Ubumba Olungashi:

A Case Study of South African Artist Hezekiel Ntuli's Unfired Ceramics.

by

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ABSTRACT AND KEY TERMS

Hezekiel Ntuli (1912-1973) was a sculptor from KwaZulu Natal, South Africa, renowned for the wide variety of busts he made out of unfired clay (Ubumba Olungashi in Zulu). Many of Ntuli's artworks were sold to the tourist industry; and are therefore mostly found in private collections today. Throughout the years, however, museums have been able to acquire some of Hezekiel Ntuli's works by way of donations or other means, such as purchasing the works. Due to the high demand for Ntuli's work he would produce several copies of a single form and by-pass the firing process. From a conservation point of view, unfired clay is not as stable as fired clay and presents challenges such as powdering, cracking, breaks, flaking, and sensitivity to moisture. The latter results in increased complexity for conservation treatment. Outside of an archaeological context, there is very little information or published research on the conservation of unfired clay. The paucity of current research and publications which discuss Hezekiel Ntuli's unfired clay sculpture, as well as those of similar artists who created sculptures of a similar type and material, is what has prompted this research. The present research could thus potentially be applied to addressing the conservation needs of a variety of South Africa's clay sculptors.

Keywords:
South African Ceramics, Unfired Clay, Conservation, Hezekiel Ntuli.

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Chapter 1

I solemnly swear I'm up to no good (Introduction)

1.1 Background and Aim

Hezekiel Ntuli was a Black South African Artist who lived between 1912 and 1973. During his lifetime he was well known for his sculptures of animals, such as leopards, and his busts of Zulu men and women. He made the majority of his works out of two materials. The main and most important one being unfired clay and the other being paint (perhaps commercial enamel paint though this has never been properly confirmed). Ntuli was committed to his art, even going so far as to relocate to the Eshowe district of KwaZulu Natal[1] to have continued access to the high-quality clay in the area. During his lifetime Ntuli's art was highly sought after and he could not keep up with the demand (Schlosser, 1975:90). Even though Hezekiel Ntuli was highly popular during his life there is not much information to be found on him. He has been mentioned in books such as *Land and Lives*[2], and there few journal articles - but largely it is incredibly difficult to find information on this once very well-known artist. Some museums still have his artwork on display such as the Pietermaritzburg Museum who have fourteen of his works on display and three in storage, places like the Vukani Zulu Cultural Museum (Vukani Museum) in Eshowe also have approximately ten of his works currently in storage. In addition, his works appear in private collections - because of his popularity in the tourism trade.

I first encountered Hezekiel Ntuli's work in January 2023 in the Leeb du Toit collection owned by the University of Pretoria's Museums. I was immediately drawn to his sculptures because of the life Hezekiel managed to bring into his works. The first time I saw his *Bust of a Zulu Man* I was taken by how kind the man looked. It was then that I started to consider the material and method of production. It was while I was looking at the sculptures questioning how he made them that I started to notice some loss of material in the form of crumbling on his *Leopard Ashtrays* and his *Bushman* bust; this is when I started questioning how one would go about conserving unfired clay. During this line of questioning, I came to the startling realisation that there is even less research documenting the conservation of unfired clay than there is

[1] Province on the east coastline of South Africa
[2] Land and Lives: A Story of Early Black Artists by Elza Miles published in 1997 by the Johannesburg Art Gallery & Human and Rousseau, 1997.

documenting the life and art of Hezekiel Ntuli. It was from combining these two gaps in literature that I came to the subject of this dissertation. The question I asked myself was who was Hezekiel Ntuli, and how can I conserve his work.

In this paper I will be making use of a literature review to briefly document the life of Hezekiel Ntuli. I will also be looking at how the Leeb du Toit collection was acquired and what drove Ms Leeb du Toit to collect the art she did. In this literature review I will be looking at the process of conservation of ceramics as a whole before focusing on the conservation of unfired ceramics.

1.2 Feasibility and Importance of the Research

This research is possible as the University of Pretoria (UP) has six of Hezekiel Ntuli's works in its Museum holdings, four of these works are busts and t two are painted animal sculptures. The research focusses on documenting the works and their condition, analyse the materials, and identify possibilities for conservation treatment. The importance of this research is underscored by a lack of available data. During his time Hezekiel Ntuli was a very sought-after artist and demand for his work often outweighed the supply. This means that there are many of his works scattered across the world while not much is known about him. Little research has been carried out to understand the care and treatment of these types of objects. I am hoping this paper will contain valuable information for the handling, care, and conservation of unfired clay sculptures as well as information on Hezekiel Ntuli himself.

1.3 Research Methodology

Data for the research was obtained through a variety of research methods including a literature review (see Chapter 2), which was further supplemented with informal interviews with the collector and the artist's son. These interviews were augmented with observations of local potters plying their trade and the collection of original clay used for experimental purposes in thinking about treatment of the artworks. The approach in the research is a treatment-based approach on five case study objects created by Hezekiel Ntuli, informed by the literature review. An empirical methodology was used for the treatment-based approach as decision-making was based on my observations as I worked with Ntuli's artworks. Choice of materials for treatment was based on existing research by O'Connor's (2021) to determine which consolidants and their preparation may be deemed the most suitable for UP's Ntuli's artworks.

As conservation materials are made to be reversible to allow for retreatment in the future, they too have a finite life and can be affected by environmental conditions, for example some adhesives may yellow or bloom in certain environments, or slump at higher temperature ranges. This is in part why each object needs to be viewed on a case-by-case and there is generally no one-size-fits-all approach to conservation. Therefore, any materials unsuitable for the storage and display conditions at the University of Pretoria were precluded from the start of the research and only those adhesives that may be appropriate and reversible were selected and tested on the sculptures to determine the best course of action.

In addition, the opportunity arose to visit the Fort Nonquai Historical Museum (Pietermaritzburg, Kwa-Zulu Natal) for a comparative review of their Ntuli sculptures (see Appendix D). As the collections in both institutions were limited, all five artworks at the University of Pretoria Museums and al 10 artworks at the Fort Nonquai Historical Museum were examined, documented and analysed. The UP artworks are included in the main body of text as case studies, whilst the Fort Nonquai artworks are included in Appendix D, with the analytical results available in Appendix E and F. In order to observe the elemental composition of the clay sculptures to see if the sculptures are all produced from the same source of clay, X-Ray fluorescence (XRF) was used; whilst X-Ray Diffraction (XRD) analysis was applied to observe if there are any changes in the structure of the clay once a consolidant has been applied to it.

XRF is a non-invasive and portable technique that can be done wherever the object is residing since it is a handheld machine and thus a preferred method of understanding materials in a cultural heritage setting. The XRF emits x-ray fluorescence in order to detect elemental compositions of an object and was used to determine the micro elements present in Hezekiel Ntuli's sculptures. By analysing these micro elements, one could ascertain if the clay came from the same source, as the micro elemental composition of clay changes depending on the environment.

XRD on the other hand is an invasive technique as samples are required to carry out the analysis. Permission for sampling of the case study objects was obtained from the UP Museums (see Appendix B) and each sample of approximately 10mm by 10mm was scraped off the underside of the base of the UP sculptures where they are out of sight and do not affect the overall aesthetic of the object. The Fort Nonquai sculptures had areas of damage including fragments that had become loosened and these 'self sampling' fragments were used for the analysis. XRD was required to understand whether or not adding a consolidant to unfired clay affected the clay's structure. The XRD identifies the structure of materials by flooding the material with X-rays and then taking measurements of the angles on how these X-rays leave the sample, giving off unique and characteristic signatures showing the structure of the material (Getty Institute, 2009).

Scanning Electron Microscopy (SEM) which is also involves sampling, unlike the XRF and XRD data which is quantitative, produces detailed, magnified images of the surface of an object by scanning using a focused beam of electrons. The resulting images describe what the object is made of and its physical features and would also be helpful in understanding the penetration and potential change the application of a consolidant would affect the clay.

1.4 Chapter Outline

Chapter 1 serves as a brief introduction to the research, its background, aims and methodology.

Chapter 2 reviews available literature. The chapter will be split into five parts. First, looking at Hezekiel Ntuli, his life, his art and his method. The second part of the chapter looks at the Leeb du Toit collection as a whole, and its provenance. The third part of the chapter looks at understanding the difference between clay and ceramic, whilst the fourth section looks at understanding conservation as a concept and broad umbrella term. Part 5 looks at how ceramics are conserved with subheadings for the conservation of fired clay and the conservation of unfired clay.

Chapter 3 looks at the 5 case study objects from the UP collection. The chapter will thus be divided into 5 sections, each focussing on a full description and condition assessment of a selected artwork. The aim of this chapter is to fully study and document the artworks, most of which are currently undocumented, thus adding to the museum records of the UP Museums. The chapter concludes with a summary of the conservation challenges and potential pitfalls for the group of selected artworks and by association other works by Hezekiel Ntuli.

Chapter 4 picks up from the discussion of conservation challenges with a review of potential treatments applied to unfired ceramic objects and proposes a selection of potential treatments. Experimentation on clay samples and pre-treatment tests on the case study objects allow for an evaluation of the proposed treatments and selection of a course on action for treatment which is then recorded for each object.

Chapter 5 concludes the dissertation by summarising the research with an assessment on its limitations as well as suggestions on further research that can be carried out.

Further information is included in the appendices including the letters of introduction, interview transcripts, condition reports and raw data.

Chapter 2

Navigating the maze (Literature Review)

This literature review is divided into five parts. Firstly, I review the available literature on the South African Artist Hezekiel Ntuli, whose artworks are the focus of the present research; secondly, I give some background on the original owner of the collection Juliette Leeb du Toit (LDT) and how this collection came to the University of Pretoria. The literature study then looks at the difference between clay and ceramics; what conservation is and what the conservation of ceramics entails both preventative and in terms of interventive treatments.

2.1. Hezekiel Ntuli, Life and Art:

Hezekiel Ntuli was a Black South African artist that predominantly catered to the white tourist industry. He was born in 1912 to a Zulu father and a Swazi mother in the area of Ntueni, near Eshowe. According to the book *Land and Lives* by Elza Miles, by the age of four Ntuli was modelling sculptures of oxen and calves using fresh cattle dung as a medium. Unfortunately, he did not have much time for his hobby as he was responsible for caring for his two younger twin brothers. This task would have originally fallen to Ntuli's twin sister, but she sadly passed at a young age (Miles, 1997: 38).

From an early age like most Zulu boys, Ntuli began to herd his father's cattle. To pass the time, young Ntuli began to study and observe the wild animals and insects of the area. It was at this moment that Ntuli discovered the medium that he would work with for the rest of his life. Secretly, he would dig clay out from the riverbed, and sculpt the animals and insects he observed. Unfortunately, these early animal sculptures by Hezekiel Ntuli are no more. It seems that neither Ntuli's mother nor father approved of this pastime. According to a 1955 article by Van As cited in Miles (1997:38) Ntuli's mother went so far as to burn his hands to prevent her son from sculpting in the fear that the hobby would turn her son into a "blockhead". On the other hand, once Hezekiel Ntuli's father realised that others were interested in his son's art, he encouraged him to model new things such as members of the family (Miles, 1997: 38).

According to Elza Miles (1997: 38-39), Ntuli began his formal education at the age of seven but hated it so much that he would skip school to hide in dongas[3] to make his clay figurines. Once Ntuli completed standard two (grade four, 7-8 years) his parents took him out of school to herd his father's cattle once again. According to a paper written by Katesa Schlosser in 1975 after she interviewed both Ntuli and his brother Jabulani Ntuli, Hezekiel Ntuli was first educated at the American Lutheran Church near Entumeni, a missionary school, followed by two years of schooling in Pietermaritzburg (Schlosser, 1975: 89). Information on Ntuli's education in Pietermaritzburg seems to originate from a *Sunday Times* article from 1947 referenced by Ezra Miles. This source claims that Ntuli's art was discovered by a European when he was 13 years old. Ntuli's patron then sent him to a school in Pietermaritzburg for two years. At the young age of 11, Ntuli reportedly sold one of his first sculptures to a Mr Vorster who lived in Eshowe (Miles, 1997: 38-39).

In 1929 at the young age of seventeen, Ntuli exhibited for the first time. This was in Zululand, and he ended up winning first prize, with the prize approximately seven shillings. It was during this time that Ntuli met his mentor, Mr Stanly Williams. Mr. Williams was a very strict instructor who valued the quality of work over the quantity of work. He taught this to young Ntuli by purchasing seven of his lion sculptures that he made and breaking all but one in front of the artist (Miles, 1997: 39).

Unlike other artists who sculpted animals, Ntuli was not very worried about the muscular structure of the animals; instead, he was more interested in their postures and the ways they flowed and moved. It seemed that Ntuli had an almost photographic memory when it came to his art. For example, when he was a boy, Ntuli got so absorbed in observing a group of baboons that one of the cattle got injured. After a day this injury began to fester, and a local farmer provided Ntuli with the medication he needed to help the cattle. Years later Ntuli was still able to recreate and model the incident from clay from memory alone (Miles, 1997: 39).

In a conversation with Hezekiel Ntuli's son Paddy Ntuli (29 May 2023), I discovered that Hezekiel Ntuli, also used to model his sculptures after pictures. Ntuli would have a small picture in front of him and from that he would model his beautiful life like sculptures (Figure 1).

[3] A *donga* is an Afrikaans word used to describe a dry gully formed by the eroding action of running water.

Figure 1: (left) Images used by Hezekiel Ntuli and now his son, Paddy Ntuli as models for their sculptures; (right) woman's bust by Paddy Ntuli (Photo credit: Chelsea Roberts, 29 May 2023)

While Mr Ntuli made use of a clay that was very similar to that of local Zulu potters, he did not make use of the same methods as traditional potters would, namely to use slab and coiling methods to build up their vessels. Rather, his sculptures were modelled from solid lumps of clay, he did not make use of the traditional coiling method that most potters use as it is not applicable to creating three-dimensional figures. The works were also not fired, but the surfaces of the artworks were often treated with different finishes such as making use of a slip on his busts or making use of paints[4] to seal and decorate the surfaces of some of his animal sculptures such as his leopard sculptures. Ntuli even went so far as to make use of varnish on some of his works, these paints and varnishes acted as a sealant for his sculptures and are the reason why his pieces are for the most part in a good condition even to this day (Revisions, 2006: 28).

In 1936, Ntuli moved to the area of Eshowe because he had found good quality clay in the area. Ntuli was very passionate about his art and was a highly sought-after artist, especially in the tourism industry. This popularity even resulted in forgers passing their work off as a “Real Hezekiel Ntuli” (Schlosser, 1975: 90). Ntuli’s sculptures became so popular that he had no time to properly dry them before they were swept away by tourism brokers. His art became so

[4] Some people mention that the paint was enamel paint while others say it was acrylic. There is no definitive way of knowing what type of paint was used.

popular that Ntuli could have afforded to live in a European style home but apparently, he preferred the traditional Zulu lifestyle of living in a round grass beehive hut or *indlu*[5], but was comfortably lodged with European furniture in his home (Schlosser, 1975: 90-91).

While talking with Paddy Ntuli, he mentioned that he was only one of Hezekiel Ntuli's twelve children, all born to a single wife, Paddy recounted how this trade allowed him to take good care of his family (Ntuli, 2023). He built them a large round *indlu* to live in that was apparently very impressive to behold. Ntuli himself seems to have been so dedicated to his art that he, himself slept in a smaller hutch that was his art studio (Figure 2). It has also been documented that he expanded his home in 1960 to have a bigger kraal and a secondary round (Schlosser, 1975: 89).

Figure 2: Hezekiel Ntuli at his homestead (photo credit: Schlosser, 1959 :103).

Ntuli had quite a variety of works that he could create by now, predominantly creating busts of Zulu men and women as well as sculptures of animals, such as rhinos, leopards, cattle, and elephants. There was also apparently the occasional group sculpture, but I have never been fortunate enough to see one (Schlosser, 1975: 89-90). Hezekiel Ntuli was an incredibly talented man; he was highly sought after during his life and was even visited by the King of England during one of his royal visits in 1947 (Johannesburg Art Gallery, 1991: 122). This popularity

[5] See Schlosser, 2006: 103-114 for additional images of Ntuli's homestead and studio.

lead Ntuli to be one of the first black South African artists identified by his own name, due largely to the 71 works he allegedly donated to the Pietermaritzburg Museum in KwaZulu-Natal (Pietermaritzburg Museum, 2023). In a recent visit to this museum, it was mentioned that there are currently only seventeen pieces of Ntuli's art present in the museum's collection, but no information was shared regarding the whereabouts of the other artworks. The Pietermaritzburg Museum is not the only museum where one can find Hezekiel Ntuli's art in South Africa. There are artworks in the Killie Campbell Collections in Durban, at the National Cultural History Museum in Pretoria, at the Vukani Zulu Cultural Museum in Eshowe, and at the Natal Museum in Pietermaritzburg (Revisions, 2006: 28). There are also about four of his works currently present at the William Humphreys Art Gallery in Kimberley (Stockenström, 2014: 4-5, 99-100). There are also private collections that contain work by Hezekiel Ntuli and the main case studies of this paper were found in a collection previously privately owned by Juliette Leeb du Toit. Mr Ntuli was also included in many exhibitions all across South Africa and in an exhibit at the *Museum für Volkerkunde (Museum of Ethnology)* at the Kiel Museum in Germany (Revisions, 2006: 28).

Ntuli was a very passionate and talented artist during his lifetime; Hezekiel Ntuli passed away in 1973 at the age of 61 in Mlalazi, near Eshowe. As documented in the exhibit at the Pietermaritzburg Museum, Hezekiel Ntuli passed as the result of a brain haemorrhage (Pietermaritzburg Museum, 2023). According to Ronald Watt in a paper he wrote in 2020, Hezekiel Ntuli was one of the first recorded African Artists of the 20th century, and even though he predated the era of African Modernism in art, you can see echoes of this era in his work (Watt, 2020: 102). He left behind his son Paddy Ntuli who inherited his father's artistic skills and continues to carry his father's artistic legacy (Figure 3; Figure 4). The difference as seen in Figure 4 is that Paddy The fact that Paddy continues to produce works in the same style and themes as his father's sculptures which were also copied by other craftsmen highlights the difficulties that could arise with provenance research on these artworks. Provenance as described by Davis (2017) refers to the history of creation, ownership, change of ownership, use and changes to the object through time. This ensures that collectors and collecting institutions know exactly what they have in their collections, can prove legal ownership and can therefore legally attend to the conservation needs of their collections.

Figure 3: (left) Hezekiel Ntuli with his young son Paddy Ntuli; (right) Paddy and his father Hezekiel holding one of his sculptures (photo credits: Revisions, 2006: 28).

Figure 4: Paddy Ntuli with his own sculptures in the style and imagery of his father's artworks (photo credit: Eshowe.com, 2023).

2.2. Juliette Leeb du Toit:

In terms of provenance, the Leeb du Toit collection was bought from Juliette Leeb du Toit by the University of Pretoria Museums in 2021. Juliette Leeb du Toit is an art historian, and author[6]. The collection consists of 41 objects from a variety of different artists. There are some unknown artists in the collection, but the collection also contains works by Hezekiel Ntuli, Samuele Makoanyane, Mdletshe, M.T Mhlongo, H. Delange, S. Younge, Masscheme, Nago, F. Kruger, and Nkomo. The majority of this collection consists of busts, but the wide variety of artists means that there is a large amount of diversity involved with the different art styles present in the collection.

While researching Hezekiel Ntuli, I contacted Ms Leeb du Toit and we were able to exchange emails. The email communication highlighted her choice of artists and her interests in collecting although her recollection of where are how the artworks in the collection were acquired is somewhat scant and thus the items do not have a very good provenance record prior to her acquiring them. Ms Leeb du Toit in her email (Leeb du Toit, 2023) began by recounting how she started collecting art at the age of eight, focussing predominantly on South African art. Although unusual for an eight-year-old, this interest stemmed from a multitude of factors such as circumstance, what she was exposed to as well as her own shift in ideology. As Juliette Leeb du Toit stated in her email (Leeb du Toit, 2023), she was predominantly raised by three African women who worked in her parent's household; Mina who was probably Tswana came to look after her when she was six months old, then came Louisa who was South Sotho and finally Evelyn Masote a Sotho woman who cared for Juliette and her siblings until Ms Leeb du Toit went to university. But these three women were not the only African influences Juliette had in her life, she observed the *amalaitas*[7] that passed the house as well as their gardener Simon, a Venda Man, and William who ran her aunt's household. In addition, local Ndebele women would come to work in the area in their full married regalia[8]. These people in Juliette's life influenced how she was raised. For example, Ms. Masote brought around her interest in things such as embroidered pillowcases as well as food such as *morogo* and *pap*[9]. This intimate relationship with her African caretakers engendered a fascination with black physiognomies and local culture including her interest in beadwork as the Ndebele regalia she saw often included heavily beaded anklets, and neck pieces that caused the elongation of their necks.

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[6] See Leeb du Toit, J. 1993. *Spiritual art of Natal*. Pietermaritzburg: The Gallery; Leeb du Toit, J. 2017. *ISISHWESHWE, a history of the indigenisation of blueprint in southern Africa*. University Of KwaZulu-Natal Press; Leeb du Toit, 2009. *Mmakgabo Mmapula Mmankgato Helen Sebidi*. Educational Supplement, Taxi Art Books Series. David Krut Publishing.

[7] The *amalaitas* are youth gangs, made up of young boys who that beat people with sticks (Kynoch, 1999: 56-57).

[8] This is an outfit that the Ndebele woman wear once they have been married. It normally contains a lot of intricate bead work. (Smith & Dlodlo, 2018: 180)

[9] *Morogo* is a type of plant very similar to spinach, it is high in nutrients and antioxidants and is used in food and often paired with *pap*, a maize meal porridge and a staple food in South Africa (Njume; Goduka; George, 2014: 1933-1936).

While Juliette Leeb du Toit was influenced by her own personal encounters, Social Studies was a subject at school that spiked her interest. In Social Studies classes, learners were taught about the various ethnic groups, where they were located in South Africa and their cultural practices, as well as select studies about European people. Juliette (Leeb du Toit, 2023) recalls that about every six months, the students would have to do an independent project about a local African cultural group. She recalls having done projects on the Venda, Ndebele, Southern Sotho, and Bushman people as well as a project on African art. She sourced the images and information for these projects from publications such as *Bantu* and *Panorama*. The Social Studies course also took annual trips to see the local 'ethnic settlements and areas' according to Juliette such as the Voortrekker Monument and a Ndebele village near Pretoria. Once Juliette enrolled at the University of Pretoria she even managed to be included on archaeological field trips to the iron age site of Mapungubwe[10] even though archaeology was not her primary focus of study.

Juliette Leeb du Toit was strongly influenced by her grandfather when it came to collecting artwork (Leeb du Toit, 2023). Her grandfather, Justice Quartus de Wet, pesided over the 1963 Rivonia Trial of Nelson Mandela. Justice de Wet was himself a collector, with a focus on oriental carpets, as well as Dutch and Chinese VOC blue and white ceramics. What was most intriguing to Juliette Leeb Du Toit though was her grandfather's very own cabinet de curiosities, which even though she wasn't allowed to touch, was a source of endless intrigue (Leeb du Toit, 2023). This strongly influenced Leeb du Toit to begin to collect items that she found intriguing, such as beaded horns and dolls from the Ndebele village. Each outing she went on would be an opportunity for her to expand her collection of objects (Leeb du Toit, 2023).

According to Juliette (Leeb du Toit, 2023), she started her collection around 1957 with small objects such as Melton Doek[11], pipes, and beaded works. By 1975 Leeb du Toit's interests took a slight shift, she had moved to Natal and developed an interest in ceramics and local Zulu material culture. This interest was further encouraged by two of her colleagues, Ian Calder and Juliette Armstrong[12] who held multiple exhibits displaying pottery from the rural areas, such as the Eshowe area, in the late 1980s. Ms Leeb du Toit started collecting artifacts very early in her life and she is still collecting works today. Juliette used the possessions she collected over the years to decorate her home, she displayed the works in her sitting room, as well as in her office at the University of KwaZulu Natal and her study (Leeb du Toit, 2023).

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[10] Mapungubwe was a kingdom in South Africa during the Late Iron Age and was inhabited from about 970 AD to 1290 AD (Tiley, 2004)

[11] A Melton Doek is a traditional Xhosa head wrap, worn predominantly by African woman to cover their head and is an indication of marital status (Anon, 2023).

[12] Ian Calder is a researcher in the Center for Visual Art at the University of KwaZulu-Natal he is currently focused on Indigenous ceramics of KwaZulu-Natal, South Africa. Juliette Armstrong also works at the University of KwaZulu-Natal, with focus on fine arts, sculpture and ceramics (LinkedIn, 2023).

