in the archaeological investigation of the area. This therefore necessitated a systematic survey which narrowed the general broad objectives of the HREC regional project to that of a local study. The major challenge was to establish why a key area located in a dynamic prehistoric landscape which has provided extensive archaeological information on the complex social formations and processes of the region and the Basin has attracted almost no research interest.

Evaluation of past environmental conditions in the Basin in Chapter 2 highlighted the fact that previous archaeological undertakings emphasised a direct link between climatic changes, especially in rainfall and temperature, and the occupation and abandonment of the Basin. Wetter and warmer conditions attracted settlement, while colder and drier conditions implied drought generally signifying collapse and abandonment of settlement. From the studies conducted using the available environmental data (e.g. Holmgren and Öberg, 2006; Smith, 2005), there is evidence that the development of complex states and their settlement structures represented an interaction of both long- and short-term cultural, economic and environmental processes. In times of economic and environmental stress, when societal demands exceed production levels and social aggregation exceeds sustainable levels in local communities, there is reason to be apprehensive about the future. In regional climatic models (Holmgren *et al.*, 2003; Holmgren and Öberg, 2006; Tyson and Lindesay, 1992), the period between AD 900 and 1300, generally referred to as the Medieval Warm Epoch, was mainly a climatically favourable period and therefore encouraged human occupation, innovation and wealth accumulation in southern Africa which resulted in the establishment of the centres of Schroda, K2/Mapungubwe and Great Zimbabwe. However, (Holmgren and Öberg, 2006:188), caution that even though it is evident that there were societal expansions, there seems to be no direct correlation with changes in climate. For example, the first agricultural expansion resulted in a population growth of about four times (1900 to 9000) between *ca.* AD 900–1290, an expansion which took place in spite of the drier conditions prevailing between *ca.* AD 1100 and 1200. It is also observed that at the same time there was a shift in settlement location from Schroda to K2 at the confluence and at Toutswe and its environs in central Botswana. This may have been undertaken in order to circumvent the catastrophic event without any abandonment or societal collapse taking place. Considering the economic strength of the area at the time to have been largely dependent on extensive trade and exchange network systems, diversification of resources was another option. There are mechanisms exist in sedentary societies as mentioned in Section 2.3, particularly as the link is largely to do with climate change in terms of rainfall variability and inadequacy. It is in this light that the present study concurs with the conclusions made by Smith (2005) and Holmgren and Öberg (2006) that, even though societal changes coincided with climate changes, the changes were not absolute. Again, as Ekblom (2004) observes, archaeological scholarship in the region has depended on common knowledge in discussing issues of long-term environmental change. With little or no evidence of past environmental dynamics, it can be difficult to establish whether problems of over-population, carrying capacity and environmental degradation are key issues embedded in sequences of events leading to the occupation and abandonment of sites. The human response to environmental changes varies depending on the subsistence patterns and how close the population is to the carrying capacity of the land. Societies can cope with environmental changes by exploring adaptation strategies such as long and short-term flexibility, mobility and re-organisation of resources, flexibility in agricultural practices and in types of staple crops, transhumance, digging of wells, increasing wild resources within their diet, relocating fields to unaffected areas of the landscape, and diversification of resources including the controlling of the distribution of resources through established cultural structures. The continuous exploitation of the landscapes of the Zimbabwean side of the Basin from the about 14th century AD to the present day (Manyanga, 2006) in the dry and hot climatic conditions, is a clear indication of how humans can remain resilient and thrive under such adverse conditions. Had it not been for the colonial relocation and displacement of the indigenous communities, the same scenario could be observed on the Botswana and South African sides. To redress this situation, a simultaneous reconstruction of changes in climate, the physical landscape and biological environment at the time of occupation can prove useful in examining if one or a combination of these coincided with the cultural changes. In this study assessment of the confluence physical landscape from the reconnaissance survey and through remote sensing analysis provided a crucial basis for understanding why it was continuously occupied from the 10–12th century AD. It has been found that land management and utilisation strategies were informed by certain key aspects of the physiographic landscape.

This study conducted an assessment of the research work in the SLB and found out that previous research work had concentrated on monumental and architectural structures, and the sites explicitly targeted for investigation were those with the ability to contribute towards the understanding of the development of social complexity. The hypothesis of this study is that this selective research was informed by the fact that some sites in the SLB landscape are highly visible in terms of size and therefore status (political and economic) and some had considerable artifact densities. This archaeological data was therefore critical in offering insights into the social formations amongst agropastoral societies in line with the now controversial Bantu migration theory reviewed on Chapter 3. This study has adopted an off-site archaeological methodological approach where the invisible and intangible aspects of the archaeological sites are considered and outlined in the conceptual framework on Chapter 4. It advanced the argument by (Foley, 1981a; Foley, 1981b) that as the result of human behaviour sites are preferentially concentrated at spatial foci, but it is neither all products of human behaviour that conform to this spatially centralised perception, nor it is the exact location of an activity area that tells us about the human use of the landscape. Parts of the landscape unsuitable for human occupation in terms of establishing settlement structures will remain free of artifactual accumulation because site location systems operate above ground at a local and regional scale. The reconstruction of human behaviour over time and space, and people's perceptions of how to use the landscape for their immediate needs, requires the use of a range of methods and approaches that complement one another and combine to meet the overall research goals. The results of those approaches are presented, discussed and summarised in detail on Chapter 5.

The findings of this research using landscape analysis from aerial photographs supported by test-excavations showed how the landscape acted as a medium for land-use diversification, resource utilisation, and human behaviour. The landscape data facilitated a framework evidently pointing to the influence of terrain units of any given geomorphologic setting on settlement decision making and the resultant characterisation of varying types of activities. Habitation sites were preferentially located on hill-tops, while lower- and higher-ground areas comprised elements which could be linked to social and cultural practices. The low-lying areas and floodplains had little or no visible artifact concentrations.

The sites of Tuli Circle 2 and Megwe Hill, even though they are in close proximity, reflected different uses. From aerial photographs they possessed attributes used in the identification of archaeological sites but when surveyed and test-excavated the types of materials recovered showed the Megwe Hill site to be predominantly a habitation site which, from the thickness of the deposits, was occupied over a long period of time. A total of 5 test-excavations were conducted at Megwe Hill and yet none produced any human remains, whilst Valley site 2, located just below the hill on the eastern side with scanty surface scatters produced burial remains (see Figure 5.1). The location and aspect of this site is indicative of a specific use – mortuary practices amongst the Megwe Hill residents and an ethnographically entrenched practice amongst contemporary societies where burials or graveyards are located to the east of a settlement. The ^{14}C dates for the skeletal remains also suggest the Zhizo period of occupation which from past environmental reconstruction studies is regarded to have been generally wet. If that were the case, this location would have been ideal as it is protected from flooding which is prevalent in this area. It also has to be appreciated that the Shashe and Limpopo Rivers and climatic changes in the watershed of their tributaries created a dynamic landscape and therefore a variety of cultural responses. Valley site 2 as a graveyard possibly catered for the occupants of Tuli Circle, with Pitsane Kopje, as another alternative burial site (see an unpublished report by Hanisch (not dated). The hill-top location of sites is characteristic of all the well-known sites of Mapungubwe, K2 and Schroda in neighbouring South Africa and some of those in Zimbabwe such as Mapela (Manyanga, 2006; Manyanga *et al.*, 2000) away from the floodplain. This physiographically influenced settlement phenomenon is observed on the archaeological site distribution map *vis-à-vis* land units of Botswana presented in Figure 2.1, where more than three quarters of the contemporary population resides in the eastern part or hardveld.

