# SPHERULITES: EVIDENCE OF HERDING STRATEGIES AT MAPUNGUBWE

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## DECLARATION

I declare that this thesis is my own original work. It is submitted for the degree of Master of Science in the school of Geography, Archaeology and Environmental Studies, University of the Witwatersrand, Johannesburg. This work has not been submitted before for any other degree or examination in any other university.

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## ABSTRACT

Agropastoralists during the Iron Age established their settlements in the Limpopo Valley to take advantage of the rich floodplains of the Shashe-Limpopo confluence. Trade in ivory may have been a draw card in the earlier Zhizo period (AD 900), but good climate and increased rainfall helped to maintain a growing population which in turn contributed to the rise of complex society and the first state in southern Africa, i.e. Mapungubwe (AD 1250-1300). The population increase and the concomitant agricultural land use, together with several droughts, would have challenged livestock management. Using carbon signatures, J. Smith (2005) discovered that cattle were sustained on graze alone, indicating sufficient grass in the valley for pasture during the Iron Age. I have used spherulites found in cattle dung to investigate the use of the confluence vlei area. Vlei grass would have provided extra pasturage.

I considered time and space to interpret samples. For the Zhizo and Leokwe periods, I examined 13 samples, including Castle Rock, of which six were positive. K2 had nine positive samples out of 17 while Transitional K2 had 20 positives samples. The TK2 results suggest there was a greater need for extra pasturage associated with drought from AD 1220 to 1250. The Mapungubwe period is represented by 11 samples and five yielded positive results while the Khami period yielded 12 positive results out of 26 samples. These results show a regular use of the confluence vlei during the Iron Age associated with dry conditions.

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# CHAPTER I: INTRODUCTION

The Shashe-Limpopo confluence area has been of interest to archaeologists since the discovery of Mapungubwe (Fouché 1937; Gardner 1963) in the 1930s. Since the 1990s, archaeologists at the University of the Witwatersrand have conducted formal research projects in this region. These projects have included ethnic interaction (Calabrese 2005), rainmaking (Murimbika 2006; Schoeman 2006a, b) and herding strategies (Smith 2005; Smith *et al* 2007; Mashimbye 2007). My thesis continues the investigations of herding strategies.

As part of my Honours programme, I completed a study of herding strategies through quantitative analyses of opal phytoliths in cattle dung. In summary, I wanted to know if Iron Age villagers had been burning the large vlei near the confluence in order to provide extra grazing for their livestock. Results of the phytolith study were inconclusive. Spherulites in the dung, however, had the potential to answer my research questions.

The aim of my Masters project is now to use spherulites to investigate the use of the confluence vlei as part of larger herding strategies.

## GEOLOGY AND VEGETATION OF THE STUDY AREA

Understanding the vegetation and geology of the area is crucial to this study. Located at the junction of Botswana, South Africa and Zimbabwe, the Mapungubwe landscape (**Figure 1.1**) is an outlier of the Karoo system. The hills and valleys comprise sandstone, shales and mudstones of the cave sandstone stage (McCarthy & Rubidge 2005). Furthermore, the basin is part of the Limpopo Mobile belt. This belt includes gneisses and granites and mafic intrusions that resulted from movement between two old granite-dominated cratons, the Kaapvaal on the southern margin and the Rhodesian to the north (van Biljon & Legg 1983). Unconsolidated Cainozoic deposits occur along the river valley. This geology forms various soils including: Calcic and Gleyic Luvisols, Chromic and Vertic Cambisols, and a combination of Lithic Leptosols and Vertisols (FAO 1977-8).

These soils and geology support an open, deciduous tree savannah comprising *Commiphora-Combretum* with mopane at medium and low altitudes and *Terminalia serica* at medium altitudes and in the river valley. Baobabs (*Adonsonia digitata*) are also common. The narrow floodplain supports saltbush (*Salvadora angustifolia)* and large trees on the river bank in a microhabitat. Currently, grasses are sparse, but they are palatable and attract large herds of grazers. The low rainfall supports a sweet veld of annual grasses available at almost all altitudes throughout the year (Lightfoot 1975). *Eragrostis sp.* dominates the sweetveld, and it is sensitive to both overgrazing and extensive drought (Murimbika 2006).

## VLEI AREA

Back water flooding from the Shashe-Limpopo confluence feeds a large vlei that supports extensive grassland attractive to elephants. Most importantly, the mafic layer underneath the vlei releases calcium because it is continually wet; and so the vlei grasses are rich in calcium. The vlei margins are also prime agricultural ground. In addition to the larger vlei near the confluence, there is another smaller vlei known as Leeu Pan on the farm Den Staat close to the Kolope River. Furthermore, the Shashe River also deposits silts, resulting in extensive floodplains downstream of the confluence.

## PLAN OF PRESENTATION

Chapter II outlines the Iron Age sequence in the Mapungubwe cultural landscape and climate change during the Iron Age. In chapter III, I provide details of related research projects dealing with herding patterns within the Shashe-Limpopo region. This is followed in Chapter IV by an outline of the techniques used to collect, prepare and analyze the data and the limiting factors during the processes. Chapter V is a presentation of data by time period. Then to conclude, Chapter VI provides a detailed discussion of the results of the study as well as some recommendations.

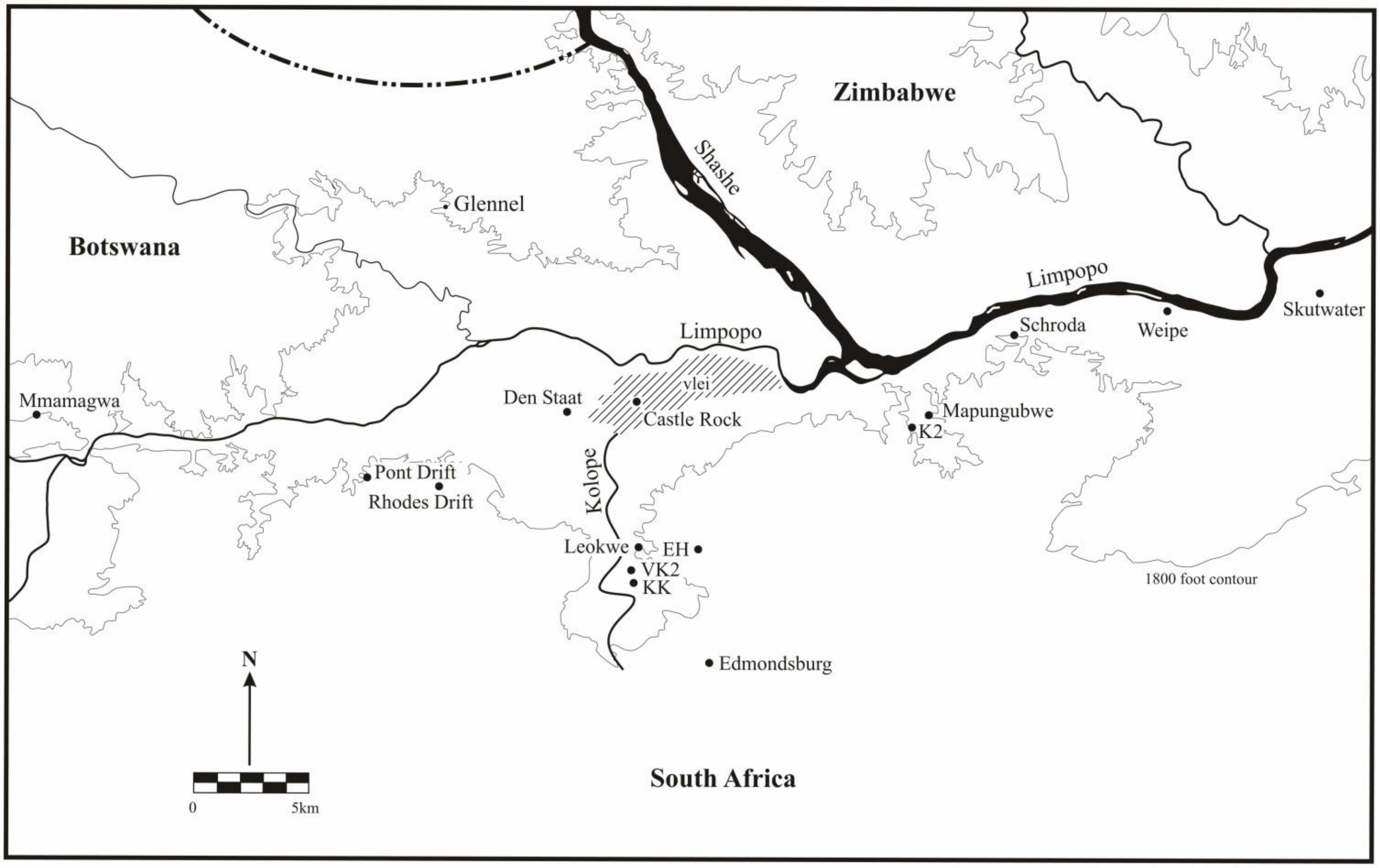


**Figure 1.1**. Location of significant sites in the Shashe-Limpopo valley (from Huffman 2007a).

# CHAPTER II: BACKGROUND TO ARCHAEOLOGICAL RESEARCH IN THE MAPUNGUBWE CULTURAL LANDSCAPE

## THE IRON AGE SEQUENCE

The Middle Iron Age (MIA), between about AD 900 and 1300, is an important era. This is when the first complex society developed in southern Africa. The sequence begins at about AD 900 when Zhizo people moved south from Zimbabwe. Like all other groups of people, they are recognised by their distinctive pottery (**Figure 2.1**), and as a convention, named after the pottery. These 'Zhizo' people established a major settlement at Schroda, near the banks of the Limpopo. The remains of cattle dung and domestic animal bones are evidence that they herded cattle and small stock, while grindstones and the burnt remains of grain bins show that they were farmers. Schroda appears to have been the largest settlement in the valley at the time, and was probably the capital. Besides cattle herding and subsistence farming, Zhizo people also participated in the East Coast trade (Hanisch 1980, Voigt 1983). Indeed, some evidence suggests that they moved into the Shashe-Limpopo valley to hunt elephant for this purpose (Huffman 2007b; Smith 2005). For one thing, their homesteads were located some distance from the best agricultural land around the floodplains (**Figure 2.2**); probably because elephants would have destroyed their crops (Huffman 2007b).

Around AD 1000, Leopard's Kopje people moved into the region from the southeast. As a result most Zhizo people moved west to Botswana (Huffman 1986), where they become incorporated into the archaeological group known as Toutswe (Denbow 1986). Leopard's Kopje ceramics are represented by three diachronic facies in the Mapungubwe area: *K2*, *Transitional K2* (*TK2*) and *Mapungubwe* (Huffman 1974, 2007b).

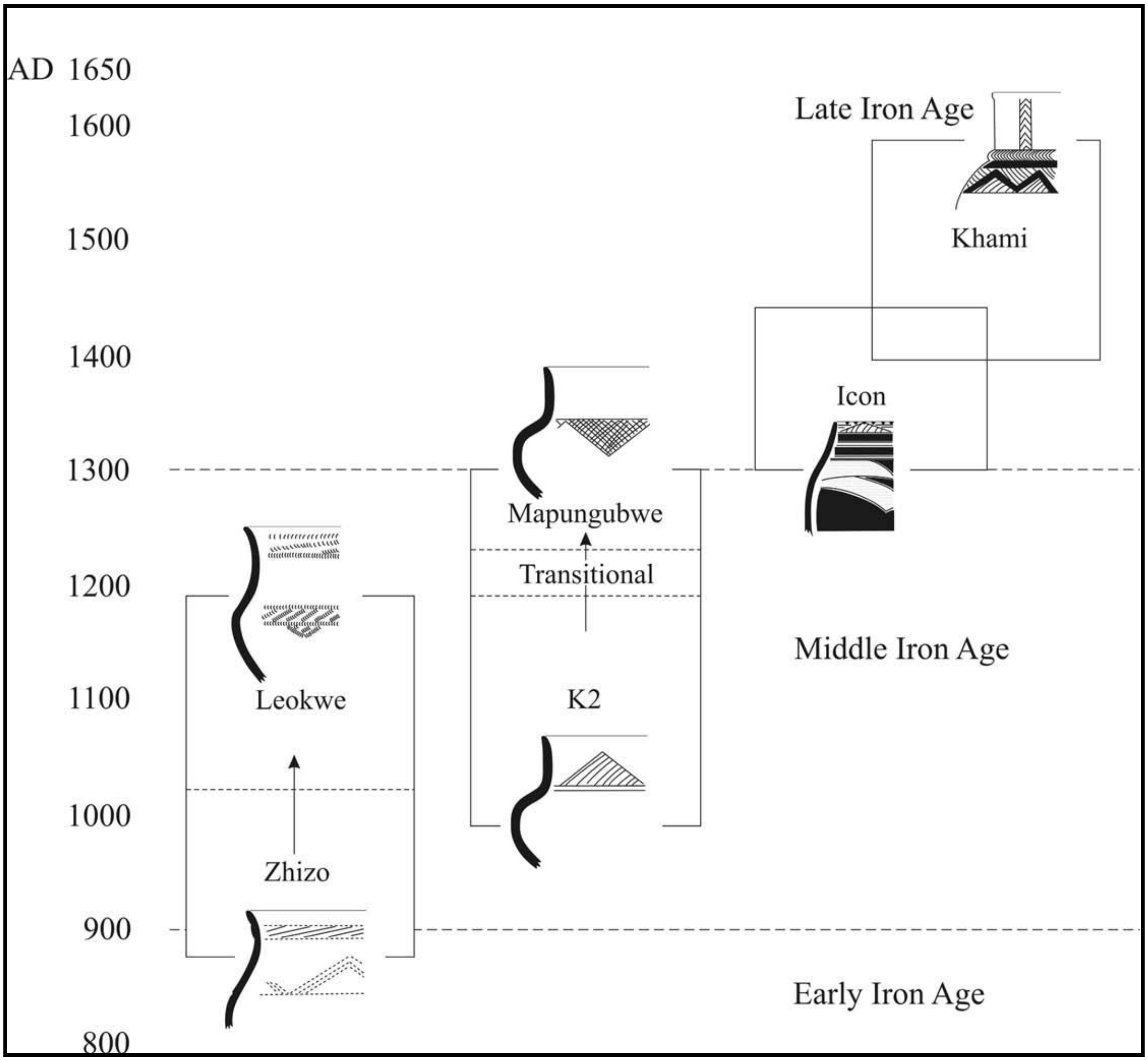


**Figure 2.1**. Middle to Late Iron Age sequence in the Mapungubwe region (from Huffman 2007b:166).

Between AD 1000 and 1220, K2 was the capital (Fouché 1937; Gardner 1963). At the same time, K2 commoners settled in the valley, next to cultivatable soil (Huffman 2000; Smith 2005). K2 people practised mixed agriculture, growing pearl millet (*Pennisetim thyphoides*) and sorghum (*Sorghum bicolor*) as well as different types of beans and peas (Eloff & Meyer 1981:16), and they herded cattle, sheep and goats. The K2 elite took over the long distance trade with the East Coast. In addition, K2 artisans made their own glass beads from imports, now called 'garden rollers' (Gardner 1963; Wood 2000). During this long period, there was a significant change in spatial organisation at K2: cattle were moved away from the centre, and the court midden grew over the old kraal (Huffman 1982). This marked the beginning of class based society.

