

https://dspace.org/

Digital Preservation and Access to Cultural Heritage in South Africa The Case of the African Rock Art Digital Archive

Mduduzi Maseko; Mbongeni Tembe; Sello Mocumi; Sibongiseni Lukhele; Yola Nzimela

https://hdl.handle.net/10539/46583
SCOPUS

Downloaded from a DSpace repository. https://dspace.org/

Article

Mduduzi I. Maseko*, Mbongeni Tembe, Sello Mocumi, Sibongiseni Lukhele and Yola Nzimela

Digital Preservation and Access to Cultural Heritage in South Africa: The Case of the African Rock Art Digital Archive

https://doi.org/10.1515/pdtc-2024-0078
Received December 6, 2024; accepted April 9, 2025;
published online June 16, 2025

Abstract: Rock art, in the form of paintings and engravings made on rock surfaces worldwide, has garnered the interest of scholars since the nineteenth century. In southern Africa, rock art is one of the most ubiquitous kinds of material cultural heritage, allowing researchers access to the lifeways and thoughts of people through millennia, whose identities were shaped and impacted by contact between African groups and, later, all but eradicated by the colonial project. In this manner, rock art stands as a statement of indigeneity for marginalized peoples across the world, in the post-colonial present, and must be preserved. The African Rock Art Digital Archive (ARADA) at the University of the Witwatersrand's Rock Art Research Institute (RARI) contributes to such preservation by digitizing rock art collections and related materials from cultural heritage sites across the African continent. Such an initiative ensures that the materials are permanently stored in the digital archive, preventing physical damage and loss of information while providing access to researchers and the wider public. This paper describes the tools and strategies used by ARADA to achieve this important work. In turn, it aims to raise awareness of the continuing cruciality of preserving South Africa's cultural heritage.

Keywords: art; digital preservation; access; cultural heritage; cultural awareness; South Africa

***Corresponding author: Mduduzi I. Maseko**, Rock Art Research Institute, University of the Witwatersrand, Johannesburg, Gauteng, South Africa, E-mail: mduduzi.maseko@wits.ac.za. https://orcid.org/0000-0002-5302-9494

Mbongeni Tembe, Sello Mocumi, Sibongiseni Lukhele and Yola Nzimela, Rock Art Research Institute, University of the Witwatersrand, Johannesburg, Gauteng, South Africa, E-mail: mbongeni.tembe@wits.ac.za (M. Tembe), sello.mocumi@wits.ac.za (S. Mocumi), sibongiseni.lukhele@wits.ac.za (S. Lukhele), yola.nzimela@wits.ac.za (Y. Nzimela). https://orcid.org/0009-0008-9176-4212 (M. Tembe). https://orcid.org/0000-0001-9983-896X (Y. Nzimela)

1 Introduction

Across the South African landscape, and in areas associated with South Africa's indigenous communities, are rock markings in the form of engravings and paintings, which make up thousands of sites recorded and studied by archaeologists and other researchers since the early twentieth century. Similar rock markings left by indigenous peoples, often related to ritual activity (see Lewis-Williams 1994 on rock art and ritual), can be found the world over (Clottes 2008; Hollmann 2014; David and McNiven 2018; Clottes et al. 2019; Whitley 2021; Hampson et al 2022). These markings are understood to be intentionally made on rock surfaces by past communities, as a way of communicating and expressing human thought and concepts which relate to certain aspects of their worldviews and beliefs (Chippindale and Taçon 1998; Bahn 2010). There is also some evidence that sites adorned with such markings hold spiritual significance for contemporary communities (e.g. Regensberg 2013; Siteleki 2014). Collectively, these markings are termed "rock art."