It has to be appreciated that most of the sites were identified and followed up during field work survey because of their appearance on the aerial photographs. This is not a new site location technique; it has been used to locate Iron Age sites in southern Africa. In previous studies, particularly in Botswana, Denbow (1979) has used the technique to associate the white appearance on the photographs with a specific grass species, *C. ciliaris*, as an ecological indicator of Iron Age middens. Most of these were located on hill-tops. Similar phenomena have also been observed in East Africa where the patches are commonly referred to as savanna glades. Their presence is also attributed to settlements of former pastoralists, and they are said to represent nutrient-enriched abandoned cattle enclosures with palatable grass that is liked by ungulates (Payton, 2005). They can, however, remain free of grass as the browsing and grazing activities could in turn suppress the invasion of the vegetation. Indeed, a study by Smith (2005), has associated the geology of some locations within the study area, like Tuli Circle, to be suitable for herd pasturage. These, she suggests, were areas outsourced by the K2 population in a bid to ease congestion and overstocking at K2. Interestingly, this conforms to some of the assumptions and findings made in this study where savanna glades are confined to the hilly terrain but are grass depleted and too numerous to solely represent livestock enclosures. Test-excavations supported by phosphate analysis suggest a combination of activities managed from small groups of homesteads which were engaged in small-scale activities similar to those undertaken at the core sites of Schroda, K2, and/or Mapungubwe. It is possible that these are the peripheral sites that supplied items of trade, farm produce and craft skills to the core. Apparent in this study is that savanna glades do not seem to conform to the cattle enclosure theory, but they are indeed humanly-induced signatures which require the use of other techniques of data recovery to arrive at a definitive interpretation. It has been suggested from other studies elsewhere that the higher reflectivity of savanna glades when seen from the air could be the result of better drainage of the sites' anthropogenically-modified soils and poorly developed soil structure, or the more developed soil structure, texture, mineralogy and water-retaining properties of the surrounding areas (Ur, 2003:105). Future works could consider these for alternative explanations, especially as archaeological deposits in this study vary in both intensity and nature which is an indication of land-use diversity and human behaviour. The geomorphological setting has been shown to influence land-use management strategies in the confluence area and this diverse use was in prehistoric times just like today particularly sensitive to small-scale changes in climate, especially flooding. This has implications for understanding the archaeology of the wetland environments which are now dry, typical of that of the Basin.

This work has incorporated practical analytical techniques that offer an alternative approach to the long, traditional, descriptive interpretations that were based on classification and inferential analogies without properly formulated research questions. The geographical information systems dataset generated from the identification and location of sites and landscape features on aerial photographs and satellite images has shed further light on the organisational dynamics of the Shashe–Limpopo Basin beyond the political boundaries. As an agro-pastoral society involved in trade, people and animals moved back and forth to major sites between pastures, fields and settlements, and these have left pathways, dams, wells, processing and distribution sites, which are archaeologically invisible and yet recoverable using remote sensing techniques. Indeed the Shashe–Limpopo confluence is covered by soils that provided important pasture for pastoral practices as it still does today to flourishing wildlife undeterred by the imposed boundaries. Vegetation marks following landscape terrain units such as rivers and valleys are critical indicators which offer important information regarding the busy life-style of the area with people and animals traversing the landscape to and from the floodplains and the rivers.

The primary aim of using geochemical analysis in this thesis was to test certain methodological aspects, which included sample collection, sampling intervals, and analysis of soil samples for phosphates and heavy metal and trace elements. This was entirely because no known attempts have previously been made in the Basin to assess geochemical testing as a potential technique for understanding this dynamic landscape. From the findings of this study, these techniques have produced interesting results in locating the extent of activities at the Shashe–Limpopo Basin site of Tuli circle 2. The different concentration levels from a 100 x 100 square metre grid and its spatial distribution shown on Figure 5.25, is a clear indication of how useful a tool phosphate analysis can be in the interpretation of intra-site relationships, which definitely varied as demonstrated by the transect analysis using t-test statistical analysis. With greater spatial coverage and a broader spectrum of elements and traces to test it is believed that a more coherent picture that could aid our understanding of their potential uses as indicators of certain types of activities such as cooking, kraals, burials and metal working can emerge. It is also suggested that research of this nature is critical for archaeologists in appreciating the potential of geochemical analysis as an interpretative tool that can permit us to examine the function of individual structures as well as the use of space within habitation sites and beyond and in that regard we can incorporate in our interpretations the diverse approaches that humans can employ for optimum use of their surrounding landscape.

The soils of the study area are characterised by low phosphate concentrations typical of Botswana soils. It must, however, be acknowledged that natural phosphorus is highly dependent on several factors including soil type and texture, topography, hydrology and vegetation history of an area (Eidt, 1973; Isendahl, 2002). In this study topography was the only factor considered and it has been found that soil phosphate levels varied significantly with the different units of the terrain. It is recommended that in the future the sample area could be increased and other natural factors such as vegetation history could be investigated. For comparative purposes the geochemical analysis could also include a range of other chemical testing methods, especially carbonates. There is usually a strong relationship between human activities and carbonates and phosphates (Isendahl, 2002), which can aid the determination of the functional use of certain areas, e.g. architectural structures within a site identified through phosphate anomalies. If these techniques could be used and a more extensive excavation of the sites such at Tuli Circle subdivision C test-pit 2 (Figure 6.1) this study believes a reconstruction of the different types of activities undertaken could emerge. More excavation also need to be undertaken at Valley site 2 where human bones emerged in the test-pit during test excavation but because of the scope of the study, time and financial constraints no further work could be done.

It is evident that the combination of geochemical analysis, test-excavations, and landscape analysis using aerial photographs and savanna glades, have been valuable indicators of the presence of human activities in the form of *dhaka* remains used in construction of buildings, middens, animal enclosures and burials. Employing both geochemical and geophysical methods to analyse the relative concentrations and intensity of these metals can produce anomalies that may signify locations where people engaged in particular domestic, craft, and/or industrial activities, enabling inferences to be made about the socio-economic developments among agro-pastoralists communities. It is hoped that further work on the site and beyond will provide information that will permit us to understand the dynamic relationship that exists between human behaviour