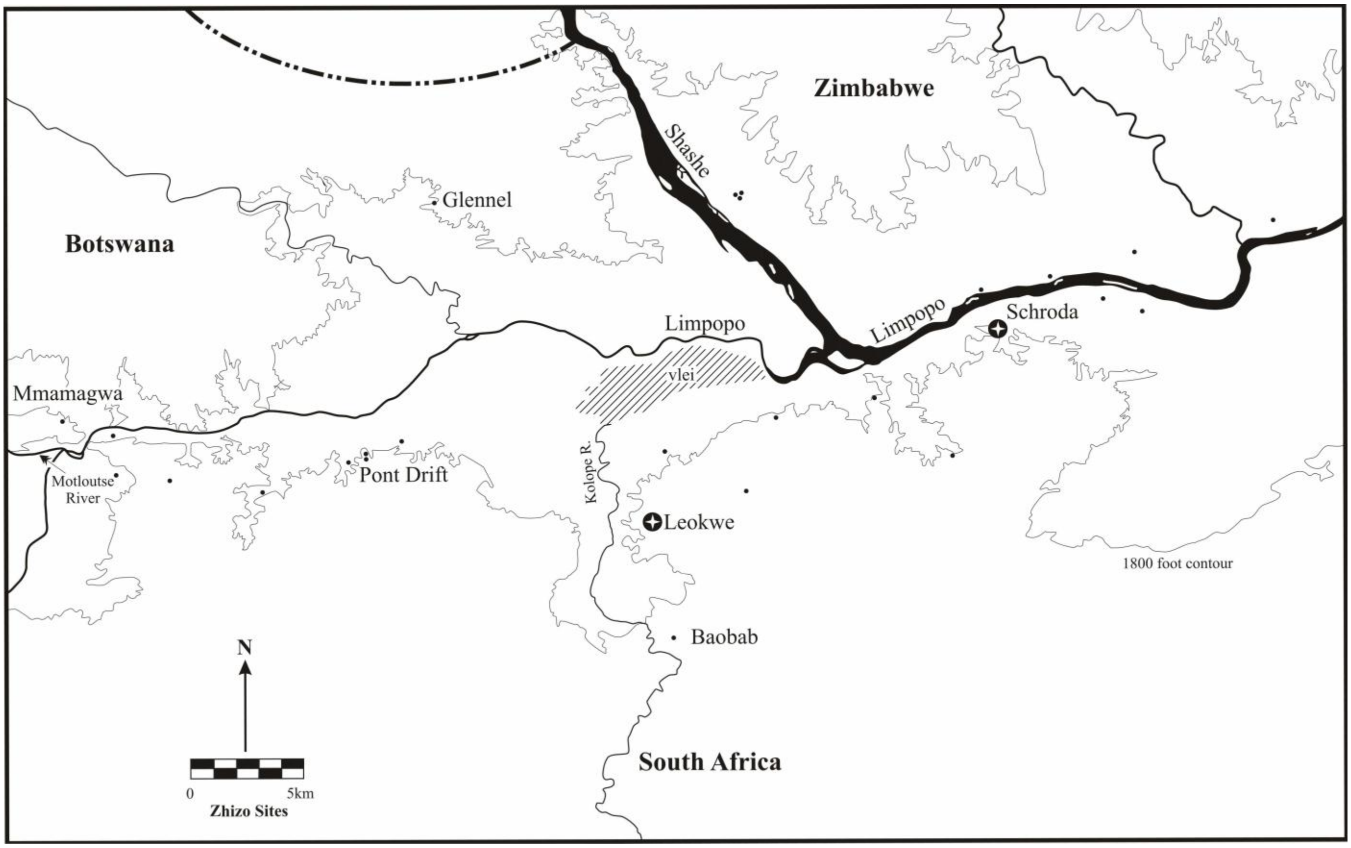


**Figure 2.2.** Distribution of Zhizo sites on record in the Shashe-Limpopo valley (from Huffman 2008:2038).

The Leopard's Kopje occupation, however, did not replace all earlier people, nor suppress different group identities. A number of Zhizo people (now called Leokwe after their pottery) stayed behind and continued to signal an independent identity with their material culture (Calabrese 2000, 2007). This is the first evidence for ethnic interaction in the whole of southern Africa; that is to say, distinct groups of historically related people maintained separate identities in multicultural situations (following Hammond-Tooke 2000).

Ultimately, Leokwe people were incorporated in a politically subordinate position. This allowed some Leokwe people to continue acting as ritual specialists, and to build status this way (Calabrese 2005; Huffman 2007b). Interaction between K2 and

Leokwe people was first noted by Calabrese (2007) at Castle Rock. He concluded that Leokwe people maintained some level of independence after K2 people arrived in the valley. At a later stage, K2 people denied Leokwe people any political authority, and *K2* ceramics then became dominant in the valley. Calabrese (2005) also suggested that it was only after spatial transformations in settlement layout at K2 and Leokwe Hill itself that *Leokwe* ceramics became a subordinate style. However, renewed excavations at Castle Rock and other Leokwe sites revise this interpretation. The evidence from the new excavations suggests that Leokwe people were incorporated into K2 society as subordinates from the beginning of their interaction.

Faunal assemblages from several Leokwe sites in the Mapungubwe region also point toward a subordinate pattern (Fatherley 2009). Found in the faunal assemblages were low-index parts (feet and lower legs) (Fatherley 2009; Huffman pers. comm., 2008). According to Shona and Venda ethnography (e.g. Stayt 1931), owners reward herdsmen with these parts. Excavations at K2 (court midden), Mapungubwe (summit) and Weipe (court sample) yielded mostly bones from the front and back quarters (high-index meat) of cattle, while Leokwe Hill, Main Rest Camp, Castle Rock (Fatherley 2009) and upper Schroda yielded mostly low-index meat (M. Kloppers pers. comm., 2009). Therefore, it has been suggested that the Leokwe people were herdsman for the K2 elite (Huffman *et al.,* 2003; Huffman & Du Piesanie 2011).

A similar custom is practiced today in some areas of Botswana. According to informants from the Mosu and Babirwa areas (Peter 2001), people sometimes keep livestock for their relatives as *mafisa*. *Mafisa* is a system where a man places his cattle into the keeping of another, and in exchange the herdsman has the right to use them in various ways, for example for milk (Schapera 1994). As a result, some cattle posts have more livestock than others, or one homestead has several cattle kraals. In cases where herdsmen are not the owners, management strategies still remain their domain.

Significantly, some Leokwe sites appear to have ‘extra’ kraals. Both the Zhizo and Leopard’s Kopje people organized their settlements according to the Central Cattle Pattern (CCP). In the CCP, the centre of the settlement was the male domain, and main cattle area. Men related by blood and other important people were buried in these central kraals. This male domain included a meeting area where men resolved disputes and made political decisions, and it could also include a smithing area and sunken storage pits for long term storage. Individual wives occupied the outer residential area where they kept their private sleeping house, kitchen, short-term storage pits and grain bins (Huffman 1982, 2000, 2008). 'Extra kraals', that is, outside the homestead, suggest Leokwe people kept cattle for others. Beginning in K2 times, some settlements were orientated towards agriculture, while others emphasised herding.

Sometime between AD 1200 and 1220, Mapungubwe became the capital. Most people settled below the hill, but a few elite people lived on the summit from the beginning. This was the first time in the prehistory of southern Africa that a senior leader was physically separated from commoners (Huffman 1982, 1986). During the K2/Mapungubwe period, cattle together with trade goods were a significant source of wealth for elites.

The resulting power and wealth led to the expansion of Mapungubwe into a state (Huffman 1986, 1996). The pottery of this period (AD 1200-1250) is called *Transitional K2*. By AD 1250, classic *Mapungubwe* pottery had evolved. The Transitional period marks the beginning of sacred leadership as it was from this period that leaders lived on rain making hills. The leader at Mapungubwe controlled rainmaking (Schoeman 2006a, b; Murimbika 2006), and the distribution of trade goods. The influence of Mapungubwe in the Shashe-Limpopo region faded at the end of the thirteenth century when the capital was abandoned. Whatever the reason for its abandonment, Mapungubwe was succeeded by Great Zimbabwe. Great Zimbabwe's growth as an elite centre began immediately after the abandonment of Mapungubwe (Huffman & Vogel 1991), or slightly before. At its peak, Great Zimbabwe was a large capital, five times as large as Mapungubwe, with an estimated population of 18,000 people (Huffman 1986).

Two dynasties succeeded Great Zimbabwe: Torwa and Mutapa. The Torwa dynasty can be identified at the large capital known as Khami (ca. 1450-1640). In overall extent the Khami capital was approximately two-thirds the size of Great Zimbabwe, including the outer buildings, and therefore supported 7000 to 12,000 people (Huffman 1986). Similar to Great Zimbabwe, Khami probably controlled a six-tiered hierarchy (Huffman 1986). This indicates just how complex political structures were after

Mapungubwe. The political influence of the Khami state covered parts of Zimbabwe, Botswana and South Africa (Huffman 2007a, b).

## CLIMATE CHANGE

Archaeologists use different styles of pottery to date the sites in the Mapungubwe region. Among other things, the ceramic sequence is important for understanding climate change. During Zhizo times, the mean seasonal precipitation (MSP) was no better than today, which is about 320mm. A trend towards a higher MSP of ≥500mm characterises the K2 period. This wetter phase continued until about AD 1200 to1250, when there was a series of droughts. After AD 1250, average rainfall recovered to the previous high level of ≥500mm (Smith 2005).

Isotopic data (Smith 2005) document the droughts during the Transitional period. Other indicators of these droughts are substantial amounts of rainmaking deposit on hills (Murimbika 2006; Schoeman 2006), and burnt grain bins in normal settlements (Huffman 2009). Ethnographic data suggest burnt grain bins were the result of cleansing rituals to end the drought (Huffman 2009). Simultaneous burnings across south-east Africa show that these droughts were caused by intensive El Niño events (Huffman 2010). Such droughts would have affected grazing strategies.

## SUMMARY

In this chapter I presented a brief sequence of occupations in the Mapungubwe region during the Middle Iron Age and the beginning of the Later Iron Age. The climate at about AD 900 was not necessarily favourable for farming activities, and Zhizo people may have moved into this area to hunt elephant for the coastal trade. Around AD 1000, Leopard's Kopje people took over the area and the trade, and most Zhizo people moved west to Botswana. Some Zhizo people stayed behind and became Leokwe. Ultimately, Leokwe people were incorporated in a politically subordinate position.

By AD 1250, classic *Mapungubwe* pottery had evolved, and Mapungubwe was the capital of the first southern African state. The collapse of Mapungubwe saw the development of Great Zimbabwe, and then some 150 years later, Khami became dominant.

# CHAPTER III: INVESTIGATING HERDING PATTERNS, PAST AND PRESENT

## CURRENT GRAZING STRATEGIES IN THE SOUTHERN AFRICAN REGION

In the Shashe-Limpopo area today, herding is associated with mopane veld and *Acacia* grasslands. Agro-pastoralists living to the northwest in Botswana synchronise herding activities with crop production and seasonal precipitation (Smith 2005). To sustain livestock, they move their herds strategically between different ecological zones to offset seasonal and annual variability in water and vegetation. During the wet season, livestock graze on communal land, and some animals wander up to 20 km before they are brought back to kraals in the evening. When the winter season arrives, water is limited and grass depleted. During winter, herds can be kept either at cattle-posts or near the villages. Most agro-pastoralists said they either keep cattle year round with relatives and friends or at their own cattle-posts where it is wetter and there is better pasturage. These cattle-posts are located some 10 to 50 km away. Mopane browse will sustain livestock in most years until there is new growth at the beginning of the wet season. In addition, cattle graze on sorghum and millet stalks after harvest, as they do throughout southern Africa today.

According to Van Waarden (1989), good agricultural land should ideally be no more than 4 km away from a water source. Usually, fields are close to residences. The close proximity between water, fields and homestead saves energy, especially during the dry season. Cattle posts, on the other hand, are normally about 7 km away from water. In this regard, a GIS spatial analysis indicated that K2 sites dominated both the Limpopo and Kolope rivers (**Figure 3.1**), while most Leokwe sites were some distance away (Du Piesanie 2008).

Faunal remains show that Iron Age herds consisted of cattle, sheep and goats; all are indigenous breeds well adapted to hot semi-arid environments. Their distribution and reproduction, however, would have been limited by the availability of water, pastureland and environments free of pests and disease. Because climates have changed, there could have been different herding strategies.