Beyond its aesthetic value, South African rock art stands out for its diversity, having been made by hunter-gatherers and African pastoralists (ancestors of the Khoe and San), as well as agro-pastoralist (isiNtu-speaking) communities. Due to advances in research, we now understand that many of these images were, in the past, associated with spiritual beliefs, initiation rites, and other ritualistic practices (Lewis-Williams 1981, 1994; Smith and Ouzman 2004; Namono and Eastwood 2005; Hollmann 2014). As such, many rock art sites are recognized as National Heritage (Department of Arts and Culture 1999) and protected by legislation, while some enjoy World Heritage status (Ndlovu 2016; Laue et al 2018). However, many issues create an imbalance between preserving this cultural heritage and opening accessibility to the public (see Ndlovu 2009, 2016 for a critique). Consequently, the average South African knows very little about rock art and its significance, despite some rock art images being used as national symbols – for instance, the two human figures on the South African Coat of Arms, or the "hunting scenes" depicted on bank notes

Open Access. © 2025 the author(s), published by De Gruyter. This work is licensed under the Creative Commons Attribution 4.0 International License.

(see Smith et al. 2000; Smith 2016; Hampson and Challis 2024 for discussion and critique).

While rock art is often overlooked, it is an important cultural heritage resource, and its preservation is crucial. As noted by the French archaeologist Jean Clottes (2008), rock art – which he sees as an endangered world heritage – is "one of the major cultural riches of humankind" (1). As such, our efforts should not just end at preserving this resource, but we should focus intently on raising public awareness about its significance (Clottes 2008). In a session on the digitization of African heritage at the "Right to Research" international conference, held in January 2023 at the University of Cape Town, in South Africa, conference organizer Teresa Hackett remarked that preservation is not enough – repository institutions must also take upon themselves the responsibility to make heritage accessible. A similar remark was made by the historian Carolyn Hamilton, who was in attendance (virtually). These important remarks resonate with the work which has been carried out at the University of the Witwatersrand's Rock Art Research Institute (RARI) for two decades now. This paper aims to inform on the different ways in which RARI's online platform, the African Rock Art Digital Archive (www.sarada.co.za), works to achieve preservation of African rock art materials and facilitate access to these materials for researchers across the globe.

2 The Rock Art Research Institute

RARI, initially known as the Rock Art Research Unit, was founded in 1986, at the University of the Witwatersrand, in Johannesburg, after its first director, Professor David Lewis-Williams, moved from the Social Anthropology Department to the Archaeology Department. The first project done by RARI was aimed at surveying and recording the rock art of the Harrismith District in South Africa's Free State Province. This project was supported by the Human Science Research Council (HSRC). Today, the Institute is a world-renowned leader in the field of rock art research. It has existed for over four decades to demonstrate the significance of rock art in illuminating indigenous histories and narratives, encouraging rock art research, and ensuring the protection of rock art sites across the African continent.

A key moment in the history of RARI was in 2000, when – under the directorship of Professor Ben Smith – the Institute was tasked by the administration of then-President Thabo Mbeki to select a rock art image which would be used in the new South African Coat of Arms (see Smith et al. 2000). A rock art symbol juxtaposed with a new national identity would play a crucial role towards what Mbeki called the "African Renaissance" (Smith 2016). This idea of a Renaissance aimed to encourage, among other things, intellectual conversations around restoration and African unity, as well as a sense of pride in our heritage as South Africans and as Africans. The image selected to be used in the Coat of Arms was taken from the Linton Panel, which is housed at Iziko Museums, in Cape Town. Along with the /Xam (an extinct indigenous language) words *!Ke e: /xarra//ke*, it was to stand as part of a new, post-apartheid, national identity. As Mbeki would have it, this new image would stand in contrast to what it meant to be South African in the apartheid era: "It [the image] is both African and universal. It serves to evoke our distant past, our living present and our future as it unfolds before us. It represents the permanent yet evolving identity of the South African people as it shapes itself through time and space" (Mbeki 2000, in Smith 2016, 147).