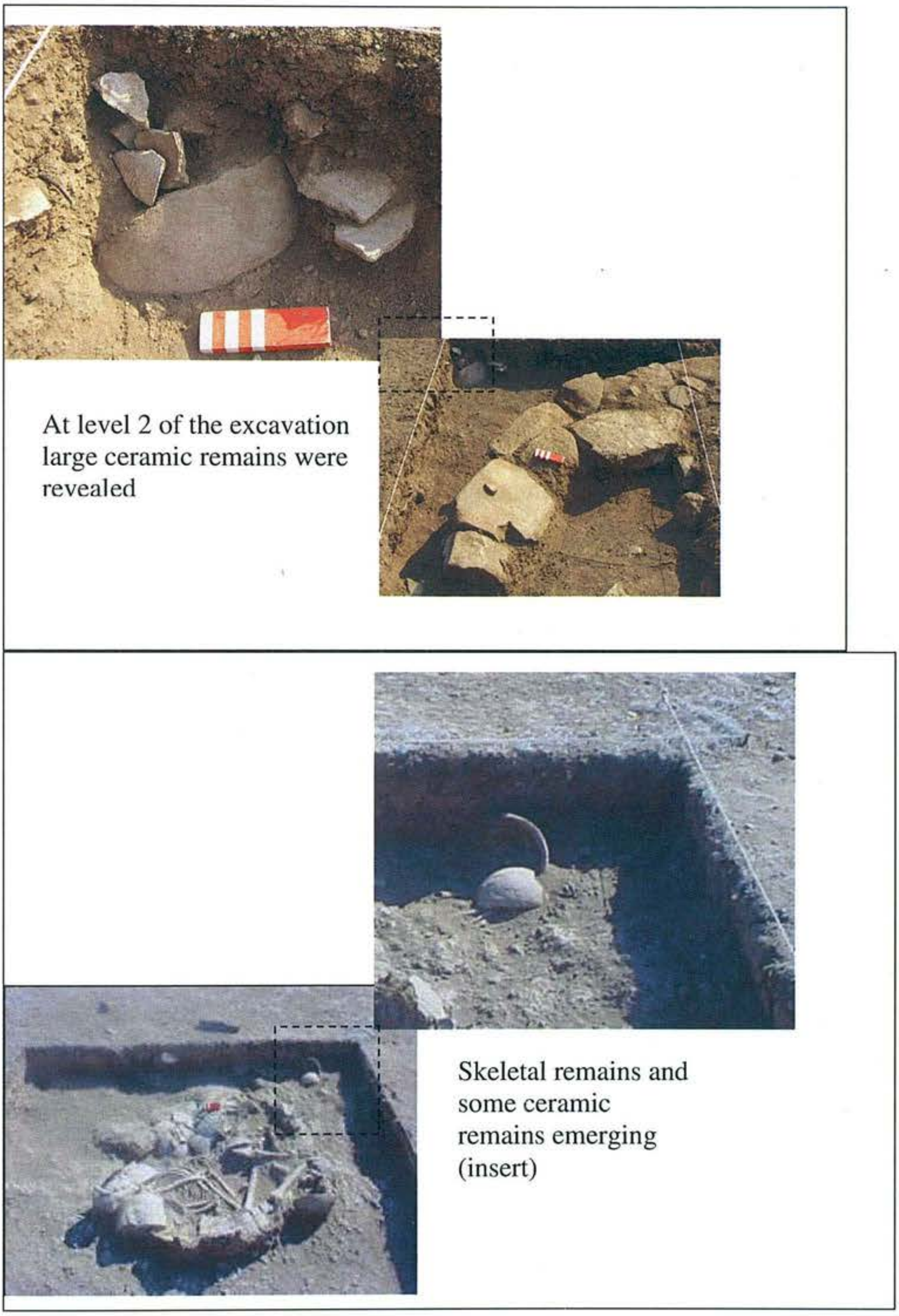

Figure 6.1 Tuli Circle 2, test-pit 2, level 2 (top) and Valley site 2 burial (below) revealing remains which could not be investigated further during this study. These sites are to be revisited to further establish the various uses the inhabitants engaged in.

and the use of Basin environments which could have acted as a stimulus for cultural change.

Furthermore, this study argues that the determination of soil phosphates and elemental and trace metals can also be useful in pre-development archaeological surveys. The Botswana Monuments and Relics Act (1970) interprets all historical and prehistoric archaeological remains as national assets that should not be disturbed by construction work without impact assessments being conducted. Soil phosphate survey and geophysical analysis, in the form of soil resistivity and magnetic susceptibility, can become extremely useful under such circumstances where the method can be used both for finding sites and for guiding where excavations should be conducted within a reasonable time and budget, and with minimum damage being inflicted on the sites. In light of the tri-partite Trans Frontier Park envisaged for the area, this technique will be crucial for the location and documentation of sites especially on the Botswana side of the Basin where most of the sites are located and access is difficult because of the wildlife. Phosphate survey has an advantage in that it is a rapid, relatively inexpensive, survey method capable of producing much useful data.

As another way of trying to understand the socio-cultural and economic dynamics of the study area, this research involved the analysis of pottery samples for their mineralogical composition, and the justification for this is outlined in Section 4.3.3.1. It can be reiterated that as the most numerous kinds of portable artefacts in any archaeological deposit, ceramic remains can be used to divide a temporal and spatial continuum of any given area into discrete cultural packages. This division is done by visual analysis of vessel form and its intricate decoration to define stylistic types. This classification is perceived as representing cultures, cultural traditions and/or cultural phases that are indicative of lines of descent within the region, and interactions within and between sites of different cultures, whether social or economic, can be determined from the presence of sherds of different ceramic traditions. This study perceived these approaches to suggest modest levels of interaction and movement of materials throughout prehistory. Interactions within and between sites of the same (or a different) ceramic tradition will be difficult if not impossible to determine from stylistic analysis alone. Ethnographic evidence suggests that the making of ceramic products was a rare skill, and there are communities with no or just one pot-making specialist. This is considered to have been possibly the case in the past. Another factor worthy of consideration is that pot-making clay is not always readily available, and in some instances it can be sourced from areas beyond the marginal locations where the pots were being produced. In other words, the raw material and pots, just like people, can move from one point to another.

The rationale behind this x-ray diffraction analysis approach is that different clay sources have specific elemental compositions of minerals, and pottery remains made of these clays can be distinctive. Even though this was a preliminary attempt at a qualitative and quantitative analysis of the pottery remains using x-ray diffraction techniques the results are significant. Samples collected from individual sites, test-pits and levels of excavations had ceramic sherds with varying mineralogical phases. Diffractograms produced diffraction patterns with information on the crystalline phases/substances in the ceramic tempers, clays, and their derivatives. The fundamental finding is that pottery remains within and between the levels, sites and settlements did differ in their mineralogical compositions. As hypothesised, a number of factors, including the movement of people, pots and/or raw materials, could have played a role, and this takes us back to the question of the authorship of ceramic traditions of the Basin, as well as the socio-economic dynamics of its occupants and beyond. As a widely accepted chronostratigraphic marker and a cultural change indicator (pottery), these findings on differences in the geochemistry of the products are important and call for such classification initiatives to be revisited. For example, results of a single test-pit at Megwe show that the mineralogical composition of ceramic samples differs within the level, as well as between the levels indicating that the pots were made from clays or had inclusions with different chemical compositions. This could be attributed to:

- changes in occupation by different cultures over time, bringing with them pottery products from elsewhere
- movement of pottery through trade and exchange; inter-community marriage
- seasonal movement of people across the landscape
- raw materials outsourced at different locations
- inclusions and tempers gathered from different sources

In light of pottery remains having shown a significant variation in their geochemistry and because of the small scale of the materials analysed, it would be important for future research to further the objectives of this study in order to find alternative interpretations of the changes that really took place at the confluence. These could be done by:

1. Identifying clay sources from the vicinity of a number of known sites in the study areas, and sample, analyse and compare the clays with the pottery remains found at the sites themselves. This would help to establish whether the pots were manufactured locally from a local raw material or were obtained from elsewhere through other means.

2. Establishing intra-site production and distribution of ceramics by comparing pottery from settlement sites within the Basin and related sites to establish the distribution areas of products from point of production, thereby understanding the underlying economic value of the pottery trade and its broad significance at the time of the site occupations.

3. Establishing long distance trade and exchange patterns where foreign ceramic patterns not conforming to the geology of the Basin would further be analysed to reveal their source and determine if that interaction can be linked to the established movement of people and cultural sequences.

The evidence from this study as presented by the field surface survey, test-excavations, GIS extrapolation from air photography and satellite images, x-ray diffraction analysis of ceramic remains and the geochemical analysis of soils do point to the fact that the confluence zone has archaeological data that can contribute significantly to our understanding of the socio-cultural formation processes and environmental changes that took place at the SLB. Owing to its dynamic environmental setting, which tends to obscure what a traditional archaeological eye is trained to do, it has remained unexplored. This has been further compounded by the current land-use of the area as a private nature reserve with wildlife, which makes research undertakings unsafe and financially costly. Nonetheless, it is believed that the contribution of this study to knowledge of the archaeology of the confluence, Basin and southern Africa will be acknowledged by other practitioners as a new innovation presenting new challenges which suggest future directions for research that emphasise the appreciation of the dynamic relationship between human behaviour and their landscapes. Comparison with archaeological studies further afield in similar environments allows for a contribution to landscape archaeology debates at a global scale.