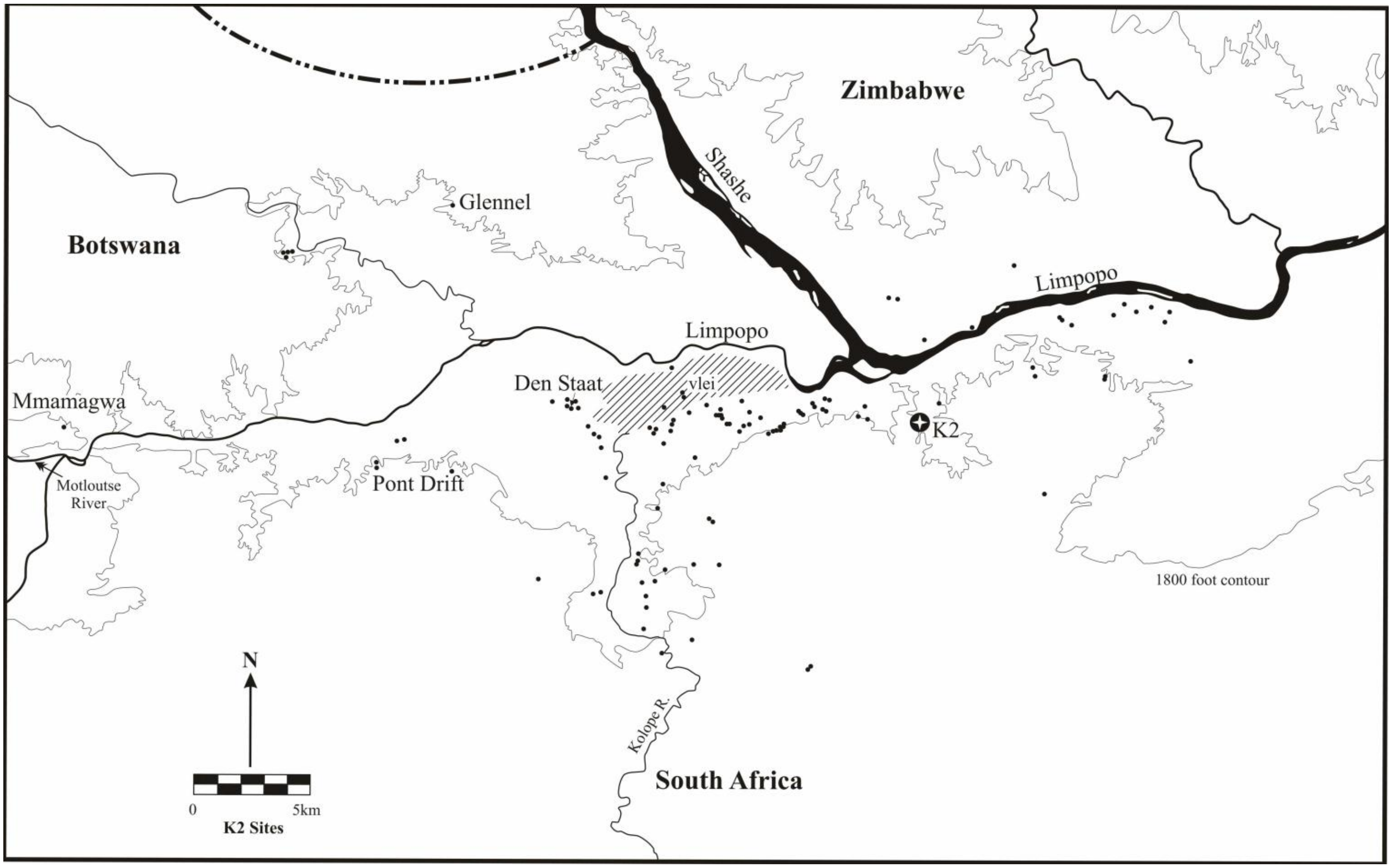


**Figure 3.1**. Distribution of K2 period settlements (Adapted from Huffman 2008).

## RESEARCH ON HERDING STRATEGIES IN THE REGION DURING THE IRON AGE

Until recently, the main focus of Iron Age research in the Shashe-Limpopo valley has been on the chrono-stratigraphic aspects of capital sites such as Schroda, K2 and Mapungubwe. Interest has been on the farmer sequence and socio-political change, especially the shift from rank-based to class-based systems (e.g. Huffman 1982). Because of the importance of agro-pastoralism, however, research has now shifted to include past diets and herding patterns, as well as other aspects of village livelihood. Researchers use different methods to determine animal diet, including the analysis of strontium, resin, pollen, phytoliths and spherulites. I briefly consider the major methods.

**Strontium**

It is possible to investigate herding strategies through strontium isotope signatures. The diverse geologies of the Shashe-Limpopo region each have different strontium values, incorporated in the local vegetation and then passed on to grazing animals. Analysing modern herbivores from known habitats, Smith (2005) created a strontium map of livestock bones from prehistoric and modern faunal remains. She found that cattle only grazed during the Middle Iron Age. Indeed, Smith's isotopic study shows a sustained C4 diet; in other words, there was sufficient grass for year round grazing and that cattle did not browse on mopane in winter.

Moreover, her results indicate that intra-tooth variability was not significant in individual animals at first (Smith 2005). Strontium data for cattle specimens from the Leokwe layer at Schroda, and K2 occupations at K2, show that herds were primarily pastured in the immediate vicinity. This finding suggests little movement between geological areas during tooth formation, or perhaps that livestock movement could not be detected using this particular procedure.

Later, during the Transitional and Mapungubwe periods, some livestock were kept further away, for example in Botswana. Following these findings, together with data on site distribution (Huffman 2000), it is clear that the population increase from K2 to Mapungubwe led to extensive crop production along the floodplains. Agricultural activities therefore dominated land use in this core area, and pastureland in the valley would have decreased. Hence herding patterns incorporated different pastures.

**Resin**

Kinahan's current research in Namibia on herding patterns also provides relevant results. He found no evidence of mopane residue in winter dung even though cattle had ingested it (J Kinahan to TN Huffman pers. comm., 2007). Mopane resin, however, maybe worth pursuing in order to find evidence of its consumption. Because mopane is well adapted to arid conditions, it would have been ideal for winter browse when the grass was depleted. Resin analyses would serve as a check on strontium studies.

**Pollen**

Results showed a scarcity of tree pollen in Iron Age dung in contrast to modern dung (Carrión *et al.* 2000). This scarcity may be attributed to either human impact or climatic conditions. Evidently, climate was not the reason for the sparse tree cover because conditions were usually favourable for vegetation growth during the Middle Iron Age (Smith 2005). On the other hand, settlement areas would have been cleared for firewood, and there would be few trees (if any) available for local browse.

**Phytoliths**

Another approach involves phytoliths. Phytoliths are particles of hydrated silica formed in the cells of living plants through transpiration. Such particles are produced in different kinds of plant tissues, including the epidermis and mesophyll. In addition, within each tissue area, different types of cells accumulate silica (Twiss 1986; Pearsall & Dinan 1992). Their characteristic shapes are both the result of environment and genetics. Because of the genetic component, grass and tree phytoliths can be easily separated. In southern Africa, archaeologists have used phytolith analysis to recognize the presence of cattle kraals (e.g. Huffman 1993).

Zhizo and Leopard's Kopje people both followed the CCP, and so cattle were kraaled in the settlement for at least part of the year. These kraal deposits contain phytoliths.

My pilot study (Mashimbye 2007) examined phytoliths to document the use of the confluence vlei for pasturage. As noted earlier, the results were inconclusive, while spherulites showed meaningful differences. As a result I turned to spherulites for answers.

**Spherulites**

Spherulites are minute (usually 5-15 μm) spheres of radially crystallized calcium carbonate surrounded by an organic coating. They have an approximately circular outline and a permanent cross of extinction visible under cross-polarized light (Canti 1997; Shahack-Gross *et al*., 2003). Spherulites are formed in the intestines of adult animals during the digestive process. In a study conducted in Uzzo, Italy, droppings from two month old lambs lacked spherulites, indicating that only adults produce the crystals (Villa *et al.* 1992). Spherulites are best preserved in ashy (alkaline) conditions (Canti 1998, 1999). Highly acidic conditions destroy them, but cattle kraals are more neutral than surrounding soil due to ash deposited there, as well as the nature of the dung itself. Experimental work by Canti (1999) demonstrates that a pH above 6 is required for the production and preservation of spherulites. The alkaline soils characteristic of arid and semiarid regions usually have pH values higher than 7 because there is little leaching, leaving basic cations behind (Brady 1990). Following this line of evidence, the calcium rich vlei area will support spherulite production.

Originally it was thought that spherulites were common in sheep and only occasionally in cattle (Villa *et al.* 1992). It was later found, however, that in northern Europe, sheep samples did not consistently contain spherulites while cattle frequently did. An important factor in this case appeared to be the calcium content of the local soil (Canti 1997). Furthermore, spherulite production may vary between males and females because females need to absorb more calcium (Canti 1999).

There are other materials found in animal dung that are related to and can be confused with spherulites. The most common are coccoliths and calcium oxalates. One form of calcium oxalate in plants is a cluster of radiating crystals known as druses. These druses are much larger and more coarsely crystalline than faecal spherulites (see Canti 1998).

The distinction between pastoral and hunter-gatherer sites has been at the forefront of research in most regions of Africa and Europe. Generally, dung degrades in open air sites and is not easily identified. Scholars have therefore used mineralogical components associated with organic matter such as phytoliths, calcium oxalate druses and spherulites to identify animal enclosures (Albert *et al.* 2008; Shahack-Gross *et al.* 2003; Shahack-Gross & Finkelstein 2008; Villa *et al.* 1992). **Table 3.1** presents their results. As their study shows, spherulites occur in other domestic animals, such as donkeys and camels.

I follow the lead of previous research in this study.

**Table. 4.1.** Phytoliths and spherulites concentration (expressed in millions per 1g) in modern and archaeological samples in Israel (after Shahack-Gross & Finkelstein 2008).

| Sample | Location | Phytolith concentration | Dung spherulites concentration |
|---|---|---|---|
| *Modern dung* | | | |
| Black dwarf goats (free ranging, 1984) | Nahal Avdat (Wadi er-Ramliyeh) | 0.2 | 37 |
| Camels (free ranging, 1984) | Nahal Avdat (Wadi er-Ramliyeh) | 4.9 | 100 |
| Donkeys (free ranging, 1984) | Nahal Avdat (Wadi er-Ramliyeh) | 1.8 | 90 |
| Goats (spring 2005) | Nahal Aqrab | 9.6 | 200 |
| Camels (spring 2005) | Nahal Aqrab | 5.2 | 4 |
| Camels (winter 2005) | Nahal Haroa | 0.9 | 13 |
| Sheep (free ranging, spring 2005) | Yatir | 6.3 | 5 |
| Sheep (free ranging + supplements, summer 2005) | Yatir | 4.8 | 0.3 |
| Black dwarf goats (in captivity, 2006) | Zoological Garden, Tel-Aviv U. | 4.8 | 0 |
| Ibex (free ranging, autumn 2006) | Avdat | 3.6 | 62.5 |
| *Archaeological gray-colored sediments* | | | |
| Atar Haroa | Courtyard gray sediment | 0.06, 0.02, 0.02 | 20 |
| Atar Haroa | Floated dung pellet | 0.3 | 34 |
| Atar Haroa | Locus 1 | 0.1 | 15.2 |
| Atar Haroa | Locus 6 | 0.001 | 3.5, 76.3 |
| *Control sediments* | | | |
| Atar Haroa | Southwest of site | 0.01, 0.0005, 0 | 0 |
| Atar Haroa | Southeast of site | 0 | 0.1 |
| Nahal Avdat (Wadi er-Ramliyeh) | North of site | 0.001 | 0 |
| Yatir | Northeast of site | 0.7 | 0 |
| Atar Haroa | Basal reddish soil | 0.003, 0 | 0 |
| Atar Haroa | Upper yellow loess | 0.3 | 4, 0.8 |
| *Fodder from the Negev* | | | |
| *Ramalina maciformis* | Lichen, preferred by black goats | 0.2 | Not applicable |
| *Peganum harmala* | Perennial, preferred by donkeys | 0.05 | Not applicable |
| *Anabasis articulate* | Shrub, eaten by camels and goats | 0.01 | Not applicable |
| *Stipa capensis* | Annual grass, prevalent in the Atar Haroa vicinity | 15.2 | Not applicable |
| *Artemisia sieberi* | Shrub, Atar Haroa vicinity | 0.1 | Not applicable |

## SUMMARY

Cattle herding and subsistence agriculture were important to Iron Age people in the Shashe-Limpopo valley. Different methods have been used to determine animal diet, including analyses of resin, pollen, carbon, phytoliths and spherulites. The common conclusion from these different approaches appears to be that grass in the region was probably sufficient for livestock, and that winter browsing was probably not practiced. Strontium data suggest that cattle grazed on plateau grass during summer months. Likewise, according to pollen studies tree cover was less in the Middle Iron Age than it is today. Livestock during the K2 and Mapungubwe periods appear to have been kept some distance away from the capitals.

# CHAPTER IV: RESEARCH DESIGN

This chapter outlines my sampling methods and techniques. The last part addresses the limitations of the research. I begin with a brief outline of my original pilot study, including some of the methods I used then.

## MY PREVIOUS RESEARCH

The aim of my pilot study in 2007 was to investigate herding strategies by microscopic examination of kraal dung. I examined 10 Iron Age kraals from seven sites around the large vlei, from the Kolope River area and on the plateau where mopane trees are now common. To identify phytoliths, I prepared mopane leaves, cenchrus and vlei grasses following O'Brien's (1974) method.

The mopane leaves did not have any phytoliths, while grasses had a substantial number embedded in their leaves. As expected from Kinahan's work, there was no trace of mopane in the archaeological samples. Spherulites, however, were present in most samples from the vlei area but not elsewhere. The reason for this was probably because of the underlying igneous rock that produces calcium carbonate. If this was true, the calcium rich grass aided spherulite development in the intestines of cattle. Further investigation was thought worthwhile, and is the reason for my current research.

## SAMPLING AND ANALYSES FOR CURRENT RESEARCH

For the Pilot study, only seven sites were examined. This is not a good representation as there are now over 1160 Iron Age sites on record in the Mapungubwe landscape (TN Huffman, pers. comm., 2012). For this study, I analyzed 115 dung samples from 100 Iron Age kraals (**Figure 4.1**). Some sites have more than one kraal: besides cattle they include enclosures for small livestock such as sheep/goat and calves. Because of the European study where only sheep/goat kraals had evidence of spherulites (Villa *et al.* 1992), I collected dung from sheep/goat kraals (e.g. AB32) for comparative purposes.

