

**APPLICATION FOR PERMIT:  
Excavation, collection**

Project:	<b>Geoarchaeology in the middle Limpopo</b>
Applicant:	<b>Professor Innocent Pikirayi</b> Professor in Archaeology and Head of Department Anthropology and Archaeology University of Pretoria  Email: <a href="mailto:innocent.pikirayi@up.ac.za">innocent.pikirayi@up.ac.za</a> Tel.: 012 420 4661
Date of submission:	<b>7 November 2012</b>
Contents:	Research proposal Map of the study area Letter of support and bilateral agreement with SANParks



*Collapse of Ancient Societies:  
Crisis and resilience in three spheres - Mapungubwe, Great Zimbabwe, and Aksum*

## **Geoarchaeology in the middle Limpopo**

Professor Innocent Pikirayi  
*Anthropology and Archaeology, University of Pretoria*

### **RESEARCH PROPOSAL**

This proposal is for conducting geoarchaeological investigations, including archaeological excavations and geomorphological survey, in the Mapungubwe Cultural Landscape and its hinterland as part of a cross-disciplinary research programme on '*Collapse of Ancient Societies: Crisis and resilience in three spheres - Mapungubwe, Great Zimbabwe, and Aksum*' led by the applicant and supported by the NRF Blue Skies initiative.

The research programme (2012–2015) seeks to understand the relationship between landscape history and settlement development, with a particular focus on the role that water (rainfall, rivers, and groundwater) played in the rise and demise of early urban societies in South Africa (Mapungubwe), Zimbabwe (Great Zimbabwe), and Ethiopia (Aksum). The study primarily employs geoarchaeological approaches, field research and laboratory analyses of soils to reconstruct the history of the environment of the three study areas.

This proposal provides an outline of the fieldwork which we are planning to do at the Limpopo-Shashe Confluence. By eliciting environmental and archaeological records, the proposed research will investigate local landscape sequences and will compare and contrast them with each other in order to assess the local impact of, and responses to, environmental and, in particular hydrological, and cultural changes over time in the middle Limpopo basin.

Building on previous research and archaeological investigations in the region, the proposed project will focus specifically on the collection of palaeoenvironmental and cultural data from the Mapungubwe region. Research in the field will combine the excavations of exploratory trenches on archaeological sites and geoarchaeological investigations on the Samaria 28 MS farm, now under the management of SANParks. The proposed research has the full support of the Mapungubwe National Park and SANParks (see bilateral agreement document in attachment) and will be conducted with the assistance of the park's staff, including the park's archaeologist Mr Chrispen Chauke.

### **Research background and rationale**

Although the middle Limpopo region is today characterised by a very hot and dry environment, stable nitrogen isotope ratio studies (Smith et al. 2007) derived from modern and archaeological fauna suggest that past rainfall conditions were significantly different.

Accordingly, farming communities living in the region between AD 700 and 1000 would have experienced arid to semi-arid conditions, while subsequent populations who lived between AD 1000 and 1300 – during the development and decline of the urbanized Mapungubwe State – lived under increased rainfall conditions. Conditions only became drier after 1450 AD, suggesting that the demise of the Mapungubwe State was triggered by factors other than climate change (Huffmann 2007).

Although nearly a century of intermittent research has elucidated important aspects of Mapungubwe's past, the sparse and limited record can only allow beginning addressing key questions such as: what environmental conditions were in place before urban development? What were the relations between settlements and their contemporary landscape? Were these affected by climate change and, if so, how? How did local communities deal with climate and landscape changes?

The proposed research, thus, sets out to examine how the growth of an urban and agriculturally based society affected the local landscape in the past, and any legacies into the present day. Equally important, this project will examine widely held views about the development of historic landscapes and land use in semi-arid environments, using the culturally rich and diverse history of the Mapungubwe Cultural Landscape. To address these primary research issues, research within the Mapungubwe Cultural Landscape and its hinterland seeks to:

1. Situate the cultural and settlement sequence of the K2 and Mapungubwe societies into an environmental and landscape context;
2. Investigate regional urban dynamics and assess whether some of the settlement shifts apparent in the middle Limpopo and adjacent regions were in response to environmental deterioration or otherwise;
3. Assess if and how flooding and prolonged episodes of aridity influenced the rise and demise of complex societies in the Mapungubwe Cultural Landscape;
4. Determined whether new environmental and cultural records support current hypotheses on the collapse of the Mapungubwe State in the late 13<sup>th</sup> century AD, and if so, ascertain the role of environmental factors. Or, where new data would indicate different scenarios, reconstruct a new integrated sequence for the Mapungubwe Cultural Landscape based on site-specific and cross-disciplinary datasets and assess it against previous regional models.