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Appendix A: Sites and their Coordinates

Site number	south degress	south minutes	south seconds	Northings	north degress	north minutes	north seconds	Eastings	Elevation (msl)
29-A1-1	22	4	16.58	7557575	29	14	48.77	731852	555
29-A1-2	22	4	16.19	7557234	29	14	48.45	731694	
29-A1-3	22	4	18.52	7557162	29	14	49.25	731716	550
29-A1-4	22	4	21.25	7557079	29	14	14.18	731682	550
29-A1-5	22	4	16.85	7557209	29	14	59.01	731996	
29-A12-6	22	4	14.06	7557293	29	15	4.36	732151	546
29-A1-7	22	4	8.71	7557457	29	15	4.98	732171	549
29-A1-8	22	4	15.94	7557238	29	14	57.83	731963	546
29-A1-9	22	4	16.17	7557234	29	14	49.21	731716	555
29-A1-10	22	4	27.11	7556899	29	14	45.75	731612	564
29-A1-11	22	4	25.78	7556940	29	14	45.41	731603	572
29-A1-12	22	4	26.67	7556913	29	14	45.23	731597	565
29-A1-13	22	4	24.22	7556986	29	14	51.3	731772	568
29-A1-14	22	4	15.33		29	15	6.71		562
29-A1-15	22	9	44.15	7547341	29	12	42.55	727341	536
29-A1-16	22	7	54.97	7550749	29	10	44.38	724603	573
29-A1-17	22	7	54.38	7550767	29	10	44.16	724596	573
29-A1-18	22	7	54.94	7550749	29	10	45.23	724627	573
29-A1-19	22	7	54.66	7550756	29	10	47.53	724693	565
29-A1-20	22	4	4.56	7557750	29	14	15.8	730767	548
29-A2-1	22	5	23.25	7555297	29	15	27.62	732790	529
29-A2-2	22	5	20.32	7555392	29	15	16.79	732481	531
29-A2-3	22	10	22.32	7545131	29	18	54.56	738569	528
29-A2-4	22	9	0.45	7548486	29	14	53.57	731712	581
29-A2-5	22	8	55.06	7548805	29	14	32.61	731118	544
29-A2-6	22	11	5.39	7544703	29	18	6.52	737186	507

29-A2-7	22	5	53	22.09805556	29	16	2.2	29.26727778
29-A2-8	22	5	55.5	22.09875	29	16	3.2	29.26755556
29-A2-9	22	5	55.4	22.09872222	29	16	3	29.2675
29-A2-10	22	5	55.3	22.09869444	29	16	3	29.2675
29-A2-11	22	5	55.1	22.09863889	29	16	3	29.2675
29-A2-12	22	5	54.8	22.09855556	29	16	2.8	29.26744444
29-A2-13	22	5	54.7	22.09852778	29	16	2.9	29.26747222
29-A2-14	22	5	54.6	22.0985	29	16	2.8	29.26744444
29-A2-15	22	5	54.4	22.09844444	29	16	2.9	29.26747222
29-A2-16	22	5	54.2	22.09838889	29	16	2.8	29.26744444
29-A2-17	22	5	49.4	22.09705556	29	15	59.8	29.26661111
29-A2-18	22	5	54.9	22.09858333	29	16	2.9	29.26747222
29-A2-19	22	5	48.2	22.09672222	29	15	55.5	29.26541667
29-A2-20	22	5	39	22.09416667	29	16	1.3	29.26702778
29-A2-21	22	5	33	22.0925	29	16	7.9	29.26886111
29-A2-22	22	5	41.9	22.09497222	29	16	12.6	29.27016667
29-A2-23	22	5	42.1	22.09502778	29	16	12.7	29.27019444
29-A2-24	22	5	43.4	22.09538889	29	16	11.3	29.26980556
29-A2-25	22	5	55.9	22.09886111	29	16	9	29.26916667
29-A2-26	22	5	55.5	22.09875	29	16	8.5	29.26902778
29-A2-27	22	10	45.2	22.17922222	29	13	57.5	29.23263889
29-A2-28	22	5	43.2	22.09533333	29	16	11.4	29.26983333
29-A2-29	22	4	12.8	22.07022222	29	14	51.3	29.24758333
29-A2-30	22	5	54.9	22.09858333	29	16	2.9	29.26747222
29-A1-21	22	3	45	22.0625	29	14	30.3	29.24175

Appendix B: Soil Sampling Points from Tuli Circle 2

	south degrees	south minutes	south seconds	Northings	east degrees	east minutes	east seconds	Eastings
North West Point A	22	4	11.4	7557944.19	29	14	40.3	731617.12
South West Point B	22	4	29	7557402.79	29	14	40.3	731609.15
South East Point C	22	4	29	7557396.78	29	14	54.5	732016.32
North East Point D	22	4	11.4	7557938.18	29	14	54.5	732024.3
a40	22	4	11.4	7557938.18	29	14	54.5	732024.3
a39	22	4	11.4	7557912.84	29	15	54.2	733736.21
a38	22	4	11.4	7557913.01	29	15	53.8	733724.74
a37	22	4	11.4	7557938.65	29	14	53.4	731992.76
a36	22	4	11.4	7557938.82	29	14	53	731981.29
a35	22	4	11.4	7557938.95	29	14	52.7	731972.69
a34	22	4	11.4	7557939.16	29	14	52.2	731958.35
a33	22	4	11.4	7557939.28	29	14	51.9	731949.75
a32	22	4	11.4	7557939.41	29	14	51.6	731941.15
a31	22	4	11.4	7557938.62	29	14	51.1	731926.81
a30	22	4	11.4	7557939.79	29	14	50.7	731915.34
b40	22	4	11.7	7557947.1	29	14	11.5	730791.14
b39 No sample								
b38	22	4	11.8	7557926.05	29	14	54.1	732012.65
b37	22	4	11.8	7557926.26	29	14	53.6	731998.32
b36 No sample								
b35	22	4	11.8	7557926.6	29	14	52.8	731975.38
b34	22	4	11.6	7557932.84	29	14	52.6	731969.73
b33	22	4	11.7	7557929.93	29	14	52.2	731958.22
b32	22	4	11.7	7557930.14	29	14	51.7	731943.88
b31	22	4	11.6	7557933.43	29	14	51.2	731929.59
b30	22	4	11.6	7557933.55	29	14	50.9	731920.98
c40	22	4	12.1		29	14	?	
c39 No sample	22	4	12	7557916.74	29	14	54.3	732018.25
c38 No sample	22	4	12	7557919.98	29	14	53.9	732006.83

c37	22	4	12	7557920.19	29	14		53.4	731992.49
c36 No sample	22	4	12.1	7557917.29	29	14		53	731980.97
c35 No sample									
c34	22	4	12	7557920.62	29	14		52.4	731963.81
c33 No sample	22	4	12	7557920.87	29	14		51.8	731946.61
c32 No sample	22	4	11.1	7557948.64	29	14		51.6	731941.28
c31	22	4	12	7557921.08	29	14		51.3	731932.27
c30	22	4	12	7557921.29	29	14		50.8	731917.93
d40	22	4	12.4		29	14	?		
d37	22	4	12.3	7557910.84	29	14		53.7	732000.96
d34	22	4	12.3	7557911.3	29	14		52.6	731969.41
d31	22	4	12.3	7557911.81	29	14		51.4	731935
d30	22	4	12.3	7557911.98	29	14		51	731923.53
e40	22	4	12.8		29	14	?		
e39	22	4	12.6	7557895.2	29	14		54.3	732017.93
e38	22	4	12.6	7557901.52	29	14		53.9	732006.56
e37	22	4	12.5	7557904.69	29	14		53.7	732000.87
e36 No sample									
e35 No sample									
e34	22	4	12.7	7557899.12	29	14		52.3	731960.63
e33	22	4	12.5	7557905.4	29	14		52	731952.12
e32 No sample									
c31	22	4	12.7	7557899.59	29	14		51.2	731929.09
c30	22	4	12.6	7557902.88	29	14		50.7	731914.8
f40	22	4	13.2		29	14	?		
f39	22	4	13	7557889.01	29	14		54.4	732020.71
f38	22	4	13	7557889.18	29	14		54	732009.24