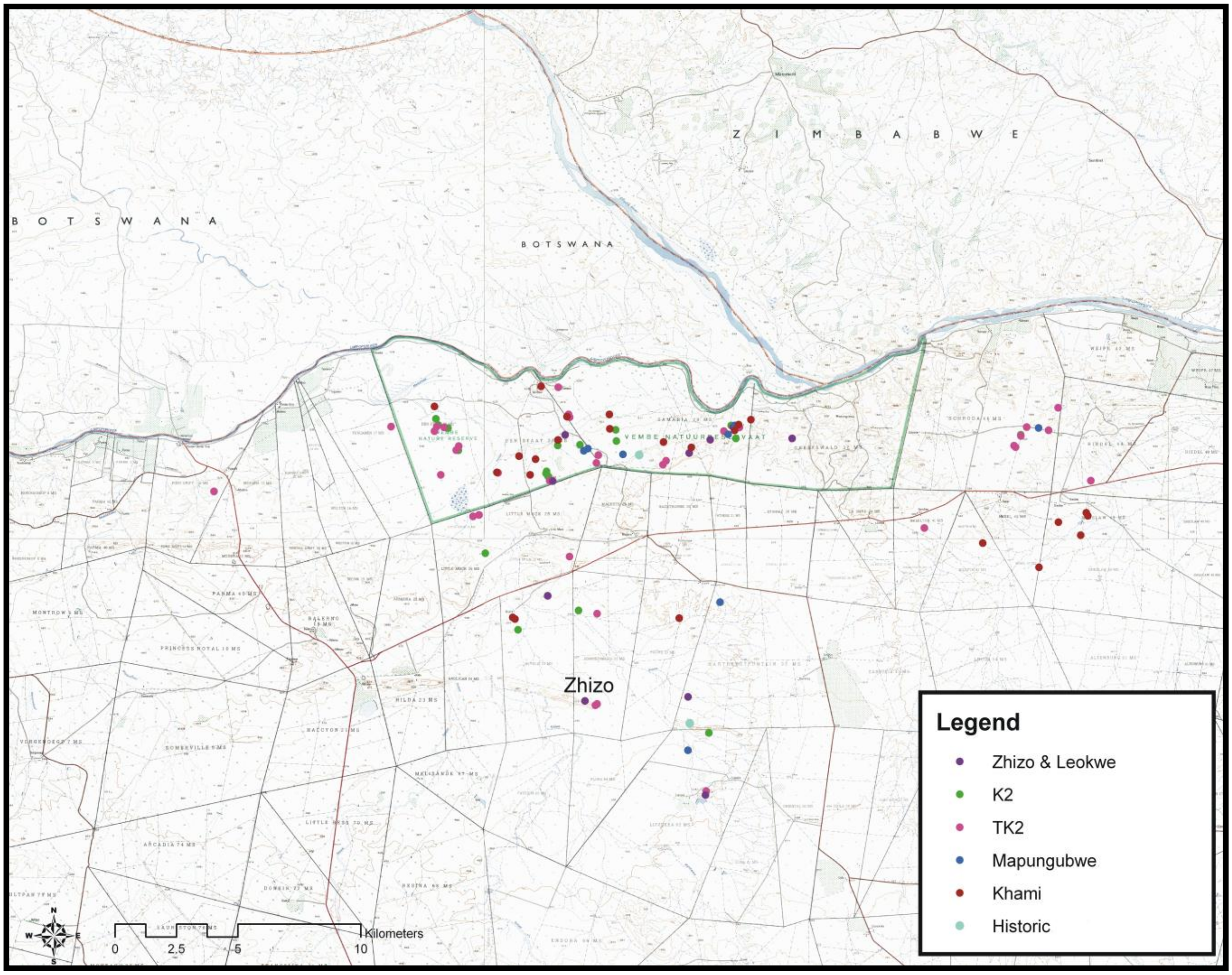


**Figure 4.1.** The distribution of all sampled sites

The dung samples were collected from the surface and during excavations at 2229AB32, AB184, AB508, AD109, AD110, AD197, and AD198 in the Limpopo Valley between 2007and 2009. I grouped the sites into four geological areas: (1) the confluence vlei; (2) the Kolope River area southwest of Mapungubwe; (3) downstream from the confluence; and (4) the plateau in between the Limpopo and smaller drainages such as the Kolope and Kongo Loop. I separated the sites by area in order to determine who had access to the large vlei.

The quality of the dung was classified into three varieties: good dung (compacted or granular); poor dung (loose sand and dung particles): and vitrified dung (burnt and crystallized). Compacted dung indicates that there has been little disturbance by modern animals, and plant residues are presumably better preserved. A poor dung sample is not compacted because of animal disturbance or some form of erosion; in fact, some kraals are almost completely washed away (e.g. 2229AA14c). Vitrification is caused by high temperatures (Butterworth 1979), and this may destroy spherulites and phytoliths.

To avoid misrepresentation, I also collected for analysis zebra and, impala dung from the surface of AB 474 and elephant dung from the vlei. These animals often use ancient kraals as dust baths and then leave their dung behind. As these animals are herbivores, they may also influence the phytolith and spherulite content in the soil. I wanted to see if these animals could contaminate the archaeological samples.

**Techniques**

There are several techniques that can be used to identify spherulites in archaeological deposits. The two standard techniques are thin section and liquid mounts, whereby sieved material is immersed in a refractive liquid (Canti 1998). Other researchers also pre-treat the material by cleansing the samples with hydrogen peroxide at 30% to remove organic material (Villa *et, al* 1992). Other researchers have ashed animal dung in an oven at 550º for 4 hours (Albert *et.al* 2008). For my research, I simply scraped a miniscule amount of dung onto a slide, and then added a few drops of tap water.

I then examined samples using an Olympus microscope with internal (reflected) light source and a polarizer lens under 20x magnifications. The analyzer and polarizer lenses were used in combination to cross-polarize the light as the birefringence effects indicate the presence of spherulites and similar plant material and fibres. Briefly, birefringence is when a ray of light, passing through anisotropic material, such as calcite crystals, is decompressed into two rays (double refraction) depending on the polarization of the light (Williamson 2000; Lombard 2003). Only the analyzer light was used to search for phytoliths as they are not birefringent.

Slides were examined in five positions (the four corners of a glass slip and the centre) to identify and count spherulites. I used an eye piece reticule to measure size and to compare them with starch grains and to ensure that the spherulites were within the typical size range of 5-20µm.

**Limitations**

The technique described above is not the best method of separating particles and understanding spherulites morphology. However, it is effective for identifying and counting spherulites.

The first limiting factor was the lack of resources and lack of training in the other methods (see Canti 1997, 1998; Villa *et al.*, 1992; Shahack-Gross *et al.*, 2003).

Secondly, the Shashe-Limpopo valley is also home to a variety of wild animals which use the prehistoric kraals as dust baths and as sleeping areas. I have tried to eliminate the most common animals.

Another limiting factor was that the low power Olympus microscope was unable to photograph spherulites viewed under cross-polarized light. Therefore, no pictures of spherulites are presented in this work.

Fourthly, sampling was not extensive or systematic within any one kraal. It is thus not possible to use these present data to examine seasonal shifts in grazing.

Furthermore, due to the nature of collection and curation, modern contaminants such as fibres from the curator's clothing, paper fibres and finger grease were present in the samples. Fortunately, these contaminants are easily distinguishable from the archaeological material. Modern fibres are usually brightly coloured in shades of blue (most common), yellow, red and green, and they are also not birefringent. Plant or cellulose fibres usually have broken ends that look shattered (Williamson 2000; Lombard 2003).

Finally, I did not test the pH of the various samples or grazing areas. Although an issue elsewhere, in my case it is probably not important because the vlei is a single biosphere with the same substrate; it is therefore alkaline. If surrounding pasturage has a lower pH, then it is still true that spherulites in dung point to the use of the vlei for supplemental grazing.

# CHAPTER V: DATA PRESENTATION

I present the analyses according to ceramic facies and time period, from Zhizo (AD 900-1000) and Leokwe (AD 1000-1200) to Khami (AD 1450-1640). Furthermore, I divide the Mapungubwe landscape into four geophysical sections; (1) the vlei area to the west of the confluence; (2) downstream from the confluence for 10km; (3) the plateau; and (4) the Kolope River valley and surrounds (**Figure 4.1**). Because Castle Rock (Site AB84) has three components, and it was the stimulus for the present study, I present it separately.

## ANALYTICAL RESULTS

### Wild animal dung

I collected elephant dung from the vlei so that it would contain the characteristic vlei grass. The sample did not yield any spherulites. Likewise, the impala and zebra dung, collected from AB474, were also negative. Thus, dung from these animals has most likely not contaminated the ancient samples.

### Castle Rock (AB184)

Castle Rock is an isolated hill on the edge of the vlei on the farm Den Staat. John Calabrese (2005, 2007) started excavations here in 1999, and discovered that Leokwe kraal 4 was contemporaneous with the K2 capital (Calabrese 2005; Du Piesanie 2008). As detailed in his thesis, this is the first evidence for ethnic interaction during the Iron Age in southern Africa. Ceramic evidence from the 2007 Honours excavations indicates that there were three occupations: Leokwe, Transitional K2 and Khami (Huffman 2008). Ceramic remains from kraals 1 and 4 were identified as Leokwe (under TK2), and ceramics from the Khami period were collected from the surface of kraal 7. Results from the 2007 phytolith study led to the current research when spherulites were noted from a dung sample (Mashimbye 2007).

As part of the current research, I examined dung samples from five kraals: 1, 2, 3 and 3b, which underlies kraal 3 (**Figure 5.1**), and kraal 4. Spherulites were present in four of the five samples (**Table 5.1**). Spherulites were present in kraal 3, but absent from kraal 3 (b), despite compaction of the dung. Nonetheless, the positive results for spherulites in kraals 1 (Leokwe), 2 (Khami), 3 (TK2?) and 4 (Leokwe) indicate that the vlei was used for grazing cattle at different times.

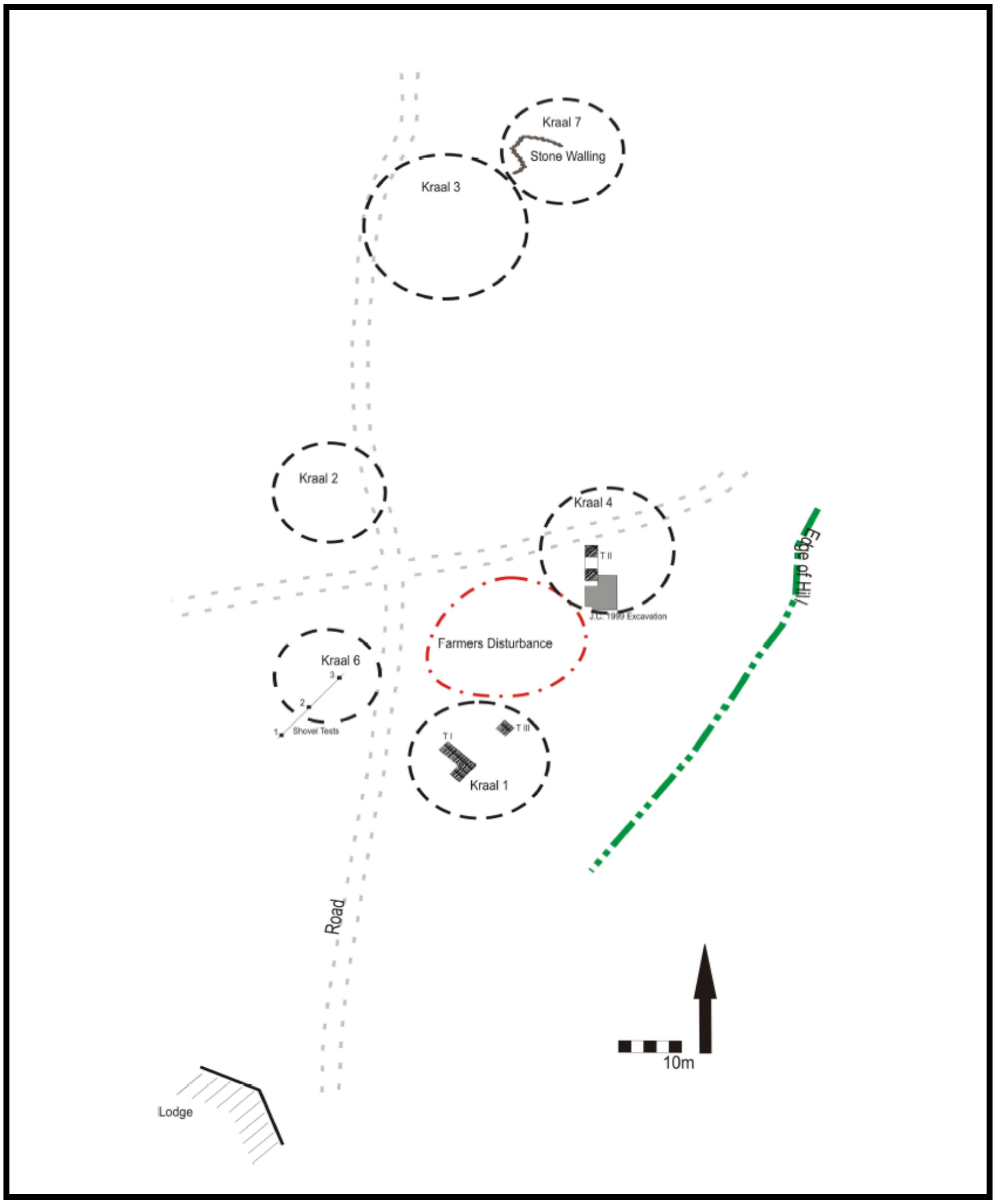


**Figure 5.1.** Castle Rock: layout of surface features.

**Table 5.1.** Spherulite count for Castle Rock.

| Map | Site No. | Sample | Quality | Co-Ordinates | Number | Other | Area |
|---|---|---|---|---|---|---|---|
| 2229 | AB 184 | Kraal 1 Leokwe | Good | 22 12 29.1<br>29 15 56.5 | 26 | | Vlei |
| 2229 | AB 184 | Kraal 4 Leokwe | Good | 22 12 28<br>29 15 57.6 | 3 | | Vlei |
| 2229 | AB 184 | Kraal 3 TK2? | Good | 22 12 26.1<br>29 15 57.2 | 18 | | Vlei |
| 2229 | AB 184 | Kraal 3b TK2 | Good | 22 12 26.1<br>29 15 57.2 | 0 | | Vlei |
| 2229 | AB 184 | Kraal 2 Khami | Good | 22 12 27.5<br>29 15 56.2 | 14 | | Vlei |

I now consider other sites dating to the Zhizo (AD 900-1000) and Leokwe periods (AD 1000-1200).