### **Area of investigations**

Field research will concentrate on the southern and western sectors on Samaria 28 MS (Fig. 1 in appendix). Although farmed until recently, this part of Samaria is now managed by SANParks (Samaria, Portion 3 was proclaimed in 2008, Gov. Gazette 31461; SANParks 2012: 76). At present, the land is monitored by SANParks and not accessible to the public. The environmental settings are generally consistent throughout the region with predominant gently sloping to flat lands, punctuated by the characteristic Karoo sandstone hills and ridges.

Previous research in the region has recorded the presence of K2/Mapugubwe period archaeology in Samaria 28 MS (see Meyer 2000, 2003; Huffman and Hanisch 1987; Huffman 2000), but none of the geographical coordinates fall directly in the study area proposed for research. This is rather a c. 3 x 7 km long transect running from south of Samaria Citrus Farm to the Limpopo River on N-S axis (S 22°15'28.4"/11'27.3" – E029°17'46.3"/19'21.6"). The area is characterised by a discrete topographic variability from the higher flat lands (c. 550 m a.s.l.) to the south leading onto the gently sloping Limpopo floodplain (c. 520 m a.s.l.). The local geology is characterised by steep-sided red sandstone hills and crests resting on mudstone deposits and intersected by dolerite dykes (Meyer 1998; Chinoda et al. 2009). The higher lands are covered by open bushveld savannah vegetation with mopane (*Colophospermu mopane*) and acacia (*Acacia* sp.) trees and rare occurrences of baobab trees (*Adansonia digitata*) and euphorbia (*Euphorbia ingens*). The soil cover is a light brown sandy loam with common rock (sandstone and basalt) fragments on the ground<sup>1</sup>. Further downslope toward the floodplain, the landscape opens up and the mopane trees are more sparsely distributed. Isolated sandstone outcrops/low hills dot this plain and the margin of the floodplain is marked by a change in soil cover to a light reddish brown fine sandy loam, stone free and with common coarse sand. Increased thorn-bushes and *eland* weed (*Tribulus terrestris*) are found in the floodplain.

#### *Archaeological sites*

The whole area is punctuated by kraal-settlement complexes seemingly aligned on an N-S axis. The archaeological evidence suggests a fairly substantial occupation and use of the area since early K2 times to post-Mapungubwe period, and perhaps even earlier. The geomorphological settings is characterised by broad terraces gently sloping and separated by sandstone ridges and leading onto the Limpopo floodplain, providing differential preservation conditions of palaeoenvironmental records. These make the area ideal for investigating off-site records and settlement pattern. On the basis of preliminary reconnaissance survey in the in Samaria 28 MS, four sites have been selected for archaeological excavations (Table 1 in appendix). In addition to their potential as sources of cultural and environmental data for the proposed project, the sites selected for excavations are currently threatened by erosion and animal disturbance as indicated by recently exposed structures and common sizable burrows (see Fig. 3c). In the light of this, it is imperative to investigate these sites and perform full assessment of their cultural heritage.

---

<sup>1</sup> Regional soil survey studies identify cambisols and fluvisols as the most widespread in Shashe-Limpopo confluence zone, see Bangira and Manyevere 2009.

### **SAMARIA 1**

GPS: S22°13'14.4" - E029°18'01.4"

This is located on natural terrace c. 0.6 km south of the Samaria Farm Road. Ground surface evidence indicates the presence of two kraal-settlement complexes. The kraal areas are about 20 x 30 m each and surface scatter around them includes K2 and Mapungubwe potsherds and grinding stones (Fig. 2 in appendix).

### **SAMARIA 2**

GPS: S22°12'47.8" - E029°17'47.7"

This is located further north toward the edge of the floodplain and c. 0.9 km from the Samaria Farm road. Ground surface evidences indicates the presence of a kraal (c. 20 x 20 m) and surface scatter includes K2 potsherds, grinding stones and slag fragments (Fig. 3 in appendix)

### **SAMARIA 3**

GPS: S22°12'43.8" - E029°17'48.5"

This is located at the foot of a sandstone crest c. 1.7 km north of the Samaria Farm Road. There is evidence of a kraal (c. 20 x 30 m) and surface scatter includes K2 potsherds (Fig. 4 in appendix).

### **SAMARIA 4**

GPS: S22°12'42.7" - 029°17'46.0"

This is located further north about 1.78km from the Samaria Farm Road. Ample scatter of K2 potsherds suggests the presence of a settlement site next to a sandstone crest. The remnants of a circular wall are visible on the northern side of the sandstone crest (Fig. 5 in appendix).