f37	22	4	13	7557889.35	29	14	53.6	731997.77
f36 No sample								
f35	22	4	13.1	7557886.57	29	14	52.9	731977.65
f34 No sample								
f33	22	4	13	7557890.02	29	14	52	731951.89
f32	22	4	13.2	7557883.96	29	14	51.8	731946.07
f31	22	4	13.1	7557887.2	29	14	51.4	731934.64
f30	22	4	13.1	7557887.37	29	14	51	731923.17
g40	22	4	13.5	7557873.59	29	14	54.5	732023.35
g39	22	4	13.4	7557876.7	29	14	54.4	732020.53
g38	22	4	13.3	7557879.99	29	14	53.9	732006.24
g37	22	4			29	14		
g36	22	4			29	14		
g35	22	4	13.4	7557877.38	29	14	52.8	731974.65
g34	22	4			29	14		
g33	22	4	13.4	7557877.72	29	14	52	731951.71
g32	22	4	13.3	7557880.92	29	14	51.7	731943.15
g31	22	4	13.3	7557881.13	29	14	51.2	731928.82
g30	22	4	13.4	7557878.18	29	14	50.9	731920.17
h40	22	4	13.9	7557861.28	29	14	54.5	732023.17
h39	22	4	13.8	7557864.4	29	14	54.4	732020.35
h38	22	4	13.8	7557864.53	29	14	54.1	732011.75
h37	22	4	13.7	7557867.73	29	14	53.8	732003.19
h36	22	4	13.7	7557868.03	29	14	53.1	731983.12
h35	22	4	13.8	7557865.03	29	14	52.9	731977.34
h34	22	4	13.8	7557865.2	29	14	52.5	731965.87
h33	22	4	13.7	7557868.45	29	14	52.1	731954.44
h32	22	4	13.8	7557865.5	29	14	51.8	731945.79
h31	22	4	13.8	7557865.67	29	14	51.4	731934.32
h30	22	4	13.8	7557865.92	29	14	50.8	731917.12
i40	22	4	14.2	7557852.05	29	14	54.5	732023.03
i39	22	4	14.1	7557855.21	29	14	54.3	732017.34
i38	22	4	14.3	7557848.85	29	14	54.8	732031.59

i37	22	4	14.1	7557855.59	29	14	53.4	731991.54
i36	22	4	14.2	7557852.6	29	14	53.2	731985.76
i35	22	4	14	7557858.92	29	14	52.8	731974.38
i34	22	4	14	7557859.14	29	14	52.3	731960.04
i33								
i32	22	4	14.1	7557856.31	29	14	51.7	731942.79
i31	22	4	14	7557859.6	29	14	51.2	731928.5
i30	22	4	14.1	7557856.65	29	14	50.9	731919.85
j40	22	4	14.5	7557842.82	29	14	54.5	732022.9
j39	22	4	14.5	7557842.87	29	14	54.4	732020.03
j38	22	4	14.4	7557846.11	29	14	54	732008.61
j37	22	4	14.4	7557846.24	29	14	53.7	732000
j36	22	4	14.4	7557846.24	29	14	53.7	732000
j35	22	4	14.4	7557846.45	29	14	53.2	731985.67
j34	22	4	14.4	7557846.58	29	14	52.9	731977.06
j33								
j32								
j31	22	4	14.4	7557847.25	29	14	51.3	731931.18
j30	22	4	14.4	7557847.38	29	14	51	731922.58
k40	22	14	15	7539370.47	29	14	54.5	731749.39
k41	22	14	15	7539370.34	29	14	54.8	731757.98
k42	22	14	15	7539370.17	29	14	55.2	731769.44
k43	22	14	15	7539370.04	29	14	55.5	731778.03
k44	22	14	15	7539369.87	29	14	55.9	731789.49
k45	22	14	15	7539369.74	29	14	56.2	731798.08
k46	22	14	15	7539369.57	29	14	56.6	731809.54
k47	22	14	15	7539369.49	29	14	56.8	731815.27
k48	22	14	15	7539369.32	29	14	57.2	731826.72
k49	22	14	15	7539369.15	29	14	57.6	731838.18
k50	22	14	15	7539369.02	29	14	57.9	731846.77
k51	22	14	15	7539368.89	29	14	58.2	731855.36
k52	22	14	15	7536368.72	29	14	58.6	731866.82
k53	22	14	15	7539368.55	29	14	59	731878.28

k54	22	14	15	7539368.42	29	14	59.3	731886.87
k55	22	14	15	7539342.65	29	15	59.6	733613.93
k56	22	14	15	7539368.12	29	15	0	731906.92
k57	22	14	15	7539368.11	29	15	0.03	731907.78
k58	22	14	15	7539368.09	29	15	0.07	731908.92
k59	22	14	15	7539367.7	29	15	1	731935.56
k60	22	14	15	7539367.57	29	15	1.3	731944.15
bc01	22	4	11.5	7557937.35	29	14	49.2	731872.28
bc03	22	4	11.5	7557937.35	29	14	49.2	731872.28
bc04	22	4	12.8	7557897.36	29	14	49.2	731871.69
bc05	22	4	13.2	7557885.06	29	14	49.2	731871.51
bc06								
bc07	22	4	13.9	7557863.52	29	14	49.2	731871.19
bc08	22	4	14.2	7557854.29	29	14	49.2	731871.06
bc09								
bc10	22	4	15	7557829.68	29	14	49.2	731870.69
bc11	22	4	15.3	7557820.46	29	14	49.2	731870.56
bc12	22	4	15.6	7557811.23	29	14	49.2	731870.42
bc13	22	4	15.9	7557802	29	14	49.2	731870.29
bc14	22	4	16.2	7557792.77	29	14	49.2	731870.15
bc15	22	4	16.5	7557783.54	29	14	49.2	731870.01
bc16 pot sherds	22	4	16.8	7557774.31	29	14	49.2	731869.88
bc17 pot sherds	22	4	17.1	7557765.09	29	14	49.2	731869.74
bc18	22	4	17.5	7557752.78	29	14	49.2	731869.56
bc19	22	4	17.8	7557743.55	29	14	49.2	731969.42
bc20	22	4	18.1	7557734.32	29	14	49.2	731869.29
bc21	22	4	18.4	7557725.1	29	14	49.2	731869.15
bc22	22	4	18.8	7557712.79	29	14	49.2	731868.97
bc23	22	4	19.1	7557703.56	29	14	49.2	731868.83
bc24	22	4	19.4	7557694.33	29	14	49.2	731868.7
bc25	22	4	19.8	7557682.03	29	14	49.2	731868.52
bc26	22	4	20	7557475.88	29	14	49.2	731868.43

bc27		22	4	20.3	7557666.65	29	14	49.2	731868.29
bc28		22	4	20.7	7557654.35	29	14	49.2	731868.11
bc29		22	4	21	7557645.12	29	14	49.2	731867.97
bc30	pot sheds,lithic	22	4	21.3	7557635.89	29	14	49.2	731867.84
bc31	stoney,rocky	22	4	21.6	7557626.66	29	14	49.2	731867.7
bc32		22	4	22	7557614.36	29	14	49.2	731867.52
bc33		22	4	22.3	7557605.13	29	14	49.2	731867.38
bc34		22	4	22.6	7557595.9	29	14	49.2	731867.25
bc35		22	4	22.9	7557586.67	29	14	49.2	731867.11
bc36		22	4	23.2	7557577.44	29	14	49.2	731866.98
bc37		22	4	23.6	7557595.14	29	14	49.2	731866.79
bc38		22	4	23.9	7557555.91	29	14	49.2	731866.66
bc39		22	4	24.2	7557546.68	29	14	49.2	731866.52
bc40		22	4	24.5	7557537.45	29	14	49.2	731866.39
bc41		22	4	24.9	7557525.15	29	14	49.2	731866.2
bc42		22	4	25.2	7557515.92	29	14	49.2	731866.07
bc43		22	4	25.5	7557506.69	29	14	49.2	731865.93
bc44		22	4	25.8	7557497.46	29	14	49.2	731865.8
bc45		22	4	26.1	7557488.23	29	14	49.2	731865.66
bc46		22	4	26.5	7557475.93	29	14	49.2	731865.48
bc47		22	4	26.8	7557466.7	29	14	49.2	731865.34
bc48		22	4	27.2	7557454.4	29	14	49.2	731865.16
bc49		22	4	27.5	7557445.17	29	14	49.2	731865.02
bc50		22	4	27.8	7557435.94	29	14	49.2	731864.89
bc51		22	4	28.1	7557426.71	29	14	49.2	731864.75
bc52		22	4	28.3	7557420.56	29	14	49.2	731865.66
bc53		22	4	28.7	7557408.25	29	14	49.2	731864.48
bc54		22	4	29	7557399.03	29	14	49.2	731864.34
at30		22	4	26.1	7557487.6	29	14	50.7	731908.67
at29		22	4	26.1	7557487.77	29	14	50.3	731897.2
at28		22	4	26.1	7557487.9	29	14	50	731888.6
at27		22	4	26.1	7557488.06	29	14	49.6	731877.13
at26		22	4	26.1	7557488.23	29	14	49.2	731865.66