## Zhizo and Leokwe periods

**Table 5.2** presents the results of the analyses and **Figure 5.2** shows the locations of the kraals. I examined 12 samples from nine Leokwe sites as well as the Zhizo site known as Baobab (AD6). This was the only Zhizo sample available for study. There were six samples from the vlei area. Only samples from AB249 (and Castle Rock reported above) had spherulites. Out of five samples from the Kolope River area, all three from AD144 were positive, while AD6 had none. Site AD208, located on the plateau, also had negative results.

**Table. 5.2**. Spherulite count for Zhizo and Leokwe sites in the Shashe-Limpopo valley.

| Map | Site No. | Sample | Quality | Co-Ordinates | Number | Other | Area |
|---|---|---|---|---|---|---|---|
| 2229 | AB42 | | Good | 22 12 38.7<br>29 20 27 | 0 | | Vlei |
| 2229 | AB223 | | Good | 22 12 53.35<br>29 21 44.5 | 0 | | Vlei |
| 2229 | AB249 | | Good | 22 12 48.8<br>29 16 46 | 27 | | Vlei |
| 2229 | AB280 | | Good | 22 13 48.5<br>29 16 29.5 | 0 | | Vlei |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2229 | AB333 | | Good | 22 12 55<br>29 19 56.8 | 0 | | Vlei |
| 2229 | AB383 | | Good | 22 13 12.3<br>29 19 29.1 | 0 | | Vlei |
| 2229 | AD06 | Zhizo | Good | 22 18 33<br>29 17 12 | 0 | | Kolope |
| 2229 | AD144 | Kraal 1 | Good | 22 16 17<br>29 16 23 | 11 | | Kolope |
| 2229 | AD144 | Kraal 2 | Good | 22 16 17<br>29 16 23 | 9 | 2 | Kolope |
| 2229 | AD144 | Kraal 3 | Good | 22 16 17<br>29 16 23 | 26 | | Kolope |
| 2229 | AD172 | | Good | 22 18 27.7<br>29 16 27.6 | 2 | 2 | Kolope |
| 2229 | AD208 | | Good | 22 20 34.8<br>29 19 50.6 | 0 | | Plateau |

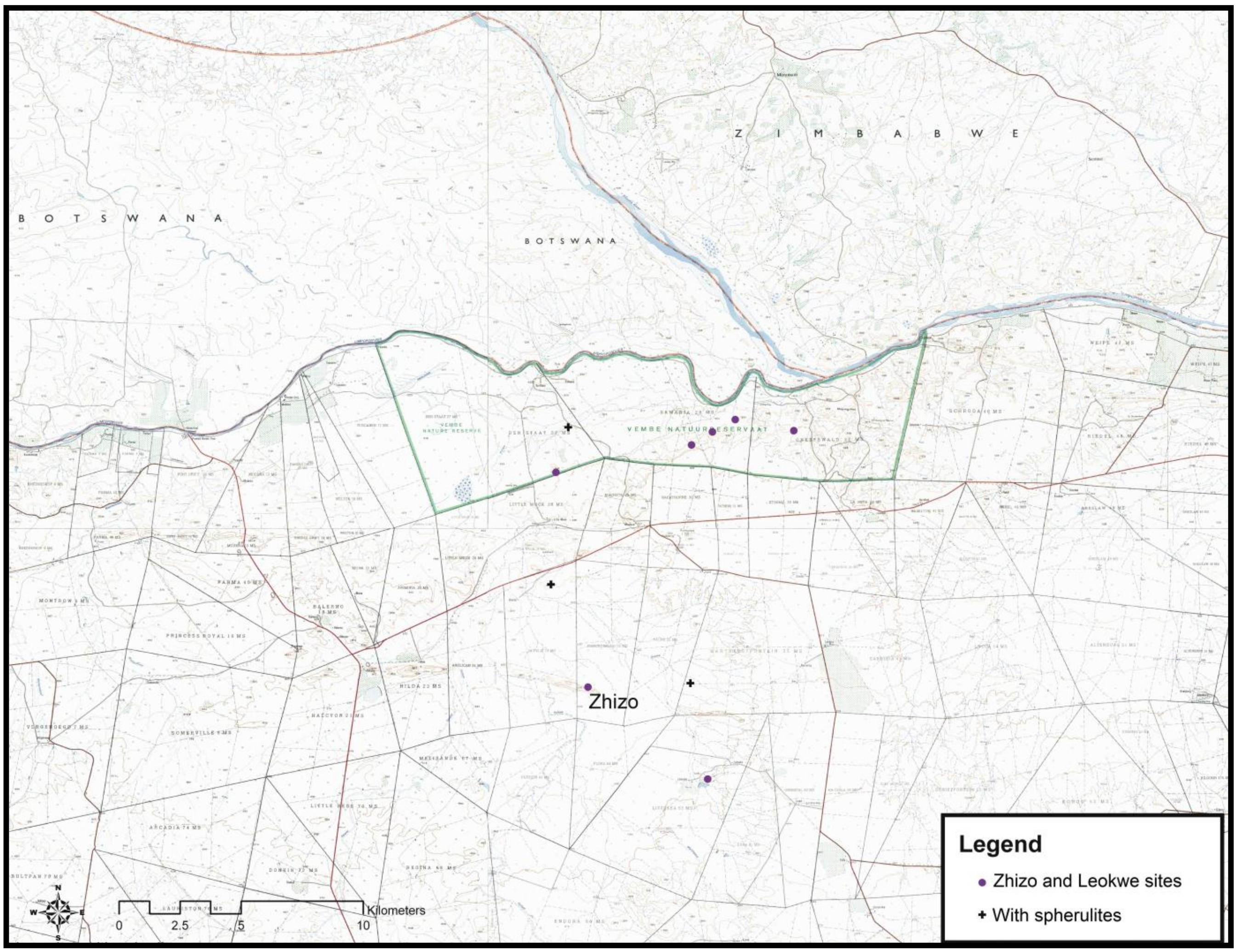


**Figure 5.2**. Sampled Zhizo and Leokwe sites.

**K2 period**

Some 24 samples represent the K2 period (AD 1000-1200); 17 samples from the vlei area, three from the Kolope area, and four from the plateau (**Figure. 5.3**). Out of the 17 samples from the vlei area, nine had positive results, including AB254 even though it was a poor sample. In addition to a few spherulites, calcium oxalate druses were also found at AB276. One sample from the Kolope area and two from the plateau also had positive results (**Table 5.3**).

**Table 5.3.** Spherulite count for K2 sites

| **Map** | **Site No.** | **Sample** | **Quality** | **Co-Ordinates** | **Number** | **Other** | **Area** |
|---|---|---|---|---|---|---|---|
| 2229 | AA 14c | Main Kraal | Poor | 22 12 36<br>29 13 58.9 | 0 | | Vlei |
| 2229 | AA 14c | Calf Kraal | Poor | 22 12 36<br>29 13 58.9 | 0 | | Vlei |
| 2229 | AA 19 | | Good | 22 12 28<br>29 13 56 | 3 | | Vlei |
| 2229 | AA 33 | | Good | 22 13 08.7<br>29 14 25.5 | 1 | | Vlei |
| 2229 | AA 64 | | Good | 22 12 40.1<br>29 14 11.9 | 29 | | Vlei |
| 2229 | AB 157 | Upper Kraal | Good | 22 12 42.2<br>29 17 52.4 | 0 | | Vlei |
| 2229 | AB 157 | Lower Kraal | Good | 22 12 42.2<br>29 17 52.4 | 5 | | Vlei |
| 2229 | AB 168 | | Good | 22 12 56.8<br>29 17 53.3 | 24 | | Vlei |
| 2229 | AB 245 | | Good | 22 13 01.6<br>29 17 05.4 | 0 | | Vlei |
| 2229 | AB 254 | | Poor | 22 13 02.6<br>29 16 36.2 | 6 | | Vlei |
| 2229 | AB 272 | Kraal 1 | Good | 22 13 20.3<br>29 16 07.0 | 32 | | Vlei |
| 2229 | AB 276 | | Good | 22 13 36<br>29 16 21.5 | 4 | 1 | Vlei |
| 2229 | AB 277 | K2? | Good | 22 13 38.6<br>29 16 20.8 | 0 | 3 | Vlei |
| 2229 | AB 278a | | Good | 22 13 42<br>29 16 23.2 | 26 | | Vlei |
| 2229 | AB 278b | | Good | 22 13 43<br>29 16 24.1 | 0 | 4 | Vlei |
| 2229 | AB 357 | | Good | 22 12 53.4<br>29 20 30.6 | 0 | | Vlei |
| 2229 | AB 358 | | Poor | 22 12 36.7<br>29 20 24.4 | 0 | | Vlei |
| 2229 | AB 475 | K2? | Good | 22 12 45.6<br>29 27 19.5 | 0 | | Plateau |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2229 | AB 479 | | Good | 22 12 48.6<br>29 26 45.1 | 18 | | Plateau |
| 2229 | AD 19 | | Good | 22 15 22<br>29 15 01 | 0 | | Kolope |
| 2229 | AD 117 | | Good | 22 17 01<br>29 15 44 | 0 | | Kolope |
| 2229 | AD138 | | Good | 22 16 36<br>29 17 03.5 | 20 | | Kolope |
| 2229 | AD 197 | Kraal 1 | Good | 22 19 14.3<br>29 19 55 | 0 | | Plateau |
| 2229 | AD 197 | Kraal 2 | Good | 22 19 14.3<br>29 19 55 | 18 | | Plateau |

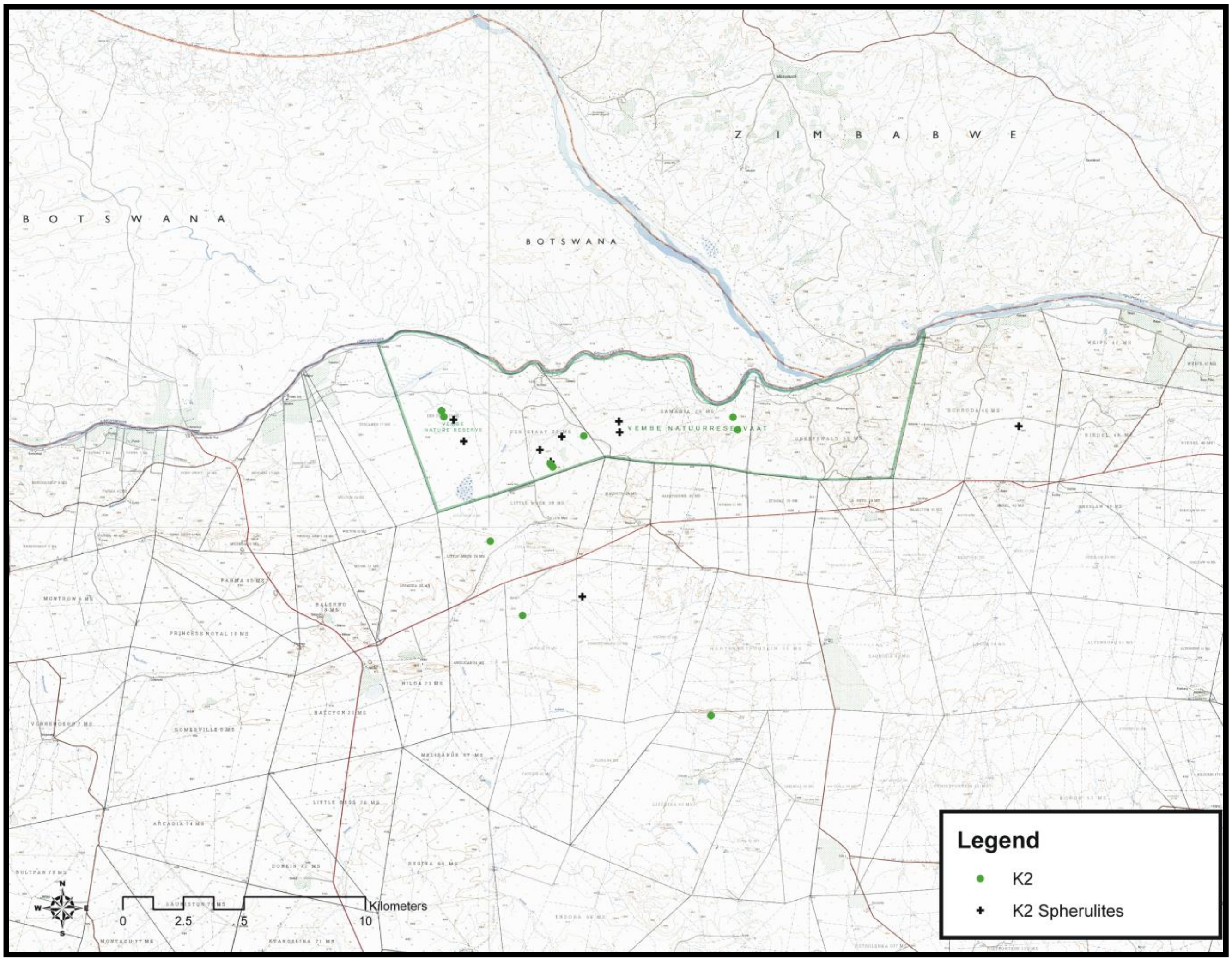


**Figure 5.3.** Sampled K2 sites.

**Transitional K2 period**

**Table 5.4** presents the results for the Transitional K2 period (AD 1200- 1250). In total, 38 samples were examined (**Figure. 5.4**). The vlei area is well represented with 23 samples, of which 14 had spherulites. There were ten samples from the Kolope area, four yielded positive results. Lastly, eight samples from the plateau, four of which were positive.

It is significant that the Impala and Zebra dung from AB 474 yielded negative results, while the ancient dung was positive.