### *Geoarchaeological investigations*

The aim of the geoarchaeological field work is to investigate the stratigraphic sequences across different landscape units and recover palaeoenvironmental records from soils and sediments associated with environmental conditions in place before, during and after the development of human settlement and resource use in the study area. Geoarchaeological investigations (see details on the methods below) will concentrated on an N-S transect (3 x 7 km; GPS: S 22°15'28'4/11'27.3" – E029°17'46.3"/19'21.6") from the Samaria Farm Road to the Limpopo River, exclusively limited to lands owned by SANParks (Fig. 1 in appendix). The area encompasses the sites aforementioned and stretches further north into the Limpopo River, thus affording the exploration of different landscape units: from the higher grounds (S of Samaria Citrus Farm) to gently sloping plains and tributary valleys into the Limpopo floodplain. As detailed below, the geoarchaeological investigations do not include excavations of archaeological deposits or any other invasive intervention at sites other than those listed above (Samaria 1 to 4).

## **METHODS**

This project combines archaeological survey and excavations and geoarchaeological (pedological and palaeobotanical) approaches using novel methods, rarely employed in the region, to reconstruct a diachronic picture of human-environment interactions in the Mapungubwe region.

### **Archaeological excavation**

Exploratory trenches will be excavated to ascertain the cultural sequences of the sites aforementioned and to retrieve well-dated and integrated cultural, settlement and agricultural records and firm chronological sequences (using radiocarbon dating) that are essential to contextualise the offsite information originating from geoarchaeological investigations (see below). Excavation, recording and artefact collection will be conducted following the Regulation and Guidelines pertaining to the National Heritage Resources Act (Act 25 of 1999). In addition, a geoarchaeological approach will be applied to record and sample archaeological sediments from key cultural deposits for laboratory analyses (see below). Excavation trenches will be appropriately filled at the end of each season. Field work will be supervised by the applicant with the assistance of professional archaeologists from the University of Pretoria (UP) and Mr Chauke (archaeologist, SANParks), and will include the participation of UP Archaeology students. Artefacts recovered from the excavations will be transferred to UP for full study and cataloguing, and they will be debatably stored as part of the Mapungubwe Collection at UP Archaeology.

### **Survey and soil profile recording**

This will include non-systematic, selective geoarchaeological survey across the entire study area and systematic borehole survey of an N-S transect on Samaria.

*Non-systematic, selective geoarchaeological survey:* this includes field-walking for overall recording of landscape characteristics by compiling general survey form and taking pictures; areas of interests (sedimentary deposits) will be fully recorded by compiling of ad hoc description forms, drawing sections and taking pictures. The description of stratigraphic sequence will involve a gentle brushing of exposed sections and full recording of each layer to include: depth (from ground surface), soil/sediment colour, texture, structure, organic content, and inclusions. Stratigraphic sequences will be recorded primarily in gullies and streambeds. However, where exposures are not available and in the case of partially buried sequences, the local stratigraphy will be explored by means of small trenches (1 x 1 m) in order to allow full recording and the collection of soil samples.

*Systematic borehole survey:* this includes the excavation of bore holes using a Dutch hand auger or similar auguring tools across an N-S transect from the encompassing the archaeological sites aforementioned (Samaria 1 to 4) and stretching into the Limpopo

floodplain as indicated in Fig. 1. Borehole surveys are becoming increasingly applied in the study of ancient landscapes and settlement pattern (e.g. French 2003; Chapman et al. 2009). In practical terms, this type of survey implies the augering of bore holes (c. 2-4cm in diameter) to establish the depth and characteristics of the local stratigraphy. Each bore hole will be mapped using a GPS and the sediments fully recorded; each hole will be then refilled. In case cultural deposits will be detected, these will be recorded separately and listed as potential sites.

### **Laboratory analyses of ceramics and soil/sediment samples**

*Ceramics:* These will be fully described, including illustrations of diagnostic potsherds, and will be analysed by context – with no implications for damage. The assemblage will then be fully catalogued and stored as part of UP Archaeology’s Mapungubwe Collection. The project proposes also to undertake lipid analysis on a selection of ceramics of various forms and decoration types in order to investigate food sources and consumption patterns. The lack of archaeobotanical research in this area has limited the research concerning consumption patterns. The results originating from lipid analysis will therefore provide a very first dataset on consumption patterns. Furthermore the relationship between form and function will be explored, by determining whether different foodstuffs were prepared in different ceramic forms.

*Soils/sediments:* Samples of soils/sediments will be collected from cultural deposits (e.g. floors) and buried soils for chemical, physical, micromorphological analyses. This suite of analyses is increasingly applied to the study of human-environment interactions over time (e.g. French 2003, 2010, Macphail and Goldberg 2006), though applications to African contexts remain very limited. In the middle Limpopo, the combination of these techniques will provide essential records on past environmental and climatic conditions, plant cover, land uses, and domestic activities associated with archaeological deposits and buried soils. Samples of loose soils/sediments will be used for multi-element chemical analyses (ICP-AES on 34 elements), determination of magnetic properties (Low frequency Magnetic Susceptibility) and particle size distribution. The microstratigraphy will be analysed via soil micromorphology. This technique is designed to study the stratigraphy of a given deposit at a microscopic scale and, thus, it requires the sampling of undisturbed and oriented blocks of soil/stratified sediment (Courty et al. 1989; French 2003). The study of microstratigraphy will characterise environmental and land use sequences as well as refining activity areas within occupation deposits, and it will contextualise the results of bulk analyses outlined above.