Still, although rock art is appropriated in all kinds of South African visual media (see Hampson and Challis 2024 for a critique), the significance of the imagery is often lost to the average South African. In recording and studying rock art, RARI aims to redress this important social issue. The Institute's mission is threefold:

(i) To convey to the public and academic community the complexity, subtlety, and social value of South African and African rock art in terms of indigenous beliefs, customs, rituals, and lifeways.
(ii) To teach and train future scholars and technicians to further the understanding and appreciation of rock art and to conserve it for generations to come.
(iii) To record Africa's fast-vanishing rock art heritage using all techniques at its disposal and to make these records available to the world via an online digital platform.

This Africa-wide scope allows for the provision of easier access to rock art materials (including images and site data) to researchers in the local and international community, while acting towards the preservation of this important but often overlooked heritage. Thus, aligning with its mission to educate and disseminate information about the history and complexities of rock art, indigenous beliefs, and values, RARI runs an initiative known as the African Rock Art Digital Archive.

3 The African Rock Art Digital Archive

The African Rock Art Digital Archive was created in the early 2000s, beginning with the establishment of a laboratory in 2001, aimed initially at digitizing RARI's collections. The

establishment of the lab, including the purchasing of new digitization equipment, was achieved with financial support from the Ringing Rocks Foundation (Rock Art Research Institute 2002). Funding from this American-based foundation also paid for the employment of three staff members, the chief of whom was Willem Steyn from 2001 to 2003, whose responsibility was to digitize the Institute's collections and to construct an online web-based archive that would be accessible to researchers from across the world (Rock Art Research Institute 2002) – a project which was completed in 2004 (Rock Art Research Institute 2007). Building upon this initial success, the Andrew W. Mellon Foundation commissioned the laboratory to digitize a series of major institutional and private collections (Rock Art Research Institute 2007), thereby expanding the digital archive of southern African rock art materials to include 128,000 images from RARI, 52,400 images from the Analysis of Rock Art in Lesotho (ARAL) project, and 5,729 images from the Janette Deacon private collection. These collections were to be integrated (along with 75,913 images from other institutions) into an African-based digital archive known as the South African Rock Art Digital Archive (SARADA) and its accompanying website (www.sarada.co.za) in 2004. This was done in collaboration with Aluka – an American-based online digital library (now part of JSTOR) focused on preserving and enabling access to Africa-related scholarly sources.

The collaboration with Aluka and the Mellon Foundation ensured that the digitization project continued for many years, until funding ceased in 2012. Between 2013 and 2016, the lab – managed by Azizo Da Fonseca – acquired funding from the National Lotteries Distribution Trust Fund (Rock Art Research Institute 2019) to work on a further five projects. It was during this time that the repository changed its name from SARADA to the African Rock Art Digital Archive (ARADA from hereon). The name change was due to the expansion of ARADA's collections to include those from institutions in other regions of Africa, some of which are housed at European institutions (see the list of stakeholders in Table 1 below). Over 300,000 images from over 7,000 rock art sites have been digitized to date and comprise part of this archive. Digitization of the vast material held in RARI's physical archives continues daily. Despite some funding challenges between 2017 and 2020, a new team of staff members led by Mbongeni Tembe and funded by Canon South Africa were employed in 2022, who continue to work on the digitization of African rock art and maintaining the ARADA online platform – including the maintenance and upgrading of its hardware and software – to facilitate access.

ARADA works on digitizing content that is deemed to be part of South Africa's collective memory and cultural heritage. Many of its collections comprise photographs, digital images, drawings, image slides, and tangible historical documents. At the center of this important work are three pillars which are the core of ARADA's mission: preservation, education, and digital innovation. These three pillars are focused on the important issue of access for all. In this manner, ARADA serves as the unofficial national repository for rock art heritage in South Africa.

Table 1: List of ARADA's stakeholders.