As the present research is focused on the clay artworks of Hezekiel Ntuli, I found it pertinent to enquire whether she could recall how she acquired her Ntuli sculptures. Ms Leeb du Toit recalls her interest stemmed from a paper that her colleague Ian Calder wrote about a collection of Ntuli's work at the KwaZulu-Natal Museum[13] (Leeb du Toit, 2023). The publication of that article spurred on colleagues and collectors to scour any second-hand outlets, auctions as well as local sales to locate examples of Ntuli's work. Leeb du Toit (2023) recounts how sometimes Ntuli's work was acquired via field trips to the Eshowe area. It was at a Pietermaritzburg Hospice[14] shop that she found the large Bushman bust that was used in this paper. Leeb du Toit (2023) also mentions that Ntuli's artworks were available for sale at a tourist outlet shop called Ivy's. In the interview (Leeb du Toit, 2023), Juliette states that she was at first hesitant to collect his works: "While previously I was aware of Ntuli pieces for sale at places like the tourist outlet Ivy's, I did not quite like the representational quality of the work at first." (Leeb du Toit, 2023). I found this interesting as I was drawn to Ntuli's work because of its strong representational quality, and how his sculptures appear life-like. Unfortunately, even though there was an occasional field trip to Eshowe, Juliette did not acquire any of the works from Hezekiel Ntuli himself, all of the works were acquired via secondary outlets such as auctions and hospices, as such their provenance record as stated previously is somewhat limited.

Even though Leeb du Toit only started acquiring Ntuli's works later on, she was aware of his work since the late 1960s. It seems that Ntuli's work was so widely spread that it was even found in the tourist outlet stores in Pretoria. She also recalls seeing some articles about him in journals such as *Bantu* and *Panorama.* Likewise, she recalls viewing his work at the Royal Agricultural Show in Pietermaritzburg, where Ntuli displayed his work regularly and where he had won multiple awards for his art. According to Ms Leeb du Toit, Ntuli knew the artist Gerard Bhengu who she had published several articles on, and she recounts that "Both were drawn to ethnic studies because of the widespread popularity of this idiom among white buyers/collectors and later also predominantly black supporters (if not buyers per se)." (Leeb du Toit, 2023).

While at the University of KwaZulu Natal, Juliette Leeb du Toit completed a two-year course on ceramics through the Centre for Visual Arts (CVA). According to Juliette the reason she did this was she was becoming increasingly fascinated in understanding how these works of art were made. This led her to collect works by certain artists, as she explains "I wanted to amass as many as possible in order to trace the variety and proficiency in the works." (Leeb du Toit, 2023). This meant that when collecting artworks, she collected art by artists that she could identify.

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[13] *see* Calder, I. 1997. Zulu warriors, Nguni cattle and wildlife: The ceramics of Hezekile Ntuli at the Natal Museum, Pietermaritzburg. Proceedings of the Twelfth Annual Conference of the South African Association of Art Historians, 3–6. Pietermaritzburg: University of Natal.

[14] In this case the hospice mentioned is a charity shop that raises money for a Hospice that looks after people during the end of their lives when their terminal illnesses are no longer treatable (APCC, 2023).

2.3. Understanding the raw material: Clay vs Ceramic.

Clay is a naturally occurring material, present in abundance across the Earth's surface. Clay formation is a long and arduous process, where clay is made up of hydrated silicate of aluminium formed over thousands of years through the process of the weathering and breaking down of igneous and metamorphic rock found in the Earth's crust. There are two different types of clay, primary clay and secondary clay. Primary clays are found at the site of their formation and are usually formed by weathering caused by groundwater, steam and gasses (Buys & Oakley, 1993:4; Breuer, 2012:1); they have a higher degree of purity (for example, the bright white kaolin clay used to make fine porcelain) (Hawkins, 2020:11). Secondary clays on the other hand refers to clay that can no longer be found at its primary source. This clay has been transported by natural features such as rivers, where it undergoes further weathering and decomposition during its transportation (Oakley and Jain, 2002:2). As the clay is transported it picks up additional minerals along with organic material a while being ground to a finer particle size. The impurities colour the clay, making it unsuitable for the production of translucent white porcelain but appropriate for earthenware production and accounting for the wide variety of colour and characteristics of secondary clays (Hawkins, 2020:11-12). Different types of clayey soils are readily available as a natural resource in South Africa (Mulaba-Bafubiandi, 2015: 79). According to Heckroodt (1991: 355), in the Kwa-Zulu Natal coastal region, good quality kaolin derived from granite occurs at a number of localities in the Inanda-Ndwedwe area, north of Durban. Heckroodt (1991:355) names a few areas where good-quality material can be found, including near Nozandla, approximately 30 km east of Eshowe towards the coast. Heckroodt (1991:355) further states "The deposits are clearly residual and their formation is ascribed to the downward percolation of surface water, which leached the feldspar-rich granite of the Basement Complex. The kaolinization took place particularly in a zone between the upper and the lower levels of the fluctuating water table, immediately below the contact between the granite and the overlying sediments of the Natal Group, as well as along fault zones."

Clay has a very interesting property related to the small size and shape of its particles which allows water to cling to the surface of each individual particle. This makes the clay very malleable, with an almost plastic consistency (Oakley and Jain, 2002:2). In the past, potters would have made use of naturally occurring clay, but through time as demand increased, potters began to make additions to their clays by adding hardeners, fluxes, and fillers. Hardeners as the name suggests imparts strength, fluxes flow between the clay particles and fuse everything together, and the fillers (also called openers–such as sand and grog) provide texture to the clay.

Fillers also make it easier to work, and assist with the evaporation of water out of the clay (Buys & Oakley, 1993:4-5; Oakley and Jain, 2002:2-3). Preparation of the clay includes grinding, mulling and sieving when dry, adding water to form a slurry, and possibly sieving once again for a more homogeneous mixture. Excess water is then removed, and the clay is worked by kneading and wedging to remove excess air and bubbles from the clay (Hawkins, 2020:12). Clay can thus be moulded and retains any shape that it has been manipulated into, making it an ideal material for artists to work in as they can rework the clay until the desired outcome is achieved. Once the moulded clay begins to harden, the mechanically bound water present between the particles is released via evaporation (Buys & Oakley, 1993:8-9). The important mineral in pottery is kaolinite, which contains 1:1 silicon to aluminium oxides. The crystal structure shows plate-like particles, which are stacked in layers linked by hydrogen bonds. During dehydration, the clay sheets move closer together, the kaolinite hydroxyls become hydrogen bonded to the next sheet layer, forming a stronger, firmer structure experienced as shrinkage of the clay of 5% or more. At this stage, however, the clay can be re-hydrated and softened once again if needed (Oakley and Jain, 2002: 2).

In order to turn clay into ceramic, an altogether different material, both the mechanically and the chemically bound water needs to be driven out of the clay molecules; according to Buys and Oakley (2011:8-9) this is classified as *"ceramic change"*. During this process, the weak hydrogen bonds are replaced by stronger and shorter oxygen bridges which results in the clay shrinking a little further. This ceramic change only occurs once the clay is heated beyond a certain temperature between 400˚C and 600˚C. After the 500˚C mark the clay will be fully dehydrated, meaning that the clay will be irreversibly altered as it has undergone "*ceramic change*", where the regular sheet-like crystal structure of kaolinite is being lost and amorphous metakaolinite is formed. The clay will therefore no longer slake[15] or disintegrate when it is exposed to water. However, this firing temperature still does not fully protect the clay from the effects of water. As Buys and Oakley (2011:26) explained, even clay fired to around 600˚C (the temperature for low fired clay) will still rehydrate when exposed to wet conditions for an extended period of time and may begin to dissolve and deform. In addition, water affects both the ceramic as well as fillers in the clay such as Gypsum (hydrated calcium sulphate) and calcite

[15] 'Slaking' refers to the breakdown that normally occurs when thoroughly dried clay chunks or lumps are immersed in water (damp or wet lumps will not normally break down in the same manner because the wet clay resists the penetration of water). Typically, the water attacks the surface and particles simply fall away. Online: https://digitalfire.com/glossary/slaking

(calcium carbonate). Both of these fillers dissolve in water with long exposure. The lower the firing rate of clay, the more porous the finished product. This level of porosity thus affects how vulnerable a ceramic item is to water as the more porous the work, the more water it can absorb. Consequently, objects made of unfired clay are the most susceptible to being damaged and altered by the presence of water.

Once fired, ceramic objects decrease in porosity turning the plastic clay material into a hard and brittle ceramic one (Buys & Oakley, 1993:9). A ceramic object may undergo multiple firings depending on its decorative elements. The first firing would be biscuit firing, followed by a glaze firing or multiple lower temperature firings to achieve different decorative effects. (Buys & Oakley, 1993:8). The strength of a ceramic is governed by its firing temperature, as resistance to mechanical wear is governed by how hard the ceramic is, and as such highly porous ceramics have a very low mechanical strength and while non-porous ceramics have high mechanical strength (Buys & Oakley, 1993:18-19). Consequently, the environmental factors that cause damage and deterioration to the ceramic also change; hard non-porous ceramics will break and crack easily, while 'softer' low-fired or unfired ceramics may powder.

As Hawkins (2020:7) states: "for the conservator and restorer, it is of profound importance to understand and recognise the differences between types of ceramics before any restoration procedures are carried out" because it can provide information about provenance of the ceramic– its materials, when it was made, who made the object and where the object was produced. This understanding affects how ceramics absorb contaminants and informs the removal of these during cleaning. Likewise, the adhesion process for ceramics is also affected by the type of ceramic, as some adhesives that are used on a ceramic such as porcelain, will be ineffective on an earthenware ceramic because of its absorbency (Hawkins, 2020: 21-22).

A clear distinction thus needs to be made between fired and unfired objects, even though unfired clay sculptures are classed together with ceramics, they are in effect not To be classified as ceramic, clay needs to be fired at least to a certain degree, which Hezekiel Ntuli's clay sculptures are not.

2.4. Understanding conservation

Conservation is an umbrella term which refers to all the actions and processes used to promote and extend the life of cultural heritage. This includes recommendations for appropriate handling, storage, functional use and or exhibition, known as preventative conservation, as well as remedial treatment known as interventive conservation (AIC, 2023). In an institutional environment this also includes examination, documentation, research and education. Some treatments such as cleaning, although interventive, can also be preventative in nature, as by removing soiling one slows or halts deterioration processes. Preventative conservation focuses on minimising any future deterioration or damage to an object. This is mainly achieved by ensuring appropriate and careful handling and transport, adjusting the exhibition and storage environments the object is in, monitoring for any changes in the object's condition and appearance and responding to these; and ideally these methods do not change or interfere with the appearance, structure or material of the object (ICCROM, 2023). Buys and Oakley (1993) detail how ceramics are mostly susceptible to mechanical damage from careless handling, packing and transportation (Buys and Oakley, 1993: 20), causing breaks, impact damage, abrasion and scratches. Ceramics are also prone to damage from salts, dirt and staining, as well as chemical deterioration from water (Buys and Oakley, 1993: 27-28), acids, alkalis (Buys and Oakley, 1993: 27), and fire (Buys and Oakley, 1993: 28).

Conservation and restoration are guided by ethical codes and guidelines, that guide practice (AIC Ethics and Guidelines for practice). Referring to Jedrzejewska (1976), Brooks (1998), and Ashley-Smith (1982), Caple (2000) further states that these ethics provide the basis for making choices, they form a conceptional framework for the conservation profession as well as the basis for professional conservation practices (Caple, 2000:59). These ethical considerations affect the treatment of an object, ideally any treatment performed should be reversable, the treatment should also be as minimally invasive as possible and one must only do what is necessary to preserve as much original material as possible. Other factors that influence the way an object is conserved is the intended use of an object as well as the value of the object. Value is not just monetary, although artifacts lose a certain amount of monetary value when damaged[16], rather value as defined by Applebaum (2010:86-115) refers to historical value, art value, aesthetic value, use value, research value, educational value, age value, newness value, sentimental value, associative value, commemorative value, as well as rarity value.

There is a difference between treating an object in a museum collection and treating an object

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[16] *Kintsugi* is an example of Japanese ceramic repair which aims to restore some of the lost value by filling these loses with precious metal (Hammil, 2016: 70-73)

for a private collection. This can be simply illustrated with a focus on reversibility as well as minimal intervention in a museum setting, whereas when treating an object for a private client one may focuses more on restoring the functionality and use of the object. In addition, objects in museum may often be expected to look old, whereas in private hands these same objects are expected to look the way they did before damage occurred. For example, a damaged glazed platter in a private setting may be fully painted to mask damage, whilst in a museum setting areas of loss may just be filled or new sections inserted without mimicking the original surface decorations. This is of course an over-simplification as different museums may have their own agendas and works in art museums are more likely to make aesthetic repairs than a cultural history museum, but museums focussing on indigenous material may have tribal consultants who would insist on improving the aesthetic appearance of cultural material as it would be disrespectful to the ancestor-maker to exhibit the work in a worn condition.

Objects in private settings have different uses than objects in museums. Museum objects will also be handled with more care and will be stored in favourable conditions, while objects in a private setting may not be subjected to the same level of care, such as a teapot that in private hands would perhaps still be in use. Therefore, objects that are in a private setting may be treated with restoration materials that are hardier and more difficult to reverse in order to ensure safe use, while museum objects will be treated with materials that despite being strong are easier to reverse and less hardy including cellulose based fill materials and water based acrylic paint (Hawkins, 2020: 7). This difference between museums and private is also one that opposes conservation and restoration as the long-term goals of treatment, both guided by their respective codes of ethics.

2.*5.* The Conservation of Ceramics:

As Scott (2011:5) points out "much has been written concerning the conservation of ceramics over the past 30 years", this is particularly true of recording the historical development of conservation. Clay has been in use since at least 15 000 to 10000 BCE (Buys & Oakley, 1993: 63) and the vast majority were made to be functional, such as a vessels made to store or cook food. Decorative objects were also made and tended to be highly prized and often had a religious meaning (Dye, 2018: 1). The value of these objects meant that there would be a desire to repair them if they ever broke or got damaged and indeed, according to Williams (1988:147-149) in Buys and Oakley (1993: 63) the oldest example of a ceramic repair can be found in the British museum and dates back to 7000 BCE these examples are rare. According to Odegaard, and O'Grady (2016: 85) "ancient ceramics were rarely repurposed or repaired after a breakage because it was difficult to restore their original function as a container". These and other authors illustrate that the repairing of ceramics has been around for a very long time with differing levels of success and has evolved from 'handy house maids' repairing broken objects in 1861 (Buys & Oakley, 1993:63), to specially trained ceramic conservators today.

Koob (1998: 49-50) suggests that as ceramics began to be viewed as objects of value, a greater desire arose for ceramics to be re-paired to their previous appearance. From the 19th century Koob (1998: 50) mentions there was an increase in demand for ancient ceramics with a desire to possess these pieces of the past, but in a fully restored state. Although very little documentation on the conservation of ceramics exists prior to the 20th century, by the turn of the 20th century, there was an increase in the number of ceramics in museum and private collections, and this new found interest led to a need for formal ceramic restoration workshops. From the 1960s onwards many 'how to' manuals were published for the amateur and professional ceramic restorer such as Malone, 1976 *How to Mend Your Treasured Porcelain, China, Glass and Pottery* (Koob, 1998: 51). With this evolution the materials used for ceramic conservation also changed over time and much has been published on the conservation or previous restoration of ceramics from 1990 to 2005 (Scott, 2011:5).

Many early repair materials used naturally occurring materials, including bitumen (this material becomes extremely brittle with age and breaks into sharp pieces), wax (this material ages poorly and tends to discolour, because of the slightly tacky surface it has a tendency to pick up dust and grime), animal glues (this material darkens with age, and can stain the ceramic, the material also shrinks with age, is sensitive to water and becomes brittle), shellac (shellac is very sensitive to changes in climate which causes it to be brittle, it is also a very hard material to reverse the repair) and plaster (this material has a poor reversibility, can leach chemicals into the surrounding ceramic and weighed more than the ceramic surrounding it causing stress) (Garachon, 2010: 3; Koob, 1998: 53-58). These previousrepairs can tell the conservator about how indigenous cultures made use of materials they had access to, in order to repair ceramics (Odegaard, Moreno, White & Smith, 2009: 3)

Older methods used to mend breaks included mechanical fastenings and adhesion of fragments, or a combination of both. Mechanical fastening or bindings included making use of reeds, ropes, wires or metal plates and screws which can be seen in repairs of surviving Greek and Roman pottery (Koob, 1998: 50; Garachon, 2010: 3). In today's conservation world, it is very rare to see such methods still in use, especially the use of mechanical bindings such as rivets and wire. In some cases, these rivets and wires were often removed by conservators of the past. Today conservators may make the decision to keep such mechanical bindings on the ceramics in order to preserve the history of conservation and how its methods have evolved (Garachon, 2010: 3; Albert, 2012: 1). From viewing ceramics that have previously been repaired by mechanical means such as rivets, it is plain to see why previous conservators chose to dispose of the technique, as the repair can be unslighlty, affecting the legibility and aesthetic value of the piece. In other cases, the iron rivets or brass plates can oxidize and leave discolorations and cause staining in the ceramic body and glaze.

When ceramics break, they experience a certain amount of loss, in many cases a fill is required., Materials such as adhesive pastes or putties are used or a ceramic fill is made for the areas of loss. One can make two types of ceramic fills, the first for a porous ceramic (low fired) and the second for a non-porous ceramic (high fired) (Geschke, 2010: 74). Replacement material may not always be made from ceramic; some repairs and areas of loss such as handles and lids have been replaced with a whole different medium such as wood or metal (Koob, 1998: 54-56).

The common theme with all of these previous repair materials is that for the most part they do not have good aging properties. As the repair materials age, they begin to discolour, shrink or become brittle. These poor aging characteristics mean that previous repairs often become unstable and need to be removed and replaced, preferably with a material that has favourable aging characteristics. In the past previous repairs would be removed and the object retreated without proper documentation, meaning that the process and materials would not have been very clearly explained and there would have been little to no photographic documentation of the repair before treatment and removal of the previous repair. It is only in the last 20 to 30 years that conservators have been thoroughly documenting previous repair materials and methods (Scott, 2011: 5). These previous repairs are a part of the history of conservation and can allow conservators a clear picture of how the profession has evolved and improved over time, but also serves as explanation for certain causes of damage observed in ceramic objects. These repairs can also shed some insight into how the communities of origin repaired their ceramics (Odegaard, et al, 2009: 3)

According to Scott (2011: 5) the repair materials of the past have laid the path for the production of our conservation materials of today, “fills or joins with shellac or lime plaster of the 1900s gave way to crosslinking PVA’s, nitrocellulose and AJK dough [Alvar-Jute-Kaolin;

a mixture prone to considerable shrinkage and now obsolete] in England in the 1960-1980 period, which was replaced by Pliacre epoxy resin in the 1990s." At the same time some materials that were used in the past by conservators are making a comeback in the conservation world today as conservators look for conservation materials that promote ease of retreatability. Scott (2011: 5) states that "the same story can be seen in the use of animal glue, plaster and shellac, followed by cellulose acetates, polyvinyl acetates, cellulose nitrates, into the modern role of more stable polymethyl acrylate copolymers, and the return of tradition materials once spurned by the ceramic conservator , such as starch pastes, paper fibre, water soluble glues and different types of synthetic cellulose products, such as hydroxypropylcelluloses which were not available in earlier periods." While there are many methods and tools used in conservation that are no longer in use there are still hundreds of different materials and tools used in new modern conservation. How one selects which materials and tools for the conservation of a particular object is dependent on several factors, including the type of ceramic you are working with, the expectations of the custodians and the future use of the object whether this will be functional, exhibition or research. Firstly, the type of ceramic affects the type of materials and techniques that can be applied to the treatment of that object. There are broadly three categories of ceramics based on firing temperature, namely earthenware, stoneware and porcelain (Jain & Oakley, 2002: 3). The different clays and their firing temperature affect the porosity of the ceramic body, which in turn defines the ceramic's ability to absorb contaminants resulting in disfiguring staining or damaging salts. An object's porosity also dictates whether solutions would be able to draw out these contaminants during cleaning processes, or the type and viscosity of adhesive to use.

The second area of consideration prior to treatment which affects decision-making focuses on the future use of the object. The conservation materials and techniques used for an object in a controlled indoor environment, such as that of a museum, will differ vastly from those used to restore a large outdoor monumental sculpture, or the functionality of a household item. For example, if one was commissioned to repair/restore a damaged fruit bowl that held heavy sentimental value to a client but was in daily use, one would use materials that would have a certain amount of resistance to daily use, such as serving food and cleaning-up afterwards.

Lastly, determining the custodian's expectations of the treatment links with the above section on future use. Once again, a setting where an object is in private ownership may require for the object to be fit for use, or in a seemingly pristine condition with near invisible restoration, following a six-foot, six inches rule as explained by Scott (2011: 6) where "fills [are imperceptible and] are not recognisable as such from six feet away, but become evident from six inches [away].” Whereas in a museum setting, where there is a certain expectation of visible ageing as part of the object’s accepted value and significance, areas of loss may be reconstructed with a plain undecorated fill and left unpainted, rather than reconstructing the missing area and presenting the object as complete and undamaged. In fact, this museum approach is one aligned with conservation ethical guidelines of minimal intervention, where only treatments that are needed to stabilise and appreciate the artefact are carried out, to reveal the ‘true nature’ and ‘authenticity’ of the object (Buys & Oakley, 1993: 139-140)

In addition, today’s conservation revolves around promoting treatments that ensure the reversibility of previous conservation interventions in order to ensure retreatability (Buys & Oakley, 1993: 108). Old treatments may require reversal due to a long-term complication such as discolouring or to reveal an original surface hidden beneath restoration materials for research purposes. However, no treatment is ever fully reversible, in particular consolidation treatments which seek to strengthen and stabilise artefacts through impregnating them with dilute adhesives run the risk of collapsing the original material if fully reversed and are thus not promoted. Appelbaum (1987) tackles the issue of reversibility as a tenet in conservation, its meaning in terms of ensuring treatments carried out to cultural material cause little to no damage, bearing in mind that conservation materials age, and that retreatment is a likely outcome for any materials which has previously been treated.

2.5.1. Types of conservation treatment:

Ceramic conservation can be a multi-step process often including steps in cleaning, the removal of previous repairs, consolidation or stabilisation, adhesion, loss compensation, and finally aesthetic integration of the restored area. The following section explains these steps in further detail in the order that they will typically be carried out. As in everything in conservation though, there is no single approach or solution and it is important to remember that each object is unique and may require one or more treatments but not necessarily all, and the order may change as dictated by the conservation needs of the object receiving treatment.

2.5.1.1. Cleaning

According to Oakley and Jain (2002: 45) “The process of cleaning a ceramic object involves the removal of foreign material that is not part of the original fabric.” This means that any material that is not part of the original object can be classified as soiling including superficial dirt or staining caused by handling or pollutants in the atmosphere, contaminants absorbed during use or burial, and previous repairs (Oakley & Jain, 2002: 45). In addition, when original material changes in response to its environment or as a result of deterioration processes, it can lead to the creation of a product of alteration (*Science for Conservators*, 2005: 14). However not all soiling should be removed indiscriminately as some of the 'soiling' could be integral to interpretation as is the case with archaeological ceramics. Residues from use can provide valuable research data as to how the object was used, for example information on what foodstuffs were made or stored in vessels can assist with site interpretation and understanding past lifeways; understanding the contents of storage and transport vessels from wrecks can give an indication of trade routes and goods. Data collection and interpretation of residues is not limited to cooking, storage or transport vessels, in some cultures sculpted ceramics objects were painted or ritually fed. As cleaning is a destructive treatment in the sense that once removed a 'contaminant' cannot be placed back onto the object. In addition, in the case of soiling which is a product of alteration such as silver tarnish, cleaning the silver to remove the tarnish eliminates both the foreign sulphur atoms as well as silver atoms from the objects (*Science for Conservators*, 2005: 14). Cleaning should thus be carefully considered. The goal of cleaning should be to remove any foreign material that is first and foremost actively damaging or weakening the object, or obscuring the object's original colour, surface decorations and texture which in turn compromises the interpretation and understanding of the object. In addition, areas of material that are not properly cleaned can emphasize areas of damage such as cracks and breaks even once the ceramic has been re-adhered.

There are different methods when it comes to cleaning and each method is dependent on the needs of the object that is being conserved. Mechanical cleanings involve actions such as dusting and brushing (this usually takes care of any surface dirt), picking and cutting (this is used to remove soiling closely attached to the object, this cleaning method could possibly cause damage to the object), abrading (this makes use of an abrasive suspended in a liquid or gel, this type of cleaning removes soiling that is trapped in small scratches and gaps in the ceramic), and lastly the use of vibrations such as with the use of dental ablators (*Science for Conservators*, 2005: 27-40) or air blown from an airbrush. Most objects can withstand mechanical surface cleaning to remove loose dust and particles without much interference, however not all objects can withstand immersion in water or solvents.