*Organic/biogenic material:* The recovery of animal remains and plant macro-fossil (charcoal, seeds) will be performed as part of the archaeological excavation and data management process. Charcoal fragments and charred wood remains (> 2 mm) will be analysed for species identification and used for radiocarbon dating. In addition, the proposed research will focus on the recovery and study of plant micro-fossils (opal silica or phytoliths) from archaeological sediments and buried soils. Phytolith analysis is now routinely applied in the

study of plant-people interaction from domestic contexts to landscapes (e.g. Badenhorst 2009; Mercader et al. 2010; Parker et al. 2011; Sulas and Madella 2012) as phytoliths are deposited in situ and preserved in most conditions, thus enhancing recovery potential and control over taphonomic processes (see Piperno 2006). In the middle Limpopo, phytolith analysis will allow the investigation of plant material used in occupation contexts and vegetation cover associated in past land cover.

### **Research team and schedule**

The research is led by the principal investigator Professor Innocent Pikirayi with the assistance of archaeologists and students from UP Archaeology, and specialists from other universities. Fieldwork will be conducted in full compliance with national heritage management and protection regulations, and the proposed programme has already the full support of the Mapungubwe National Park and SANPark (see bilateral agreement in attachment).

The 3-year research schedule is as follows. The first year of the project (2012-2013) is concentrating on archival research and archaeological fieldwork on Mapungubwe; the second year (2013-2014) will be largely devoted to laboratory analyses and the completion of survey and mapping. Although there is no current plan to conduct field research in the second year, the team reserves the possibility of undertaking limited investigations if the results of the first year will prove them necessary. The final year (2014-2015) will focus on data elaboration and research outputs.

### **Capacity building and data management**

The project places great emphasis on capacity building and knowledge transfer within and beyond academia. The interdisciplinary nature of the research offers excellent training opportunities for local students, including dedicated specialist training offered by the project associates. At a local community level, a series of informal workshops will be held in the study areas to present ongoing research results and assist local communities in understanding the sites/landscapes as well as the role of archaeologists.

All environmental and archaeological samples collected from the field will be adequately stored in the UP's South Campus Archaeology Facility, where they will be documented and catalogued.

### **Project significance and broader implications**

Guided by an approach that views the landscape holistically and integrates historical, cultural and environmental variables, the research will test assumptions concerning the environmental impact of climate change, ancient resource management, and urbanism in semiarid environments. The results will contribute to our understanding of the multidimensional factors involved in the origin and evolution of complex societies in sub-Saharan Africa. Furthermore, this research will add context to the long-term natural and cultural processes that have contributed to present landscape conditions in critical regions. The comparative nature of the research places the project in the position of stewarding archaeology within and

beyond the frontiers of southern Africa. At the same time, this aspect may well stimulate novel debates on the significance of southern African earliest complex societies in the wider, international scholarships on social complexity and urbanism.

At a regional scale, research on Mapungubwe will provide an extensive and integrated dataset of environmental and archaeological records that will allow contextualising the development of settlement and subsistence strategies in their ecological settings. Significantly, the focus on landscape, together with the integration of cross-disciplinary data, will allow assessment of the diversity and consistency of environmental conditions and cultural characteristics between the centre of Mapungubwe and its hinterland. The new data will characterise the nature and evolution of soils and land-forms, plant cover, and the links with changing water conditions. Ultimately, the relationships forged between these environmental aspects and human settlements are the result of how the modern community and landscape evolved, mutually influencing each other, and their legacies into the present-day.