**Table 5.4.** Spherulite count for Transitional K2 sites

| Map | Site No. | Sample | Quality | Co-Ordinates | Number | Other | Area |
|---|---|---|---|---|---|---|---|
| 2229 | AA12 | TK2? | Good | 22 14 02<br>29 09 04 | 11 | | Pont Drift |
| 2229 | AA13a | | Good | 22 12 44<br>29 13 54 | 6 | | Vlei |
| 2229 | AA14d | | Good | 22 12 38.1-37.5<br>29 12 57 | 0 | | Vlei |
| 2229 | AA14b | | Poor | 22 12 38.1-37.5<br>29 13 57 | 0 | | Vlei |
| 2229 | AA17 | | Good | 22 13 3.3<br>29 14 25.9 | 8 | | Vlei |
| 2229 | AA35 | | Good | 22 13 08.6<br>29 14 22.5 | 46 | | Vlei |
| 2229 | AA63 | | Good | 22 12 40.5<br>29 14 02.3 | 0 | | Vlei |
| 2229 | AA65 | K2/TK2 | Good | 22 12 39.1<br>29 14 06.8 | 7 | | Vlei |
| 2229 | AA138a | | Good | 22 14 32.4<br>29 14 52.6 | 17 | | Vlei |
| 2229 | AA138b | | Good | 22 14 32.4<br>29 14 52.6 | 11 | | Vlei |
| 2229 | AA141 | | Good | 22 14 34.2<br>29 14 44.7 | 0 | | Vlei |
| 2229 | AB 32 | V/Z/4 | Good | 22 13 37.8<br>29 15 17.7 | 0 | | Kolope |
| 2229 | AB 32 | V/B/GB<br>sheep/goat | Good | 22 13 37.8<br>29 15 17.7 | 0 | | Kolope |
| 2229 | AB 32 | VI/B/3 | Good | 22 13 37.8<br>29 15 17.7 | 6 | | Kolope |
| 2229 | AB 32 | VI/G/2 | Good | 22 13 37.8<br>29 15 17.7 | 2 | | Kolope |
| 2229 | AB101 | | Good | 22 14 49.2<br>29 24 38.3 | 0 | | Plateau |
| 2229 | AB187b | | Good | 22 13 09.4<br>29 17 10.6 | 29 | | Vlei |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2229 | AB 234 | | Good | 22 13 25<br>29 17 29.6 | 0 | | Vlei |
| 2229 | AB 281 | | Good | 22 13 25.1<br>29 17 27.1 | 13 | | Vlei |
| 2229 | AB 345 | | Good | 22 12 44<br>29 20 14.8 | 0 | | Vlei |
| 2229 | AB 356 | | Good | 22 12 39.1<br>29 20 35.2 | 13 | | Vlei |
| 2229 | AB 400 | | Good | 22 13 27.4<br>29 18 54.5 | 0 | | Vlei |
| 2229 | AB 403 | | Good | 22 13 22.2<br>29 18 58.8 | 18 | | Vlei |
| 2229 | AB 474 | | Good | 22 12 42.8<br>29 27 21.8 | 23 | | Plateau |
| 2229 | AB 477 | | Good | 22 12 38.7<br>29 26 53.1 | 22 | | Plateau |
| 2229 | AB 478 | | Good | 22 12 50.1<br>29 26 45.3 | 12 | | Plateau |
| 2229 | AB 480 | | Good | 22 13 04.7<br>29 26 38.3 | 0 | | Plateau |
| 2229 | AB 481 | | Poor | 22 13 02.7<br>29 26 36.3 | 0 | | Plateau |
| 2229 | AB 485 | | Good | 22 12 13.8<br>29 27 34.4 | 16 | | Plateau |
| 2229 | AB 565 | | Good | 22 12 22.3<br>29 16 50.5 | 17 | | Vlei |
| 2229 | AB 568 | | Good | 22 12 24<br>29 16 49.1 | 48 | | Vlei |
| 2229 | AB 569 | | Good | 22 12 26<br>29 16 52 | 22 | | Vlei |
| 2229 | AB 569 | TK2? | Good | 22 15 26.2<br>29 16 51.8 | 0 | | Vlei |
| 2229 | AB 571 | | Good | 22 11 47.2<br>29 16 36.9 | 0 | 3 | Vlei |
| 2229 | AB 604 | | Good | 22 14 37.1<br>29 28 17.3 | 0 | | Plateau |
| 2229 | AB 609 | | Good | 22 13 48.1<br>29 16 25.7 | 109 | | Vlei |
| 2229 | AD 131 | | Good | 22 16 40<br>29 17 28 | 0 | | Kolope |
| 2229 | AD 157 | | Good | 22 18 38.7<br>29 17 25.8 | 0 | | Kolope |
| 2229 | AD 198 | Kraal 1 | VD | 22 19 36.8<br>29 19 27.4 | 0 | | Kolope |
| 2229 | AD 05 | Big kraal | Good | 22 18 37<br>29 17 28 | 0 | | Kolope |
| 2229 | AD 05 | Small kraal | Good | 22 18 37<br>29 17 28 | 0 | 2 | Kolope |
| 2229 | AD 243 | TK2? | Good | 22 20 29.7<br>29 19 51.5 | 5 | 5 | Kolope |

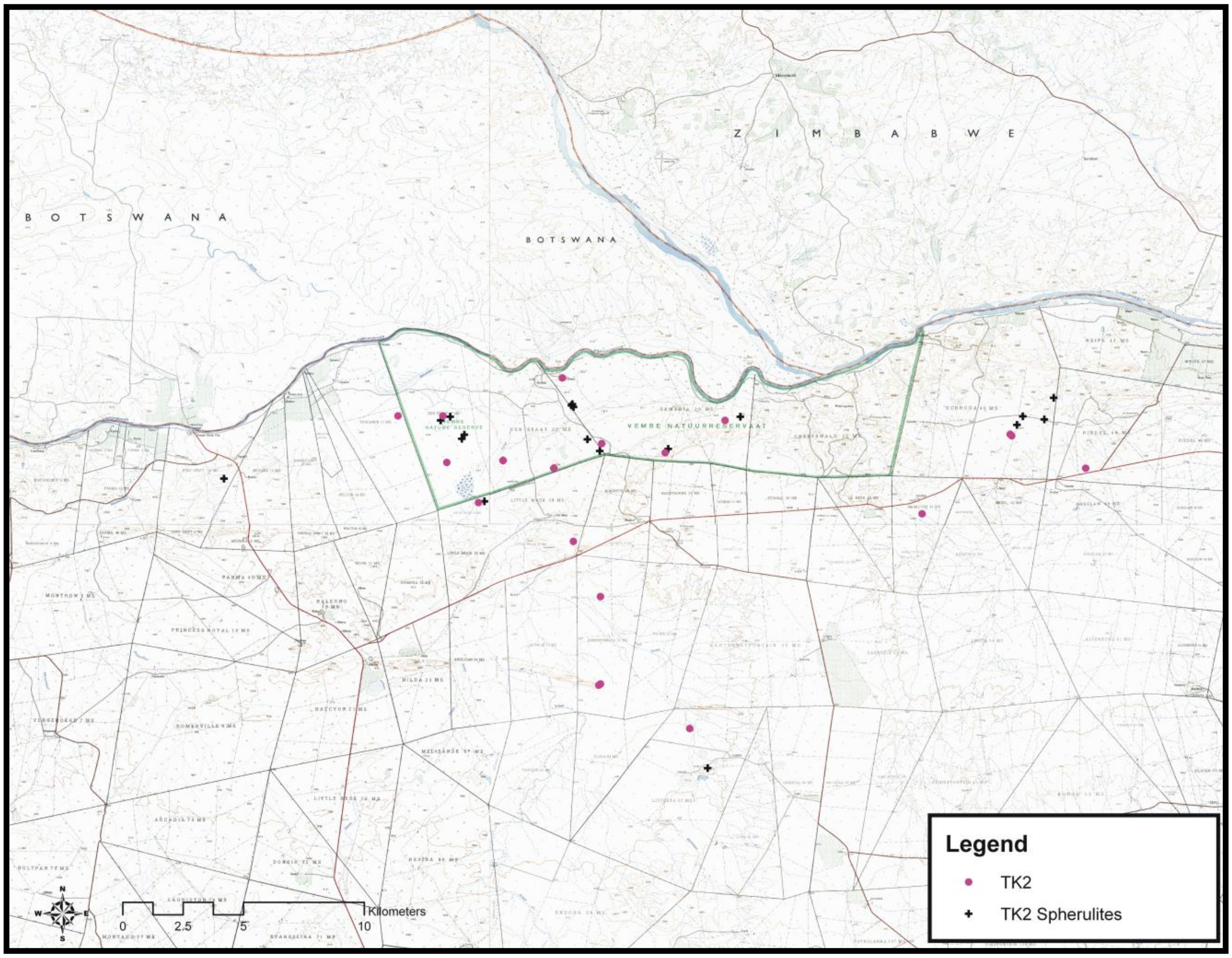


**Figure 5.4.** Sampled Transitional K2 sites.

One site deserves special mention. Site AB32 is a Khami-period headman's village located next to the Kolope (**Figure. 5.5**). Excavations there in 2009 (Huffman and Du Piesanie 2011) uncovered older kraals underneath the Khami horizon. I sampled one sheep/goat kraal at the back of the TK2 homestead (V/B/GB), the buried kraal 8 (V/Z/4) and buried kraal 9 (VI/B and G). Only kraal 9 yielded positive results.

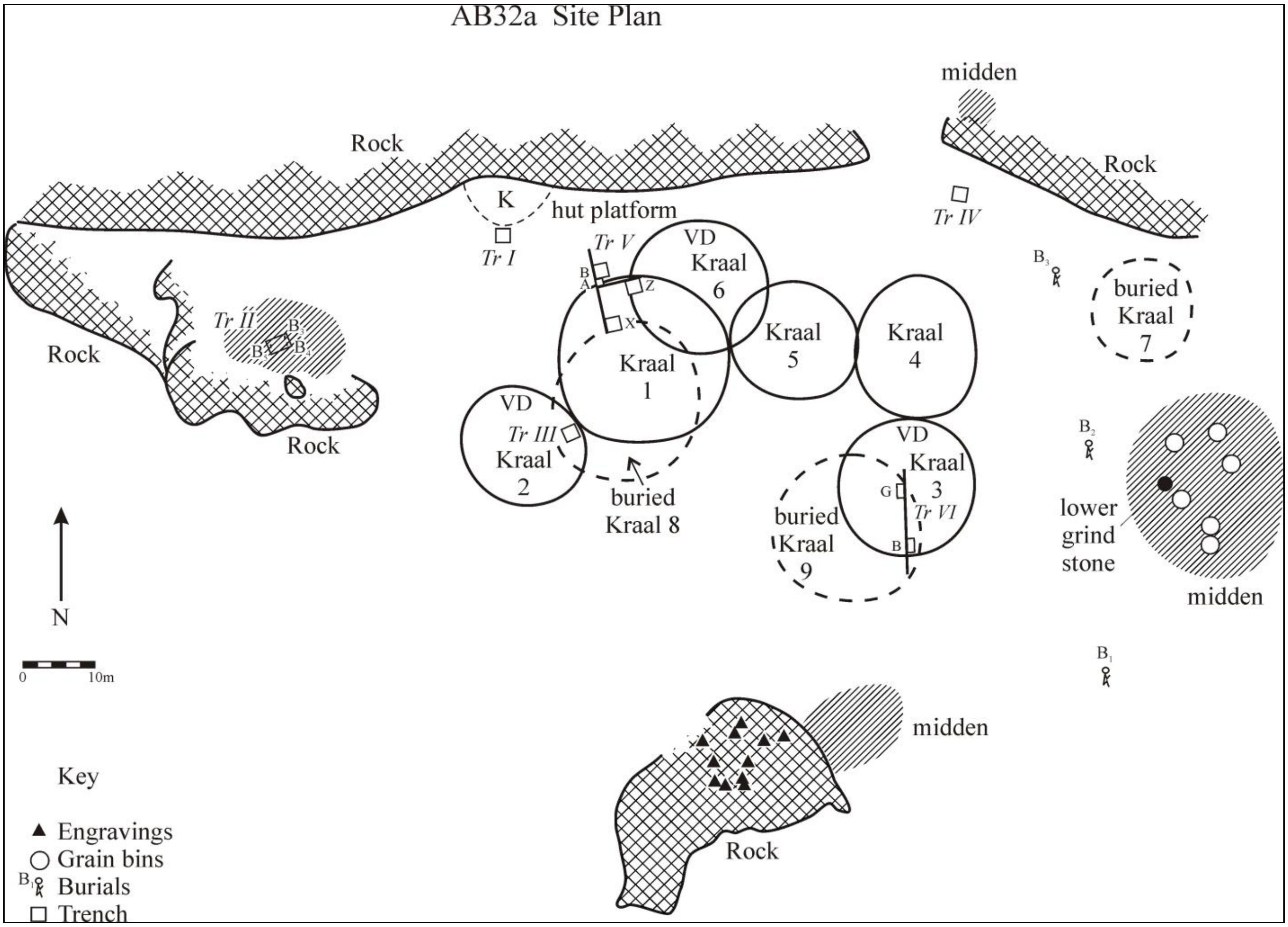


**Figure 5.5.** 2229AB32: site layout.

**Mapungubwe period**

Results for the Mapungubwe period (AD 1250-1300) appear in **Table 5.5**. Eleven samples were examined (**Figure 5.6**). Four samples from the vlei area were positive, while one (AB 473) out of the three samples from the plateau yielded spherulites and other calcium oxalate druses. It is unclear when the dry spell ended (perhaps at about AD 1250), but the results show that the use of the vlei continued afterwards.