Institutions/projects	No. of digital objects
Albany Museum	852
Analysis of Rock Art in Lesotho	34,983
Ditsong Museums of South Africa	1,714
Iziko Museums of South Africa	9,342
Marianhill Monastery	274
Nasprstek National Museum	5
Natal Museum	3,803
National Museum of Cultural History	34,723
National Museum of Namibia	999
National Museum of South Africa	18,698
Ukhahlamba Rock Art Mapping Project	6,349
University of Cape Town	8,801
University of Cologne	10,905
University of Rome La Sapienza	1,142
University of South Africa	155

4 Digitization in the African Rock Art Digital Archive

Digitization is a time-consuming procedure that requires adequate resources, labour, and expertise. Pandey and Misra (2014) suggest that digitizing materials serves various purposes, including but not limited to:

- Preserving valuable historical materials for prolonged future use.
- Enabling innovative modes of access and utilisation.
- Improving and expanding access to a specified collection of research materials.
- Establishing a centralized access point for documentation from various institutions on a specific subject.
- Promoting democratic ideals by enhancing public access to archival records.
- Providing institutions with opportunities for developing technical infrastructure and enhancing staff skills.

The various steps involved in the process of digitization are: (i) setting objectives/clarifying purposes; (ii) selecting material; (iii) choice of technology; and (iv) preservation (Pandey and Misra 2014).

The digitization programme at ARADA aims to make materials widely available and easily accessible. Aspects of the ARADA digital strategy that are particularly important include adherence to international standards, compliance with copyright laws, and adherence to the best community practices for preserving digital information. The ARADA digital repository is founded on the Content Management System, RARI IMS 1.14, and incorporates the core characteristics of a reliable digital repository.

The digitization of materials at ARADA is done by digital laboratory technicians who have been trained by RARI to manage the digital archival of rock art materials within the institution. Physical-to-digital conversion is a laborious task, but digital technicians work tirelessly to digitize things according to a schedule, while also administering and updating the database system as needed. The digitization process entails analyzing the physical materials to determine their suitability for digital imaging as well as the technical requirements necessary for imaging. Thereafter, they are scanned, indexed, and transformed into a managed electronic file. The material's metadata are then recorded. Finally, the content is digitally displayed, and a copy of the digital content is accessible through the website. The materials scanned are maps, photographs, tracings, redrawings, paintings, and historical documents.

5 Stakeholders

The images stored in ARADA's database are used by different researchers and educators across the world for varied reasons, including exhibitions, publications, and annual projects and site reports, amongst other things. Many of the collections in the digital archive are owned by various respective institutions (Table 1), for which RARI acts as a custodian. Other images are owned by RARI and its affiliates; some are bound by the Collections Policy of the University of the Witwatersrand, while, for others, copyright is owned by individual donors and stakeholders. The institutions which own collections stored in ARADA's database are listed in the table below:

6 Equipment and Resources

ARADA employs a variety of scanning equipment to scan various materials. Scanning is a great preservation tool for the paper and image slide archives of RARI, which are slowly deteriorating for several reasons. The digitization lab is equipped with a Kodak IQ Smart Scanner for scanning photographs, image slides, and documents. This scanner is favorable as it can scan various materials and save images in different file formats. Specifically, regarding image scans, a maximum of 40 image transparencies can be scanned at once because the scanner bed can accommodate one container or "mask" into which collections are slipped. The scanned images are then converted into various formats, and they can be scanned in both color and greyscale. The transparencies are scanned at an optical resolution of 2,500 dpi, resulting in an image file size of 40 MB per image. Thus, the image can be enlarged from its original 35 mm dimension to larger than A3 size with minimal or no pixelation. The scanner generates images with a high resolution and can scan up to 5,600 dpi optical resolution and 1,100 dpi interpolated resolution. The only disadvantage of using the equipment is that pre-scanned images must be manually cropped for accurate scanning.