### **Selected project bibliography**

#### *Cited references*

- Badenhorst, S. 2009. Phytoliths and livestock dung at Early Iron Age sites in southern Africa. *South African Archaeological Bulletin* 64, 45–50.
- Bangira, C., A. Manyevere 2009. *Baseline Report on the Soils and the Limpopo River Basin* (WaterNet Working Paper 8). Harare: WATERnet.
- Chapman, H., J. Adcock, J. Gater 2009. An approach to mapping buried prehistoric palaeosols of the Atlantic seaboard in Northwest Europe using GPR, geoarchaeology and GIS and the implications for heritage management. *Journal of Archaeological Science* 36, 2308–2313.
- Chinoda, G., W. Moyace, N. Matura, R. Owen 2009. *Baseline Report on the Geology of the Limpopo Basin Area* (WaterNet Working Paper 7). Harare: WATERnet.
- Courty, M.-A., P. Goldberg, R. I. Macphail 1989. *Soils and micromorphology in archaeology*. Cambridge: Cambridge University Press.
- French, C. 2003. *Geoarchaeology in action: studies in soils micromorphology and landscape evolution*. London: Routledge.
- French, C. 2010. People, Societies, and Landscapes. *Science* 328/5977, 443–444.
- Goldberg, P., R. I. Macphail 2006. *Practical and theoretical geoarchaeology*. Oxford: Blackwell.
- Huffman, T. 2000. Mapungubwe and the origin of the Zimbabwe Culture. *South African Archaeological Society Goodwin Series* 8 (African Naissance: The Limpopo Valley 1000 Years Ago), 14–29.
- Huffman, T. N. 2007. *Handbook to the Iron Age: The archaeology of pre-colonial farming societies in southern Africa*. Scottsville: University of KwaZulu-Natal Press.
- Huffman, T. N., E. O. M. Hanisch. 1987. Settlement hierarchies in the Northern Transvaal: Zimbabwe ruins and Venda history. *African Studies* 46/1, 79–116.

- Mercader, J., F. Astudillo, M. Barkworth, T. Bennett, C. Esselmont, R. Kinyanjui, D. Laskin Grossman, S. Stimpson, D. Walde 2010. Poaceae phytoliths from the Niassa Rift, Mozambique. *Journal of Archaeological Science* 37, 1953–1967.
- Meyer, A. 1998. *The Archaeological Sites of Greefswald: Stratigraphy and Chronology of the Sites and a History of Investigations*. Pretoria: University of Pretoria.
- Meyer, A. 2000. K2 and Mapungubwe. *South African Archaeological Society Goodwin Series* 8 (African Naissance: The Limpopo Valley 1000 Years Ago), 4–13.
- Meyer, A. 2003. A survey of Iron Age sites on Samaria 28 MS and Hamilton 41 MS. Field notes in preparation for publication. Available on SAHRIS (accessed 25 October 2012): [www.sahra.org.za/sahris](http://www.sahra.org.za/sahris)
- Parker, A. G., J. Lee-Thorpe, P. Mitchell 2011. Late Holocene neoglacial conditions from the Lesotho highlands, southern Africa: phytoliths and stable carbon isotope evidence from the archaeological site of Likoaeng. *Proceedings of the Geologists Association* 122, 201–211.
- Piperno, D. R. 2006. *Phytoliths*. Lanham, MD: Altamira.
- SANParks 2012. *Mapungubwe National Park and World Heritage Site: Management Plan*. Online publication (accessed 20 October 2012): [www.sanparks.org/assets/docs/conservation/park\\_man/mapungubwe-draft-plan.pdf](http://www.sanparks.org/assets/docs/conservation/park_man/mapungubwe-draft-plan.pdf)
- Smith, J., J. Lee-Thorpe, S. Hall 2007. Climate Change and Agropastoralist Settlement in the Shashe-Limpopo River Basin, Southern Africa: AD 880 to 1700. *The South African Archaeological Bulletin* 62/186, 115–125.
- Sulas, F., M. Madella 2012. Archaeology at the micro-scale: micromorphology and phytoliths at a Swahili stonetown. *Archaeological and Anthropological Sciences* 4/2, 145–159.

#### *Non-cited references*

- Botha, G. A., N. Fedoroff 1995. Palaeosols in Late Quaternary colluvium, northern KwaZulu-Natal, South Africa. *Journal of African Earth Sciences* 21/2, 291–311.
- Butzer, K. W. 1982. *Archaeology as human ecology*. Cambridge: Cambridge University Press.
- Butzer, K. W. 2005. Environmental history in the Mediterranean world: cross-disciplinary investigation of cause-and-effect for degradation and soil erosion. *Journal of Archaeological Science* 32, 1773–1800.
- Chew, S. C. 2001. *World ecological degradation: Accumulation, urbanization and deforestation 3000 BC–AD 2000*. New York: Alta Mira.
- Chirikure, S., I. Pikirayi. 2008. Inside and outside the drystone walls: revisiting the material culture of Great Zimbabwe. *Antiquity* 82, 976–993.
- Dearing, J. A. 2007. Human-Environmental Interactions: learning from the past. In R. Costanza, L. J. Graumlich and W. Steffen (eds.), *Sustainability or Collapse? An Integrated History and Future of People on Earth*, pp. 19–38. Cambridge, MA: The MIT Press.
- Dollar, E. S. J. 1998. Palaeofluvial geomorphology in southern Africa: a review. *Progress in Physical Geography* 22/3, 325–349.
- Eklom, A., L. Gillson, J. Risberg, K. Holmgren, Z. Chidoub 2012. Rainfall variability and vegetation dynamics of the lower Limpopo Valley, Southern Africa, 500 AD to present.