at25	22	4	26.1	7557488.36	29	14	48.9	731857.06
at24	22	4	26.1	7557488.49	29	14	48.6	731848.46
at23	22	4	26.1	7557488.66	29	14	48.2	731836.99
at22	22	4	26.1	7557488.78	29	14	47.9	731828.38
at21	22	4	26.1	7557488.95	29	14	47.5	731816.91
at20	22	4	26.1	7557489.16	29	14	47	731802.58
at19	22	4	26.1	7557489.25	29	14	46.8	731796.84
at18								
pots,stone,dagga	22	4	26.1	7557489.38	29	14	46.5	731788.24
at17	22	4	26.1	7557489.54	29	14	46.1	731776.77
at16 photographed	22	4	26.1	7557489.67	29	14	45.8	731768.17
at15	22	4	26.1	7557489.84	29	14	45.4	731756.7
at14	22	4	26.1	7557489.97	29	14	45.1	731748.1
at13	22	4	26.1	7557490.09	29	14	44.8	731739.49
at12	22	4	26.1	7557490.26	29	14	44.4	731728.02
at11	22	4	26.1	7557490.43	29	14	44	731716.55
at10	22	4	26.1	7557490.56	29	14	43.7	731707.95
at09 photographed	22	4	26.1	7557490.73	29	14	43.3	731696.48
r30	22	4	17.1	7557764.45	29	14	50.7	731912.75
r29	22	4	17.1	7557764.58	29	14	50.4	731904.15
r28	22	4	17.1	7557764.71	29	14	50.1	731895.55
r27	22	4	17.1	7557764.87	29	14	49.7	731884.08
r26	22	4	17.1	7557765	29	14	49.4	731875.48
r25	22	4	17.1	7557765.17	29	14	49	731864.01
r24	22	4	17.1	7557765.3	29	14	48.7	731855.4
r23	22	4	17.1	7557765.42	29	14	48.4	731846.8
r22 no sample								
r21	22	4	17.1	7557765.72	29	14	47.7	731826.73
r20	22	4	17.1	7557765.89	29	14	47.3	731815.26
r19	22	4	17.1	7557766.06	29	14	46.9	731803.79
r18	22	4	17.1	7557766.14	29	14	46.7	731798.06
r17 no sample								
r16 no sample								
r15	22	4	17.1	7557766.61	29	14	45.6	731766.51

r14	22	4	17.1	7557766.73	29	14	45.3	731757.91
r13	22	4	17.1	7557766.9	29	14	44.9	731746.44
r12								
r11	22	4	17.1	7557767.2	29	14	44.2	731726.37
r10	22	4	17.1	7557767.37	29	14	43.8	731714.9
r9	22	4	17.1	7557767.49	29	14	43.5	731706.3

Appendix C: Phosphates Concentrations and pH values for Soil Samples from Tuli Circle 2

Sample ID	pH KCl	pH H_2O	ABS	PO^{3-}_4
30a	8.37	8.46	0.1857	2.1328
31a	8.4	8.51	0.1843	2.1174
32a	8.26	8.32	0.1875	2.1538
33a	7.36	7.49	0.1904	2.1875
34a	7.05	7.16	0.1931	2.2183
35a	6.96	7.1	0.1996	2.2926
36a	7.29	7.31	0.2014	2.3137
37a	7.17	7.46	0.2034	2.3361
38a	6.84	6.99	0.2019	2.3193
39a	7.82	7.92	0.2025	2.3263
40a	7.83	7.86	0.1598	1.8355
30b	7.86	7.92	0.382	4.3876
31b	8.49	8.63	0.4685	5.3818
32b	7.01	7.12	0.2172	2.4946
33b	6.89	7.95	0.3064	3.5196
34b	6.95	7.01	0.1456	1.6729
35b	7.95	8.12	0.1451	1.6672
37b	8.16	8.53	0.4512	5.1826
38b	7.72	7.94	0.2777	3.1901
40b	7.35	7.41	0.2894	3.3247
30c	8.09	8.19	0.2936	3.3724
31c	8.16	8.32	0.1622	1.8636
32c	7.17	7.36	0.2994	3.4397
33c	7	7.17	0.2921	3.3555
34c	6.91	7.12	0.3524	4.0482
36c	8.03	8.41	0.3583	4.1155
37c	7.7	7.84	0.1965	2.2576
38c	7.75	7.92	0.2141	2.4595
39c	7.69	7.83	0.24	2.7568
40c	8.52	8.75	0.3368	3.8687
30d	8.59	8.81	0.4775	5.4855
31d	7.11	7.36	0.365	4.1927
34d	7.27	7.71	0.2976	3.1486
37d	8.18	8.32	0.1776	2.0402
40d	7.13	7.53	0.1108	1.2732
30e	8.48	8.63	0.1764	2.0262
31e	8.69	8.92	0.3218	3.6963
33e	8.42	8.61	0.3209	3.6865
34e	6.91	7.03	0.2933	3.3696
37e	6.85	6.98	0.1785	2.0501
38e	7.19	7.32	0.1761	2.0234
39e	7.96	8.03	0.3279	3.7664
40e	6.87	6.99	0.2179	2.503

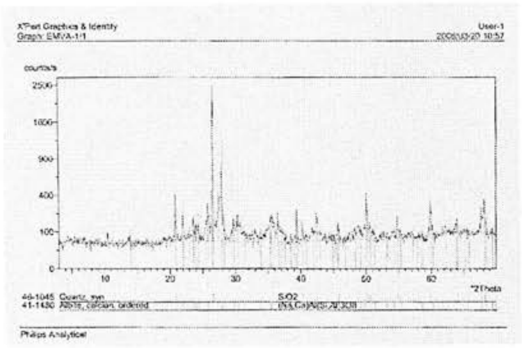
30f	8.35	8.57	0.4167	4.7872
31f	8.48	8.59	0.3273	3.7594
32f	7.37	7.42	0.3726	4.2796
33f	7.64	7.71	0.3141	3.6079
35f	7.23	7.32	0.4108	4.1785
37f	7.12	7.2	0.1976	2.2702
38f	7.79	7.82	0.1965	2.2576
39f	6.88	6.97	0.2396	2.7526
40f	8.26	8.48	0.2719	3.1228
30g	8.64	9.12	0.3789	4.3525
31g	7.23	7.73	0.3584	4.1169
32g	8.01	8.23	0.2985	3.4284
33g	8.44	8.53	0.3055	3.5098
35g	6.96	7.08	0.3837	4.4072
38g	7.1	7.37	0.2872	3.2994
39g	8.75	8.82	0.3416	3.9234
40g/g30/1	7.22	7.42	0.2726	3.1312
h0	8.41	8.73	0.2311	2.6379
h1	8.04	8.28	0.1886	2.153
h2	8.34	8.62	0.2983	3.4057
h3	8.84	9.03	0.259	0.2957
h4	8.75	8.92	0.2258	2.578
h5	8.4	8.73	0.1718	1.9607
h6	8.35	8.62	0.2444	2.7898
h7	8.53	8.79	0.1768	2.018
h8	8.56	8.72	0.1075	1.2277
h^2	8.28	8.39	0.2562	2.9249
h30	7.96	8.07	0.1893	2.1749
h31	8.57	8.62	0.2325	2.6712
h32	8.27	8.35	0.3099	3.5603
h33	7.17	7.23	0.1385	1.5915
h35	7.47	7.56	0.1409	1.6182
h36	6.8	7.93	0.1509	1.7332
h37	8.22	8.33	0.1503	1.7261
h38	7.24	7.51	0.1418	1.6294
h39	7.96	8.01	0.177	2.0332
h40	7.1	7.23	0.2203	2.531
i30	6.85	6.91	0.1968	2.2604
i31	8.86	8.99	0.1969	2.2618
i32	7.98	8.13	0.2822	3.242
i34	6.76	7.82	0.1884	2.1636
i35	7.12	7.32	0.1306	1.5004
i36	6.8	6.83	0.1787	2.0529
i37	8.22	8.29	0.1521	1.7472
i38	7.24	7.31	0.1993	2.2898
i39	7.96	8.01	0.4081	4.6876
i40	7.1	7.29	0.186	2.137
j31	6.85	6.91	0.4503	5.1728