If mechanical cleaning methods do not remove all the soiling on an object one can move on to solvent solutions. Solvent solutions include both aqueous or water-based solutions, as well as chemical solvents. Aqueous cleaning makes use of water, which is often described as the universal solvent and is one of the safest and cheapest ways to remove soiling from a ceramic object either through swabbing with dampened rolled cottonwool, or wet brushes, immersion or even steam. Although the latter two modes of delivery may be appropriate for non-porous wares, they may cause problems for objects with areas that have been previously restored, are unstable, or objects that are low-fired or unfired, or are made of other materials as well as ceramic such as metal, it is thus always best to test first. (Buys & Oakley, 1993: 88-89)

If water alone is not able to solubilise or mobilise the soiling, water's cleaning properties can be enhanced by the addition of soaps and detergents (*Science for Conservators*, 2005: 75-85), or by modifying pH using acids or alkalis[17] (*Science for Conservators*, 2005: 89-103). Cleaning can also be enhanced through the use of solvents (*Science for Conservators*, 2005: 61-71), as well as chemical reactions including oxidation and reduction reactions, and the use of sequestering agents[18] or catalysts such as enzymes[19] (*Science for Conservators*, 2005: 107-126).

There are different methods of delivery for cleaning treatments including steam cleaning, immersion or poulticing. When contaminants such as salts and stains have penetrated deep into the body of ceramics, methods include drawing the contaminant out using desalination in the case of salts from burial environments or household use (Oakley & Jain, 2002: 54-56); alternatively poulticing can be used to mobilise the particles of the stain by making use of a solvent, and draw stains out of the ceramic and into the poulticing pack (Buys & Oakley, 1993: 92-93)[20]. In some cases where drawing stains out is insufficient, disfiguring discolouration can

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[17] Acids can be used to remove salt from the surface of ceramics. This is often used in an archaeological site as well as in water environments such as excavations in both salt and fresh water. Can be damaging to both the conservator and the object so one must handle with care.

[18] Sequestering agents are used to remove surface concretions and dirt by isolating and binding to specific components within the dirt.

[19] Enzymes are used to *digest* soiling such as fats, carbohydrates and proteins.

[20] Poulticing aims to mobilise the particles of the stain by making use of a solvent in a poulticing pack. Depending on the context different materials can be used to create the poulticing pack from pulped paper to cotton wool or different clays to which aqueous solution solvents or detergents can be added. The pack is applied to the stained area in a gel form limiting the amount of liquid in contact with the object, a preferred method for objects that would otherwise be sensitive to the presence of liquids. As the poulticing pack dries out it draws the solvents and contaminates from the object back towards the pack. This technique is particularly useful when artifacts would otherwise not withstand immersion in solvents or solutions.

sometimes be lightened using chemicals such as hydrogen peroxide (Oakley & Jain, 2002: 51-53).

Some of these materials can be damaging to a ceramic, depending on the object's unique characteristics. Even water, though the gentlest of all methods listed, can still cause damage to a ceramic if the ceramic is not treated properly. Before aqueous and chemical cleaning is undertakenone should first have an understanding of the object they are working with to determine both the appropriateness of the method and materials they will make use of (Oakley & Jain, 2002: 47-51).

All of these methods fall under the general classification of dry and wet cleaning and are the first step that a conservator takes when working on an object. If this first step is not done properly, it can affect the rest of the conservation effort.

2.5.1.2. Removal of Previous Restoration

If the object receiving treatment has been repaired or restored in the past, the removal of restoration materials is usually tackled next if the repair materials are no longer stable or pose potential damage to the object. This step is not always necessary, either because there is no previous repair or because the previous repair has aged favourably and is not causing any damage to the ceramic (Portell, 2003: 1). Conservators may also choose not to remove the previous repair as it has historic significance or because removing the previous repair could cause more harm than good. Previous repairs can be found in multiple places such as in the surface, whether in the form of inpainting or glaze, it can be found as an adhesive, as a fill and even in the form of a mechanical binding material (Oakley & Jain, 2002: 39-44). It is sometimes possible for a conservator to upgrade the previous repair instead of removing it fully, for example, a poorly aged surface coatings or paint used for retouching and has aged poorly is now visible when looking at the object while underlying fill or adhesion is stable. Then only the paint may potentially be removed and replaced (Oakley & Jain, 2002: 39). Previous repairs can be reversed mechanically using a scalpel to pick, ping or shave off layers, or the conservator may use heat or solvents which will degrade the particular adhesives used.

Deciding which method to use depends on the restoration materials used in the previous repair, the fragility of the ceramic body, risks to the ceramic body and surface decorations. For an unglazed or low fired ceramic, a scalpel can scratch the surface of the object and so another approach may be preferred; on the other hand, an instrument like a scalpel can be used on surfaces that are glazed, running the blade along the surface as this would cause little to no damage (Oakley & Jain, 2002: 39-40; Larney, 2013: 70).

When looking at an adhesion as a previous repair there are some precautions that need to be taken into account. When separating joints, it is usually left up to solvents to do most of the work. One normally only makes use of mechanical methods when removing any remaining adhesive on the sherd edges. But one needs to be careful as specific solvents only work on specific adhesives, for example animal glue is soluble in warm water while Paraloid B-72 is soluble in acetone. Nel (2007: 35) placing the object under UV light can sometimes assist in identifying the type of adhesive used in a non-invasive manner in order to identify the compatible solvent that will allow for the safe degrading the adhesive or solubilising it. This means that as one is trying to undo an adhesion some precautions need to be taken. In the case of low fired or unfired ceramics they may react differently to a solvent being applied to them than a glazed ceramic. Because of their high porosity, these types of ceramic readily absorb liquids and thus it is best to avoid exposure to liquids for a long period of time. Such as with the type of material, the type of decoration can also be affected by the application of solvents. This means that small unnoticeable areas should be tested first to ascertain how the object will react and if damage is likely to occur. When undoing an adhesion, it is very important to support the ceramic as it is possible that the adhesion will reverse faster than anticipated leading to a collapse of the object and additional damage. The last precaution is that one should always go for the least harmful solvent first; there should be no damaged sustained by the object or by the conservator (Oakley & Jain, 2002: 40-41).

Previous repairs can also include the filling of join lines, small gaps and chips, as well as rebuilding larger areas of loss. This can be done using a variety of repair materials, thus their removal depends on the position of the material used, the position of the fill, as well as its method of attachment, whether fills were built up or were applied directly to the ceramic to fill small gaps, or as a detachable fill which is then adhered in place (Oakley & Jain, 2002:42, 77-80). In the case of the latter, the fill could be weakened by the removal of the adhesive, which will cause the fill to be easily removed. There are in addition mechanical ways of working down fills (plaster, epoxy putties and the like will be removed mechanically), and chemical ways of degrading the fill material itself to remove it (cellulose pulp fills for example could be removed by swelling with water). Part of good planning for conservation treatments should thus include how one can deal with reversing such repairs in the future as often reversal of repairs requires very different processes than the initial application, as Horie (2012: 5)

[21]explains “polymers applied from dispersions diluted with water (selected perhaps because the adherend was sensitive to solvent action), require considerable amounts of organic solvents for swelling and washing out the polymer. In the process the polymer will expand, causing fractures in the object at the micro and macro levels.” Consistently retreating objects thus places them at risk of damage and why retreatablity should be a vital consideration.

Any reversal of previous restoration or repair will be followed by thorough cleaning of the object and the repair site, including all sherd edges. Any remaining adhesive residues will affect the success of further treatments. Cleaning will then be followed by thorough clearance cycles to ensure there are no residues left behind from the cleaning treatment that could affect any subsequent treatment. If abrasive sponges or erasers were used, vacuuming would ensure adequate clearance of the dry surface cleaning material by suctioning away any particulate residues. In the event of wet treatments, water is usually used to remove any chemical residues (Oakley & Jain, 2002: 45-56).

2.5.1.3. Consolidation

Consolidation treatments are carried out when an object or part of its surface is in an extremely fragile state and in risk of disintegrating. Materials that require consolidation are actively deteriorating and need to be stabilised, the consolidant acts as a binding material and so needs to be able to impregnate the object to impart structural and cohesive strength (*Science for Conservators 3*: 123). Thus, consolidants are generally dilute, low viscosity adhesives, either pure resins in pellet form dissolved in a solvent; or as emulsions formed by suspending a resin or solvent solution in water (Sease, 1991: 11). Consolidants are selected to penetrate within the object or seal off its surface to prevent other materials from being absorbed. When it comes to this stage of conservation, one must begin to think of the ethical considerations of this treatment. One needs to consider, is this treatment reversible, and if not, is there perhaps another consolidant that would work the same but be reversible[22] (Oakley & Jain, 2002: 57).

When selecting a consolidant there needs to be some considerations. Firstly, one needs to consider the penetration of the consolidant, how far will the consolidant soak in if it soaks in

[21] In the case of the Horie, 2012 reference, this refers to the introduction of the book *Adhesives and Consolidants in Painting Conservation* edited by D’Sa. The section is titled: Setting the scene: Considerations and decision making for planning and undertaking treatments by Velson Horie p1-6

[22]Reversable meaning that the treatment is not permanent and can be undone if the need arises, this need can be because of poor ageing characteristic.

too much it is incredibly hard to reverse if it soaks in too little the treatment is not useful. Next consideration is appearance, will there be a change in the surface appearance of the object if a consolidant is applied. Third consideration is the condition of the object, for example, if the object is damp a water-based consolidant may work best, but at the same time if the object is too wet, the consolidant may not dry and would therefore serve no purpose. The last condition to consider is the ultimate housing environment of the object. Some consolidants are affected by environmental factors such as temperature. If the temperature becomes too hot and exceeds an adhesive's glass transition temperature, it can cause the once hard adhesive material of the consolidant to soften. For example, Paraloid B72, an acrylic resin (ethyl-methacrylate copolymer), is one of the preferred adhesives in conservation as its properties and ageing characteristics are well documented. It is suitable for use on stone, ceramic and many other materials and can carry a heavy load; it also does not become brittle or discolour when ageing. However, it has a glass transition temperature of 40˚C and if used on a statue that stands outside in the sun in hot climates, the adhesive, will begin to weaken and potentially causing damage to the object. Thus, in this context a different adhesive may be required. In addition, consolidants used in hot climates my soften at the surface layer and become tacky, leading to the surface attracting dirt and pollutants (Oakley & Jain, 2002: 57-58).

There are multiple ways to apply consolidants, whether by making use of a brush, a pipette, an injection, a sprayer, by immersing the object in the consolidant or by making use of vacuum impregnation. The key to a successful consolidation is how well the mixture penetrates into the object, which is dependent on the viscosity of the consolidant; the more viscous/thick the solution, the less it will penetrate into the ceramic. In consolidation one will usually make use of a concentration between 5% to 15%, anything over this may be too viscous to penetrate the ceramic (Oakley & Jain, 2002: 58-59). According to Koob (2023) if one is consolidating for strength, they need at least a 7% solution.

The final part of consolidation is the drying of the treatment. One should always test the solvent used for the consolidant solution on its own first to see how the surface will react, then the consolidant in solution can be tested on an unobtrusive section of the ceramic. This test section will be the deciding factor on what consolidant is chosen. Once dry the consolidant can be shiny, be too matt or too opaque or the consolidant could have bloomed while drying, causing a noticeable colour change in the surrounding area. In such cases, use of a different solvent, perhaps one that evaporates more slowly such as butyl alcohol. Alternatively, drying of the consolidant can be slowed down in an attempt to prevent blooming; this can be done by placing the object in a solvent atmosphere for up to two days (Oakley & Jain, 2002: 59-60).

2.5.1.4. Adhesion and Joining of Pieces

Horie (2012: 1) describes adhesives as "a substance that holds two surfaces together by interfacial forces." In industry, the goal of adhesion is to create a strong bond that will not fail and adhesives used commercially tend to be stronger than the material they join together. Although adhesives in both the commercial and conservation fields need to adjust to stresses and strains, in conservation adhesives are usually selected so that they are weaker than the substrate so that built-up stresses and strains will lead to failure of the adhesive rather than than breakage of the ceramic parallel to join lines (Horie, 2012: 4). As Horie (2012: 4) "When stresses are applied to a joint, even greater stresses can be generated at the adhesive interface than those originally applied, thus increasing potential for damage. Clever design at the joint is critical to reducing these maximum forces below the (unknown) value that the object can withstand."

Conservation thus has an element of engineering in its design and problem-solving approach, one can adjust the properties of adhesives to suit the particular and unique requirements of each object under treatment (Horie, 2012: 3).

When joining pieces of a ceramic there are some theoretical considerations that need to be taken into account. Firstly, one needs to think about the substrate including composition, porosity, surface uniformity and any previous coatings such as consolidants on the adherend (Mecklenburg, Fuster-Lopez & Ottolini, 2012: 9). Next, the adhesive's properties need to be taken into consideration including the type of adhesive, its molecular size and weight, glass transition temperature, solvent choice for dilution, concentration of the adhesive in the solution, viscosity, tack, application method, method of cure of the adhesive, curing time, any potential shrinkage, and lastly any health and safety hazards to be aware of (Mecklenburg, Fuster-Lopez & Ottolini, 2012: 9).

All of these characteristics ensure the adhesive selected is appropriate for not only the object being treated, but also the future use of the object, ensuring the adhesive is strong enough to properly join the fragments without causing unnecessary damage to the object. Then comes the consideration of reversibility: can one reverse the adhesion without damaging the object if the need arises? One must also ensure the liquid adhesive will flow over the surface as "if the liquid is not attracted to the substrate surface, as is the case with water on wax, it will ball up into droplets that sit on the surface without wetting it. If the liquid is attracted to the surface, for example acetone on varnish, the drop will spread spontaneously." (Horie, 2012: 2). Thus, the viscosity of the adhesive needs to be considered as a low viscosity adhesive will soak right into a porous substrate consolidating it, but will leave too little adhesive on the adherend and a good join will not be formed. In addition, all materials age including the substrate of the object treated, as well as the conservation materials themselves. Understanding the long-term physical and chemical changes of adhesives as well as of the object, including those changes as a result of the object's use, ensures the adhesive selected has good ageing characteristics, that is it will not shrink, will be durable and not discolour with age (Horie, 2012: 5; Oakley & Jain, 2002: 61-62; Larney, 2013: 71-72).

Once the adhesive has been selected, when adhering an object, it is always best to do a dry run of the assembly order without making use of any adhesive. This way the conservator knows in what order the fragments need to be adhered and no fragment is locked out; this method also helps to lessen gaps between the sherd edges (Oakley & Jain, 2002: 63-64).

2.5.1.5. Gap Filling

There is inevitably a certain amount of material that is lost when a ceramic is broken. For strong ceramics like porcelain, this loss may be minimal but for soft ceramics such as low fired ceramics, this loss may be more extensive. To repair the object the lost material is replaced with the addition of another substitute material. As mentioned earlier in this chapter (see 2.5.) replacement materials were rarely made of the same material as the original ceramic and included plaster, wood, metal replacements amongst others. Today the conservator has a selection of synthetic polymers at their disposal and selection depends on extent of damage or loss and the type of ceramic under treatment. The type of fill material selected comes down to the hardness the ceramic that is being treated. One should not have a fill material that is stronger than the ceramic, this will just cause the ceramic to break in a new place and not along the old breakage point.

For low fired ceramics one will make use of materials such as calcium-based fills including Plaster of Paris, Polyfilla, a Flügger and Modostuc which come as premade pastes. These are all on the softer side of filling materials allowing for easy shaping and removal and can be used either for gap filling or reconstruction of missing parts (Larney, 2013: 74-75). From working with an acrylic resin such as Paraloid B-72[23] I have seen that it can be reconstituted in a number of potential solvents, allowing the conservator to select desired characteristics for a sympathetic repair material. When using Paraloind B-72 as a fill material the solution can be bulked out with fillers and bulking agents, as well as tinted to be less visually intrusive.

For harder ceramics filling materials such as epoxies are used. Two examples of these fill materials are both two-part epoxies, one is a liquid resin and is called Araldite and the other is an epoxy putty called Milliput, which comes in multiple shades. These two-part epoxies include a resin and hardener which when combined initiate a chemical reaction, transforming the two liquids into a cross-linked solid as they cure. Although they can be chemically broken down or mechanically removed, they cannot be resolubilised making retreatability more complex and potentially damaging to the object (Larney, 2013: 73-74).

When attending to large gaps or recreating missing pieces of a ceramic one may want to make use of a mould. The simplest way of doing this would be to use dental putty, which becomes malleable when exposed to warm water and causes no damage to the ceramic. There are other methods such as making use of liquid rubber latex to make a two-part mould, using materials where an impression can be left such as on silicone rubber, or alternatively just make a mould out of liquid silicone rubber. In the cases of moulds one can decide whether to make a one-piece mould or a two-piece mould. One-piece moulds would work just fine for flat objects or decoration, but they will not work for 3D elements on a ceramic, such as handles (Larney 2013: 75-76). This is where a two-piece mould would come into play, or one can make use of a support which is then sculpted over (Oakley & Jain, 2002: 78-83).

Once the fill is complete it often has to be worked down in order to blend with the rest of the ceramic. Depending on the fill, one may ordinarily start with a scalpel to work the fill down to a more manageable size, once this is done rifflers are brought in to shape and remove most of the excess fill still left behind, finally the cushioned abrasives are brought out. These abrasives do the final work on the object, by smoothing out and levelling the surface, ideally there will be no ridges and your fill will be flush with the surface of the ceramic. Once the conservator has fully worked down the fill, polishing cream is brought out to smooth any final small

[23] In this case the Paraloid cannot be used plainly, it will be too liquid, so in cases like these fillers and bulking agent are used in order to thicken up the Paraloid for easier workability. Paraloid can be bulked and filled until it reaches the right opacity and texture of the ceramic. Another advantage is that it can constantly be re hydrated using acetone, it is also a very revisable fill material.

scratches or imperfections once it has been worked it, it is removed using an appropriate solvent (Oakley & Jain, 2002: 83-85).

In the past conservators chose a fill that would be the most visibly integrating to the object, now they may decide to go with a fill that stands out. Fills can be left plain, can be of a matching background colour, or can be of a completely different colour, or can be painted over (Sweetnam & Henderson, 2022: 63).

2.5.1.6. Aesthetic Integration of the Repair

When working with ceramics, one may choose to integrate the repair so that it visually blends in completely with the ceramic. There are many different ways of doing this. But there are aspects of repair that need to be taken into consideration first. As with other conservation material selection, the material used should ideally be reversible, have good ageing characteristics, be easy to apply, safe to use, be compatible with any other material used, and most importantly is the appropriate colour.

Depending on what the repair material is made of, the first step in integrating a repair is to seal the fill so that it is no longer porous on the surface. Next a base layer is usually applied in a similar colour to the ceramic itself, for example if the repair was of a porcelain vase, the base layer would be a white colour in order to blend the repair into the ceramic. Next, background colours are added to ensure a good integration of the ceramic repair. The final part of a proper integration is to do inpainting of the decorations present on the ceramic, these decorations ordinarily go on top of the colour matched background layer (Larney, 2013: 78). Acrylic paints and varnishes, formaldehyde resins, alkyd resins, bleached shellac, epoxy resins are all used depending on the object treated and the desired finish. Ready-made paints, or dry pigments that the conservator mixes into binding media such as a cold glaze or a resin can all be used although typically conservation grade materials are selected so that colours are less likely to shift, fade or yellow over time due to light exposure (Oakley & Jain, 2002: 88-90).

Once the repair has been integrated surface gloss can be adjusted with matting agents, varnishes, and sealants. At the same time though, one will rarely achieve the perfect finish during retouching. In this case materials such as abrasives and polishes can be used by the conservator to achieve the desired finish to the ceramic repair. When working with ceramics there is always a possibility that one will need to make use of gilding or replicating metallic finishes, this is ordinarily the last process to take place in a full ceramic repair integration. (Oakley & Jain, 2002: 90-95)

When aesthetically integrating a repair, the most important thing to remember is lighting, a repair may look accurate in the lighting of a conservation studio but in natural lighting the match is not good[24]. Therefore, one should attempt to work with as much natural lighting as possible in order to ensure they have the best possible integration (Oakley & Jain, 2002: 87-88).

Other considerations to bear in mind are whether the ceramic is glazed or painted. Glaze is usually stronger than the ceramic body as it is fully vitrified and can therefore handle harsher materials, one has more options when it comes to the conservation of glaze. With paint, depending on the paint, materials such as water can cause a lifting in the paint other materials such as acetone-based adhesives can cause the paint to dissolve. Once again depending on the type of paint used or the thickness of the glaze it could be possible that darkening will be observed in any areas where adhesive or consolidants have been added. Once the glaze has been observed one needs to identify whether or not the ceramic has decorations under the glaze or over the glaze, overglaze decoration also known as enamelling is more delicate than decorations that have been glazed over. After consistent use the enamelling is likely to fade or chip off and can be susceptible to harsh cleaning. Another factor that effects a ceramics conservation is whether or not it has gilding. These metallic decorations are very delicate and can be very challenging to recreate. (Buys & Oakley, 1993: 149-160)

2.5.2. Considerations in the Conservation of Unfired Clay

As outlined above, remedial conservation treatment involves a number of sub-treatments which are themselves completely dependent on the material(s) the object is made from. Sturdier materials can withstand more treatments and there are more variations in the types of treatments and conservation materials that the conservator can select to tailor the treatment to the particular object. When looking at the treatment of unfired clay a number of challenges are highlighted. Clay, while abundant, is not a stable material when unfired. It is often prone to cracking whether from the drying process or from age, and is also prone to crumbling, powdering, flaking and is quite fragile which leads to easy breakage (Odegaard, 2014: 1316;

[24] This is referred to as Metamerism and refers to a phenomenon in colour perception where two colours that match under one light source may appear different under another light source

Buys & Oakley, 1993). The biggest stressor to unfired clay though is moisture (Odegaard, 2014: 1316). This moisture can come from many sources such as a rise in moisture content on a humid day, or a flood. As a result of clay's natural tendency to absorb water readily humidity causes the clay to become damp meaning that it is more likely to attract dust and particulate contaminants, whilst flooding on the other hand would cause the clay to rehydrate and will cause erosion, deformation, such as slumping or complete loss of the work (Odegaard, 2014: 1316). Unfired clay's instability in the presence of moisture is thus a real challenge when thinking about conservation treatments, as any contact with liquids could be problematic.

This influences the choice of cleaning techniques, as immersion may cause the clay to hydrate and dissolve, and mechanical cleaning with a damp swab runs the risk of smudging or softening details. Not being able to use wet cleaning techniques means that staining is a very difficult thing to eliminate? remediate? as where for other ceramics one can make use of things like poultices or vapour cleaning to remove any surface residues and staining. In the case of unfired clay, the staining will probably become part of the object and its history, as it is near impossible to remove. Ventikou (2001) shares the difficulty in treating a painted unfired clay sculpture,

> "Initially, heavy dust was removed by soft brushes. Solubility and consolidation tests were carried out in order to determine the effect of solvents on the polychromy. Azurite and Prussian blue were found to be affected by water, acetone, Industrial Methylated Spirits (IMS) and isopropanol. 1-methoxypropan-2-ol did not have an effect on them, whilst white spirit slightly dissolved Prussian blue, but did not dissolve azurite. The white overpaint on the cushion was dissolved by ethanol and water; the latter however did not affect the original white layer. The red paint layer was dissolved by IMS but remained unaffected by white spirit and water.
>
> Solvent cleaning was applied selectively in areas of accumulated dirt. The head was cleaned with white spirit, the hand was cleaned with a poultice of ethanol and water and the overpaint on the cushion was removed mechanically and with the aid of water. The remaining overpaints were not removed because the preservation of the original materials could not be guaranteed."

Ventikou's (2001) case study demonstrates how challenging cleaning treatments can be and how each material will react in different ways, including previous conservation and repair materials and at times the best course of action is no treatment at all. For clay sculptures one is thus almost completely limited to dry surface dusting with tools such as soft brushes and vacuums, but if the sculpture is currently crumbling even these cleaning implements will cause damage and loss of material.

Unfired clay's sensitivity to liquids also affects the application of consolidants to fragile objects and adhesives, as both need to be absorbed in liquid form before they dry or cure to a solid form. In Ventikou's (2001: sp) treatment, the aim of consolidation was both to strengthen and stabilise the unfired clay, as well as the paint layer. "Consolidation tests were performed in areas of loss by using different solutions of Paraloid B72 and Aquazol 500. Since the use of purely water-based treatment was excluded as too risky for the unfired clay, those two acrylic resins were chosen because they polymerise by solvent evaporation." (Ventikou, 2001: sp). For the Chines unfired clay sculpture Ventikou selected Paraloid B72 as it was readily available to the V&A, it "dissolves in a wide range of solvents, displays long-term stability and is widely used with satisfactory results". Aquazol® 500 likewise is "soluble in a range of solvents, is stable, does not cross-link during ageing […] it does not cause discolouration."