The second scanner is the Contex HD5450, which is designed to scan original materials larger than A4 size and up to 137 mm wide at a maximum of 900 dpi optical resolution, as well as materials with a thickness of up to 15 mm, allowing for the scanning of materials of any length up to A4 format. This allows for scanning vulnerable materials that may require a protective folder or carrying case. The scanner's light source consists of dual color-balanced stabilized lights with a low dynamic range and low heat output. Low levels of heat ensure that scanned materials remain undamaged. The Book2Net Flash scanner is used to digitize books specifically and documents and allows for the scans to be saved in different formats and scans up to 9,600 dpi resolution. This scanning process results in high-quality images with dimension information on a scale with the original rock image. The scanner can depict whatever the eye can see – if the writing is visible the scan should be able to digitize the content. A disadvantage of this scanning process is that it requires manual labor, which opens a margin for human error. However, errors can be mitigated.

Adobe Photoshop is used to improve the scanned files. These files are transferred from the computer's hard drive to mobile external hard drives. The Scan-In folder is the destination for all images which have been scanned and cleaned using Adobe Photoshop. Images are dropped into this folder and are automatically processed; the Joint Photographic Expert Group (JPG) format is then produced to appear on the ARADA website. Therefore, images found on the ARADA website (for public use) are in the JPG format, while images requested by users are provided in the Tag Image File Format (TIFF) format. The JPG images are saved in a compressed format; consequently, some of the image detail is pixelated and cannot be reproduced, whereas the TIFF format is uncompressed.

The files are then renamed using a Bulk Rename Utility (BRU) which is used to rename files in bulk, where necessary. The ARADA website has its naming format system which is

applied to this software. Information on specific sites and collections is also depicted on the web page. To make searching easier, site codes and other relevant data about sites or images, the copyright holder, and the institution are collected and added as part of the image information. As part of digital preservation, Microsoft Excel is used to keep a record of the RARI paper archive; this archive is presently being digitized as part of the digital archive. This ongoing task will facilitate the rapid examination of physical archive contents and the verification that they have all been digitized and submitted to the ARADA archive, in addition to limiting the loss of information in case of any disasters. Given the importance of this data, it is imperative that permanent and reliable storage is ensured.

7 Data Storage

The important aspect in the data storage and data management of the rock art archive is to determine its scope and size. An additional aspect is to consider the number of images and other types of data that will be included or need to be stored, as well as any additional features or functionalities that may be included in the database. According to the Northeast Document Conservation Center (NEDCC) (2019), digital preservation and storage requires the participation of collections staff to identify materials to preserve and of IT staff to provide some of the storage support required to monitor materials over time. In RARI, the lab technicians create folders for different digital files as part of the archival process. Moreover, the newly digitized media are stored in magnetic disks (external media), also known as hard drives. In the past, they were also stored on optical disks (DVDs, and Blu-ray discs). These assist with good record preservation.

To ensure successful and permanent preservation, ARADA's data is hosted by digital repository services on servers, managed by the University's Information and Communication Technology Department (hereafter, Wits ICT). Wits ICT ensures responsible data backups, server space, network access, and server migration. The server storage capacity is 90 terabytes and can store primary digitized TIFF files ranging from 40 MB to 1.6 GB. All TIFF files are saved as a master file exclusively for preservation. Access to it is restricted and files are overseen by experts.

8 Facilitating Access

As was alluded to earlier, the major aim of digital preservation is to protect the collection while facilitating access. Providing digital access to African rock art heritage enables users across the world to simultaneously access these unique, frequently accessed, and sometimes fragile records in alternative formats, mitigating the effects of the physical handling of the fragile paper and slide archive. Access to ARADA's archival data can be obtained in three ways, depending on the reason for the request. The ARADA URL – www.sarada.co.za – can be used to gain interface access to images required for general non-profit purposes. For security purposes, these images have limited metadata. Those requiring access to specific collections are required to register and create profiles on the online platform before requesting access to the site's collection. Users who need to re-use or reproduce images must fill out image request forms, which are available on the website. When using privately owned images or images owned by external institutions, ARADA must obtain permission from the owner of the image's copyright. After approval, a high-resolution image (in TIFF format) is transmitted via WeTransfer to the requester. Images for non-commercial purposes, such as for scholarly publication, are free of charge, whereas images for commercial use are subject to a fee.