- Palaeogeography, Palaeoclimatology, Palaeoecology* 363-364, 69–78.
- Foster, G. C., R. C. Chiverrell, A. M. Harvey, J. A. Dearing, H. Dunsford 2008. Catchment hydro-geomorphological responses to environmental change in the Southern Uplands of Scotland. *The Holocene* 18/6, 935–950.
- Fouché, L. 1937. *Mapungubwe: Ancient Bantu Civilisation on the Limpopo*. Cambridge: Cambridge University Press.
- Gardner, G. A. 1963. *Mapungubwe, ancient Bantu civilization on the Limpopo, Vol. 2: Report on excavations at Mapungubwe and Bambandyanalo in Northern Transvaal from 1935 to 1940*. Cambridge: Cambridge University Press.
- Gotze, Albie R., Cilliers, S. S., Bezuidenhout, H., Kellner, K. 2008. Analysis of the vegetation of the sandstone ridges (Ib land type) of the north-eastern parts of the Mapungubwe National Park, Limpopo Province, South Africa. *Koedoe* [online] 50/1, 72–81.
- Hanisch, E. O. M. 1980. An Archaeological Interpretation of Certain Iron Age Sites in the Limpopo/Shashi Valleys. Unpublished MA thesis, University of Pretoria.
- Hanisch, E. O. M. 1981a. The northern Transvaal: environment and archaeology. In E. A. Voigt (ed.), *Guide to archaeological sites in the northern and eastern Transvaal*, pp. 1–6. Pretoria: Transvaal Museum.
- Holmgren, K., W. Karlén, S. E. Lauritzen, J. A. Lee-Thorp, T. C. Partridge, S. Piketh, P. Repinski, C. Stevenson, O. Svanered, P. D. Tyson, P.D. 1999. A 3000-year High-Resolution Record of Palaeoclimate for North-Eastern South Africa. *The Holocene* 9/3, 295–309.
- Holmgren, K., H. Öberg. 2006: Climate Change in Southern and East Africa during the Past Millennium and its Implications for Societal Development. *Environment, Development and Sustainability* 8, 185–195.
- Huffman, T. N. 2005. *Mapungubwe, ancient African civilisation on the Limpopo*. Johannesburg: Wits University Press.
- Huffman, T. N. 2007a. *Handbook to the Iron Age: The archaeology of pre-colonial farming societies in southern Africa*. Scottsville: University of KwaZulu-Natal Press.
- Huffman, T. N. 2007b. Leokwe and K2: Ethnic stratification during the Middle Iron Age in southern Africa. *Journal of African Archaeology* 5/2, 163–188.
- Huffman, T. N. 2008a. Climate change during the Iron Age in the Shashe-Limpopo Basin, southern Africa. *Journal of Archaeological Science* 35/7, 2032–2047.
- Huffman, T. N. 2008b. Zhizo and Leopard's Kopje: test excavations at Simamwe and Mtanye, Zimbabwe. In S. Badenhorst, P. Mitchell and J. C. Driver (eds.), *Animals and People: Archaeozoological papers in honour of Ina Plug*, pp. 200–214 (BAR Series, 1849). Oxford: Archaeopress.
- Huffman, T. N. 2009a. Mapungubwe and Great Zimbabwe: The origin and spread of social complexity in southern Africa. *Journal of Anthropological Archaeology* 28, 37–54.
- Huffman, T. N. 2009b. A cultural proxy for drought: ritual burning in the Iron Age of Southern Africa. *Journal of Archaeological Science* 36, 991–1005.
- Huffman, T. N. 2010a. Revisiting Great Zimbabwe. *Azania* 43/3, 321–328.