Consolidants or adhesives that do not have a fast enough drying time can cause damage to the object by. In addition, these liquids can cause a change in appearance in the clay surface, either causing darkening, tide lines, blooming or change in gloss in or on the clay where the adhesive or consolidant is applied. Testing prior to treatment as demonstrated in Ventikou (2001: sp) is vital and should include an evaporation test, does the adhesive or consolidant you are using dry down at a fast enough rate. The second test that needs to be run occurs on the object itself on the bottom or the least obvious place, here one needs to place a small amount of the consolidant or adhesive on a piece of clay to see if it discolours the clay or if it leaves tide marks on the clay.

There is very little literature about the conservation of unfired clay outside of an archaeological context, and for the most part that has to do with low fired clay objects. In many cases conservators have their own ways of conserving unfired clay objects. The way that these objects are treated though depends on what one finds valuable about the object[25] (Appelbaum, 2010: 65-119). If an object's value is academic, it will be treated differently to an object that's value is purely aesthetic or artistic.

[25] Barbara Appelbaum (2010) Describes in detail conservation treatment methodology, how artifacts carry different values and how treatment depends on the values one wants to highlight such as aesthetic value, art value, research value, use value etc. (Appelbaum, 2010)

In *A Conservation Manual for the Field Archaeologist* written by Catherine Sease in 1994, a way to consolidate fragile archaeological ceramics is mentioned which makes use of a two-part consolidation method. This method is specific to dry and fragile archaeological low fired ceramics. First one must ensure the ceramic is clean as possible all around before an application of consolidant is begun with a brush. To begin with Sease (1994: 28) mentions that to maximise the amount of consolidant absorbed one can apply their solvent, such as acetone or toluene to the object first. This step helps to increase the penetration of the consolidant. Before the solvent has time to fully evaporate out of the object one should apply the first layer of consolidant, starting with a weak percentage such as a 3% or a 4% concentration of the adhesive dissolved in the desired solvent. These low percentages allow for the consolidant to be soaked in easier via capillary action. The more viscous a solution is the longer it will take to be absorbed into the object. One should apply a few layers of the low percentage consolidant before moving onto a higher percentage of consolidant for strength such as a 7% or a 10% solution. The higher percentage of consolidant is for strength. One should ensure that the solvent does not have time to completely evaporate between each application because the consolidant will penetrate deeper if there is enough solvent present in the ceramic (Sease, 1994:28). Although Sease describes the consolidation process in the context of fragile archaeological ceramics, these tend to be fired at a relatively low temperature below 900°C (Odegaard, 2014: 13-16) and similarly to unfired ceramics will remain very porous and sensitive to moisture. This is a very interesting method of consolidating a fragile and deteriorating object and warrants more investigation (see Chapter 4).

Ventikou (2001:sp) tested various concentrations of solutions of Paraloid B-72 and Aquazol 500 in Industrial Methylated Spirits (IMS) and eventually settled on a 4% solution of Aquazol 500, in a mixture of one part water to two parts IMS. As Ventikou stated "Although this introduced small amounts of water, it was considered acceptable and suitable for the consolidation of both the unfired clay and the polychromy as it provided enough strength without causing darkening or swelling.

In addition to Ventikou's (2001) article, the main source of information that will be used in this paper though has been researched and documented by Ariel O'Connor in a paper titled *From Cuneiform to Contemporary: The Conservation of Unfired Clay*. This paper was presented by O'Connor in 2021 at the 19th Triennial Conference by ICOM-CC Glass and Ceramics in Beijing. In this paper Ms. O'Connor looks at multiple different methods for the conservation of unfired clay while endeavouring to find a method to conserve an unfired clay sculpture by the contemporary artist Kristen Morgin, the artwork that she is focusing on is titled *Monopoly* and was made in 2007, this artwork is made up of 146 components, with painted surfaces which presents an added challenge to the piece's conservation.

At the moment research has been done by Ferron and Matero in O'Connor (2011: 2) about the use of ethyl silicate-based consolidants for earthen architecture that they have adapted from literature on the consolidation of stone by Wheeler 2005. The method of using an ethyl silicate-based consolidant has recently been used to successfully conserve an unfired cuneiform tablet at the Louvre art gallery in France (Tiennot, Mertz, Bourges, Liégey, Chemmi & Bouquillon, 2020: 285). Treatments such as these are performed by conservators when stabilisation of clay is needed for the clay to survive a process, such as desalinisation, regular handling by researchers as well as for the structural stability of the object. These articles while focusing on the longevity of the object do not look at the effect this treatment would have on the aesthetic value of the artifact. This method was used on an artifact where the value of it comes from what has been documented on the clay, and not the works aesthetic value.

On the other hand, there is an article about the conservation of an 18th-century Chinese painted and unfired clay sculpture. This work is present at the Victoria and Albert Museum and was conserved by making use of Aquazol 500 in water and industrial methylated spirits (IMS). According to Ventikou, 2001 by combining water and the solvent one was able to soften and consolidate the polychrome surface of the artwork while simultaneously still penetrating the clay. In Hong Kong, an inner portion of a hollow painted *Wen Pang Guan* temple statue from the 18th century was conserved using a two-step process. The conservators first pre-treated the clay with the Aquazol 500, and then made use of a silicic acid ester-based consolidant to consolidate and strengthen the artwork (Leung et al., 2014: sp).

For this paper O'Connor made use of online communities, archives and message boards for conservators. She made use of the archived American Institute for Conservation (AIC)'s email DistList, Objects Specialty Group listserv (OSG-L), and Wooden Artifacts Group listserv (WAG-L). Through these services O'Connor was able to get advice from other conservators on how to conserve unfired clay based on their own experiences. According to O'Connor, what became clear to her during the research is that conservators did not have one specific way of conserving unfired clay. Conservators use a large number of different consolidants and adhesives, with a wide range of different application methods such as making use of brushes, capillary action or immersion.

O'Connor documented the multitude of different treatments that conservators across the world make use of in the conservation of unfired clay. Once she had the information she needed, she made use of clay samples provided by the artist. On these sample pieces of clay, O'Connor (2021: 6) tested eight different consolidants to see how they would affect the surface and colour of the clay once applied. In this experiment it could be seen that visually Ethulose 5% in Ethanol worked best along with methylcellulose 5% in deionized water and Butvar B-98 1% in methynol, visually these consolidants did not seem to cause much discolouring to the clay and were not glossy on the clays surface. On the other hand, Paraloid B-72 5% in toluene, seemed to have darkened the ceramic and has left a very glossy layer, the same reaction occurred with the Paraloid B-72 5% in xylene and the Rhoplex AC-33 3% emulsion.

O'Connor then made a second batch of mock-ups in order to observe how the consolidants would affect the painted decorative elements of Morgin's work. What O'Connor found was that the water-based emulsions as well as the B-72 in xylene did not visually disturb any media. On the other hand, some of the consolidants used such as the Paraloid B-72 in toluene darkened some of the media and caused running in other areas, making it unsuitable for the conservation of the media used in Miss Morgin's work.

Once these experiments had yielded results O'Connor came up with a treatment plan that she felt worked best for the object and protected the aesthetic value of the artwork. Depending on what the artwork needed O'Connor made use of different techniques and materials. In one area she made us of A 5% solution of ethulose in ethanol with a 00 paintbrush with the use of a microscope. Another method she used was adhering fragments with a 40% solution of B-72 in xylene, chosen because of its ageing properties and safety around paints. She applied this adhesive by using a 00 paintbrush that was formed into a point by allowing B-72 to dry on the brush thereby hardening it into the form she required. Once the works had been repaired, she made use of a colour fill, making use of Flügger, in order to level out any ridges or difference in level of the repaired area. With permission from the artist O'Connor made use of some preventative conservation and further reinforced any areas that did not contain backing, for this she made use of Japanese tissue paper and B-72 in xylene.

Overall, O'Connor's treatment was a success, she managed to conserve the object while still staying true to the aesthetic value of the artwork. O'Connor succeeded in treating the visible cracks and breaks and managed to match her work with the surrounding surface making her repairs invisible, all the while managing not to saturate or solubilise the surface and decorations on Morgin's work.

Another route that may come in with the conservation of unfired clay objects would be to low fire the object. This would be a final effort treatment, when nothing else has worked a conservator may decide that this is the only way to preserve the work. As I mentioned above though this would not only completely change the value of the object, but it would also change the object itself. The debate on re-firing ceramics is particularly central for archaeologists and researchers as "the conservation of archaeological ceramics includes the preservation of the research potential of the artefacts including any and all evidence that provides insight into the manufacturing technology of the time including the type of clay, temper used, the date and firing temperature of the kiln fire and any residues that speak to the vessel's use or function." (Odegaard, 2014:1316. By firing the object, one is subjecting it to chemical and mechanical changes that may prove to be detrimental to the object. There are multiple things that could go wrong when re-firing an object. "When ceramics are heated beyond their original firing temperature, they are likely to distort and melt. If there are glazes, these may become fluid and change colour. Also, existing cracks may become sprung." (Odegaard, 2014:1316). Tennant (1999) explains, that it is vital for archaeologists and researchers to know if they are dealing with original artefacts or ceramics that have been modified at a later stage as organic temper may burn away alongside any residues from use, and [thermoluminescence] dating of previously re-fired ceramics is compromised as the dating relies on re-firing the pots in a technique known as Rehydroxylation (RHX) dating[26]. In the worst-case scenario, the object itself can be damaged beyond the loss of its data, it can crack or explode in the kiln. This type of damage can be caused by air bubbles that are trapped in the clay, and since one does not know how the clay was worked or prepared, there is no way of knowing the full extent of the risks that come with re-firing ceramics or firing unfired clay. In the best-case scenario the object comes out of the kiln with no problems, it is materially stronger, and its life could be said to have been extended. Davison & Harrison (1987: 34) recount how archaeological ceramic sherds damaged and darkened by fire during the London Blitz (1941) were re-fired in 1947 as

[26] Rehydroxylation (RHX) dating relies on the characteristic of clay to chemically combine with water when exposed to the atmosphere at a predictable rate governed by the average ambient temperature a ceramic experience over its lifetime. "The dating procedure involves measuring the mass of a sample of ceramic and then heating it to around 500 degrees Celsius in a furnace, which removes the water. The re-fired ceramic is then weighed immediately, using a highly accurate microbalance, to determine precisely the rate of water recombination. Once the rate is known, the age of the artefact can be extrapolated." (Dacey, 2009: 1).

part of experimentation with the technique The sherds which had been darkened were re-fired for approximately half an hour in a muffle furnace at 700°C and the note on the experiment suggests the sherds returned to their original colour and appearance. Davison & Harrison note there seemed to be no damage to the ceramic fabric and as the three vases had already been subjected to intense heat, and dating could be done based on stylistic characteristics, Davison & Harrison (1987) thus decided that re-firing would pose no ethical concerns in terms of dating and potential damage. The archaeological ceramics were re-fired in an electric potter's kiln, the refiring was deliberately slow to prevent an explosion of steam with a starting temperature of 300C (200C if the kiln was damp), raised by no more than 50C at 30 minute intervals, kiln and sherds were then cooled overnight (Davison & Harrison, 1987: 35). As with the sherds, the experiment was successful, the discoulouration was reversed and the ceramic fabric was stabilised allowing for retreatment of the Greek vases via conventional means. In a case like such as this the decision on whether the conservation and value of the artefact outweigh the risks involved with firing the object (Oakley & Jain, 2002: 57). Re-firing is thus mostly seen on objects such as cuneiform tablets, where the threat of permanent loss of informational value surpasses the aesthetic value of the object, this is only done when every other conservation method has failed (Thicket, et al, 2002: 1).

2.6. Conclusion

The conservation of ceramics is a complex multi-phase process with no single one-size-fits-all approach. Each object presents unique characteristics and as such any conservation response needs to be tailored to that specific object's needs and circumstances. Unfired clay is particularly tricky to conserve due to its sensitivity to moisture and liquids, making any conservation treatment involving liquids, from cleaning to consolidation and adhesion highly challenging. Although some case studies suggest that the use of solvents can lead to a successful treatment, reversal of these treatments may result in partial to total loss of the object. An alternative course of treatment suggested by Oakley & Jain (2002: 57), Thicket, Odlyha and Ling (2002: 1), Buys & Oakley (1993: 104-105) that may come in with the conservation of unfired clay objects would be to fire the object at a low temperature. This is highly contexts as it would not only completely change the value of the object, but would also change the object itself. By firing the object, one is subjecting it to chemical and mechanical changes that may prove to be detrimental to the object. There are multiple things that could go wrong, the object could crack or explode in the kiln if there are any air bubbles that are trapped in the clay, and since one does not know how the clay was worked or prepared, there is no way of predicting the full extent of the risks that come with firing unfired clay (Buys & Oakley, 1993: 8-9). However, if the firing is successful, the object's life expectancy will be substantially improved as fired clay. Although the phase change from unfired clay to ceramic is an irreversible treatment, firing the object as an initial treatment would ensure retreatability in the future as the resulting ceramic is a much sturdier and more stable material which could sustain future cleaning, consolidation and adhesion treatments (Buys & Oakley, 1993: 105).

Chapter 3

Portraits in Clay (Case Studies)

Chapter 3 contains the reports of all 5 artworks by Hezekiel Ntuli found in the Leeb du Toit collection at the University of Pretoria. Each condition report contains the measurements, photographs as well as a description of the object. The object is described proceeding first from its base and moving upwards to its apex. As per conventions the term right and left in the text will refer to the sculptures' proper or true right and left, and not what I observe in front of me as being on my right and left. The chapter also notes the objects' condition and conservation needs. Condition reporting follows the framework devised and used by the team at the National Trust property, Knole House in Sevenoaks, Kent (UK) reproduced below in table 1.

Table 1: Condition assessment framework (South East Museums Development)

STABILITY	*Stable* *i*	*Potentially unstable* *ii*	*Unstable/steady deterioration* *iii*	*Highly unstable* *iv*
Definition	Condition not expected to deteriorate within the next 10+ years	Condition not expected to deteriorate within next 5-10 years	Change in condition likely to be evident between 1-5 years	Change in condition likely to be evident within 1 year
CONDITION CODE	*Excellent* A	*Good* B	*Fair* C	*Poor* D
Definition	Little or no damage evident.	Minor amount of damage and/or loss of original and added material, or with light discolouration or accretions	Noticeable damage and loss and appears disfigured with visible accretions.	Considerable and/or significant loss of original or added material or major damage/breakage or disfigurement. May be endangering other objects and surfaces.
TREATMENT PRIORITY	*No Treatment* 1	*Desirable* 2	*Necessary* 3	*Urgent* 4
Definition	Conservation treatment not required beyond routine maintenance	Conservation treatment desirable but not necessary to ensure the long term stability of the object. For instance, conservation treatment may be required for curatorial reasons	Conservation treatment necessary to avoid further deterioration, loss or undesirable strain on an object and/or loss of significance (evidential or artistic value).	Conservation treatment required to prevent significant deterioration in condition of object and/or loss of significance (evidential or artistic value). This may include structural vulnerability, risk of total loss of entire object or part of object, or risk of accident to visitors/users

The chapter also includes results of the X-Ray Fluorescence (XRF) analysis carried out on the sculptures. The data included for each sculpture is specific to that object and refers to additional slips or paint on the surface. XRF results are discussed more fully in section 3.6, with data provided in Appendix E. XRD results are discussed more fully in section 4.1.1, with data provided in Appendix F.

3.1. Bushman

Permanent Location: University of Pretoria Museums storage

Left Side View of large Bushman Bust | Recto View of large Bushman Bust | Right Side View of large Bushman Bust | Verso View of large Bushman Bust

Figure 5: The 4 sides of the large Bushman Bust by South African Artist Hezekiel Ntuli (photo credit: Chelsea Roberts, 2023)

Accession Number: 4955575

Place of Production: Eshowe District, Kwa-Zulu Natal

Inscriptions: ‘Bushman’, ‘Hezekiel Ntuli’, ‘Eshowe’

Measurements:

Weight: 8000 g

Height: 281 mm

Width: 231 mm

Depth: 210 mm

General Description:

This is a large bust of a Bushman made by the Zulu sculptor Hezekiel Ntuli. This sculpture was made in the Eshowe District of KZN (Figure 5).

Materials and manufacture:

The Bushman Bust is made of unfired clay extracted from the Eshowe District of KwaZulu-Natal. Once the Bushman sculpture was made, it was put outside where the clay was air-dried and baked in the sun until it dried out. This sculpture was analysed using XRF (see 3.6. and Appendix E) and XRD (see 4.1.1 and Appendix F), five points on the sculpture were analysed (Figure 6). The mid-chest, right shoulder, left scapula, back of the head as well as the underside of the bust were analysed. The first four sample areas displayed a very homogonous composition to the clay with the Al_2O_3 (aluminium oxide) averaging at 23.73 % and the SiO_2 (silicon dioxide) averaging at 63.12%. these averages differ greatly from the results found in the underside of the bust, the Al_2O_3 (aluminium oxide) concentration was 18.76% and the SiO_2 (silicon dioxide) measured 50.03%. This indicates that a slip was used in the production of this piece. However, the minor elements have very little differentiation between each sample which suggests that even though a slip was used the clay was from the same source.

Figure 6: Large Bushman Bust XRF points (photo credit: Chelsea Roberts, 2023).

Surface Description:

The surface of this sculpture is a cement colour with sections that represent hair that have an ochre undertone (Figure 5). The base of this sculpture is a darker grey colour than the rest of the sculpture. This colour and chemical difference suggest that Ntuli made use of a slip during the production of this sculpture which is supported by information obtained from the book

Revisions (The Campbell Smith Collection, 2006, pp. 76-77)[27]. The little dots and areas of hair that have an ochre undertone appear to have been made by Ntuli pinching a watery clay or slip onto the head in places as looking closely the yellow areas are slightly raise and place over the grey head. Where the tips of these raised hair nodules have been abraded the darker almost black clay is visible (Figure 7).

Figure 7: Close-up of the Bushman's head above his left ear (left) and left back of the head (right) showing the colour change between the hair and the surface of the sculpture (photo credit: Chelsea Roberts, 2023).

Structure Description:

The sculpture starts with an almost square base that is concave on the interior. The interior of the base is for the most part round in shape and with an interior texture almost similar to that of a pinch pot. After the base, the sculpture starts to expand outwards into the shoulder of the bust. The shoulders and chest of the bust move upwards to form the neck of the sculpture which flows into the head. The head has quite small smoothed-out ovular ears, as well as hair spotted around the sides of the head (as mentioned above these sections of hair appear to be made from a separate clay and could have been pinched on by the artist) leaving the top of the sculpture's head bald. There is also a circle beard[28] that frames the Bushman's pursed lips. The Bushman has two squinted eyes and a rounded nose, which seems centred on his face.

[27] The Campbell Smith Collection, 2006. Revisions: Expanding the Narrative of South African Art. 1st ed. Cape Town: UNISA Press.

[28] See 'list of facial hairstyles' wikipedia

All around the sculpture, there are deep gouges in the clay. These purposeful gouges or excisions form wrinkles that cover the face, neck, shoulders, and chest of the sculpture (Figure 5). As the wrinkles move away from the collarbones, they slowly become shallower and begin to fade. The wrinkles are most pronounced on the neck and the area of the chest, about 5 cm out from the neck. The sculpture also has a heavily wrinkled face, the wrinkles coupled with high and pronounced cheekbones, slim jaw, and small mouth produces a very pursed facial expression on the sculpture, almost like a person eating a lemon. The wrinkles go all the way around the neck and end in a V between the sculpture's shoulder blades. It is directly under this V-like shape that one will find Hezekiel Ntuli's signature. This signature is carved into the clay while it was still wet. It consists of three lines first it is the name of the work, Bushman, second is the artist's name Hezekiel Ntuli, and lastly, it is the place where the sculpture was made which was Eshowe (Figure 8).

Figure 8: This is an image of the back of the Bushman sculpture, showing Hezekiel Ntuli's signature (photo credits: Chelsea Roberts, 2023).

Object Condition:

Overall, the object is in a good but unstable condition, as the sculpture is crumbling, and conservation treatment is necessary to preserve this piece. Other than the crumbling there are a few chips along the base of the sculpture which exposes the clay underneath the slip. There are also a few places where the slip has been worn down perhaps from extensive handling. A section of the sculpture's left ear is missing where it appears to have been chipped off, and there is a small section of beard that is also missing on the bottom right side of the circular beard

(Figure 9). Overall, though the main concern for this sculpture and the main issue that treatment will want to rectify is the crumbling which is inherent to unfired clay.

Figure 9: This image shows to the left, the chip on the Bushman's beard and to the right, the chip on the Bushman's left ear (photo credits: Chelsea Roberts, 2023).

To better elucidate the crumbling, I have prepared a few handheld digital microscope images. In Figures 10 and 11 one can see the surface of the sculpture first at 50x magnification and then at 100x magnification. In these images, one can see that the surface of the clay is not uniform and that there are multiple foreign particles that look like specs of sand. In Figure 12 one can see a pile of what looks like dirt, this is material that fell off the Bushman sculpture as it was being examined. In Figures 13 and 14, one can see the material first at 50x magnification and then at 100x magnification. When looking at these two images one begins to see common elements such as the colour as well as the composition of the crumbling material. While it is possible that this could be foreign material, I do not think it is, by the sheer volume of the material as well as its composition under the microscope I think that it is material that has crumbled off the sculpture.

Figure 10: Image of the surface of the Bushman sculpture at 50x magnification (photo credit: Chelsea Roberts, 2023).

Figure 11: Image of the surface of the Bushman sculpture at 100x magnification (photo credit: Chelsea Roberts, 2023).

Figure 12: Powdering material that is currently coming off the Bushman sculpture (photo credit: Chelsea Roberts, 2023).

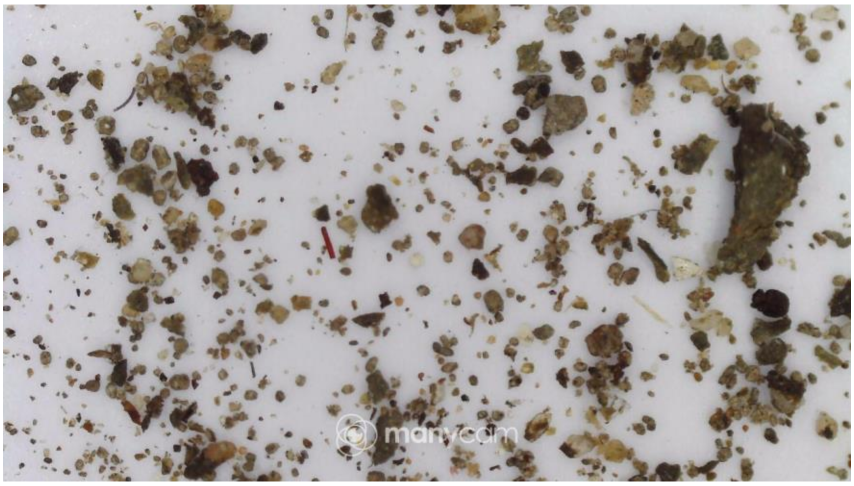


Figure 13: Close-up of the powdering material depicted in Figure 7 at 50x magnification (photo credit: Chelsea Roberts, 2023).

Figure 14: This is the same image as Figure 8 at 100x magnification, showing that it consists of the same elements as the clay slip used on the Bushman sculpture (photo credit: Chelsea Roberts, 2023).

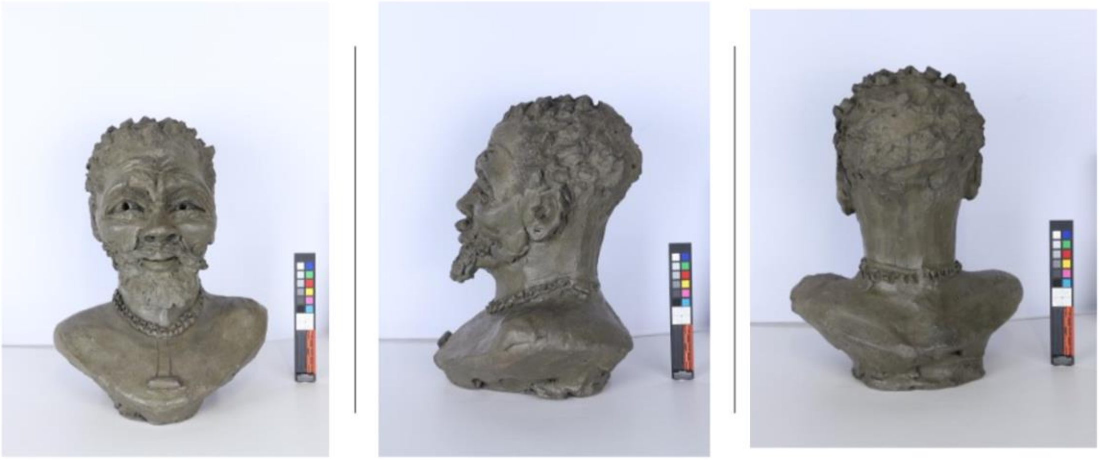
Conservation Recommendations:

- The sculpture needs to be gently surface cleaned to remove loose surface dust before this becomes cemented into the sculpture's clammy surface.
- The areas which are powdering should ideally be consolidated if the research reveals an appropriate technique and choice of consolidant that will impregnate the surface sufficiently to strengthen the area and prevent further loss. The selected consolidant should not alter the appearance of the sculpture so as to be visually intrusive.
- Handling of the sculpture should be kept to a minimum to minimise potential damage. If there is a large enough and stable enough container, the sculpture should be stored in it.