9 Challenges Faced with Digitization at ARADA

Despite the success and international recognition that RARI has enjoyed, being a custodian of a database as large as that of ARADA comes with huge responsibility and several challenges. We share the sentiments of De la Porte and Higgs (2019) that "digitization of cultural heritage material creates both opportunities and challenges for access and preservation for future generations" (1). As a result, identifying the advantages of digitizing rock art collections is needed, however, it is important to note possible difficulties before, during, and after a digitization project (De la Porte and Higgs 2019).

10 Financial Resources

Digital initiatives incur significant costs, particularly in archival automation projects (Pandey and Misra 2014; Flanders and Mylonas 2017; Khan et al. 2024). The need for substantial and sustainable funding arises from ongoing expenses related to frequent upgrades in both hardware and software, as well as the rising costs associated with subscribing to electronic databases. In ARADA, insufficient funding not only hampers the training of archivists but also poses a considerable challenge in providing adequate training for digitization and preservation of electronic formats. As is demonstrable from the history of

ARADA, adequate funding is crucial for ensuring the success and longevity of a digitization project, as it guarantees the implementation of enhanced services and the project's overall sustainability (Pandey and Misra 2014).

11 Technology Obsolescence

The degradation of digital media contributes to the loss or unavailability of digital information over time, as media tends to deteriorate or decay shortly after the digitization process (Pandey and Misra 2014). Additionally, challenges arise from the susceptibility of digital media being lost during disasters or targeted virus attacks. The necessity for re-digitization arises from the probability that electronic resources generated in earlier years using outdated technologies might become inaccessible or incompatible with newer technologies (Pandey and Misra 2014). The staff of ARADA stay ahead of such challenges by continuously monitoring hardware and software and ensuring that upgrades are implemented timeously. Failing to maintain the technology required to carry out the work could result in the disastrous loss of decades' worth of data.

12 Summary

ARADA stands as a crucial initiative in the preservation and accessibility of southern Africa's rich rock art heritage. Through digitization efforts led by RARI at the University of Witwatersrand, ARADA has amassed a vast collection of digital records encompassing rock art from diverse regions and traditions across the African continent. This digital repository not only safeguards invaluable cultural artefacts from physical degradation and loss but also facilitates widespread access for researchers, educators, and the public.

The significance of rock art in understanding the history, beliefs, and practices of ancient communities in southern Africa cannot be overstated. It provides a window into the lives and worldviews of past societies, offering insights into their social structures, spiritual beliefs, and interactions with the environment. Moreover, rock art serves as a testament to the resilience and creativity of indigenous peoples whose cultural identities have often been marginalised or erased by colonial forces.

ARADA's digitization efforts, coupled with state-of-the-art scanning equipment and robust data management systems, enable the preservation of rock art collections in various formats, including photographs, drawings, and historical documents. The repository's user-friendly interface and comprehensive metadata enhance accessibility, fostering research, education, and public engagement initiatives. However, ARADA faces several challenges, including limited funding, technological obsolescence, and the ongoing maintenance of digital media. Addressing these challenges will require consistent sustained investment, collaboration across institutions, and adherence to best practices in digital preservation and access.

Despite these challenges, ARADA remains a beacon of hope for the preservation and celebration of southern Africa's cultural heritage. By harnessing the power of digital technology, ARADA ensures that these invaluable cultural treasures continue to inspire and educate present and future generations, contributing to a deeper understanding of our shared human history and cultural diversity.

Acknowledgment: We thank the anonymous reviewer for their encouraging comments and helpful suggestions. We are also grateful to Dr Sam Challis for his support and Prof. David Pearce for providing insightful information to help with revisions. This work would not have been possible without the former staff of the Rock Art Research Institute who all helped to make the African Rock Art Digital Archive of the international standard that it is. Though we cannot name everyone, we are thankful for all their efforts.