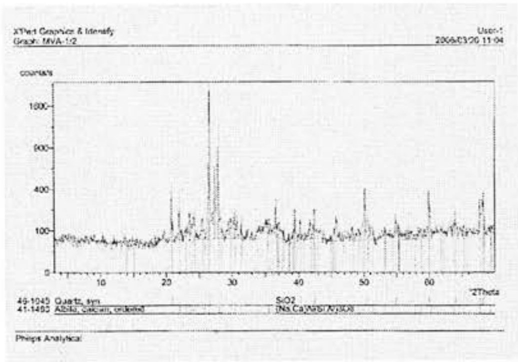
j33	8.86	8.89	0.2109	2.4231
j34	7.98	8.12	0.1732	1.9898
j35	6.78	6.93	0.1624	1.865
j36	7.12	7.41	0.1454	1.6701
j38	8.04	8.32	0.1788	2.0543
j39	6.91	7.09	0.2684	3.0835
j40	7.46	7.82	0.2827	3.2476
k30	8.85	8.95	0.2393	2.7484
k33	7.86	7.92	0.168	1.9295
k35	7.04	7.21	0.2843	3.2658
k38	7.49	7.56	0.2739	3.1466
k39	7.52	7.81	0.2241	2.5745
k40	7.98	8.12	0.1818	2.0879
26a	7.94	8.09	0.1566	1.7991
26d	7.59	7.73	0.0731	0.8399
26e	7.79	7.82	0.1079	1.2396
26f	7.46	7.61	0.1185	1.3616
26h	8.18	8.32	0.1949	2.2394
26i	7.05	7.28	0.0706	0.8105
26k	8.39	8.47	0.1025	1.1779
26l	7.83	7.92	0.0796	0.9143
26o	6.93	6.99	0.0269	0.3085
26p	7.57	7.81	0.0969	1.1134
26q	7.03	7.26	0.0472	0.5427
26r	7.68	7.74	0.0383	0.4403
26s	7.93	7.98	0.3224	3.7033
26t	7.28	7.83	0.1115	1.2802
26u	7.36	7.49	0.0938	1.0769
26v	7.19	7.33	0.1294	1.4864
26w	7.12	7.21	0.1046	1.2017
26x	7.49	7.74	0.0684	0.7852
26y	7.88	7.96	0.165	1.8958
26z	7.72	7.82	0.1257	1.4443
26aa	8.09	8.39	0.0824	0.9465
26ab	7.98	8.12	0.0885	1.0166
26ac	8.12	8.46	0.0839	0.9633
26ad	8.32	8.71	0.1144	1.3139
26ae	7.96	8.11	0.1975	2.2688
26af	8.73	8.86	0.1964	2.2562
26ag	8.47	8.69	0.1509	1.7332
26aj	8.76	8.88	0.2793	3.2083
26ak	8.92	9.03	0.2734	3.141
26al	8.03	8.12	0.2386	2.7414
26am	7.96	8.26	0.2415	2.7736
26an	8.11	8.49	0.2484	2.8535
26ao	7.2	7.79	0.2238	2.5703
26ap	7.27	7.32	0.233	2.6769
26aq	7.83	7.46	0.2267	2.6039

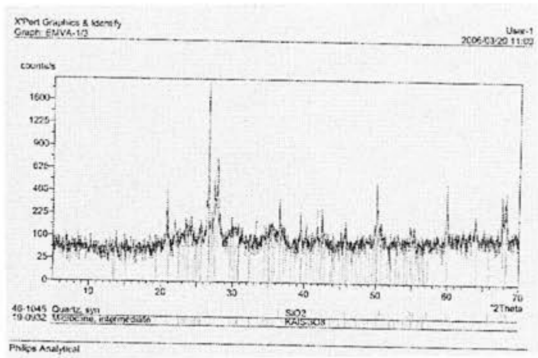
26ar	7.42	7.59	0.1832	2.1047
26as	7.63	7.8	0.192	2.2057
26at	7.64	7.97	0.3447	3.9599
26au	7.24	7.63	0.1763	2.0248
26av	7.31	7.72	0.1833	2.1061
26aw	7.53	7.88	0.1337	1.5354
26ax	7.47	7.55	0.1454	1.67.1
26ay	7.29	7.48	0.1014	1.1653
26aaa	7.52	7.63	0.1417	1.628
26aab	7.58	7.61	0.0786	0.903
26aac	7.4	7.49	0.1453	1.6687
at10	7.72	7.81	0.3466	3.9809
at11	7.96	8.13	0.1611	1.8509
at12	7.9	8.08	0.2755	3.1648
at13	7.79	7.96	0.2102	2.4146
at14	8.18	8.46	0.2704	3.1059
at15	8.26	8.51	0.2128	2.4441
at16	7.74	7.92	0.2126	2.4427
at17	7.86	8	0.2128	2.4441
at18	7.61	7.83	0.155	1.7808
at19	7.94	8.11	0.1508	1.7318
at20	8.22	8.27	0.1194	1.3714
at21	7.8	7.96	0.1884	2.1636
at22	8.02	8.13	0.2296	2.6376
at23	7.81	8.02	0.2354	2.7035
at24	7.73	7.93	0.3171	3.643
at25	8.09	8.39	0.2291	2.632
at27	7.62	7.96	0.2172	2.4946
at28	8.02	8.41	0.208	2.3894
at29	8.56	8.78	0.192	2.2057
at30	8.2	8.48	0.2179	2.503
r6	8.77	8.91	0.2301	2.6432
r7	8.89	8.97	0.198	2.2744
r8	8.27	8.48	0.2432	2.7932
r9	7.89	8.93	0.2429	2.7904
r10	8.12	8.27	0.2426	2.7862
r11	8.08	8.36	0.2169	2.4918
r13	8.11	8.29	0.2072	2.3796
r14	7.84	7.99	0.196	2.252
r15	7.89	7.93	0.1957	2.2478
r19	7.86	7.95	0.2861	3.2868
r20	7.67	7.93	0.286	3.2854
r21	8.1	8.39	0.2861	3.2868
r23	7.58	7.63	0.2861	3.2868
r24	7.97	8.01	0.3732	4.2866
r25	7.61	7.83	0.3351	3.8251
r27	8.53	8.93	0.1899	2.1683
r28	8.65	8.78	0.2738	3.1256

