People and plants in the Stone Age

May Murungi tells us about archaeobotany at Bushman Rock Shelter

Ancient plants for archaeology

At the mention of the word archaeology, for most people what comes to mind are stone tools, bones and pottery, rather than plant remains. Yet ancient plants can be preserved as macrofossils, which can be observed with the naked eye (e.g. woody parts, leaves and seeds), or as microfossils, which have to be processed from deposited archaeological material, such as sediments and stone tools, before being studied under the microscope (e.g. pollen and phytoliths).

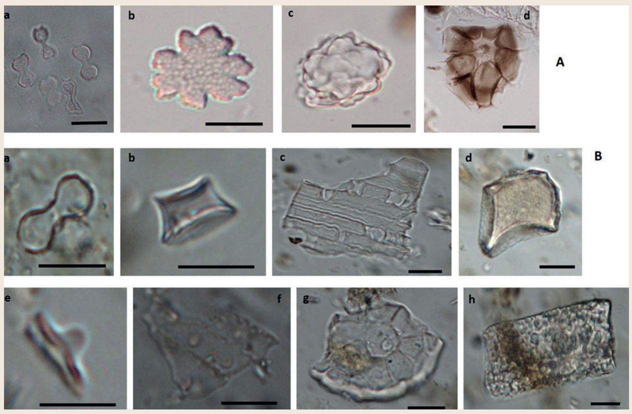
Ancient plant remains in the form of fossil charcoal, carbonised (charred) seeds, pollen and phytoliths provide information on the role of plants utilised by early modern humans for various purposes – including fire, food, medicine and bedding – helping us to understand cognitive and behavioural evolution, such as the origin of plant cultivation and the use of fire. Importantly, they can also provide insights into past vegetation and environments, indirectly telling us about the climate in which early humans thrived.

It is only in recent years, however, that archaeologists in South Africa have come to appreciate the wealth of information that can be provided by ancient plant remains studied by archaeobotanists. To this end, there is a growing body of archaeobotanical research in South Africa that started with the study of charcoal (Diepkloof Rock Shelter and Sibudu Cave) and carbonised seeds (Sibudu Cave), as well as phytolith analysis at Sibudu Cave and Pinnacle Point. Phytolith analysis is now taking shape in South Africa, with several ongoing studies at other sites, such as Bushman Rock Shelter, Border Cave and Umhlatuzana Rock Shelter.

It is often necessary to use a combination of archaeobotanical remains as proxies to provide a more complete picture of plant use and plants that were available in the vegetation at the time. For example, charcoal will give a good indication of woody plants, while phytoliths have the added advantage of providing insight into the use of non-woody plants such as grasses and sedges. Pollen is often poorly preserved at archaeological sites, as has been the case for Bushman Rock Shelter and Sibudu Cave, and phytolith analysis has proved to be more effective. In addition, while pollen tends to be blown into archaeological sites from far-off places, phytoliths are often produced on site from their

What are phytoliths?

Phytoliths are microscopic silica bodies that are formed within and between cells in many plants, as a result of absorption of silica from soil during the uptake of water and mineral salts. When plants die and decompose, or are burnt, the phytoliths are released directly into the soil, where – being hard and resistant to destruction – they can be preserved for thousands of years. Because phytoliths tend to take on the shape of living cells, they can be differentiated in many plant families, allowing for identification of taxa, sometimes up to genus level.



A - Phytoliths from modern plants:

a) bilobate-shaped grass short cells from the leaves of the grass *Melinis repens*, b) decorated bodies from the fruit of the tree *Celtis africana*, c) cystoliths from the leaves of a *Ficus* sp. tree next to the rock shelter d) hair base with polyhedral cells from the leaves of *Ficus* sp. next to the rock shelter.