References

Bahn, P. 2010. *Prehistoric Rock Art: Polemics and Progress*. Cambridge: Cambridge University Press.

Chippindale, C., and P. Taçon, eds. 1998. *The Archaeology of Rock-Art*. Cambridge: Cambridge University Press.

Clottes, J. 2008. "Rock Art: An Endangered Heritage Worldwide." *Journal of Anthropological Research* 64 (1): 1–18.

Clottes, J., B. W. Smith, S. H. Jang, E. Devlet, M. Ogawa, W. Zhang, et al. 2019. *Rock Art in East Asia: A Thematic Study*. Charenton-le-Pont: International Council on Monuments and Sites.

David, B., and I. J. McNiven, eds. 2018. *The Oxford Handbook of the Archaeology and Anthropology of Rock Art*. Oxford: Oxford University Press.

De la Porte, B., and R. Higgs. 2019. "Challenges in Digitization of Cultural Heritage Material in the Western Cape, South Africa." *South African Journal of Information Management* 21 (1): 1–11.

Department of Arts and Culture. 1999. National Heritage Resources Act 25 of 1999. https://www.gov.za/documents/acts/national-heritage-resources-act-25-1999-28-apr-1999 (accessed May 28, 2025).

Flanders, J., and E. Mylonas. 2017. "Digital Humanities." In *Encyclopedia of Library and Information Sciences*, edited by M. J Bates, and N. Maack, 1286–97. Boca Raton: CRC Press.

Hampson, J., and S. Challis. 2024. "Cultures of Appropriation: Rock Art Ownership, Indigenous Intellectual Property, and Decolonisation." In *Deep-Time Images in the Age of Globalization: Rock Art in the 21st Century*, edited by O. M. Abadia, M. W. Conkey, and J. McDonald, 275–88. Cham: Springer International Publishing.

Hampson, J., S. Challis, and J. Goldhahn, eds. 2022. *Powerful Pictures: Rock Art Research Histories Around the World*. Oxford: Archaeopress Publishing Ltd.

Hollmann, J. C. 2014. "'Geometric' Motifs in Khoe-San Rock Art: Depictions of Designs, Decorations and Ornaments in the Gestoptefontein-Driekuil Complex, South Africa." *Journal of African Archaeology* 12 (1): 25–42.

Khan, I. R., R. J. Milic, B. Su, and V. Vadász. 2024. "Learning from Practice in the Digital Age: 'Digitalisation of Heritage in New Zealand'." *Architectural Science Review* 67 (6): 1–15.

Laue, G., S. Challis, and A. Mullen. 2018. "Concerning Heritage: Lessons from Rock Art Management in the Maloti-Drakensberg Park World Heritage Site." In *Aspects of Management Planning for Cultural World Heritage Sites: Principles, Approaches and Practices*, edited by S. Makuvaza, 119–30. Johannesburg: Springer Nature.

Lewis-Williams, J. D. 1981. *Believing and Seeing: Symbolic Meanings in Southern San Rock Paintings*. London: Academic Press.

Lewis-Williams, J. D. 1994. "Rock Art and Ritual: Southern Africa and beyond." *Complutum* (5): 277–90.

Mbeki, T. 2000. "Address at the Uveiling of the Coat of Arms, Kwaggafontein, 27 April 2000." https://dirco1.azurewebsites.net/docs/speeches/2000/mbek0427.htm (accessed September 30, 2022).

Namono, C., and E. B. Eastwood. 2005. "Art, Authorship and Female Issues in a Northern Sotho Rock Painting Site." *South African Archaeological Society, Goodwin Series* 9: 77–85.

Ndlovu, N. 2009. "Access to Rock Art Sites: A Right or a Qualification?" *The South African Archaeological Bulletin* 64 (189): 61–8. https://www.jstor.org/stable/40588136.

Ndlovu, N. 2016. "The Management of Heritage Resources in the Maloti-Drakensberg Park, Lesotho-South Africa: Reflecting on the Benefits of World Heritage Status." *Southern African Humanities* 28 (1): 103–17.