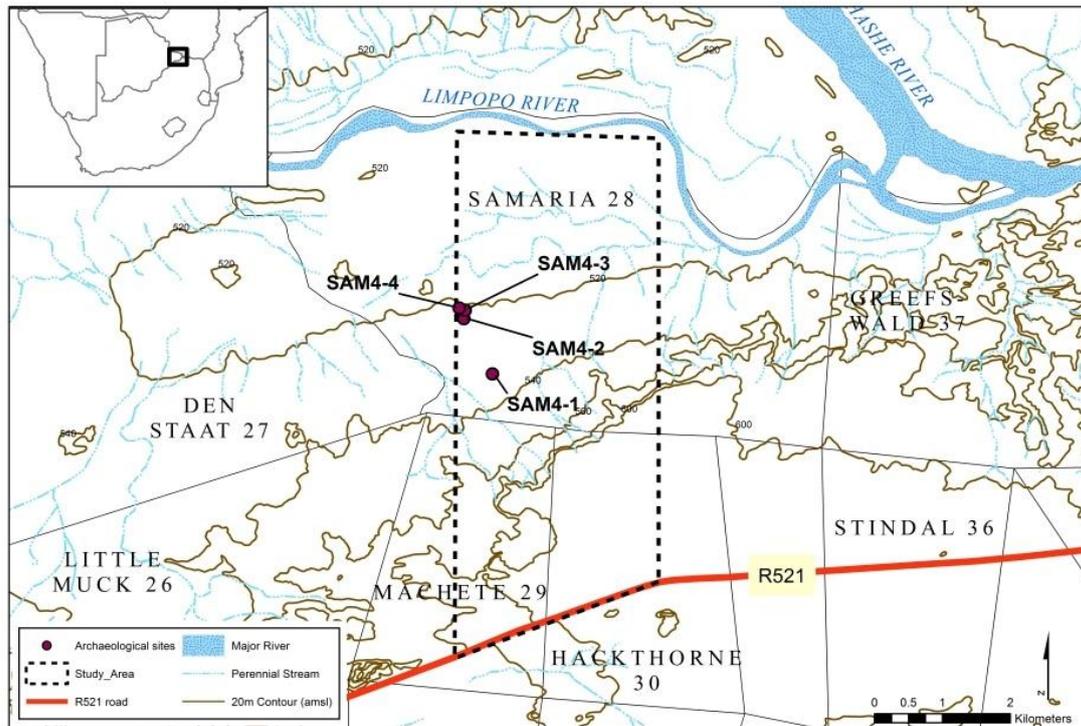
- Huffman, T. N. 2010b. Intensive El Nino and the Iron Age of South-Eastern Africa. *Journal of Archaeological Science* 37, 2572–2586.
- Huffman, T. N., J. C. Vogel. 1991. The chronology of Great Zimbabwe. *South African Archaeological Bulletin* 46, 61–70.
- Manyanga, M. 2007. *Resilient landscapes: Socio-environmental dynamics in the Shashi-Limpopo Basin, southern Zimbabwe, c. AD 800 to present* (Studies in Global Archaeology 11). Uppsala: Uppsala University.
- Manyanga, M., I Pikirayi, S. Chirikure, S. 2010. Conceptualising the Urban Mind in pre-European Southern Africa: Rethinking Mapungubwe and Great Zimbabwe. In P. J. J. Sinclair et al. (eds.), *The Urban Mind: Cultural and Environmental Dynamics*, pp. 573–590 (Studies in Global Archaeology 15). Uppsala: Uppsala University, African and Comparative Archaeology, Department of Archaeology and Ancient History.
- McAnany, P. A., N. Yoffee (eds.) 2009. *Questioning collapse: human resilience, ecological vulnerability & the aftermath of empire*. Cambridge: Cambridge University Press.
- Meyer, A., C. E. Cloete 2010. Architectural traditions of Mapungubwe and Bambandyanalo (K2). *TD The Journal for Transdisciplinary Research in Southern Africa* 6/1, 241–270.
- Murimbika, M. T. 2006. Sacred Powers and Ritual Transformation: An Ethnoarchaeological Study of Rainmaking Rituals and Agricultural Productivity During the Evolution of the Mapungubwe State, AD 1000 to AD 1300. Unpublished PhD thesis, University of Witwatersrand, Johannesburg.
- Mzezewa, J., T. Misi, L. D. van Rensburg. 2010. Characterisation of rainfall at a semi-arid ecotope in the Limpopo Province (South Africa) and its implications for sustainable crop production. *Water SA (Online)* 36/1, 19–26.
- Mzezewa, J., L. D. van Rensburg 2011. Effects of tillage on runoff from a bare clayey soil on a semi-arid ecotope in the Limpopo Province of South Africa. *Water SA (Online)* 37/2, 165–172.
- O'Connor, T.G., Kiker, G.A. 2004. Collapse of the Mapungubwe society: vulnerability of pastoralism to increasing aridity. *Climatic Change* 18, 49–66.
- Pikirayi, I. 2001. *The Zimbabwe culture: origins and decline in southern Zambezi states*, Walnut Creek: AltaMira Press.
- Pikirayi, I. 2004. Less implicit historical archaeologies: oral traditions and later Karanga settlements in south-central Zimbabwe. In A. M. Reid and P. J. Lane (eds.), *African Historical Archaeologies*, pp. 243–267. New York: Kluwer Academic/Plenum Publishers
- Pikirayi, I. 2006a. The demise of Great Zimbabwe, AD 1420–1550: an environmental re-appraisal. In A. Green and R. Leech (eds.), *Cities in the World, 1500–2000*, pp. 31–47. Leeds, UK: Maney Publishing.
- Pikirayi, I. 2006b. The kingdom, the power and forevermore: Zimbabwe culture in contemporary art and architecture. *Journal of Southern African Studies* 32/4, 755–770.
- Pikirayi, I. 2009a. The archaeology of sub-Saharan Africa: an overview. In B. Cunliffe, C. Gosden, R. A. Joyce (eds.), *The Oxford Handbook of Archaeology*, pp. 723–762. Oxford: Oxford University Press.