B - Phytoliths from the Later Stone Age layers:

a) bilobate-shaped grass short cell, b) rondel-shaped grass short cell, c) grass articulated phytoliths composed of long cells and short cells, d) bulliform grass phytolith, e) cone-shaped sedge type phytolith, f) sedge type articulated phytoliths, g) hair base with polyhedral cells (from dicots), h) a weathered blocky phytolith associated with various plant groups.

parent plant, allowing for a very local reconstruction of the use of plant resources and space at a given site. For example, a phytolith study at Sibudu Cave in KwaZulu-Natal provided evidence for the presence of hearths (fireplaces) that are no longer visible at the site, because the phytolith content of the sediments taken from non-hearth layers was similar to those taken from visible hearths. Furthermore, unlike grass pollen which cannot be taxonomically identified beyond the grass family level, phytoliths can generally be associated with grass sub-families, corresponding to grasses that are adapted to different ecological niches and environmental conditions.

It is this very characteristic that puts phytoliths ahead of other archaeobotanical proxies, since grasses are highly sensitive to environmental change. Although caution needs to be taken when interpreting such data from archaeological sites for past environmental construction – as they often represent human choices of plant use − it is assumed that plants found in the archaeological record are generally representative of the type of plants that were available in the surrounding vegetation.

Dr Aurore Val collects modern soil samples for phytolith analysis.

Phytoliths at Bushman Rock Shelter

Phytolith analyses at Bushman Rock Shelter are currently in progress as part of a postdoctoral DST-NRF Centre of Excellence fellowship (2018/19) held at the Evolutionary Studies Institute at Wits University.

Our understanding of the archaeological phytolith record is based on analogies with phytoliths found in modern plants. Phytoliths from modern surface soils under different vegetation communities are studied to determine which phytolith assemblages are representative of a given vegetation type and which phytolith types do not survive long enough in soils. It is often recommended to create region-specific modern phytolith reference collections, as phytolith assemblages from one region may differ in application or interpretation from another region.

While it is understood that ancient landscapes may not have resembled those of today, it is important to make such present-day calibrations between modern plant vegetation types and the soils beneath them to fully understand the ancient phytolith assemblages at a given site. As a first step to the fossil phytolith study at Bushman Rock Shelter, Dr Aurore Val and I therefore collected modern plant specimens (wood and leaves of trees) and soils occurring in the area in the late winter of 2017. In the summer of 2018 more plant samples from both grasses and trees were collected with the help of Dr Christine Sievers. Sediments representing the Middle Stone Age (>45 000 years ago) and Later Stone Age (16 000–10 000 years ago) periods at Bushman Rock Shelter were collected from archaeological sediment layers during different field campaigns in 2014, 2017 and 2018.

Phytoliths were extracted from each of the modern plant parts (wood, leaves and fruit) using standard methods that involve burning the plant material at 450°C in a furnace, followed by boiling the ash in hydrochloric acid to remove any carbonates, and then in nitric acid to remove the remaining organic matter. Fossil phytoliths have been extracted from several of the archaeological sediments by treating them with acids. For both modern and fossil phytoliths, the final samples are mounted on glass slides and viewed under the microscope at 400x magnification to identify and classify the phytolith morphotypes into plant types, such as grasses and sedges (monocot plants), trees, or dicot plants in general. Phytoliths from the archaeological sediments of Bushman Rock Shelter are generally of good preservation and – although their surfaces may be weathered – they are often still identifiable.

What we hope to achieve

Through phytolith analyses, we hope to supplement other ongoing botanical analyses (charcoal and seeds) at Bushman Rock Shelter by providing key information on mainly the grasses and sedges that were utilised at the site. This will in turn provide one of the best proxies to infer past climate, necessary for interpreting other studies that seek to understand how climate may have influenced technological adaptations during the Stone Age. Publication of the modern phytolith reference collection being developed will contribute to the few that currently exist for South Africa, and will provide a basis on which to interpret archaeological phytolith analyses from sites that occur within the country's Bushveld vegetation types. We hope in the future to apply this information to other sites in the area, such as the Heuningneskrans and Oliemboomspoort rock shelters.