NEDCC. 2019. *Digital Preservation Assessment Handbook*. Northeast Document Conservation Center (NDCC). https://www.dpconline.org/handbook (accessed September 11, 2024).

Pandey, P., and R. Misra. 2014. "Digitization of Library Materials in Academic Libraries: Issues and Challenges." *Journal of Industrial and Intelligent Information* 2 (2). https://doi.org/10.12720/jiii.2.2.136-141.

Regensberg, R. 2013. *The Changing Social Character of a Shelter: A Case Study from Matatiele*. Unpublished Honours Research Report, University of the Witwatersrand.

Rock Art Research Institute. 2002. *RARI Annual Report*. Johannesburg: University of the Witwatersrand.

Rock Art Research Institute. 2007. *RARI Quinquennial Report*. Johannesburg: University of the Witwatersrand.

Rock Art Research Institute. 2019. *RARI Quinquennial Report*. Johannesburg: University of the Witwatersrand.

Siteleki, M. 2014. *Plant Power and Land Use: A Case Study in GIS and IKS in Matatiele, Eastern Cape, South Africa*. Unpublished Honours Research Project, University of the Witwatersrand.

Smith, B. W. 2016. "Rock Art in South African Society Today." In *Relating to Rock Art in the Contemporary World: Navigating Symbolism, Meaning and Significance*, edited by L. M. Brady, and P. S. C. Tacon, 127–56. Boulder: University Press of Colorado.

Smith, B. W., and S. Ouzman. 2004. "Taking Stock: Identifying Khoekhoen Herder Rock Art in Southern Africa." *Current Anthropology* 45 (4): 499–526.

Smith, B. W., D. J. Lewis-Williams, G. Blundell, and C. Chippindale. 2000. "Archaeology and Symbolism in the New South African Coat of Arms." *Antiquity* 74 (285): 467–8.

Whitley, D. 2021. "Rock Art, Shamanism, and the Ontological Turn." In *Ontologies of Rock Art*, edited by O. M. Abadia, and M. Porr, 67–90. London: Routledge.

Bionotes

Mduduzi I. Maseko
37707Rock Art Research Institute, University of the Witwatersrand, Johannesburg, Gauteng, South Africa
mduduzi.maseko@wits.ac.za
https://orcid.org/0000-0002-5302-9494

Mduduzi I. Maseko is a Rupert Art Foundation Academic Intern at the University of Witwatersrand's Rock Art Research Institute, where he is the official academic liaison with the lab of the African Rock Art Digital Archive.

Mbongeni Tembe
37707Rock Art Research Institute, University of the Witwatersrand, Johannesburg, Gauteng, South Africa
mbongeni.tembe@wits.ac.za
https://orcid.org/0009-0008-9176-4212

Mbongeni Tembe is the Lab Manager of the African Rock Art Digital Archive in the Rock Art Rock Research Institute.

Sello Mocumi
37707Rock Art Research Institute, University of the Witwatersrand, Johannesburg, Gauteng, South Africa
sello.mocumi@wits.ac.za

Sello Mocumi is a Digital Image Processor in the lab of the African Rock Art Digital Archive, in the Rock Art Research Institute.

Sibongiseni Lukhele
37707Rock Art Research Institute, University of the Witwatersrand, Johannesburg, Gauteng, South Africa
sibongiseni.lukhele@wits.ac.za

Sibongiseni Lukhele is a Digital Image Processor in the lab of the African Rock Art Digital Archive, in the Rock Art Research Institute.

Yola Nzimela
37707Rock Art Research Institute, University of the Witwatersrand, Johannesburg, Gauteng, South Africa
yola.nzimela@wits.ac.za
https://orcid.org/0000-0001-9983-896X

Yola Nzimela is a Rupert Art Foundation Academic Intern and academic liaison with the lab of the African Rock Art Digital Archive in the Rock Art Research Institute.