**Table 5.5.** Spherulite count for Mapungubwe sites

| Map | Site No. | Sample | Quality | Co-Ordinates | Number | Other | Area |
|---|---|---|---|---|---|---|---|
| 2229 | AB187a | | Good | 22 13 09.4<br>29 17 10.6 | 6 | | Vlei |
| 2229 | AB135 | | Good | 22 13 14-14.6<br>29 18 02-03.4 | 0 | | Vlei |
| 2229 | AB 241 | | Good | 22 13 06.5<br>29 17 16 | 40 | | Vlei |
| 2229 | AB 250 | Deep | Good | 22 12 55.4<br>29 16 36.5 | 16 | | Vlei |
| 2229 | AB 353 | | Good | 22 12 48.1<br>29 20 20.4 | 0 | | Vlei |
| 2229 | AB 362 | | Good | 22 12 36.7<br>29 20 29.1 | 7 | | Vlei |
| 2229 | AB 473 | | Good | 22 12 39.9<br>29 27 08.7 | 7 | 5 | Plateau |
| 2229 | AB 567 | | Good | 22 12 25.2<br>29 16 48.4 | 0 | | Vlei |
| 2229 | AD 15 | S1 | Good | 22 12 25.4<br>29 20 09.6 | 0 | | Plateau |
| 2229 | AD 15 | S2 | Good | 22 12 25.4<br>29 20 09.6 | 0 | | Plateau |
| 2229 | AD 198 | Kraal 2 | Good | 22 19 36.8<br>29 19 27.4 | 9 | | Kolope |

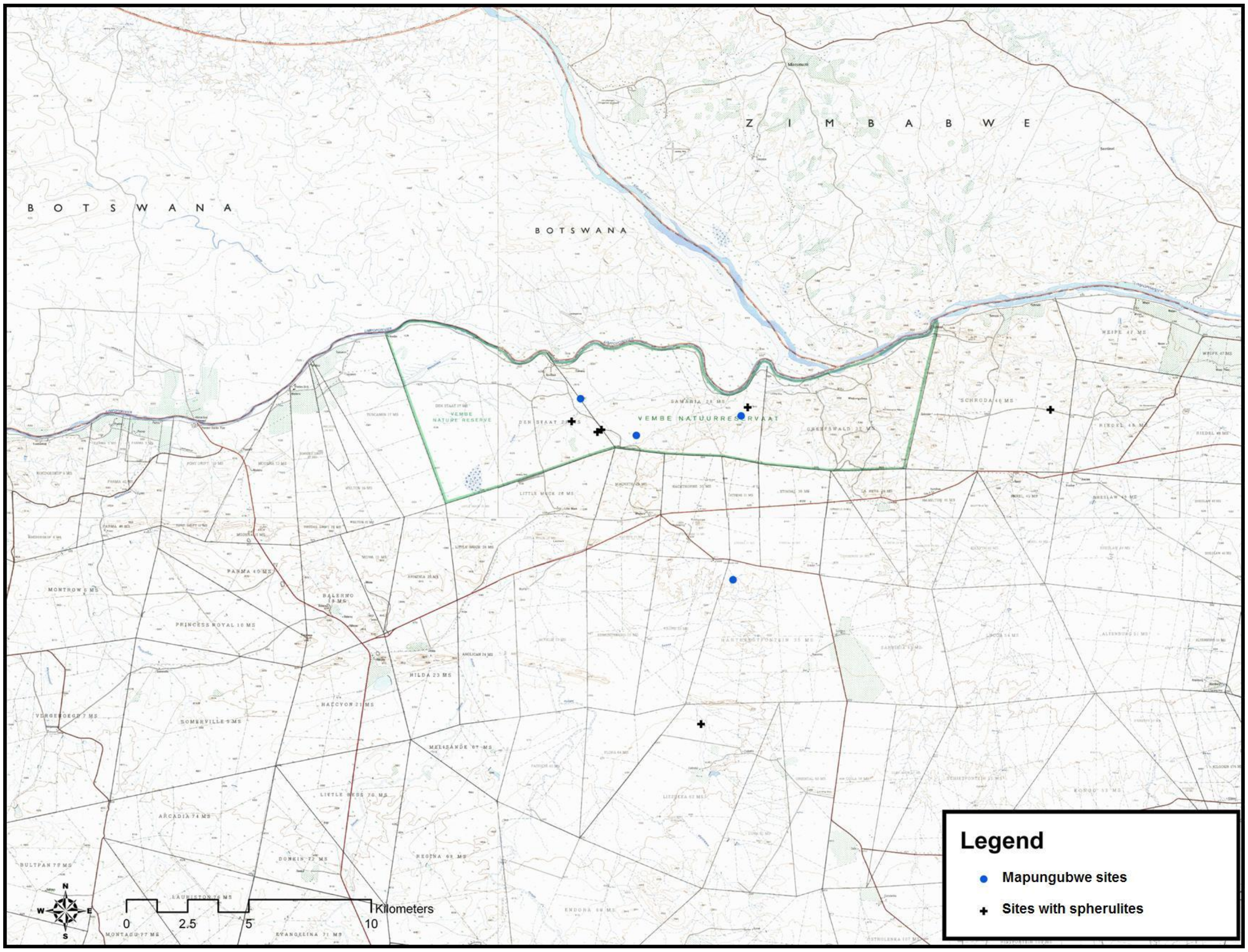


**Figure 5.6.** Sampled Mapungubwe sites.

### Khami period

Many samples were examined for the Khami period (AD 1450- 1640) because the quality was good. **Table 5.6** presents the results and **Figure. 5.7** shows locations. Eight of the samples from 15 vlei sites had positive results: three had ‘other material’. Sample AB625 is vitrified but nevertheless yielded spherulites. The downstream area is represented by only one sample, and it was negative.  Tree samples came from the Kolope area; one came from the headman site AB32 with positive resuls. The other Kolope area sites lacked spherulites. Lastly, three out of six plateau samples yielded spherulites.

**Table 5.6.** Spherulite count for Khami sites

| Map | Site No. | Sample | Quality | Co-Ordinates | Number | Other | Area |
|---|---|---|---|---|---|---|---|
| 2229 | AA 24 | | Good | 22 12 12-11.2<br>29 13 54-56.1 | 4 | 2 | Vlei |
| 2229 | AB 16 | | Good | 22 12 29.2<br>29 20 50.3 | 0 | | Downstream |
| 2229 | AB 32a | Kraal 1 | Good | 22 13 37.4<br>29 15 16.2 | 18 | 13 | Kolope |
| 2229 | AB 33 | | Good | 22 13 05<br>29 19 32-35 | 4 | | Vlei |
| 2229 | AB 37 | Kraal 2 | Good | 22 12 35.6<br>29 20 34.1 | 0 | | Vlei |
| 2229 | AB 161a | | Good | 22 12 40.9<br>29 17 44.7 | 23 | | Vlei |
| 2229 | AB 161d | | Good | 22 12 40.9<br>29 17 44.7 | 12 | | Vlei |
| 2229 | AB 180b | | Good | 22 13 40.5<br>29 15 59.9 | 6 | | Vlei |
| 2229 | AB 250 | surface | Good | 22 12 55.4<br>29 16 36.5 | 0 | | Vlei |
| 2229 | AB 250 | | Good | 22 12 55.4<br>29 16 36.5 | 0 | | Vlei |
| 2229 | AB 272 | Kraal 2 | Good | 22 13 20.3<br>29 16 07.0 | 34 | | Vlei |
| 2229 | AB 326 | | Good | 22 12 58<br>29 18 55.3 | 0 | | Vlei |
| 2229 | AB 354 | | Good | 22 12 43<br>29 20 28.8 | 0 | | Vlei |
| 2229 | AB 265 | | Good | 22 13 16.3<br>29 15 45.3 | 21 | | Vlei |
| 2229 | AB 567 | | Good | 22 12 25.2<br>29 16 48.4 | 0 | | Vlei |
| 2229 | AB 603 | | Good | 22 14 33.4<br>29 28 13.4 | 0 | | Plateau |
| 2229 | AB 605 | | Good | 22 14 29.5<br>29 28 11.3 | 0 | | Plateau |
| 2229 | AB 606 | | Good | 22 14 58.6<br>29 28 04.1 | 0 | | Plateau |
| 2229 | AB 616 | | Good | 22 14 41.8<br>29 27 34.7 | 36 | | Plateau |
| 2229 | AB 623 | | Good | 22 11 46.1<br>29 16 14.4 | 0 | | Vlei |
| 2229 | AB 625 | | VD | 22 12 22.4<br>29 17 44.2 | 6 | | Vlei |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2229 | AD 2 | | Good | 22 16 46<br>29 19 16 | 0 | | Plateau |
| 2229 | AD 109 | VK | Good | 22 16 45<br>29 15 37 | 0 | | Kolope |
| 2229 | AD 110 | KK | Good | 22 16 47<br>29 15 40 | 0 | | Kolope |
| 2229 | AD 259 | | Good | 22 15 40.2<br>29 27 09.2 | 3 | 3 | Plateau |
| 2229 | AD 268c | | Good | 22 15 08.8<br>29 25 55.1 | 2 | | Plateau |

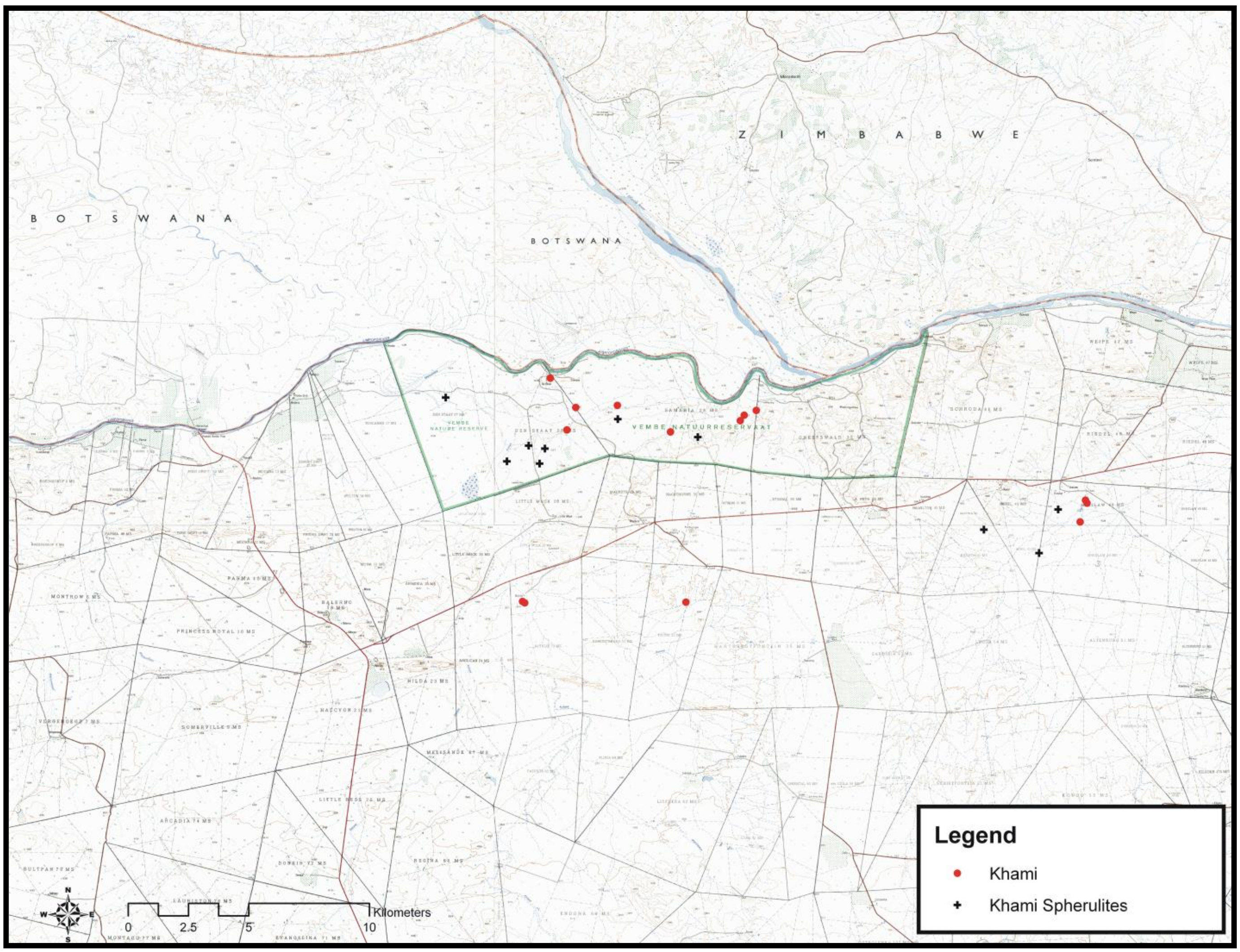


**Figure 5.7.** Sampled Khami sites.

### Historic and unidentified sites

One site lacked diagnostic artefacts, and it was therefore not possible to determine the time period. It nevertheless revealed interesting data about the geographic distribution of kraals with positive results. **Table 5.7** and **Figure 5.8** present the results. One each represented the vlei and Kolope areas.