With the increasing interest by archaeologists to understand how life of ancient populations may have been influenced by environmental change, there is growing recognition of the value of including archaeobotanists in archaeological projects in South Africa. Since there is a paucity of inland natural deposits in South Africa that span periods as long as the Stone Age, archaeologists are now depending on the environmental data that archaeobotanical studies are providing. It will therefore be up to archaeobotanists to provide quality scientific data that can be used for this kind of environmental interpretation. We will have to think of ways in which our data can contribute to archaeology beyond human subsistence, and clearly explain its limitations, given its inherent bias of human selection and the potential for misinterpretation.

Dr May Murungi completed a master's degree in biology, focusing on natural resources, ecology and conservation, at Mbarara University in Uganda in 2013. She attained a PhD in archaeobotany from Wits University in 2018 for her research on phytoliths in modern plants and Middle Stone Age sediments from Sibudu Cave. She is currently a postdoctoral fellow at Wits University's Evolutionary Studies Institute, funded by the Centre of Excellence in Palaeosciences. She joined the Bushman Rock Shelter project in 2014, and received a grant from IFAS-Recherche in 2017.

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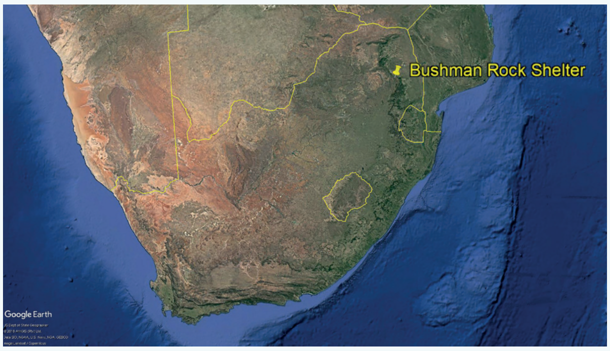
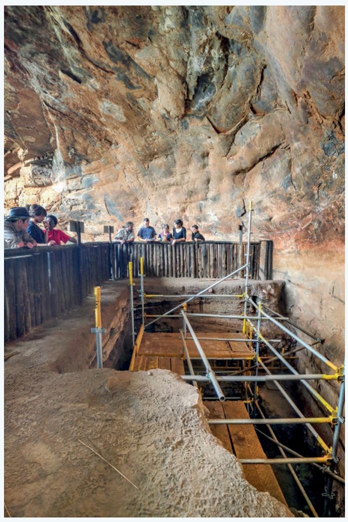


Bushman Rock Shelter

The Bushman Rock Shelter site is located in the district of Ohrigstad in Limpopo, in the northern foothills of the Drakensberg range. Excavated in the 1970s by the team of Prof. Hannes Eloff from the University of Pretoria, the site revealed archaeological strata dating from the Middle and Later Stone Age. The mineral and organic remains, perfectly preserved over 7 meters depth, are key indicators for tracking the changes in the hunter-gatherer populations spanning the last 200 000 years.

In 2014 the French National Centre for Scientific Research (CNRS) and the French Institute in South Africa (IFAS) initiated a new project at the Bushman Rock Shelter, with the aim of clarifying the stratigraphy and getting new archaeological samples. The project is funded by the French Ministry of Foreign Affairs' Commission on Archaeological Excavations and supported by Wits University and the South African Heritage Resources Agency (SAHRA).

In 2018 the project came to the end of its first four-year term, but was extended to at least 2021 and now includes the nearby site of Heuningneskrans too. Excavations at the sites are conducted as part of a field-school involving 10–15 students from France, South Africa, Zimbabwe, Zambia and Mozambique each year.



Bushman Rock Shelter is open to visitors all year round, as it houses the Museum of Man, which forms part of the Echo Caves complex – a tourist attraction offering guided tours.

For more information, see http://www.ifas.org.za/research/2019/bushman-rock-shelter-2014-2021/ or https://www.echocaves.co.za/