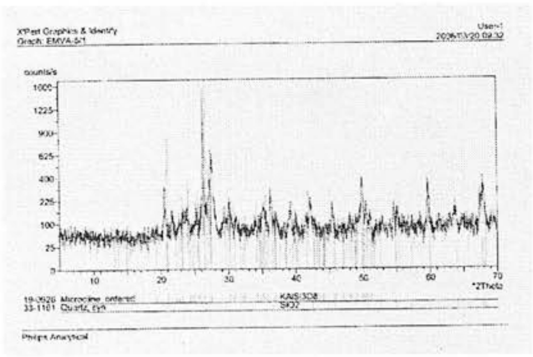
k30	8.36	8.49	0.0795	0.9072
k41	8.76	8.93	0.1885	2.1516
k42	8.76	8.87	0.2026	2.3132
k43	8.8	8.93	0.2509	2.8636
k44	8.84	9	0.2487	2.8386
k45	8.2	8.53	0.2559	2.9208
k46	8.46	8.62	0.2551	2.9124
k47	8.6	8.73	0.0643	0.7344
k48	8.21	8.46	0.2448	2.794
k49	8.61	8.99	0.2592	2.9584
k50	8.34	8.71	0.2516	2.872
k51	8.61	8.78	0.1849	2.1111
k52	8.3	8.51	0.201	2.2951
k53	8.43	8.77	0.2437	2.7814
k54	8.56	8.62	0.2545	2.9054
k55	8.84	8.97	0.2443	2.7884
k56	8.86	9.03	0.5226	5.9656
k57	8.96	9	0.2512	2.8676
k58	8.56	8.81	0.198	2.2603
k59	8.97	9.12	0.2526	2.8831
k60	8.27	8.68	0.2789	3.1841

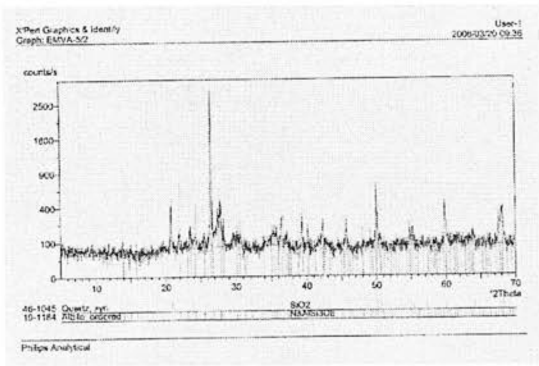
APPENDIX D: The diffractograms of some of the Ceramic Samples

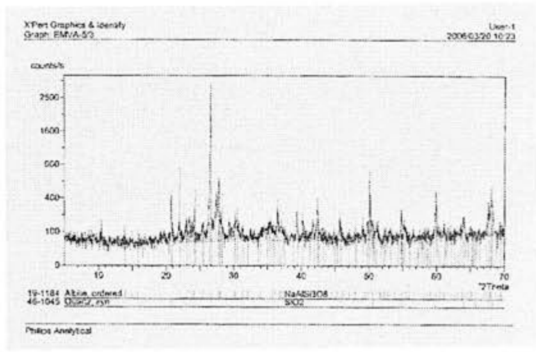


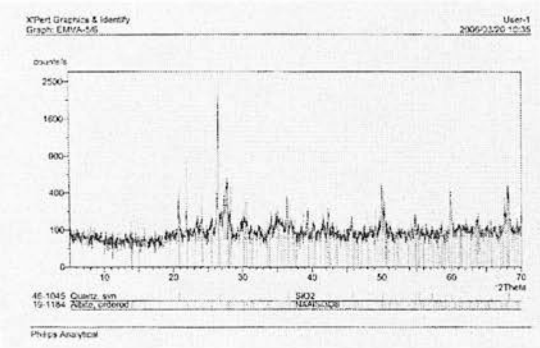








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Graph: EMVA-5/6
User-1
2006/03/20 10:35
counts/s
°2Theta
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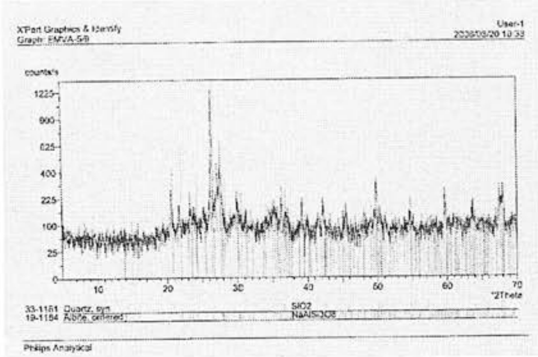
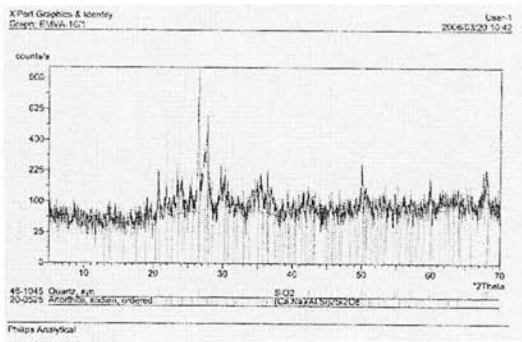
SiO2
19-1184 Albite, ordered
NaAlSi3O8
Philips Analytical


X'Pert Graphics & Identify
Graph: EMVA-5/8
User-1
counts/s
°2Theta
33-1161 Quartz, syn
SiO2
19-1184 Albite, ordered
NaAlSi3O8
Philips Analytical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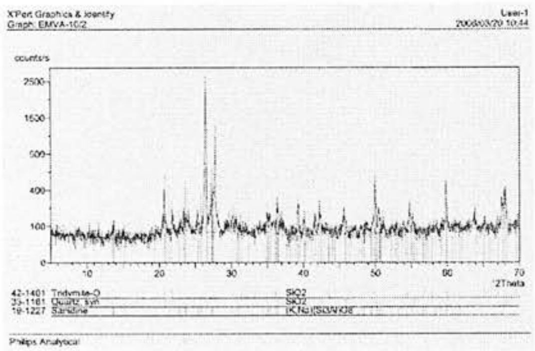
counts/s
°2Theta
46-1045 Quartz, syn
SiO2
Philips Analytical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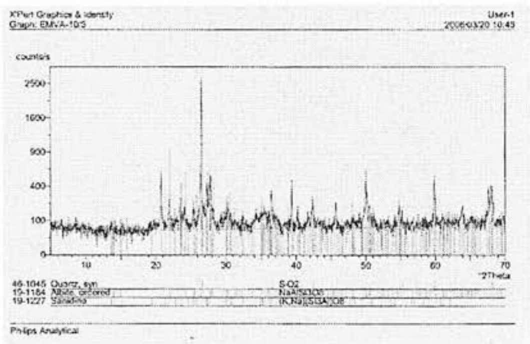
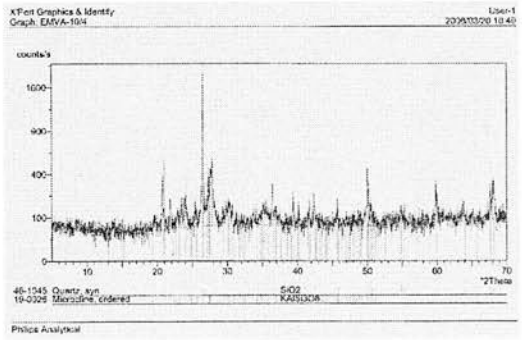
counts/s
°2Theta
42-1401 Tridymite-O
SiO2
33-1161 Quartz, syn
SiO2
19-1227 Sanidine
Philips Analytical


X'Pert Graphics & Identify
User-1
2006/03/20 10:45
counts/s
°2Theta
46-1045 Quartz, syn
19-1184 Albite, ordered
19-1227 Sanidine
Philips Analytical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Graph: EMVA-10/4
User-1
counts/s
°2Theta
46-1045 Quartz, syn
SiO2
19-0926 Microcline, ordered
KAlSi3O8
Philips Analytical