- Storage and exhibition should prioritise secondary housing to ensure the sculpture is kept dust free and avoid fluctuations, and particularly changes in temperature and humidity.
- Overall, if consolidation becomes a viable option, it is my belief that the crumbling of this sculpture is not localised and therefore consolidation will have to occur all over the sculpture.

3.2. Zulu Man, large

Permanent Location: University of Pretoria Museums exhibition



Recto View of large Zulu Man Bust

Left Side View of large Zulu Man Bust

Verso View of large Zulu Man Bust

Figure 15: This is an image of 3 different views of a large bust of a Zulu man made by the artist Hezekiel Ntuli (photo credit: Chelsea Roberts, 2023)

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Accession Number: 966524

Place of Production: Eshowe District, KwaZulu-Natal

Inscriptions: ‘Zulu’, ‘Hezekiel Ntuli’, ‘Eshowe’

Measurements:

Weight: 9200 g
Height: 316 mm
Width: 236 mm
Depth: 231 mm

General Description:

This is a large bust of a Zulu Man made by the Zulu sculptor Hezekiel Ntuli. This sculpture was made in the Eshowe District of KZN (Figure 15).

Materials:

The large bust of a *Zulu Man* is made of unfired clay that can be found in the Eshowe District of KwaZulu-Natal. Once the bust was made, it was put outside where the clay was air-dried and baked in the sun until it dried out. XRF (see 3.6. and Appendix E) and XRD (see 4.1.1. and Appendix F) analysis was used on this bust to identify the chemical composition of the bust. Firstly, the same spot on the *Zulu Man*'s chest below the right shoulder (Figure 16, points 749-759) was analysed ten times using the XRF to evaluate the standard deviation of elemental concentrations across the sculpture. Other selection point included the central bust, right shoulder under the signature, back of the neck, middle of the back, back of the hair, left scapula, left clavicula, right clavicula, right eye bank, and the left side of the forehead. Overall, the clay is quite homogenous the Al_2O_3 (aluminium oxide) averages 19.42 % and the SiO_2 (silicon dioxide) averages 47.60%. With all 10 points measured across the whole sculpture, the Al_2O_3 (aluminium oxide) has a standard deviation of 4.13% while the SiO_2 (silicon dioxide) has a standard deviation of 8.42%. While this does seem like quite a large amount for a standard deviation it is understandable considering that the clay used to make these sculptures is not commercially processed clay, it is clay from the riverbed, and this suggests that it was not thoroughly kneaded for homogenisation. To interpret the variation among points on a single sculpture, the data was compared with the initial 10 readings in exactly the same position as shown in Figure 16 (spots 749-759) indicating the statistical standard deviation of the instrument repeatability. These values were much smaller than those seen across the bust thus indicating the differences across the bust was due to variation in the clay composition and not the uncertainty in measurement statistics.

Figure 16: XRF points analysed on the large Zulu Man bust (photo credit: Chelsea Roberts, 2023).

Surface Description:

This sculpture is made of dark grey coloured clay. The base of this sculpture is of a slightly darker colour variation than the sculpture as a whole. There could be two reasons for this, the first is that this sculpture may be coated in a thin slip, and the other option is that the clay surface of the sculpture has dehydrated over time. Unfired clay as mentioned previously has water bound in its crystal structure, but the porous nature also lends itself to adsorption on the surface, which easily desorbs when the relative humidity and temperature changes. Depending on the storage conditions of the clay, the water will begin to evaporate over time, leaving the surface areas of the clay a lighter shade than the underside or interior of the clay. The danger of this process though is that as the clay is drying, the surface is becoming fragile and brittle, because the clay will absorb any moisture it comes into contact with. As the clay gains and loses water it expands and contracts causing weakening in the surface over time and material loss.

Areas where there is a loss of material and crumbling, have a darker colouration than the surface of the sculpture. There are two sections though that do not show this trend. There is a chip on the right eyebrow as well as the right upper ear that are the same colour as the sculpture.

The surface of this sculpture is also very shiny especially when exposed to a camera flash (Figure 17). This could indicate a previous sealant layer, but more likely shining with a pebble during manufacturing (burnishing), as used by traditional potters to smooth their pots and make them shiny. There is no way to prove either theory and UV light examination was inconclusive. Another observation was that during days of high humidity the sculpture becomes slightly clammy and sticky.

Figure 17: This image shows the back of the sculpture as well as the location of the artists signature, and the shine present on the sculptures surface (photo credit: Chelsea Roberts, 2023).

Structure Description:

As with the Bushman Bust the sculpture starts with an almost square base that is concave on the interior. The interior of the base is for the most part round in shape and with an interior texture almost similar to that of a pinch pot. After the base, the sculpture starts to expand outwards into the shoulder of the bust. The shoulders and chest of the bust move upwards to form the neck of the sculpture which flows into the head.

The sculpture has a necklace that goes around its neck with a stone that comes to rest on the man's sternum. The sculpture has deep frown lines that have been carved into the forehead as well as a full head of hair that appears to be pinched and smudged on. Surrounding the face of the sculpture is a circular beard that flows into the hairline of the sculpture. Although the nose is centred on the face, the eyes appear a little bit squint, where Ntuli carved out the left eye's pupil, one can see that the pupil is oriented more toward the nose and less so towards the middle of the eye (Figure 15). Ntuli signed his work by carving the words Hezekiel Ntuli, and Eshowe into the sculpture's right scapula (Figure 17) and carved the word Zulu into the sculpture's right clavicle.

Object Condition:

Overall, the condition of the object is good. But this does not mean the object is in a stable condition. I would class the object as potentially unstable, the reason being because unfired clay is inherently unstable. While the object is not crumbling heavily there is definite material loss around the base of the sculpture and the frown lines on the forehead (Figure 18). I think preservation treatment is desirable, while for now, it is perhaps not urgent because the rate of crumbling is slow, from observing other Hezekiel Ntuli sculptures I can say in the future conservation may be necessary. Treating the object now before the instability of unfired clay and the crumbling of the sculpture become a problem may thus be preferable. As mentioned above there is also other damage present such as the chip that is present on the right eyebrow as well as crumbling along the forehead and the second chip on the right ear (Figure 18,19). The object also tends to become clammy at times of higher humidity. This is a problem because the clamminess results in an almost sticky layer which is perfect for dust and dirt to settle on thereby accelerating the object's rate of deterioration.

Figure 18: A close up of the sculpture's face showing the crumbling frown lines as well as the chip to the right eyebrow (photo credit: Chelsea Roberts, 2023).

Figure 19: A close-up of the sculpture's right ear showing the chip that is present (photo credit: Chelsea Roberts, 2023).

Conservation Recommendations:

The conservation recommendations are the same as for the Bushman Bust and include:

- The sculpture needs to be gently surface cleaned to remove loose surface dust before this becomes cemented into the sculpture's clammy surface.
- The areas which are powdering should ideally be consolidated if the research reveals an appropriate technique and choice of consolidant that will impregnate the surface sufficiently to strengthen the area and prevent further loss. The selected consolidant should not alter the appearance of the sculpture so as to be visually intrusive.
- Handling of the sculpture should be kept to a minimum to minimise potential damage.
- Storage and exhibition should prioritise secondary housing to ensure the sculpture is kept dust free and avoid fluctuations, and particularly increases in temperature and humidity.

3.3. Zulu Man, small

Permanent Location: University of Pretoria Museums storage

Verso View of Small Zulu Man Bust | Right Side View of Small Zulu Man Bust | Recto View of Small Zulu Man Bust | Left Side View of Small Zulu Man Bust

Figure 20: The four sides of a Small Bust of a Zulu Man by South African Artist Hezekiel Ntuli (photo credit: Chelsea Roberts, 2023).

Accession Number: 1955573

Place of Production: Eshowe District, KwaZulu-Natal

Inscriptions: 'Zulu', 'Hezekiel Ntuli', 'Eshowe'

Measurements:

Weight: 712 g
Height: 141 mm
Width: 112 mm
Depth: 93

General Description:

This is a small bust of a Zulu Man made by the Zulu sculptor Hezekiel Ntuli. This sculpture was made in the Eshowe District of KZN (Figure 20).

Materials:

The small bust of a Zulu Man is made of unfired clay that can be found in the Eshowe District of KwaZulu Natal. Once the bust was made, it was put outside where the clay was air-dried and baked in the sun until it dried out. XRF (see 3.6. and Appendix E) and XRD (see 4.1.1. and Appendix F) analysis was done on this sculpture. The XRF results of three points were acquired, these points are the left and right scapula as well as the underside of the sculpture underneath the sternum (Figure 21). The left and right scapula displayed an Al_2O_3 (aluminium oxide) average of 29.96 % and a SiO_2 (silicone dioxide) average of 71.37%. On the other hand, the darker clay at the underside of the sculpture has an Al_2O_3 (aluminium oxide) reading of 24.59% and a SiO_2 (silicone dioxide) reading of 56.71%. These results strongly suggest that Ntuli made use of a slip in the production of this sculpture.

Figure 21: An image showing the points analysed on the small Zulu Man Bust (photo credit: Chelsea Roberts, 2023).

Surface Description:

This sculpture is made of a warm brown coloured clay. The base of this sculpture is of a slightly darker grey colour variation than the sculpture as a whole. This suggests that a slip was used in the production of this artwork. The beard and the hair of the sculpture are of a lighter grey colouration than the rest of the sculpture, which suggests that they were maybe applied with a different clay, to ensure there were colour variations (Figure 22). The surface of the object is smooth for the most part, the surface does become clammy and a bit sticky when the humidity is high. The bust in certain lighting and certain areas such as the shoulders and forehead have a sheen that reflects light slightly, but not to the extent of the large Zulu man bust. (Figure 17).

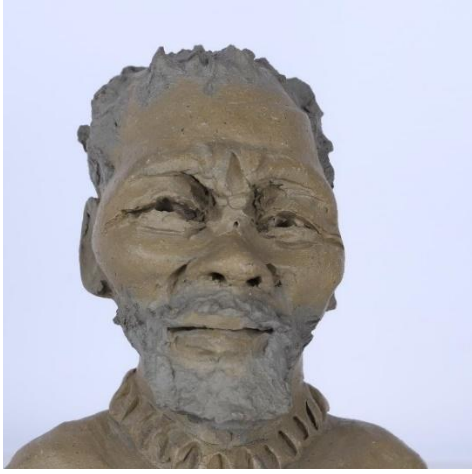

Figure 22: In this close-up image one can clearly see the colour variations between the sculpture's hair and face (photo credit: Chelsea Roberts, 2023).

Structure Description:

As the other sculptures in the collection, the sculpture starts with an almost square base that is concave on the interior. The interior of the base is for the most part round in shape and with an interior texture almost similar to that of a pinch pot. After the base, the sculpture starts to expand outwards into the shoulder of the bust. The shoulders and chest of the bust move upwards to form the neck of the sculpture which flows into the head. Surrounding the face of the sculpture is a circular beard that flows into the hairline of the sculpture. the sculpture for the most part has a full head of hair but does have a bald spot on the crown of his head (Figure 23).

The sculpture has a necklace with almost shell-like imprints all around the neck (Figure 22). The beard and the hair of the sculpture appear to have been added to the sculpture separately and the hair specifically appears to have been pinched onto the head (Figures 22 and 23). There are frown lines that have been carved into the forehead of the sculpture but even though these lines are present the sculpture appears to be smiling this was achieved by the artist by the slight upturn in the sculpture's lips as well as the slight squinting of the sculpture’s eyes. The sculpture also appears to be tilting its head slightly giving the sculpture a kind look.

Figure 23: This image shows the sculpture's bald spot as well as the pattern of the necklace, below which is the artist's signature 'Hezekiel Ntuli Eshowe' (photo credits: Chelsea Roberts, 2023).

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The artist signed his work by carving with his name, Hezekiel Ntuli, and Eshowe into the sculpture's back. He also carved the word Zulu into the sculpture's right shoulder.

Object Condition:

Overall, the object in my opinion is in good condition. There is very little damage to be found on the object and there do not appear to be any previous repairs. There are a few scratches to the slip and a chip to the sculptures hair but there is no visible crumbling or areas of immediate concern. I do think that the object can be classified as potentially unstable for three reasons: firstly, the sculpture is made of unfired clay which is an unstable material; secondly and linked to the first, when the humidity rises the clay becomes clammy which will speed up the deterioration of the object; and lastly, when one looks at the base of the object there are very obvious drying cracks present, these are areas of potential weakness (Figure 24). While treatment isn't necessary for the immediate longevity of the object it is certainly desirable, after viewing other works by Hezekiel Ntuli I feel as though it is only a matter of time before this work starts to deteriorate, so I believe that treatment should happen now before deterioration starts.

Figure 24: The base of the sculpture reveals the drying cracks present in the sculpture (photo credits: Chelsea Roberts, 2023).

Conservation Recommendations:

The conservation recommendations are similar to the previous artworks and include:

- The sculpture needs to be gently surface cleaned to remove loose surface dust before this becomes cemented into the sculpture's surface, although this artwork is not as clammy as the others.
- Unlike the previous artworks there is no active deterioration in the form of powdering or crumbling, rather this sculpture has past damage in the form of scratches and chips. The loss of the nose is particularly disfiguring, and as other copies of this artwork exist, could be replaced. In which case the scar area should be sealed with an appropriate barrier layer prior to any remodelling in situ or creating and adhesion of a replacement nose.
- Handling of the sculpture should be kept to a minimum to minimise potential damage.
- Storage and exhibition should prioritise secondary housing to ensure the sculpture is kept dust free and avoid fluctuations, and particularly increases in temperature and humidity.

3.4. Leopard Ashtrays (pair of)

Permanent Location: University of Pretoria Museums storage

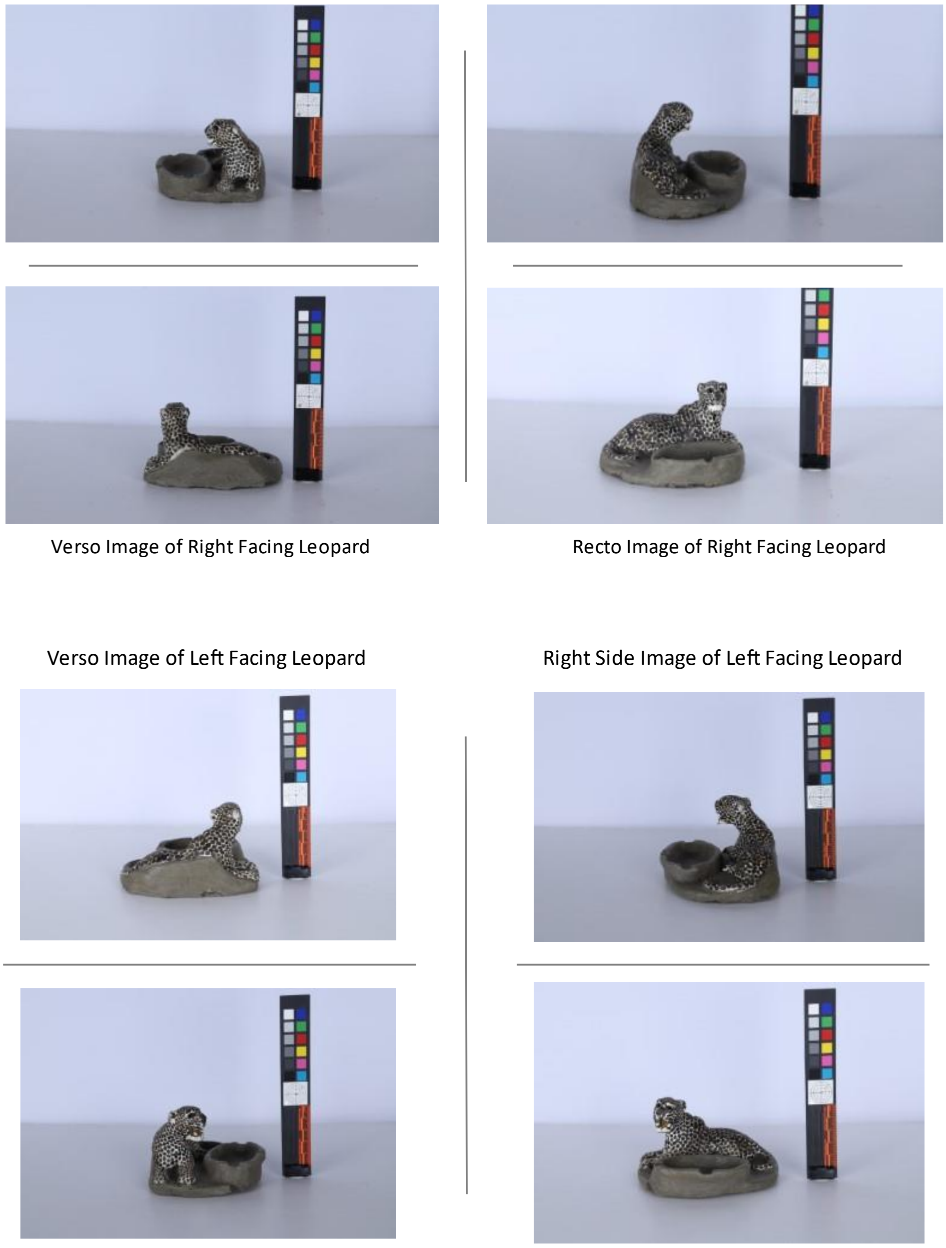

Figure 25: These images show the set of Leopard Ashtray's by South African artist Hezekiel Ntuli at 4 different views. The leopards differ in that first Leopard, Leopard A faces to the right and has a closed mouth. The second Leopard (Leopard B) faces to the right

Accession Number: 955570 (the two leopard ashtrays share a single accession number and will be referred to as 955570A and 955570B)

Place of production: possibly Eshowe District, Kwa-Zulu Natal. Unconfirmed

Inscriptions: no inscriptions.

Measurements:

Weight combined: 621 g

Weight Open Mouthed Leopard: 322 g	Weight Closed Mouth Leopard: 299 g
Height Open Mouth Leopard: 74 mm	Height Closed Mouth Leopard: 59 mm
Depth Open Mouth Leopard: 100 mm	Depth Closed Mouth Leopard: 91 mm
Width Open Mouthed Leopard: 117 mm	Width Closed Mouth Leopard: 116 mm

General Description:

These are a set of painted clay Leopard Ashtray's made by the Zulu sculptor Hezekiel Ntuli. This sculpture was made in the Eshowe District of KZN. The ashtrays are modelled in the same manner as to be mirror images of each other, with a leopard lying somewhat curved around a raised oval ashtray (Figure 25).

Materials:

The leopard ashtrays are made of unfired clay that can be found in the Eshowe District of KwaZulu-Natal. Once the forms of the leopards and the ashtrays were made, the clay was air-dried and baked in the sun, and paint was applied to the leopards. XRF (see 3.6. and Appendix E) and XRD (see 4.1.1. Appendix F) analysis were used. The points of XRF analysis can be seen on the two-leopard ashtrays (Figure 26). On each ashtray, three spots were analysed, the underside, the back of the sculpture as well as the posterior of the painted leopard. Overall, the unpainted clay samples proved that the clay is for the most part homogonous and appears to have come from the same source, the Al_2O_3 (aluminium oxide) and SiO_2 (silicone dioxide) measurements are very similar, and the average for the right facing leopard is 26.03% for the Al_2O_3 (aluminium oxide) and 55.97% for the SiO_2 (silicone dioxide), while the left facing leopard has an average of 29.25% Al_2O_3 (aluminium oxide) and 58.13% SiO_2 (silicone dioxide). What proved very interesting in this analysis was that when the painted posterior of the leopard was analysed there were elevated Ti (titanium) values which hasn't occurred in any of the other sculptures. This spike strongly suggests that Ntuli made use of titanium white paint.

Figure 26: These Images show the areas that were analysed with the XRF on the two Leopard Ashtrays (photo credits: Chelsea Roberts, 2023).

Surface Description:

These are two Leopard Ashtray sculptures by the artist Hezekiel Ntuli. This sculpture is made of a warm brown coloured clay. The surface of this sculpture consists of two elements, first the warm ochre-coloured clay and second the painted leopards sculpted on the ashtrays (Figure 27). The leopards are painted with a titanium white undercoat, with black (composition or source unidentified) spots scattered across the sculpture. There is also a light brown hue, that has an almost smudged pattern across the sides and back of the leopard (Figure 27) and may be attributed to a build-up of dust. There are areas where the sculpture is starting to crumble, and visible clay substrate is darker than the surface clay used in the production of this sculpture.

The base of this sculpture has an odd finish that has a blue/green hue to it, composition or source is unidentified.

Figure 27: A close-up of one of the Leopards, to show the colours used in its production (photo credits: Chelsea Roberts, 2023).

Structure Description:

Starting at the base, the sculptures are flat, level and oval in shape, but not symmetric. The sides while for the most part curve, have some straight areas that differentiate the shape. The shape is also not consistent through both ashtrays indicating they were handmade. The two leopards as well as the actual shallow ashtray cupping of the sculptures rise directly from the flat base. The ashtrays are oval, and each has three divots in the widened and flattened rim to hold a cigarette (Figure 27, 28). The leopards appear to be resting on their sides, one leopard has been carved with its mouth open while the other has been carved with a closed mouth. This shows that even though the ashtrays can be considered a set, each is unique. There is no way to establish if the ashtrays were carved out of a singular block of clay, or if Ntuli made the ashtray and the leopard separately and then joined them.

Figure 28: This is a close-up image of the ashtray to show the cigarette holders as well as the shape (photo credits: Chelsea Roberts, 2023).

Unlike many of Ntuli's sculptures, these leopard ashtrays are not signed at the back by Ntuli. This means that one does not know for sure if these sculptures were made by Hezekiel Ntuli, but by observing the craftsmanship of the leopards, comparing them to his other works, as well as the material it is highly possible that these are by Hezekiel Ntuli's hand.

Object Condition:

Starting at the base of the sculpture there is an unidentified blue/green residue that has discoloured the entire base of the clay sculpture on both ashtrays (Figure 26). This perhaps suggests that the sculptures were dried on something that caused the discolouration, or alternatively the bottom got rehydrated and rested on something that discoloured it as it dried. The area of discolouration is currently unstable and is crumbling at a rapid rate, unfortunately said crumbling is not localised to for example the rim, the crumbling is occurring across the entire underside of the sculpture. For this reason, handling has been limited and the sculptures are being kept in a tray lined with acid-free tissue paper. Not only does this limit handling but it also limits the loss of material, because any material that is being lost is being captured by the tray and tissue paper. Unfortunately, there is still heavy loss of material occurring whenever the ashtrays are even slightly shifted, so while the tray does minimise the loss of material, it in no way stops it. But while not completely full proof the trays do allow one a better view of the speed at which deterioration is taking place. All around the base of the leopard ashtrays crumbling is occurring. The unpainted ashtray portions of the sculpture are highly unstable, change is constantly occurring because of ease of crumbling and amount of material that falls off. The ashtrays are in poor condition, there is noticeable damage as well as a noticeable amount of loss occurring (Figure 30) without interaction with the ashtrays.

As one observes these works it becomes clear that there are two different conditions. The leopards that are present on the ashtray's are in excellent condition. There is no obvious damage to the sculpture or the paint. The painted leopards appear to be in a stable condition very much the opposite of the ashtray base. There is a slight loss of material on the leopards' ears, but this loss is purely aesthetic as there is no active chipping or loss occurring, the paint appears to have been worn down over time.

Figure 29: This is an image showing the base of the leopard ashtrays with the crumbling blue/green layer (photo credits: Chelsea Roberts, 2023).

Figure 30: This is an image showing the active deterioration and material loss that is occurring on the leopard ashtrays (photo credits: Chelsea Roberts, 2023).

As mentioned above it is the area where there is an odd blue/green residue that is crumbling the most (see Figures 29 and 30). I am unsure if the area even originated on the sculpture. The reason I say this is because, after multiple microscope images, one can see that the crumbling residue (Figure 32) while it does share some elements with the clay (Figure 31) is not a proper match. There are elements to it that are unknown such as the green hue caused perhaps by some minerals in the clay (Figure 33).

Figure 31: This is an image at 100x magnification showing the composition of the actual clay of the sculpture (photo credits: Chelsea Roberts, 2023).