**Table 5.7**. Spherulite count for Historic and unidentified sites.

| Map | Site No. | Sample | Quality | Co-Ordinates | Number | Other | Area |
|---|---|---|---|---|---|---|---|
| 2229 | AB230 | | Good | 22 13 14.8<br>29 18 23.5 | 6 | | Vlei |
| 2229 | AD 69 | Historic? | Good | 22 19 02<br>29 19 30 | 14 | | Kolope |

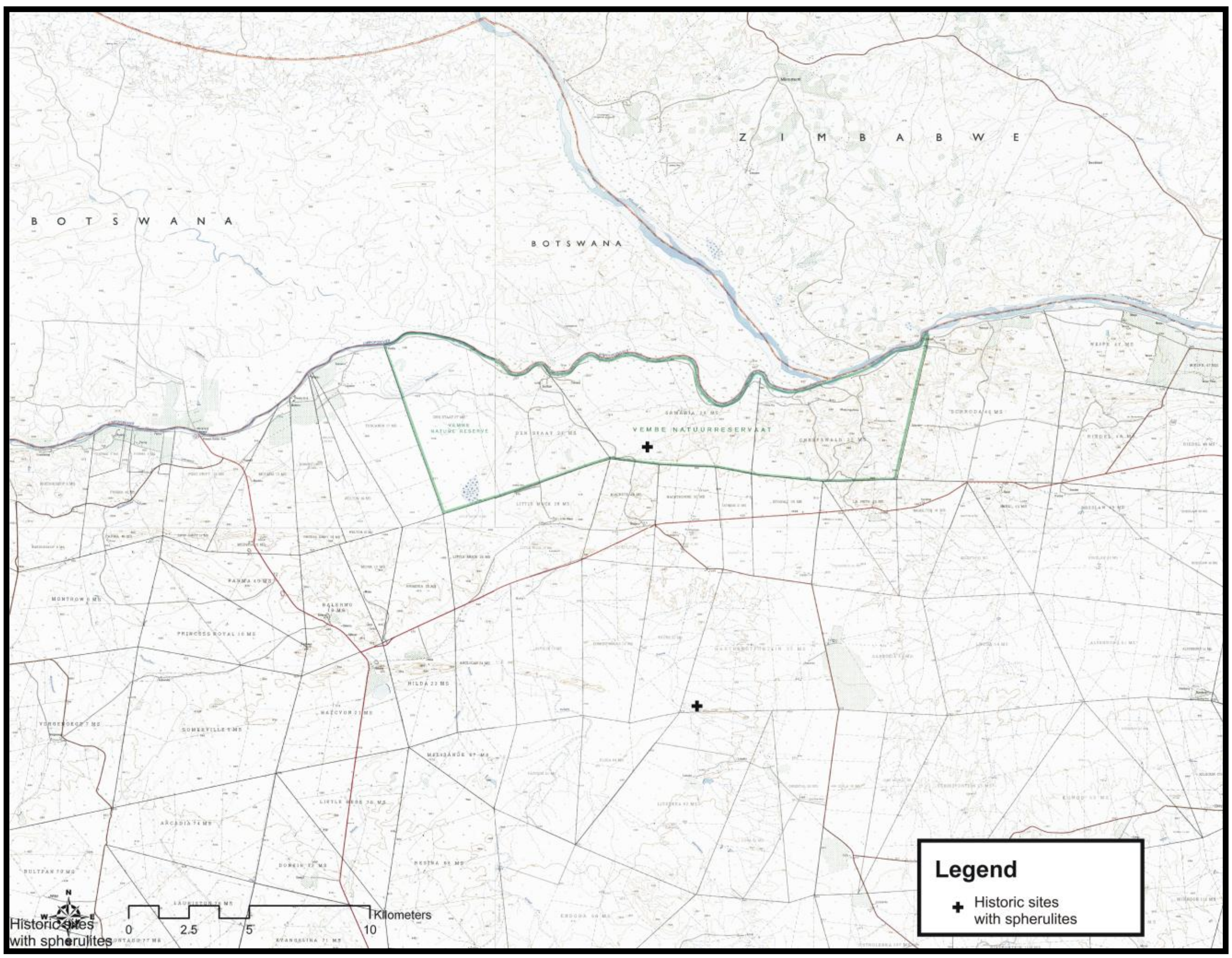


**Figure 5.8**. Historic and unidentified sites.

**SUMMARY**

Preservation was a major factor in the identification of spherulites. Overall, good samples were more likely to have positive results than poor samples. Other than Castle Rock, few Zhizo/Leokwe kraals yielded spherulites. K2, TK2 and Mapungubwe period kraals, on the other hand, yielded several positive results. Most were located near the vlei, but a few were located downstream and in the Kolope drainage. Even Khami period sites show spherulite concentrations in several geographic zones. I consider these distributions in time and space further in the next chapter.

## CHAPTER VI: DISCUSSION AND CONCLUSIONS

The previous chapter presented the results of the microscopic study of cattle dung in the Limpopo Valley. Castle Rock was a datum for this study because it is located on an outcrop inside the confluence vlei. Now I consider what these data mean regarding the use of the vlei for grazing cattle. I discuss the results in terms of time and space, taking into account climate and the ethnographic background.

### CLIMATE AND THE VLEI

First, the tall vlei grass is not palatable to cattle when mature. It is possible to burn the grass in winter after a relatively poor rainy season, however, allowing livestock to graze on fresh shoots. During periods when rainfall was relatively high (≥500mm), the vlei would not be accessible to animals, even in the dry season. The distribution of cattle posts shows that the plateau grassland was also used as pasturage; while Smith's isotopic results show that cattle did not browse on mopane in the winter. Thus, there was sufficient grass in the region to support livestock without the vlei: the vlei provided extra grazing. As herds expanded, the vlei probably became more important for the extra pasturage.

The Kolope enters the vlei to the west, creating a delta which is good agricultural ground. Because the entire margin is cultivatable, farmers established many homesteads around the vlei during most of the Iron Age. In fact, most sites around the vlei were oriented towards agriculture, as evidenced by numerous grains bins (e.g. AA14C).

The plateau south of Mapungubwe Hill supports grassland today. In good rainfall seasons in the past there would have been sufficient grass there, and water available in pans. This grassland may have also been burnt from time to time, perhaps when the vlei was utilized. Whatever the case, the vlei was most likely burnt during relatively dry periods.

## USE THROUGH TIME

The Zhizo period (AD 900-1000) is represented here by one site only, and it lacked spherulites. Therefore one cannot draw any conclusions from this result. However, I suspect that Zhizo people might not have burnt the vlei, for possibly the same reason for not cultivating the margins: that is, the presences of elephants. Further, the Zhizo population in the valley was low and the demand for grazing equally low.

By the time *K2* ceramics appear in the region (about AD 1000), both temperature and rainfall had improved. K2 samples from sites located near the vlei mostly have spherulites, as well as some of the plateau samples. Because the K2 period was wetter than the present, I suspect cattle used the vlei during the later part of the K2 occupation, around AD 1190, when there was a known drought.

Recent evidence suggests that Leokwe people may have been herdsmen for K2 elite in a manner similar to customs of the Birwa and other Bantu speaking people. This would explain the ‘extra’ kraals at the Leokwe Main Rest Camp. Indeed, the two Leokwe kraals on Castle Rock may have contained K2 cattle. Besides Castle Rock, the Leokwe period is represented by 12 samples from eight sites. Half are located near the vlei, but only one sample produced spherulites. On the other hand, spherulites and calcium oxalate druses were present in all three samples from sites AD 144, located in the Kolope River area just south of the large vlei. Presumably, the Leokwe kraals with positive results also date to around AD 1190.

During the Transitional period (AD 1200 to AD 1250), both temperature and rainfall dropped below average, and several rainmaking deposits date to this time. This drier period most likely explains the high number of TK2 sites with spherulites. Out of 42 samples, 22 had positive results, and TK2 deposits are well represented on Castle Rock. Clearly, the confluence vlei was an important pasturage at this time.

At around AD 1250 and the beginning of the Mapungubwe period, rainfall returned to previous highs (≥500mm). The confluence vlei was therefore probably too wet for burning. Four of the positive samples, however, came from sites next to the vlei, one more from the plateau and one from the Kolope area. It is unclear when the Transitional dry spell ended, but these results suggest that the use of the vlei continued afterwards. On the other hand, the dry spell around AD 1300 may account for these results. Alternatively, the pottery may have been misidentified or there are more components, and one belonged to the TK2 period.

*Khami* ceramics appear in the Limpopo Valley at about the same time as *Icon* (representing the first Sotho-Tswana people) or shortly afterwards. I did not test Icon sites. According to Smith (2005:163), rainfall had improved to at least 500 mm. The climate during the entire Khami period, however, is not well known. The first Khami phase dates to the early 15$^{th}$ century and the second to the mid 16$^{th}$ century. Perhaps Khami people abandoned the region because of poor rainfall and returned when the climate had improved. With rainfall at high levels, there would have been good pasturage throughout the region throughout the year. The samples with spherulites are from sites located closest to the large vlei. These sites may then date to a dry period at the end of the first phase.

## TERRAIN AND ACCESS

The geographical distribution of positive samples suggests that easy access to the vlei may have been a major factor (**Figure 6**). The furthest sites from the confluence with positive results are only some 12 to 14 kilometres away. As we know, this distance is not impossible for cattle to tread in a day, and the open Kolope Valley would have provided easy access. Thus, cattle from Kolope sites such as AD144 and AD172 (Leokwe), AD138

(K2), AD05 (TK2), AD198 (Mapungubwe), AD259 and AD268c (Khami) and AD65 (Historic) were within range. Moreover, cattle did not have to return to their home kraals every night because the vlei would have been free of predators. In this case, the herdsmen could have stayed at Castle Rock.

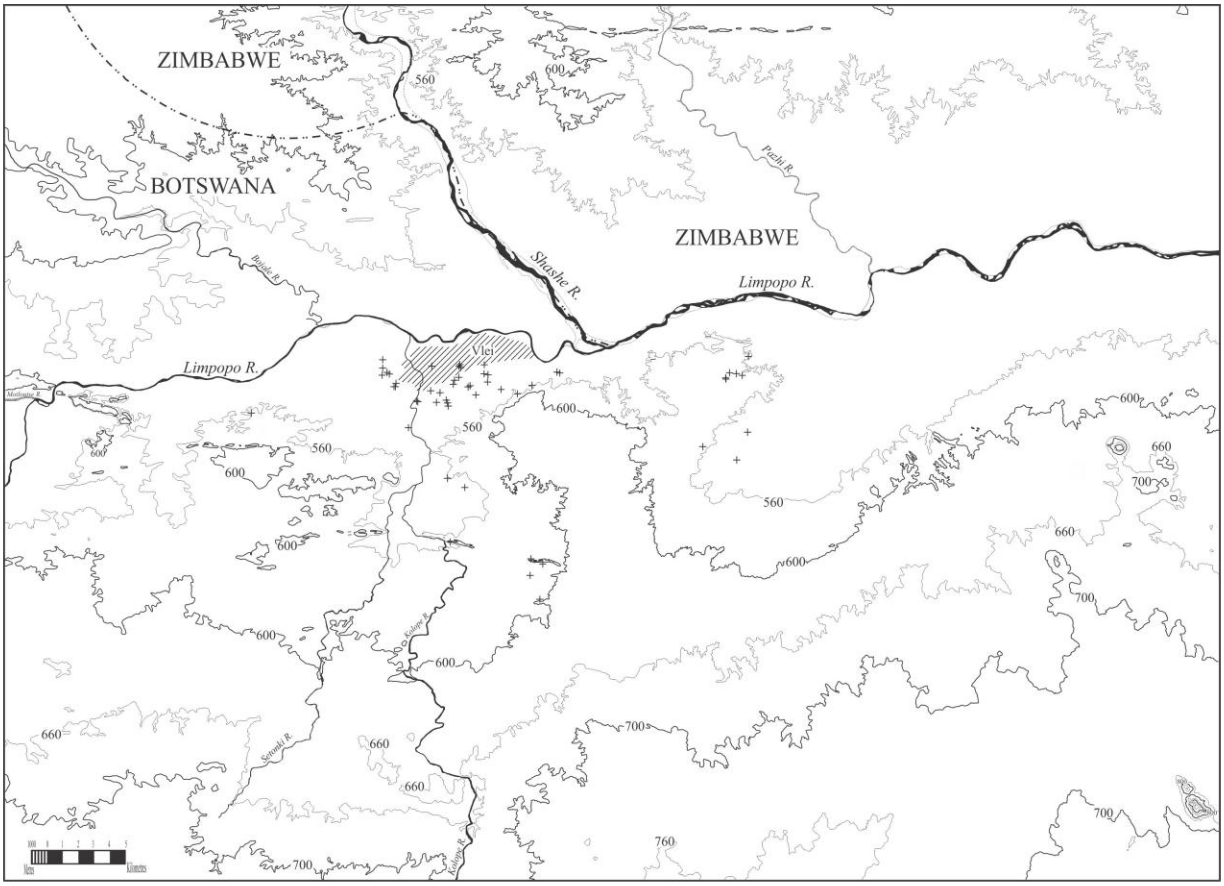


**Figure 6.** Locality of all sites with positive results in relation to the large vlei

On the other hand, the terrain between Pont Drift and the vlei was more difficult to manage than the Kolope. It is therefore possible that there was another source of grazing that was calcium rich closer or more easily accessible to people at Pont Drift. For similar reasons, people on the far eastern side of the study area may also have had another source. A cluster of kraals there yielded positive results, including AB475 and AB479 (K2), AB474, AB477, AB478, and AB485 (TK2), AB473 (Mapungubwe) and

AB616, AD255 and AD268c (Khami). The continuity through time suggests that this other source was permanent.

One should also consider the movement of cattle between districts for cultural reasons other than grazing. Cattle would have been brought from different districts for *lobola*, for instance, to strengthen alliances through marriage. Because Iron Age societies in the region were cattle rich, *lobola* probably involved several animals (cf. Huffman 1990). At this stage of research, however, it is not possible to determine the impact a few foreign cattle could have had on the composition of dung in a kraal.

## RECOMMENDATIONS FOR FUTURE RESEARCH

For similar research in the future, a few aspects need to be addressed. Among other things, more sites should be dated. Other than the capitals of Schroda, K2 and Mapungubwe, few sites of any ceramic group have been dated within the region. Indeed, of the 100 sites I sampled, only five have radiocarbon dates. The others were dated by ceramic affiliation. Ceramics are sufficient for the TK2 and Mapungubwe periods because they each lasted for only 50 years. The K2 and Khami periods, however, continued for 200 years each, and a finer resolution is important. This finer dating should be coupled with a better climatic sequence for the specific region. Smith's research laid the foundation, but more data are needed to assess further the proposed relationship between dry rainy seasons, dry winters and intentional burning. More dating and climatic data would also help to refine the Khami sequence.

Furthermore, other sites on the eastern side should be tested, especially downstream on Weipe and Skutwater. I did not sample this area to the same degree as the vlei and Kolope. At the same time, one should also look for another source in this direction.

The pH analyses in other studies highlighted variability in the spherulite production inside the same grazing area. In those studies the pH of the soil may have also affected the preservation of spherulites in the dung. For this reason a future study could consider the pH values in the various grazing areas and different cattle kraals used in my study.

Because Iron Age people most likely let their livestock graze in the fields after harvest, I wonder if the sorghum and millet grown on the vlei margin would also aid in the production of spherulites. Present-day farmers on Den Staat might be able to help to investigate this possibility.

Finally, I only tested one small stock kraal, and that was at AB32 on Den Staat. We need to know whether that negative result is an anomaly or part of a pattern. Other small stock kraals are on record for various time periods. In these cases, samples should be examined from the associated cattle kraals as well.

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