- Pikirayi, I. 2009b. What can archaeology do for society in southern Africa? *Historical Archaeology* 32/4, 125–127.
- Pikirayi, I. 2011. *Tradition, Archaeological Heritage Protection and Communities in the Limpopo Province of South Africa*. Addis Ababa: OSSREA.
- Pikirayi, I., S. Chirikure. 2011. Debating Great Zimbabwe. *Azania* 46/2, 221–231.
- Pollarolo, L., J. Wilkins, K. Kuman, L. Galletti 2010. Site formation at Kudu Koppie: A late Earlier and Middle Stone Age site in northern Limpopo Province, South Africa. *Quaternary International* 216/1–2, 151–161.
- Pwiti, G. 1996. Continuity and Change: an archaeological study of farming communities in northern Zimbabwe AD 500-1700. Ph.D. thesis, Uppsala University.
- Schoeman, M. H. 2006a. Clouding Power? Rain Control Space, Landscapes and Ideology in the Shashe-Limpopo State Formation. PhD thesis, University of Witwatersrand, Johannesburg.
- Schoeman, M. H. 2009. Excavating the 'waterpits in the mountain': the archaeology of Shashe-Limpopo Confluence Area rain-hill rock tanks. *Southern African Humanities* 21, 275–298.
- Scott, L., K. Holmgren, A. S. Talma, S. Woodborne, J. Vogel 2003. Age interpretation of the Wonderkrater spring sediments and vegetation change in the savanna biome, Limpopo Province, South Africa. *South African Journal of Science* 99, 484–488.
- Sidle, R., Y. Onda 2004. Introduction: Hydrogeomorphology: overview of an emerging science. *Hydrological Processes* (Special Issue: Hydrogeomorphology) 18/4, 597–602.
- Sinclair, P. J. J. 1987. *Space, time and social formation: a territorial approach to the archaeology and anthropology of Zimbabwe and Mozambique, c. 0-1700 AD*. Uppsala: Societas Archaeologica Upsaliensis.
- Sinclair, P. J. J., I. Pikirayi, G. Pwiti, R. Soper 1993. Urban trajectories on the Zimbabwean plateau. In T. Shaw *et al.* (eds.), *The archaeology of Africa: food, metals and towns*, pp. 705–731. London: Routledge.
- Slegers, M. F. W., L. Stroonsnijder 2008. Beyond the desertification narrative: a framework for agricultural drought in semi-arid East Africa. *Ambio* 37/5, 372–380.
- Temme, A. J. A. M., J. D. Schaap., M. P. W. Sonneveld, G. A. Botha 2012. Hydrological effects of buried palaeosols in eroding landscapes: A case study in South Africa. *Quaternary International* 265, 32-42.
- Tyson, P. D., W. Karlen, K. Holmgren, G. Heiss 2000. The Little Ice Age and medieval warming in South Africa. *South African Journal of Science* 96, 121–126.
- van Doornum, B. 2008. Sheltered from change: hunter-gatherer occupation of Balerno Main Shelter, Shashe-Limpopo confluence area, South Africa. *Southern African Humanities* 20, 294-284.
- Walker, N. J. 1995. Late Pleistocene and Holocene Hunter-gatherers of the Matopos: an archaeological study of change and continuity. Unpublished Ph.D. thesis, Uppsala University.
- Wainwright, J. 2008. Can modelling enable us to understand the role of humans in landscape evolution. *Geoforum* 29, 659–674.

## APPENDIX

*Table 1: Archaeological sites selected for excavations*

	Site code	GPS coordinates	
		Lat	Long
<b>SAMARIA 28 MS</b>	SAM4-1	S22°13'14.4"	E029°18'01.4"
	SAM4-2	S22°12'47.8"	E029°17'47.7"
	SAM4-3	S22°12'43.8"	E029°17'48.5"
	SAM4-4	S22°12'42.7"	E029°17'46.0"



*Fig. 1 Map of the middle Limpopo basin showing the location of the study area (Based on 2229AB Mapungubwe 1:50 000, South Africa topographic map, 1969)*



a



b

*Fig. 2 Samaria 1: a. view of the site; b. artefacts from surface scatter.*



a



b



c

*Fig. 3 Samaria 2: a. view of the site; b. artefacts from surface scatter; c. extensive burrowing.*



a



b

*Fig. 4 Samaria 3: a. view of the site; b. artefacts from surface scatter.*



a



b

*Fig. 5 Samaria 4: a. view of the site; b. remnants of circular wall.*