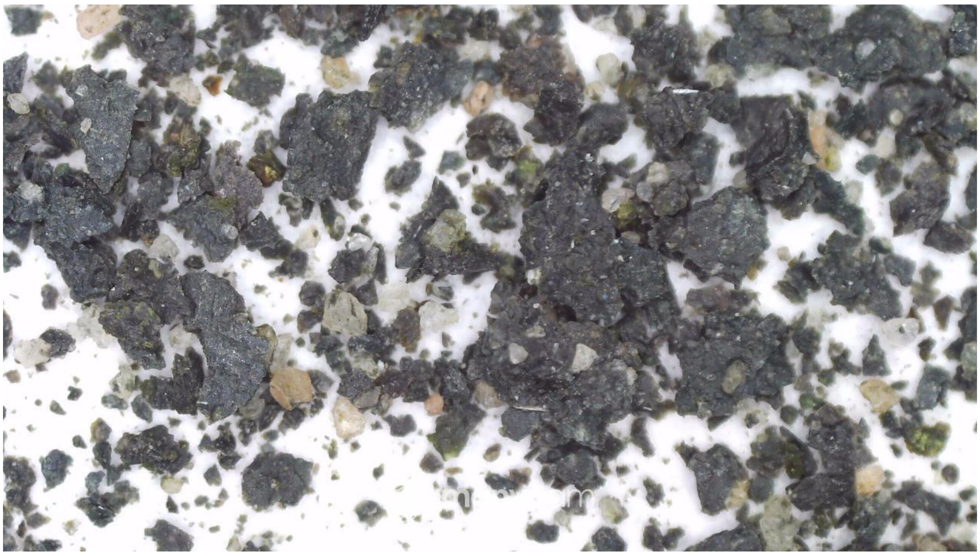

Figure 32: An image at 50x magnification showing the composition of the crumbling material of the base (photo credits: Chelsea Roberts, 2023).

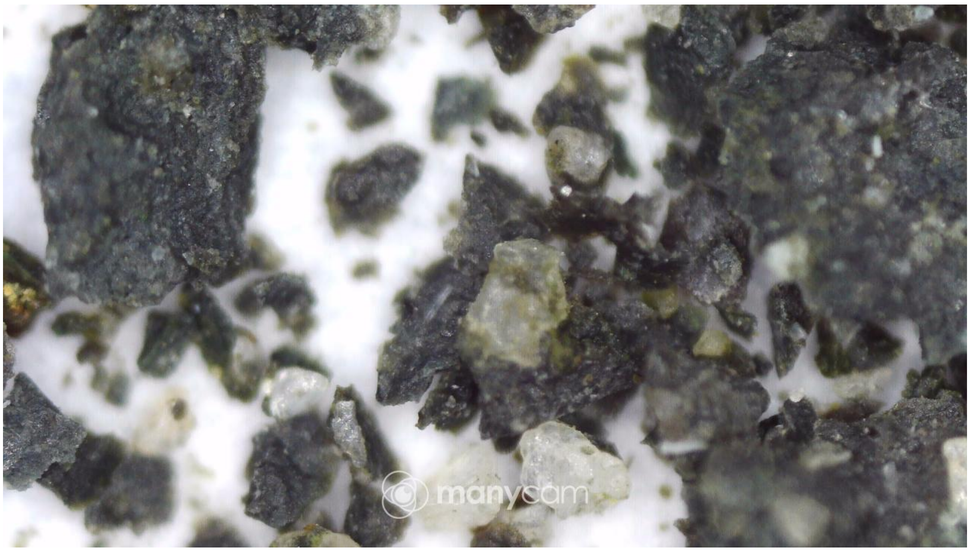

Figure 33: An image at 100x magnification showing the composition of the crumbling material, specifically focusing on the unknown green colouration (photo credits: Chelsea Roberts, 2023).

Conservation Recommendations:

The general conservation recommendations are the same as for the previous artworks and include:

- The sculpture needs to be gently surface cleaned to remove loose surface dust before this becomes cemented into the sculpture's clammy surface.
- The surface of the painted leopard needs to be cleaned, to remove what I believe is a film of compacted dust.
- The areas which are powdering and flaking should ideally be consolidated if the research reveals an appropriate technique and choice of consolidant that will impregnate the surface sufficiently to strengthen the area and prevent further loss without affecting the original paint. The selected consolidant should not alter the appearance of the sculpture so as to be visually intrusive.
- Handling of the sculpture should be kept to a minimum to minimise potential damage especially seeing as this particular sculpture is powdering and actively deteriorating.
- Storage and exhibition should prioritise secondary housing to ensure the sculpture is kept dust free and avoid fluctuations, and particularly increases in temperature and humidity. In addition, it is highly recommended that the sculptures be secured in their

packaging to prevent movement and abrasion of the base which will increase powdering and loss of the clay material.

- The areas in heavy need of treatment on this ashtray would be the main base of the ashtray. Both of the ashtrays have a crumbling bases, this crumbling needs to be treated as soon as possible.

3.5. Zulu Woman, small

Permanent Location: University of Pretoria Museums storage

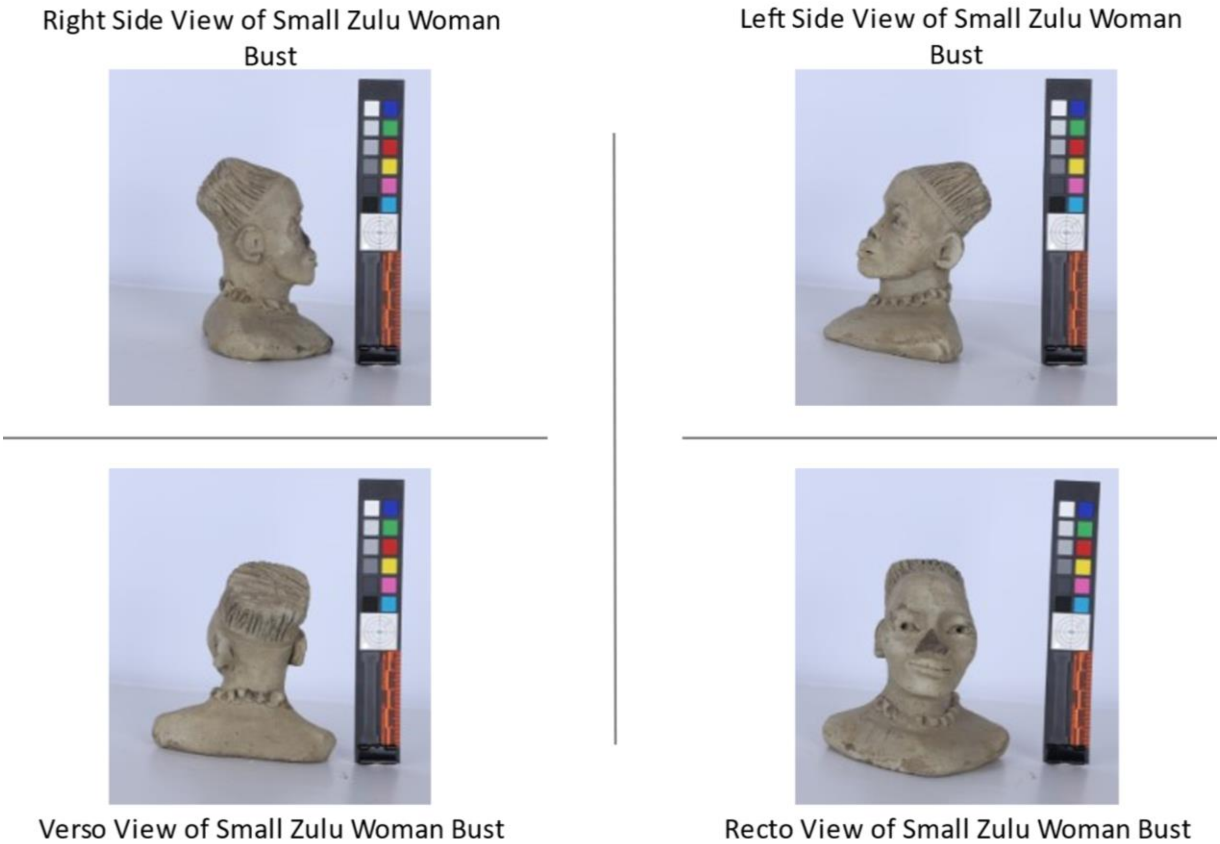

Figure 34: This is an image of the 4 sides of a bust of a Zulu woman by South African artist Hezekiel Ntuli (photo credit: Chelsea Roberts, 2023).

Accession Number: 29955572

Place of Production: possibly Eshowe District, Kwa-Zulu Natal, unconfirmed.

Inscriptions: no inscriptions.

Measurements:

Weight: 407 g

Height: 113 mm

Width: 99 mm

Depth: 85 mm

Nose Scar Width: 15 mm

Nose Scar Height: 12 mm

General Description:

Small bust of a Zulu Woman made by the Zulu sculptor Hezekiel Ntuli (Figure 34). This sculpture was made in the Eshowe District of KZN.

Materials:

The small bust of a Zulu Woman is made of unfired clay that can be found in the Eshowe District of KwaZulu Natal. Once the bust was made, it was put outside where the clay was air-dried and baked in the sun until it dried out. XRF (see 3.6. and Appendix E) and XRD (see 4.1.1. and Appendix F) analysis were carried out. XRF analysis was performed on three locations on the sculpture (Figure 35). The underside of the sculpture was analysed as well as the left and right temple. The underside showed an Al_2O_3 (aluminium oxide) reading of 24.88% and a SiO_2 (silicone dioxide) reading of 68.84%. The left and right temple on the other hand has an average reading of 18.95% for the Al_2O_3 (aluminium oxide) and an average of 59.65% for the SiO_2 (silicone dioxide). The difference between these readings suggests that Ntuli made use of a slip when producing this work.

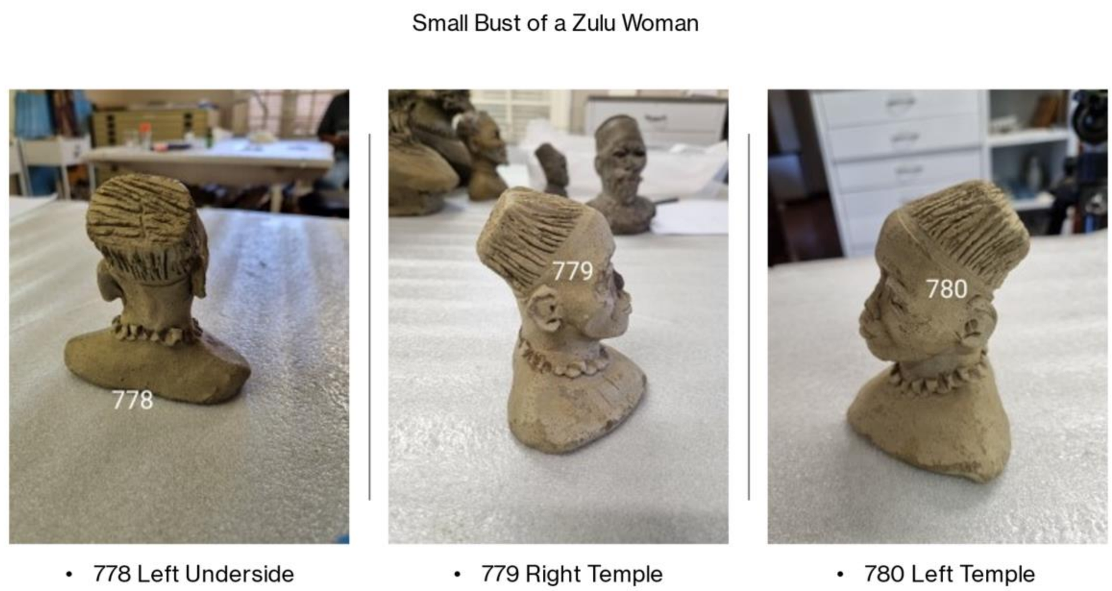

Figure 35: This image shows the 3 points of analysis on the small Zulu Woman Bust (photo credits: Chelsea Roberts, 2023).

Surface Description:

The surface of the sculpture is made of light grey coloured clay. The base of the sculpture has a darker grey colouration suggesting that Ntuli made use of a slip in the production of this work. The surface of the structure is very dry and not at all clammy, it is also quite rough to handle. This is because there are multiple little pits and abrasions across the surface of the sculpture (Figure 36).

Figure 36: A close-up image of the surface of the Zulu woman sculpture. the image shows the pits and abrasions present (photo credits: Chelsea Roberts, 2023).

Structure Description:

Unlike many of Ntuli's other busts, this bust does not have a very concave bottom. Many of Ntuli's other busts have a base that reminds one of a pinch pot, whereas this sculpture, while being slightly concave is for the most part flat (Figure 37). The base flows into the shoulders which flow into a necklace at the base of the neck. The necklace has an almost shell-like pattern. The neck flows into the youthful face of a woman. The sculpture is wearing a traditional headdress that has lines carved into it (Figure 38) the inspiration for the headdress can be seen in Figure 38. The reason I say this face is youthful is because there are no wrinkles present on the sculpture, a distinctive feature of the other busts. There is also a thinner and more delicate look to the cheekbones of the sculpture. When viewed from the side the sculpture does have quite a concave face with a larger jaw, this is accentuated with the large lips present on the sculpture (Figure 38). Unlike many sculptures by Ntuli, the artwork is not signed but there are common elements with other Zulu woman sculptures by Ntuli, which suggest his authorship. There is, however, no way of knowing for sure if this particular sculpture is by Hezekiel Ntuli, or if it is a well-made copy. There are slight differences between this work and similar works in Eshowe, such as the fact that it is not signed, the shoulders are less defined, and the surface colour and texture is different. The Eshowe Zulu woman can be seen in Appendix A. the nose of the artwork has broken off leaving a scar of darker coloured clay on the face (Figure 34).

Figure 37: An image showing the base of the Zulu woman bust (photo credits: Chelsea Roberts, 2023).

Figure 38: Profile of the Zulu woman bust showing the concaving face and carved headdress (photo credit: Chelsea Roberts, 2023), the photograph on the right shows a real example of the headdress (photo credit: Schlosser, 2006: 2).

Object Condition:

Overall, the bust is in a fair condition, it would be in good condition but since the nose of the sculpture has been broken off there is now noticeable damage, and the sculpture appears disfigured. From what has been observed the sculpture can be classified as potentially stable as I do not expect it to deteriorate further within the next five years. I do believe that the conservation of the sculpture is desirable though. There is some crumbling and chipping along the edge of the base of the sculpture (Figure 39). The nose of the sculpture is missing and there are scratches and loss to the layer of slip on the sculpture (Figure 39). I believe if left untreated now the state of the sculpture will just get worse especially because of the instability of raw clay. There are cracking and crumbling risks to be considered when looking at the loss of the nose, I do believe though that overall, the object is in a good condition, but aesthetically it is somewhat compromised and can be potentially unstable.

Figure 39: A close up image of the Zulu woman's face showing the broken nose and damage to the slip (photo credit: Chelsea Roberts, 2023).

Conservation Recommendations:

The conservation recommendations are the same as for the Bushman Bust and include:

- The sculpture needs to be gently surface cleaned to remove loose surface dust before this becomes cemented into the sculpture’s clammy surface.
- The areas which are powdering should ideally be consolidated if the research reveals an appropriate technique and choice of consolidant that will impregnate the surface sufficiently to strengthen the area and prevent further loss. The selected consolidant should not alter the appearance of the sculpture so as to be visually intrusive.
- Handling of the sculpture should be kept to a minimum to minimise potential damage.
- Storage and exhibition should prioritise secondary housing to ensure the sculpture is kept dust free and avoid fluctuations, and particularly increases in temperature and humidity.

3.6. XRF analysis

XRF analysis was carried out on two separate occasions, one at the University of Pretoria (5 May 2023), and one at the Fort Nonquai (30 May 2023). For the XRF I made use of the Bruker Tracer 5i handheld XRF using the Geochemical three phase Factory calibration covering Mg to U (Figure 40). Analysis was done on five sculptures from the Leeb du Toit Collection (annotated as LDT), ten sculptures from the Fort Nonquai Historical Museum, Eshowe KwaZulu-Natal (annotated as FN), and one sample of the original clay obtained from Hezekiel Ntuli's son Paddy Ntuli. The data is provided in Appendix E, and results are summarised here. The data showed that the clay samples did not contain different minor and trace elements and the major elemental composition was similar (although not identical as it is natural clay taken from a riverbank, not commercially homogenised clay).

For the analysis of the sculpture part of the Leeb du Toit Collection as well as the original clay, the XRF was used at the Anton van Wouw House where the artworks are currently being housed. An instrument stability (repeatability) test was performed on the large Zulu Man bust by measuring ten measurements of the same spot, subsequently ten spots across the sculpture was measured to evaluate the standard deviation across a sculpture. Five points were analysed on the Large Bushman bust, and for the smaller sculptures like the ashtrays, Zulu woman and Zulu man only three points were analysed.

The data on the clay itself is consistent with a single clay source, as no minor or trace elements were found on the different sculptures that deviated from the others. The data is consistent with art history and the artist's account that suggests he sourced his clay from a particular location in the Eshowe district. A sample of this clay was obtained during a field visit and data correlates between the clay sample and the sculptures.

The analyses also revealed the following:

- The XRF analyses showed that the chemical composition across the large Zulu man bust was not homogenous, suggesting that either the clay was not properly kneaded and mixed or that Ntuli made use of the pinching method where he pinched of a piece of clay from another source and moulded it to be part of the sculpture.
- A slip was used in the production of the large Bushman bust.
- The use of the XRF on the painted section of the Leopard ashtray was able to tell us that the paint used contained titanium white.

On the sculptures in the Fort Nonquai Historical Museum in Eshowe, the analysis was done on site and the XRF was transported down to KwaZulu-Natal (Figure 40). The analyses showed similarity to the sculptures in Pretoria, within the standard deviations experimentally determined, indicating similar clay sources for the sculptures in Eshowe and in Pretoria.

Figure 40: XRF analysis of some of the sculptures in the Vukani Zulu Cultural Museum housed at the Fort Nonquai Historical Precinct, Eshowe (Photo credit: Maggi Loubser)

Table 2: Summary table of analytical results for the sculptures and clay sample

Hezekiel Ntuli Artworks	Accession number	Condition report	XRF analysis	XRD analysis
Leeb du Toit Collection, University of Pretoria Museum				
Bushman	34955575	Section 3.1.	Appendix E (pts. 770-774)	Appendix F
Zulu Man, large	966524	Section 3.2.	Appendix E (pts. 749-769)	Appendix F
Zulu Man, small	1955573	Section 3.3.	Appendix E (pts. 775-777)	Appendix F
Leopard Ashtray A	955570A	Section 3.4.	Appendix E (pts. 784-786)	Appendix F
Leopard Ashtray B	955570B	Section 3.4.	Appendix E (pts. 781-783)	Appendix F
Bust of a Zulu Woman	29955572	Section 3.5.	Appendix E (pts.778-780)	Appendix F
Fort Nonquai Collection,				
Artwork in the FN Coll.	**Accession number**	**Condition report**	**XRF analysis**	**XRD analysis**
Seated leopard	01/266	Appendix D1	Appendix E	Appendix F

			(pts.864-867)	
Leopard in a tree	n/a	Appendix D2	Appendix E (pts.875-877)	n/a
Leopard hunting	n/a	Appendix D3	Appendix E (pts.872-874)	n/a
Walking leopard	01/269	Appendix D4	Appendix E (pts.868-870)	n/a
Old Zulu Woman	n/a	Appendix D5	Appendix E (pts.878-880)	n/a
Young Zulu Woman	n/a	Appendix D6	Appendix E (pts.881-884)	n/a
Old Zulu Man	n/a	Appendix D7	Appendix E (pts.885-888)	n/a
Induna	01/271	Appendix D8	Appendix E (pts.898-902)	n/a
uShaka	01/272	Appendix D9	Appendix E (pts.903-907)	n/a
Bushman	01/270	Appendix D10	Appendix E (pts.909-912)	n/a
Clay				
Original clay	n/a	n/a	Appendix E	Appendix F

3.7. Conclusion

XRD analysis of the sculptures did not appear to give any valuable insight. During these condition reports what became apparent to me is that it seems that Ntuli made use of a large lump of clay whenever he modelled a bust. He did not make the bust out of multiple pieces, he modelled the busts out of a singular block of clay. He would add bits of clay from other sources for decorative elements of his sculpture such as tufts of hair on some of his male sculptures. Ntuli would also make use of a slip on some of his sculptures, this can be seen in works such as the *Bushman* bust seen above. Through XRF analysis one was able to see that Ntuli made use of a titanium-based pigment for the white in his painted sculptures of the leopard ashtrays, most likely titanium white, whilst the XRF analysis of the black pigment yielded no results suggesting an organic pigment may have been used. Sadly, his son Paddy had no information regarding the type of paint that his father used and further testing may be warranted. The lack of homogeneity in the XRF data of the large *Bust of a Zulu Man* bust shows that a pinching method was used, through this can also show that perhaps the clay Ntuli was using was not kneaded thoroughly enough. The bases of Ntuli's busts were hollowed out to make them lighter and so they dry out more evenly, as a core which is still wet can shrink or expand and damage the sculpture. The signatures and names of the busts wherever present were engraved into the still wet clay. The UP busts all have the same problem, they all get clammy and almost tacky when the humidity is high. With regards to the continued preservation of the sculptures this presents a challenge as the clamminess will attract and hold dust and other pollutants that can damage the sculptures over time causing discolouration and staining, supporting mould and other biological growth such as algae and lichens as a result of organic components in the dust, this in turn can result in disfigurement, pitting, embrittlement. All these factors create a more fragile sculpture that can in turn be easily damaged when handled, impressions being left behind in the soft clammy surface, scratches and breaks occurring more easily due the sculptures' fragility.

Chapter 4

Muddy Waters (Clay Experiments)

Chapter 4 covers the experimentation part of the dissertation which include the sourcing of clay and manufacture of clay samples for chemical characterisation and consolidant testing. The chapter reviews polymers used as potential consolidants and adhesives as suggested through the literature review and includes observations and analysis of the test samples for a potential treatment proposal.

4.1. I got a jar of dirt: Clay and clay samples

As part of the research for the dissertation I went to the Eshowe district of KwaZulu-Natal. During this research I viewed some of Hezekiel Ntuli's work at the Vukani Zulu Cultural Museum. I was also fortunate enough to be taken to meet with Hezekiel Ntuli's son Paddy Ntuli and chat with him. During this conversation, Paddy Ntuli shed some light on how his father made his clay sculptures as well as the source of his clay, which was a riverbank about 30 minutes away from his home. Unfortunately, as the years have passed said river bank has become deeper and deeper and has subsequently been closed off by the municipality because of the danger of landslide involved with the area. As such I was not able to go to the clay site and retrieve a sample of the clay from what Paddy Ntuli claimed was his fathers' main source. Thankfully, Mr Ntuli had some of his father's clay left over in his garage, and generously gave me some for my research.

Figure 41: (left) Paddy Ntuli during my visit to Eshowe (photo credit: Maggi Loubser, 2023); (right) clay sample donated by Paddy (photo credit: Chelsea Roberts, 2023)

The bag of clay soil needed to be prepared before it could be analysed or used for mock-ups. To prepare the clay a granite pestle and mortar were used to work down the clay into a fine sand consistency. Before the sand was used it was double-sieved through a fine-meshed sieve. Any particles that were too large to fit through the sieve were once again ground down, this ensured there were no large particles of clay. After this, the dry clay was placed in a glass bowl, and tap water was slowly added to the sand while it was being mixed. This allowed me to judge when the clay was at the right consistency to be called clay. Once the clay was mixed, I moulded two flat disks about 1cm thick, 9 cubes around 3 x 3 cm, a long log at about 10cm x 2cm, as well as a few rounded balls. On these mock-ups, I could then test multiple consolidants in an attempt to find a good consolidant to conserve Ntuli's crumbling ceramic sculptures.

Seeing as I was given a sample of Hezekiel Ntuli’s clay, I decided to try and analyse the clay sample and compare this sample to Ntuli’s sculptures in the Vukani Museum, as well as the sculptures present in the Leeb du Toit collections. For this analysis, I looked at both X-Ray Fluorescence (XRF) discussed in chapter 3, and X-Ray Diffraction (XRD) analysis briefly discussed below.

XRD on the clay samples

For the XRD analysis (see Appendix F for raw data) I made use of the PANalytical X'Pert Pro powder diffractometer with X'Celerator detector at the University of Pretoria for the analysis I analysed 7 samples, 1 from the Fort Nonquai Museum, 5 samples from the Leeb du Toit Collection and 1 sample of original clay. As outlined in section 2.5.2. under the methodology section, each sample of approximately 10mm by 10mm was scraped off the base of the UP sculptures where sampling scars would not be visible. The Fort Nonquai self-sampling fragment was acquired from a small area that had become detached. The raw clay came from the packet of clay provided by Paddy Ntuli as seen in Figure 41.

The samples were prepared according to the standardized Panalytical backloading system, which provides a nearly random distribution of the particles.

The samples were analyzed using a PANalytical X'Pert Pro powder diffractometer in θ–θ configuration with an X'Celerator detector and variable divergence- and fixed receiving slits with Fe filtered Co-Kα radiation (λ=1.789Å). The mineralogy was determined by selecting the best–fitting pattern from the ICSD database to the measured diffraction pattern, using X'Pert Highscore plus software.

The relative phase amounts (weight% of crystalline portion) were **estimated** using the Rietveld method (X'Pert Highscore plus software). The quantitative results are listed below.

Table 3: Quantitative results of XRD analysis on the clay samples including LDT collection, Fort Nonquai and the original clay.

Collection	**Artwork**	**Quartz**	**Kaolinite**	**Magnetite**	**Lepidocrocite**	**Goethite**	**Anatase**	**Muscovite**
LDT Coll.	Bushman	55.7	39.0	0	0.7	0	0.8	3.8
	Zulu Man, large	56.4	38.5	3.3	0.9	0	0.9	0
	Zulu Man, small	73.1	25.7	0	0	0	1.3	0
	Leopard Ashtray	66.6	31.3	1.6	0	0	0.5	0
	Zulu Woman, small	73.3	24.4	1.8	0	0	0.5	0
FN Coll.	Seated Leopard	55.0	38.3	3.5	1.0	1.7	0.6	0
Original clay	Raw clay sample	61.8	33.7	1.3	2.1	0.6	0.5	0

The first round of testing done with the XRD included the unaltered clay, whilst in the second round of XRD analysis I wanted to find out if the presence of consolidants changed the results from the XRD analysis. To carry out this analysis further samples were taken from the butt-end of the clay cube samples which had been immersed in the consolidant solutions including 7% Aquazol 500 and 200, 7% Butvar B-98, 7% Paraloid B-72, 7% Raviflex BL 5 S and 7% Paraloid B48N. All of these consolidants were made into solution with Ethanol, with the exception of the Paraloid B48N which was made with Xylene. The bottoms of the samples that had been submerge in the consolidants were scraped off with a scalpel for round two of XRD testing. The samples were prepared according to the standardized Panalytical backloading system, which provides a nearly random distribution of the particles.

The samples were analyzed using a PANalytical X'Pert Pro powder diffractometer in θ–θ configuration with an X'Celerator detector and variable divergence- and fixed receiving slits with Fe filtered Co-Kα radiation (λ=1.789Å). The mineralogy was determined by selecting the best–fitting pattern from the ICSD database to the measured diffraction pattern, using X'Pert Highscore plus software.

The relative phase amounts (weight% of crystalline portion) were **estimated** using the Rietveld method (X'Pert Highscore plus software). The quantitative results are listed in table 3. No new phases formed, so the resin did not react with the clay it just covered it or penetrated only superficially. There was no large amorphous hump, so <5% resin is on sample.

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Table 4: Quantitative XRD results after consolidation of the samples

	Quartz	Lepidocrocite	Goethite	Kaolinite	Anatase
Aquazol200 in ethanol	54.5	2.3	1.9	40.2	1.1
B48 in Xylene	59.9	1.9	1.5	35.7	1.0
Raviflex in Ethanol	61.2	2.3	0.9	35.1	0.5
B72 in Ethanol 2	55.7	2.3	1.3	39.8	1.0
Butvar in Ethanol	59.9	1.8	1.5	36.1	0.8

This was followed by one last XRD analysis on the fired clay sample (see table 4) where the kaolinite is gone and only quartzite and haematite remain in the sample. The clay structure is destroyed and goethite and magnetite oxidised to haematite in a much larger percentage as the crystal waters are all gone.

Table 5: Quantitative result of XRD analysis of the fired clay sample

	Quartz	Hematite
Fired Clay	91.1	8.9

I was hoping to see if the application of consolidants in ethanol would replace the hydroxyl (-OH) groups in the clay thus stabilising it. This however was not the case.

4.2. Making things stick: A review of potential adhesives and consolidants.

Much has been written on adhesives in general for industry (Skeist, 1962; Shields, 1985; Ebnesajjad, 2011) and more specifically for their uses in conservation applications (Down, 2015; D'Sa, 2012;). There are broadly 3 main categories of adhesives namely those of vegetable origin (starches, gums and cellulose derivatives); those of animal origin (including gelatine, bone or hides glues); and synthetic adhesives (Polyvinyl Acetate Dispersions both PVA and PVAc, Polyvinyl Alcohol solutions, Acrylic dispersions and Acrylic Solutions). The following information is combined from a variety of sources including the CAMEO website from the Museum of Fine Arts Boston, the American Institute for Conservation (AIC)'s Book and Paper Group wiki and conservation material suppliers such as TALAS and CTS. The following adhesives were selected based on O'Connor's research and include: Aquazol 200 and 500, Butvar 98, Ethulose, Klucel G, Methyl Cellulose, Paraloid B48N and B72, as well as Raviflex BL 5 S.

4.2.1. Aquazol®

According to the CAMEO website (see https://cameo.mfa.org/wiki/Aquazol) Aquazol® adhesives are composed of poly(2-ethyl-2-oxazoline), with a formula of (C_5H_9NO). Aquazol® adhesives are soluble in water as well as polar organic solvents. According to CAMEO, Aquazol® adhesives appear to have good thermal stability and are used as hot melt adhesives, liquid adhesives, consolidants, transparent coatings, and gessos. Aquazol® adhesives have a glass transition Temperature of 69°C - 71°C as an amorphous solid, however Arslanoglu and Tallent (2003:12) reports that Wolbers et al. (1994) as well as Chiu et al. (1896) suggest Aquazol® 500 as a dried film made from an aqueous solution for paintings conservation has a Tg of 55°C. Despite this Aquazols® are still suitable for southern hemisphere environments with elevated temperatures (see talas https://www.talasonline.com/Aquazol).

Preliminary ageing studies suggest that Aquazol® maintains a neutral pH and good solubility over time (Wolbers et al 1994). Although Aquazol® is available in three molecular weights (MW), I decided to use both Aquazol® 200: (MW=200,000) and Aquazol® 500 (MW=500,000) due to availability in the lab.

The higher molecular weight of Aquazol® 500 may limit its ability to penetrate as deeply into the porous structure of unfired clay as opposed to the Aquazol® 200. Aquazol® 500 thus might predominantly reside on the surface, providing substantial coverage and creating a thicker layer on the surface, offering a protective barrier to environmental factors. If deeper penetration and strengthening of the internal structure of the unfired clay are crucial, Aquazol® 200 might be preferred due to its ability to reach smaller pores and interstitial spaces within the clay matrix, providing better consolidation within the material. It can form stronger bonds at a microscopic level by interacting with a larger number of clay particles, thereby reinforcing the structure more effectively. Aquazol® 500 could thus work well as a sealant prior to adhesion, rather than a consolidant and Aquazol® 200 could be a better consolidant.

4.2.2. Butvar® B98

Similarly, to the Aquazol® described above, Butvar® refers to a range of polyvinyl Butyral resins. Butvar® resins are soluble in ethanol, esters, ketones, and chloroform, and insoluble in water. CAMEO (see https://cameo.mfa.org/wiki/Butvar) describes Butvar® as colourless and transparent, UV resistant and nonyellowing resins. The glass transition temperature of Butvars® range from 62°C to 72°C, making them suitable for use in a southern hemisphere environment with elevated summer temperatures. In terms of ageing though, Butvar® resins tend to crosslink and become insoluble when exposed to UV light in the presence of oxygen. Butvars® are used commercially as adhesives, sealants, inks, and coatings to waterproof textiles and wood. Similarly, to the range of Aquazols®, Butvar® resins come in a wide range of molecular weights, I selected the Butvar B98 which has a molecular weight (MW) = 40,000 - 70,000 and a glass transition temperature of 72-78°C (Horie, 2010: p 101). According to the TALAS site, the Butvar® B98 imparts adhesion, toughness and flexibility when added to an object (TALAS, 2023). Horie (2010:101) highlights the use of Butvar 98 for fossils, wood, paper and textiles.

4.2.3. Ethulose

Ethulose is a cellulose ether with both an ethyl and a hydroxyethyl functional group substitution. Ethyl Hydroxyethyl Cellulose may be dissolved in alcohol and other organic solvents (EHEC), or in water for the Modocoll and Ethulose (see https://cameo.mfa.org/wiki/Ethylhydroxyethyl_cellulose). Ethyl Hydroxyethl Cellulose is insoluble in hot water, hydrocarbons, alcohols, toluene, xylene (https://cameo.mfa.org/wiki/Ethylhydroxyethyl_cellulose). There is no data available for the glass transition temperature of Ethulose or it's molecular weight in the manufacturer's SDS (CDH, 2023). In terms of ageing properties, Feller and Wilt (1990) suggest that "The organic soluble type EHEC is not stable for long-term use", and "The water-soluble type has at least intermediate stability and warrants further testing." According to Feller and Wilt, EHEC begins to age and deteriorate after 90 ˚C or when they are exposed to fluorescent lights, the process of thermal aging also showed that the EHEC become unsuitable for conservation as it has poor aging properties (Feller & Wilt, 1990: p 92-93).

As O'Connor (2021) made use of the water based Ethulose for her case study of small, thin unfired clay tiles in a 5% concentration of Ethulose in ethanol, I decided to try the polymer for the Ntuli unfired clay samples. When looking at the TALAS site it is stated that Ethulose does not support the growth of mould which would make it ideal for hot and humid environments such as those in the KwaZulu Natal region (TALAS, 2023).

4.2.4. Klucel G

Klucel® refers to a range of hydroxypropyl cellulose (HPC) compounds. Klucel® thermoplastic polymers are non-ionic, water soluble, ethers of cellulose. They produce solutions that range in viscosity from 200 to 2500 centipoise. According to CAMEO, Klucels® are solubilised in water or alcohols and used as binders for ceramic glazes, sizing paper and as consolidants for paintings and deteriorated leather. According to its SD sheet, Klucel G has a glass transition temperature of 100°C to 150°C (TALAS, 2023). CAMEO further states that while HPC polymers, in general, have good photochemical stability, they can exhibit poor thermal stability and discolour with age. Although the low molecular weight products, such as Klucel® G, performed better than the high molecular weight products, such as Klucel® M, testing indicates that HPC polymers should not be considered for long term use (Feller and Wilt, 1990: p 94). Similarly, to the previous polymers, there is a range of Klucel® polymers with different molecular weights Klucel® G has a low molecular weight of 370,000 (Hercules Incorporated, 2023). O'Connor (2021:5-6) states that she did not use Klucel® G in her article as she did not have access to it, however she states Anna Serotta who made use of it consolidating matt surfaces on Egyptian art conservation as there was minimal change to surface appearance, as it was available in the lab and was thus selected for experimentation.

4.2.5. Methyl Cellulose

Methyl cellulose is a cellulose ether with a methyl functional group substitution and a chemical formula of $(C_7H_{14}O_5)$ n. Although dissolved in water, it does not do so readily ad requires a few days for preparation (AIC Wiki, 2023) Methyl cellulose dries to a clear film with very little shrinkage (CAMEO, 2023). It has been used as a substitute for Gelatin and animal glue in sizing paper and has been used as an adhesive in textile and paper conservation (Kuhn, 1986). Aging studies by Feller and Wilt (1990) indicate very good stability with negligible discoloration or weight loss over time (Feller & Wilt, 1990: p 95).

Methyl Cellulose was available in the lab and as O'Connor made use of it, it was also trialled.

4.2.6. Paraloid B48N & B72

Again, Paraloid refers to a range of different acrylic resins including methacylate (MA), methylmethacrylates (MMA), ethylacrylate (EA), ethylmethacrylate (EMA), butylacrylate (BA), and butylmethacrylate (BMA). For the purposes of this research Paraloid B48N (MMA/BA) and Paraloid B72 (EMA/MA) were selected. Ideally B48N[29] will be used as a coating and adhesive for bare and primed metals, the B48N produces a tough and durable coating onto the metal while also remaining flexible to a certain degree. B48N is soluble in materials such as Xylene, Toluene and acetone. It has a molecular weight of 250,000 and a glass transition temperature of 50˚C (CAMEO, 2023). For Paraloid B72[30] this resin has been

[29] For further reading on Paraloid B48N look at : J. Down, M.MacDonald, J.Te'treault, S.Williams, Adhesive Testing at the Canadian Conservation Institute-An Evaluation of Selected Poly(Vinyl acetate) and Acrylic Adhesives", *Studies in Conservation* 41:19-44, 1996.

[30] For further readings on Paraloid B72 look at: Jerry Podany, Kathleen M. Garland, William R. Freeman, Joe Rogers, "Paraloid B-72 as a Structural Adhesive and as a Barrier Within Structural Adnesive Bonds: Evaluations of Strength and Reversibility" JAIC 40(1), 2001. J. Down, M.MacDonald, J.Te'treault, S.Williams, "Adhesive Testing at the Canadian Conservation Institute-An Evaluation of Selected Poly(Vinyl acetate) and Acrylic Adhesives", *Studies in Conservation* 41:19-44, 1996. E. de Witte, M.Goessens-Landrie, E.J.Goethals, T.Simonds, "The Structure of 'Old' and 'New' Paraloid B72", ICOM preprints 78/16/3/1-9, Zagreb, 1978. R.L.Feller, N.Stolow,

marketed as a clear no yellowing coating, that is waterproof and suitable for most materials, it is highly popular in the world of conservation because it is so stable. It is soluble in Toluene, Xylene, Acetone and Ethanol and is insoluble in water and oils. B72 has a glass transition temperature of 40˚C and a molecular weight of 105,000. (CAMEO, 2023) I chose to make use of the B48N because it was on hand in the conservation studio, and I was curious if it would work as well for ceramics as it does for metal. On the other hand, I chose to use the B72 because I had prior experience with the material, and I knew in theory how it would react because I had used it before multiple times on low fire ceramics and I am highly impressed with the material.

4.2.7. Raviflex BL 5 S

Vinavil Raviflex BL 5S is a vinylacetate homopolymer resin has a molecular weight of 22,000-30,000 and a glass transition temperature of 96°C-102°C (VINAVIL, 2023). According to deGhetaldi, Baade, Stoner, Hayes and Alderson (2017:83-86), Raviflex shares many physical properties with Mowilith 20. The authors put Raviflex through a number of tests in order to see what the properties of Raviflex would be and if it would prove to be a suitable resin to be a binder material for pigment. It was seen that, under these tests such as light ageing that the Raviflex did not cross link and therefore remained resoluble. It was found that the Raviflex was re-soluble in alcohols (deGhetaldi, et al. 2017: 83-86). Unfortunately, there is very little information to be found concerning Raviflex, making it difficult to discern how it will work as a consolidant. However, as it seemed promising, this was also selected for experimentation.

4.3. Observations and results

The selected adhesives were placed in solution for a brush application technique, as well as consolidation through capillary action to see what the differences would be in terms of visual appearance and penetration into the clay. The experimental procedure in which the consolidants were applied is described bellow and a summary is present at the end of section 4.3.2.

E.H.Jones, *On Picture Varnishes and their Solvents*, the press of Case Western Reserve University, Cleveland, 1972.

4.3.1. Brush application of consolidant

For my first bout of testing, I tested 14 consolidants on two flat disk mock-ups I made earlier. I applied three layers of the consolidant using a paintbrush to paint a straight line, with about 1cm between the beginning of each application on the same line. This method was so that I could observe the number of layers needed before there was a change in surface colourations of the clay.

The first solution I made use of was a 2% Aquazol® 500 in Ethanol, for the solution I used 0.2g of Aquazol® 500 and 10 ml of Ethanol. Once the Ethanol was added to the Aquazol® 500, there was no immediate change to the Aquazol® 500. The Aquazol® 500 became more translucent in the bottle and there was some dissolving of the Aquazol® 500 around the edges. Once the Aquazol® 500 was left overnight it became a very liquid solution, with very little viscosity. It was added onto the clay sample and was absorbed very quickly, there is very little difference visually between the multiple layers that were applied. There is a glossy layer that has now been added to the surface of the clay that was not there previously. This solution while absorbing very well may be too liquid at a low percentage like 2% to properly consolidate a large ceramic like a Hezekiel Ntuli. I think a higher percentage consolidant needs to be used instead.

The second solution I made use of was Aquazol® 200 in Ethanol, it was made in exactly the same way as the Aquazol® 500 in Ethanol and was also at a 2% solution. The Aquazol® 200 had an almost more homogenous coating to the clay. It also absorbed at an alarmingly fast rate but seemed to absorbe quicker and more evenly than the Aquazol® 500. Like the Aquazol® 500 though I believe the mixture is too liquid and weak at a 2% solution, I would rather like to test out a solution between 5% to 7%.

Solution 3 was Aquazol® 200 in water, made with 0.2g of Aquazol® 200 and 10 ml of water. The Aquazol® 200 seemed to become almost tacky as well as translucent when the water was added. It took a bit longer for the Aquazol® 200 to absorb into the mock-up compared to the Aquazol® 200 in Ethanol. There is also a clear darkening in surface colour after the addition of the second and third layer and the surface of the clay has become shinier. The Aquazol® 200 in water almost seemed to smooth out the clay in the areas where it was applied. This is certainly not ideal when working with textured clay art works.

Solution 4 was 2% Aquazol® 500 in water mixture. When the water was added to the Aquazol® 500 it became translucent and tacky. The Aquazol® 500 in water over all worked the best out of all the Aquazol® solutions used in the experiment. While perhaps a little slower at absorbing and drying than the solutions in ethanol it showed the least amount of change to the surface of the clay. The surface was not very shiny ad there was very little colour change. It smoothed out the surface slightly but not as much as the Aquazol® 200 in water solution.

Overall, my observations with the Aquazol® solutions is that they dry fast and do not cause too much change to the surface. I do not think Aquazol® in water is the way to go considering the drying time and the smoothing effect it has on the unfired clay. I can also say that for thinner pieces like the clay disks a 2% solution may work but in the case of a large and heavy sculpture I would rather try a higher percentage of Aquazol® such as a 5% or a 7%.

Solution 5 was a 5% Raviflex in Acetone solution. 3 pepbles of the Raviflex was equal to o.5 g to which 10 ml of acetone was added. As soon as the acetne came into contact with the Raviflex, the Raviflex became translucent and tacky and was nearly fully dissolved in the space of an hour. The Raviflex was applied and absorbed quickly and there was very little change in the colour of the clay between the multiple layers. There is a certain amount of a speckled shine present on the surface of the sample, and a certain amount of smoothness along the edges but overall the Raviflex appears to visibly integrate fairly well. The only changes I would make to the solution is to perhaps make it a higher percentage of Raviflex and to maybe make use of ethanol instead of acetone, considering ethanol drives off water as it dries.

For solution 6 I made use of 0.3g of Butvar B-98 with 10 ml Ethanol in order to make a 3% solution of Butvar B-98 as a possible consolidant. When ethanol is added to the Butvar B-98, the Butvar becomes slightly milky and forms one solid material. After a few hours to a day the Butvar becomes clear and when mixed becomes part of the solution fully. With raking light, it becomes easy to see where the Butvar has been place on the clay sample, it has a bit of a lighter colouring than the rest of the clay but overall it seems to be a very even layer with quick absorption there is very little difference between layer 2 and 3 and it certainly leaves a shiny coating on the clay. A 3% solution is too weak though if one wants to consolidate a large sculpture a higher percentage should be considered.

With solution 7 I made use of a solution I already had access to which was a 2% Methyl Cellulose in water. The methyl cellulose is a clear liquid which is slightly more viscous than water. The layers all blend into the clay almost seamlessly even in raking light the consolidant is not very visible. Overall, I would say that it is one of the best consolidants used in this experiment but the cellulose can promote mould growth, so maybe making use of it in somewhere like KwaZulu-Natal where there is a constant high humidity not recommended, it being in solution with water is also not the best for an unfired clay object.

A 2% Klucel G in water is what made up my 8th solution. This was another solution that I already had access to and therefore decided to try. The Klucel G like the Methlcelluslose was transparent and was a bit more viscous than water. I had used it previously with the consolidation of red clay quite successfully and decided to try it on my clay sample. Colouration wise as well as shine wise it was quite a good option as a consolidant there is a slight patchy shine present but other than that visually it looks good. It did cause some muddying and smoothing in the surface of the clay, probably because of the water and is therefore perhaps not the best option for a consolidant on this particular unfired clay.

For solution 9 I made use of Paraloid B 48N in a 5 % solution with acetone. The pellets of the Paraloid become translucent when the acetone comes into contact with them. It dissolved pretty quickly into the acetone. Once applied there was very little difference in both colour and shine between the three layers applied. Colour wise there is very little to darken the clay, but the Paraloid did leave a shiny layer on the clay which is quite noticeable when looking at it in raking light. Other than that I see little to no problems with using the Paraloid as a consolidant for the unfired clay.

For solution 10, I made use of a 5% Paraloid B48N in acetone with 2% ethanol, as a consolidant. I can tell you that there was no difference between this and solution 9 mentioned above. These solutions behaved in exactly the same way and also affected the clay in exactly the same way. Next time I would stick with just one solvent instead of making it with two.

Solution 11 was a 2% solution of Ethulose in water. The reason I made use of this material as a consolidant was because Ariel O'Connor had great success with it in her study and I decided I wanted to try it. This was quite a viscous material considering that it was only a 2% solution. It was definitely more viscous than any other of my 2% solutions. Overall, though the effect it had on the clay was quite impressive none of the three layers darkened the clay, in fact there are no visual differences between the 3 layers that were applied to the sample. One criticism for the Ethulose though is that it did leave a quite noticeable shiny layer on the clay, but other than that it did not have an effect on the clay.

Solution 12 was a 5% Ethulose in Ethanol, this was the mixture O'Connor used so I decided to test it out, the mixture did not want fully to make a solution at first and it was only once I had heated it up in a hot water bath that the Ethulose liquified enough to fully mix with the ethanol.

This was a highly viscous consolidant and was very gel like, I am unsure how this would be used as a consolidant without dilution to thin out the solution. But I still painted it onto the clay, and it actually turned out to be one of the best solutions so far, visually it blended in seamlessly, and one can only notice a difference in the clays surface when looking at the sample with side lighting.

Solution 13 was the trickiest solution yet; it was a 6% solution of Ethulose and water. The first batch of the solution I made I had to dispose of because mold started to grow in the sealed bottle which is a complete contradiction to the TALAS sight which claims that Ethulose does not support mould growth. Once a new batch was made it did not want to fully mix with the water, even after being heated up, to combat this I took a clean spatula and mixed the solution inside the bottle before once again submerging it into a warm water bath. If I though solution 12 was thick I was wrong solution 13 was a very thick gel consistency that would 100% need to be diluted before it could be used as a consolidant. Visually solution 13 did preform very well, it did not change the colour of the clay and while there was now a shine present it was not as noticeable as other consolidants.

Overall, I think the Ethulose may have been my favourite consolidant, it performed very well visually and caused some of the least changes overall, but in the end, I have decided not to include it for further testing because of how easily it became mouldy in the 6% solution. I worry that if it is used in high humidity areas such as Eshowe there will be mould growth on these already unstable artworks. Interestingly, Ethulose was noted as not supporting the growth of bacteria or mould, on the TALAS supplier website (TALAS, 2023).

My final solution for surface testing was solution 14, which was a 7% Paraloid B-72 in Acetone. The reason I chose this consolidant it because I know how Paraloid B72 behaves, I have a lot more experience with it compared to the other materials I made use of and as mentioned previously it is a widely used and well-documented adhesive. While the Paraloid did not darken the clay it did leave a very shiny surface but if this is the material that I would decide to use it can be mattified using different methods. The Paraloid was very liquid and created a homogonous line of consolidant the sample.

One thing that I have observed through the entirety of the surface testing is that some of these materials are perhaps not suited to be a consolidant. Some such as the Ethulose and Aquazol may work better as a surface sealant or as an adhesive considering that the higher one increased the percentage in a solution the thicker it gets. In Figure 42 one can see the consolidants on the samples. This image also shows which consolidants may not be suitable because of their visual characteristics. For example, consolidants 6-10 perhaps have too much of a shine to them if one is working with a matt surface such as those of unfired clay. Overall though I think the first main concern should be that these consolidants in my opinion are not strong enough to acts as a proper consolidant yet. In my opinion just based on the visual properties of these consolidants as well as a general curiosity I would like to further test Aquazol® 500 and 200, Paraloid B-48N, Paraloid B-72, Raviflex and Butvar B98.

Figure 42: The two clay disc samples used for consolidant application where the consolidant used created a reflective surface on the clay. The left disc contains solutions 1 to 10 and the right disc contains solutions 11-14 (photo credit: Chelsea Roberts, 2023).

1: 2% Aquazol® 500 in Ethanol
2: 2% Aquazol® 200 in Ethanol
3: 2% Aquazol® 200 in Water
4: 2% Aquazol® 500 in Water
5: 5% Raviflex in Acetone
6: 3% Butvar B-98 in Ethanol
7: 2% Methyl Cellulose in Water
8: 2% Klucel G in Water
9: 5% Paraloid B 48N in Acetone
10: 5% Paraloid B48N in Acetone and Ethanol
11: 2% Ethulose in Water
12: 5% Ethulose in Ethanol
13: 6% Ethulose and Water
14: 7% Paraloid B-72 in Acetone

4.3.2. Consolidation through capillary action

In a recent online talk presented by Steven Koob, he made mention that when consolidating for increased strength of a large object, the percentage of adhesive in solution needs to be well considered. In his experience with glass and ceramics, Koob recommends a 7% solution for

Paraloid B72 solutions for strength consolidation of an object (Koob, 2023). Based on this recommendation, I chose six consolidants which I felt performed the best during the brush application and which are not cellulose derivatives in order to avoid mould growth in the hot and humid KZN climate. I made a 7% solution of each consolidant using 96% AR grade anhydrous ethanol as my solvent. It is important to note some conflicting opinions regarding the use of ethanol in high concentrations in hot and humid climates. Ethanol is extremely hygroscopic and is known to combine with water in huge amounts in hot and humid conditions (Moyo, 2013: 7). This property is used to drive off water after cleaning metal artefacts as ethanol and water are both polar solvents and completely miscible forming an azeotrope mixture (with a lower boiling point than water or ethanol separately) and when this azeotrope mixture evaporates, both the water and ethanol evalporate at the same rate leaving the wet surface without water which would otherwise cause corrosion. Some literature suggests that this same hygroscopic property is what draws water to ethanol-based consolidants, introducing water into the object and potentially causing areas of weakness (Down, 2015:190). As the clay itself contains a lot of moisture and readily absorbs water, the theory was that ethanol may assist in drying out the clay and stabilising it, so was used as the solvent of choice in the present research.

I included Aquazol® 500 and 200, Paraloid B-48N, Paraloid B-72, Raviflex and Butvar B98 to immerse the base of the cube clay samples, in order to observe the rate at which the consolidant wicks into the clay as well as the depth at which it wicks in. The cube was placed in a small beaker or glass dish and sealed in two plastic ziplock bags to keep the atmosphere saturated with solvent and allow more time for penetration, as per Koob's suggestion (2023).

Figure 43: Clay cubes in vapour chamber for capillary consolidation.

For the 7% Aquazol® 500 and 200 it is quite a lot thicker than the 2% Aquazol® 500 and 200, this thickness makes me wonder if it will be able to wick into the clay sample, I have mixed a 5% solution in order to compare the viscosities, and if perhaps a 5% Aquazol® 500 and 200 would yield a better result than that of the 7% solution. The 5% wicked in at a very slow rate, with 3 ml of the solution being added when needed.

Figure 44: Clay cube after capillary consolidation with 7% Raviflex in Ethanol (Photo Credit: Chelsea Roberts)

I had very high hopes for the 7% Raviflex with ethanol, it performed very well during the surface testing stages, unfortunately something about the Raviflex in Ethanol is causing the clay piece that is immersed in it to crumble and disintegrate. The Raviflex absorbs at an incredibly fast rate and is maybe the right particle size for good absorption into the clay, but it makes the clay too unstable to use it as a consolidant, even once the solvent had evaporated.

The 7% Butvar B-98 in ethanol is perhaps too thick of a solution just like the Aquazol® 500 and 200, so I should perhaps consider making a weaker solution, overall though it has not caused damage to the clay.

The 7% Paraloid B-48N could not dissolve in the ethanol, by my own misreading I thought the Paraloid B-48N was soluble in ethanol, it is not. A new batch was made in a solution with xylene which according to Linda Roundhill, should not cause failure in the clay (O’Connor, 2021: 4). Overall, in my opinion this did pretty well, the consolidant held and while it did not absorb very far, the areas where it did absorb did not discolour, I can recommend working in a well-ventilated area with the Xylene though, because as I learnt from experience when in a poorly ventilated area it can cause headaches.

The 7% Paraloid B-72 in ethanol was not being absorbed as fast as I thought it would, but it has not caused any damage to the clay sample. It did though leave a notable shine as well as a noticeable darkening of the clay sample, I made use of the Paraloid B-72 anyway in this experiment, because I used it almost as a control. I have worked with Paraloid B-72 multiple times before so I knew most likely what the outcome would be. I did not expect there to be so little absorption though.

I assume the main reason these clay samples were not absorbing the consolidants as quickly as I thought they would, is perhaps related to the sample prep and the fact that the samples were made recently, they may still not be dry enough to absorb the consolidants at a faster rate. In future I may instead make the clay samples a month or two in advance and allow them to dry in the sun for a few days before leaving them in a dry open area until they are needed. This would be enough time to draw off most of the mechanically bound water in the samples and would hopefully yield more accurate results.

Once the capillary consolidation experiment was completed, I realised that it had not yielded the results I was hoping for. Most of the consolidants seemed to be sitting on the surface and there appeared to be little penetration which meant that although the consolidants would be well suited as a barrier layer prior to adhesion or perhaps as a a protective sealant, or to consolidate areas of light surface flaking. However, if the goal was to consolidate the bulk of the clay to impart additional structural strength to the sculptures, this poor penetration would present a challenge. I therefore needed to understand if these consolidants were penetrating into the clay or not. In an attempt to visualise this I decided to make use of UV florescent ink mixed into the consolidants and then using a UV microscope, see if it was possible to determine the penetration depth of the consolidants.

I decided to further narrow down my choices of consolidants in order to have four consolidants that I would like to test further. Although the Raviflex caused the sample to crumble I still had very high hopes for it, so I decided to try a few more methods with the Raviflex. In addition, the Aquazol® 500 and 200 were selected because visually they performed quite well, but their absorption was average. Finally, I decided to also do further testing on the Paraloid B48N, as there is very little data on this product, and it is mainly used on metal, but from what I have seen while using it on my clay samples is that it could possibly be a good consolidant for ceramics as well.

For this bout of testing, I returned to new clay cubes and followed an application technique suggested by Sease (1994: 28) where one first applies some solvent by just pressing a brush onto the sample, after about 2 coats of the solvent I moved onto a 2% concentration of m consolidants once again just pressing a consolidant wet paint brush to the clay and allowing it to absorb, once I observed that the 2% consolidants drying time was slowing down slightly, I switched to the 7% consolidant and applied this until the surface took about 20 seconds to dry. I had mixed a small amount of UV ink with each solution used in order to gain accurate results. The reason I did not paint the consolidant on and instead allowed them to move from the paintbrush onto the object, is because in previous experiments I became aware that material had begun to loosen and the samples were turning muddy when the consolidants were brushed on, whereas by simply letting the consolidant be wicked into the clay from the brush, the samples for the most part remained stable.

When looking under the UV microscope it became apparent that disappointingly, the Paraloid B48N while it mixed well with the ink it showed very little penetration occurring (Figure 45). The Aquazol® 500 just sat on the surface of the clay (Figure 46) and there was very little penetration from the Aquazol® 200 (Figure 47), but this could have been because the UV ink had a lot of trouble mixing with the consolidant, so it is possible that the ink did not mix to a suitable enough point for the result to be accurate.

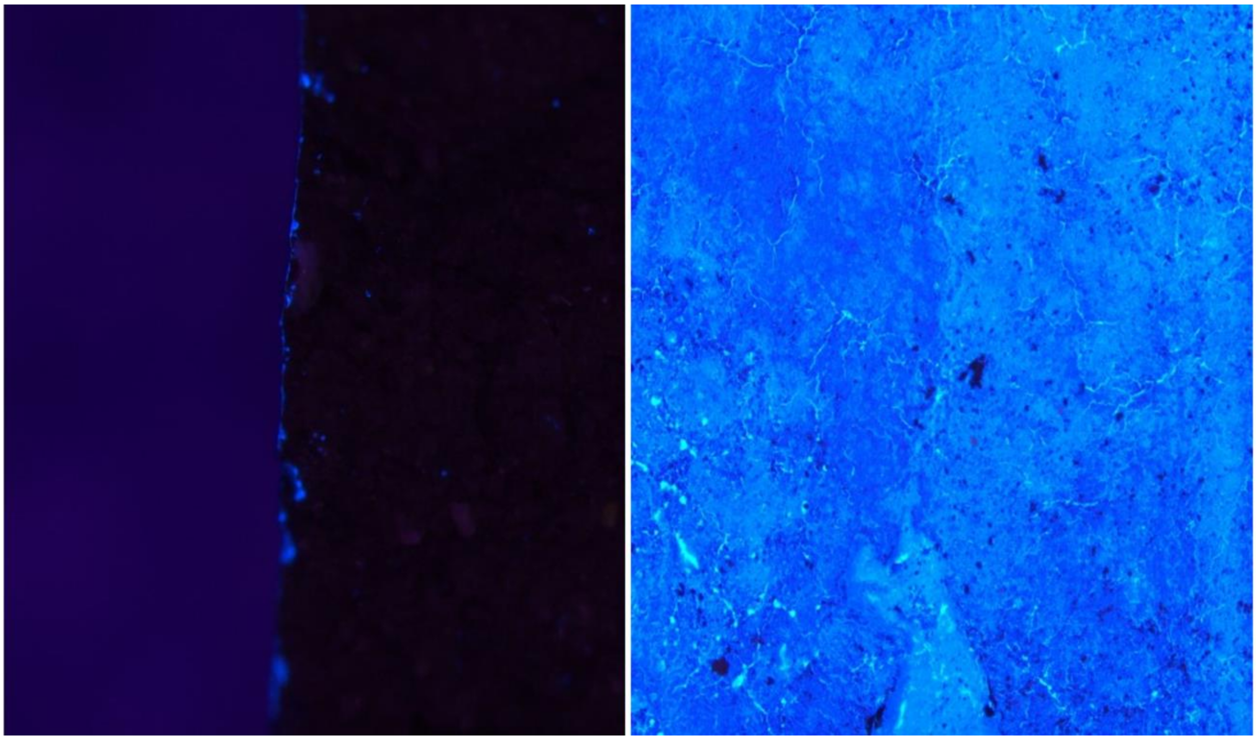

Figure 45: (left) cross section of the block painted with Paraloid B-48N and UV ink: (right) surface of the block under a UV Microscope (photo credit: Chelsea Roberts, 2023).

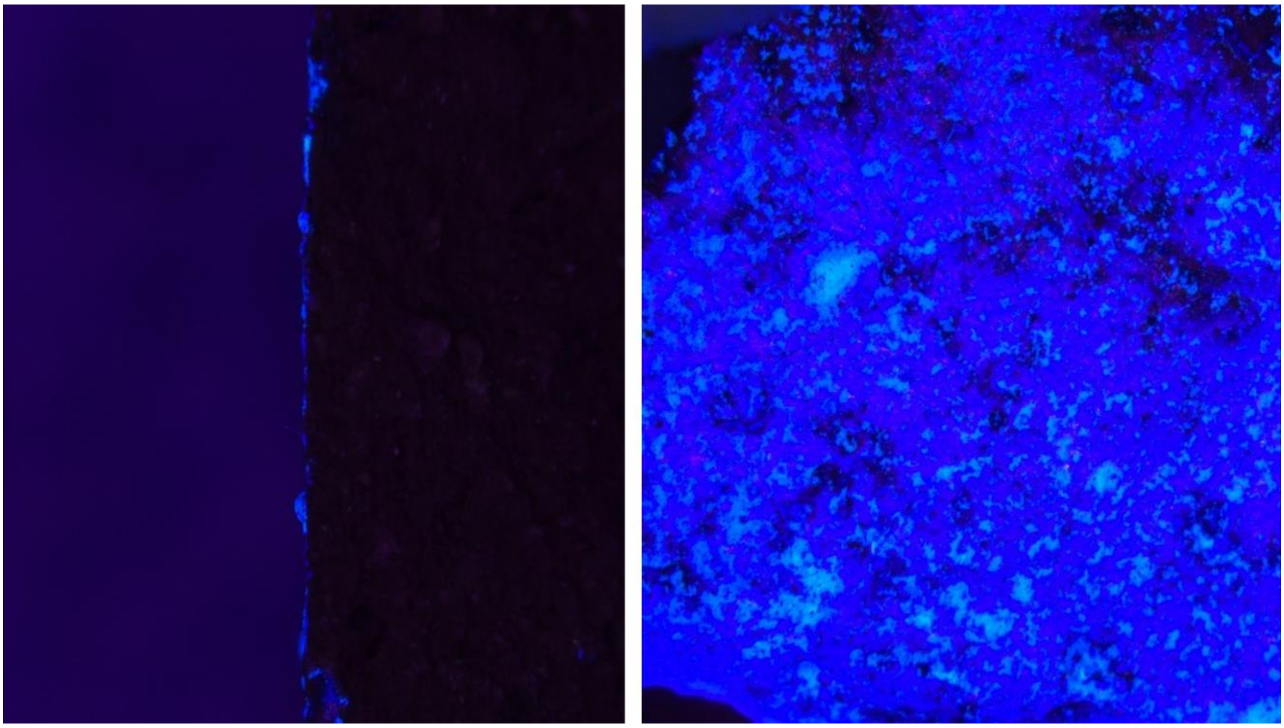

Figure 46: (left) cross section of the block painted with Aquazol® 500 and UV ink while the image (right) surface of the block under a UV Microscope, as one can see it is much patchier than Figure 45 (photo credit: Chelsea Roberts 2023).

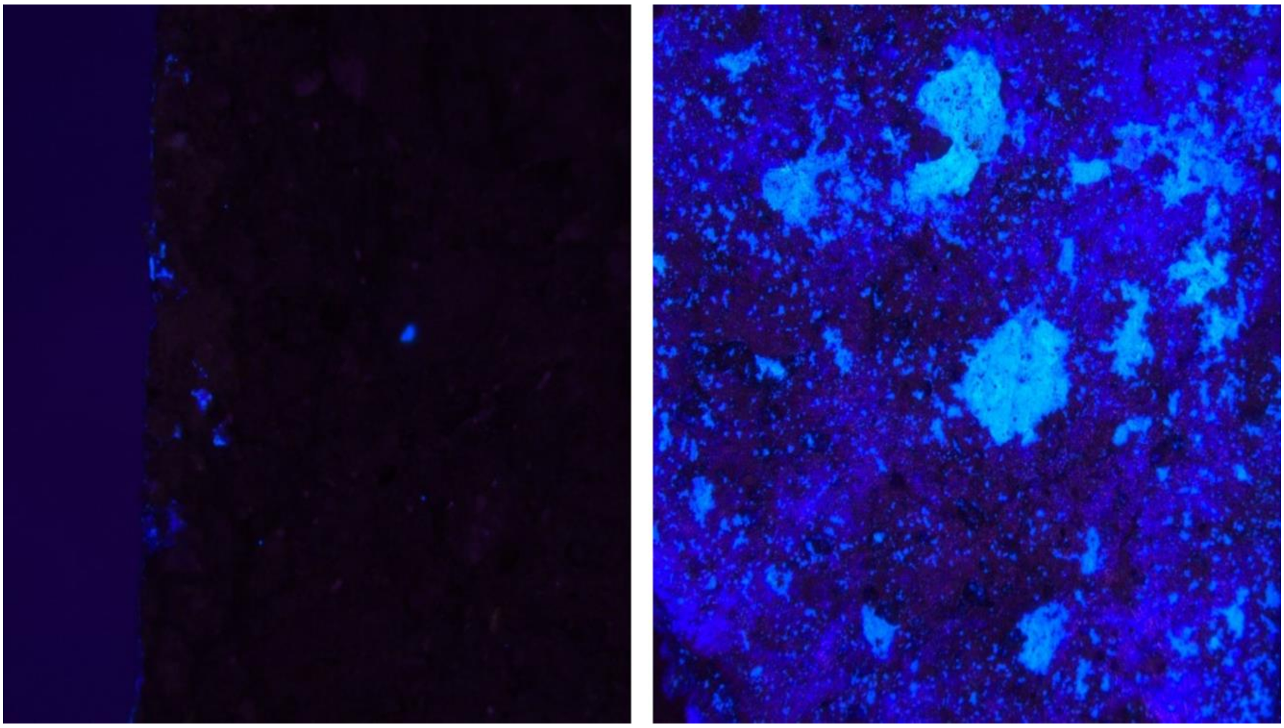

Figure 47: (left) the cross section of the block painted with Aquazol® 200 and UV ink; while the other image (right) surface of the block under a UV Microscope, as one can see the UV ink is very patchy and thinkly distributed (photo credit: Chelsea Roberts, 2023)

What I discovered from the UV images I took was that the consolidant that penetrated the best was the 7% Raviflex in Ethanol (Figure 48). When the sample was placed under the UV microscope it certainly showed that there was a better depth of penetration within the clay as compared to the other consolidant solutions, this was once again another win for Raviflex, the only thing that was working against it was the fact that the sample that was submerged in the consolidant crumbled into multiple pieces. It was then that I remembered that often Xylene and Toluene are suggested solvents for working with unfired clay and archaeological pottery because it has little effect on the clay according to Linda Roundhill (O'Connor, 2021: 4), so I decided to redo the Raviflex test but making use of Xylene as my solvent of choice, so far the Raviflex in Xylene is working, the sample that I currently have submerged in it is absorbing the consolidant and is not crumbling likes it predecessor.

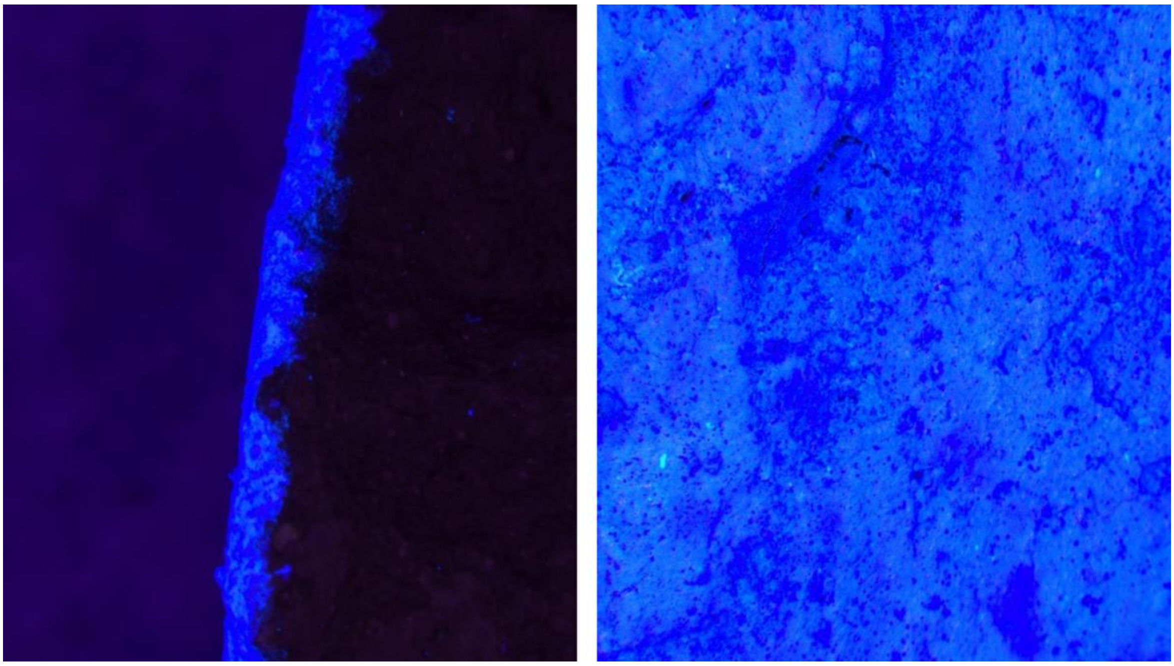

Figure 48: (left) cross section of the block where the Raviflex in Ethanol was painted on with UV ink; and (right) surface of the block under a UV Microscope, as one can see the Raviflex in Ethanol penetrated the best (photo credit: Chelsea Roberts, 2023).

For this experiment I first wet the block slightly with Xylene, then added 3ml of 2% Raviflex in Xylene. An hour later, when I had observed proper absorption, I added a further 2ml 2% solution and 1ml 7% solution, the absorption was certainly slower this time and it was only four hours later that I added a further 3m of the 7% solution. The block did not crumble and the entirety of it appeared to be almost wet to the touch telling me that capillary action was occurring. This was fantastic as other consolidants that I attempted this method with did not have the same results, and most of them only seemed to wet about 50mm up from where they were submerged. On another positive note the Xylene evaporated much slower than the Ethanol or the Acetone, suggesting that it should not cause any instability in the clay as evaporates. Unfortunately, due to time constraints I was not able to test the Raviflex in Xylene using UV ink and a UV microscope, this would definitely be an area where a bit more experimentation can take place.

Table 6: A brief summary of the sample consolidants used throughout this paper.

Sample	Solvent	Concentration	Application	Penetration	Surface Finish	Results	Xrd
Aquazol 200	Water	2%	Brush	n/a	Promising	This overall was a good solution but failed the penetration test that it was put under.	Appendix F
	Ethanol	2%	Brush	n/a	Slight shine		
	Ethanol	5%	Capillary/ Brush	Poor	Slight discolouration		
	Ethanol	7%	Capillary/ Brush	Poor	Slight discolouration		
Aquazol 500	Water	2%	Brush	n/a	Matt	This was a very promising material as absorption was good and surface finishing was good. Unfortunately, penetration was very poor	Appendix F
	Ethanol	2%	Brush	n/a	Slight discolouration		
	Ethanol	5%	Capillary/ Brush	Poor	Slight discolouration		
	Ethanol	7%	Capillary/ Brush	Poor	Slight discolouration		
Butvar B98	Ethanol	3%	Brush	n/a	Shiny	Had an acceptable absorption via capillary action, but the surface finish was too shiny.	Appendix F
	Ethanol	5%	Capillary	n/a	Shiny		
	Ethanol	7%	Capillary	n/a	Shiny		
Ethulose	Water	2%	Brush	n/a	Matt	Had a very good surface finish but as it was organic, as well as there being previous mould growth in a sample I decide to avoid it.	n/a
	Water	6%	Brush	n/a	Matt		
	Ethanol	5%	Brush	n/a	Matt		
Klucel G	Water	2%	Brush	n/a	Shiny	Surface finish was poor. Water soluble	n/a

						solutions are also being avoided for this work.	
Methyl Cellulose	Water	2%	Brush	n/a	Promising slight shine	Worked well, but decided to stay away from organics as well as water solutions.	n/a
Paraloid B48N	Acetone	5%	Brush	n/a	Shiny	This was a promising solution, there was a discolouration as well as a slight shine as well as not great penetration. Should be investigated further for ceramics.	Appendix F
	Xylene	5%	Capillary/ Brush	Poor	Slight discolouration		
	Xylene	7%	Capillary/ Brush	Poor	Slight discolouration		
	Ethanol + Acetone	5%	Brush	n/a	Shiny		
Paraloid B72	Acetone	7%	Brush	n/a	Shiny	This was used more as a control because it has been researched extensively. May use if the surface can be matted	Appendix F
	Ethanol	5%	Capillary/ Brush	n/a	Shiny		
	Ethanol	7%	Capillary/ Brush	n/a	Shiny		
Raviflex BL 5 S	Xylene	5%	Capillary/ Brush	Good	Good Match	This was the most promising as it had a good surface match and penetration	Appendix F
	Xylene	7%	Capillary/ Brush	Good	Good Match		
	Ethanol	5%	Capillary/ Brush	Good	Good Match	The combination with Ethanol cause the samples to crumble and fall apart	
	Ethanol	7%	Capillary / Brush	Good	Good Match		

4.3.3. Trial by fire: refiring as a means of stabilisation.

As part of my clay sample preparation, I was able to make two larger objects each around 120g. The first object I made was in an abstract shape of a bust while the other was in the shape of a long rectangular log. Originally these pieces were just for fun as I had extra clay, but the opportunity arose for me to make use of the muffler furnace located in the same building as the microscopy and XRD facilities. So, while I had the opportunity I jumped at the chance. I wanted to ascertain what would happen to these pieces I made if I fired them. This would then tell me what the possible outcome would be if perhaps the only way to conserve Ntuli's work would be to fire them as an initial stabilising treatment which could then allow for retreatment if the artworks were ever damaged. Due to staff availability and pressure from loadshedding (rotational power cut) schedules affecting the building, I had a very limited window of opportunity to fire my clay samples and unfortunately this could not be supervised. I went on a Friday morning to put the clay pieces in the furnace (Figure 49) the interior temperature of the muffle furnace began at about 400˚C, they then baked for 8 hours before the furnace turned off and the sculptures were left inside the furnace (which was turned off) to cool over the weekend. By the time I fetched them the following Monday morning, they were perfectly cool. Although my clay samples reached an uppermost temperature of 900˚C and were not damaged, this is certainly not how Ntuli would have fired his work had he had the opportunity. He would likely have followed a similar firing process to potters in his area.

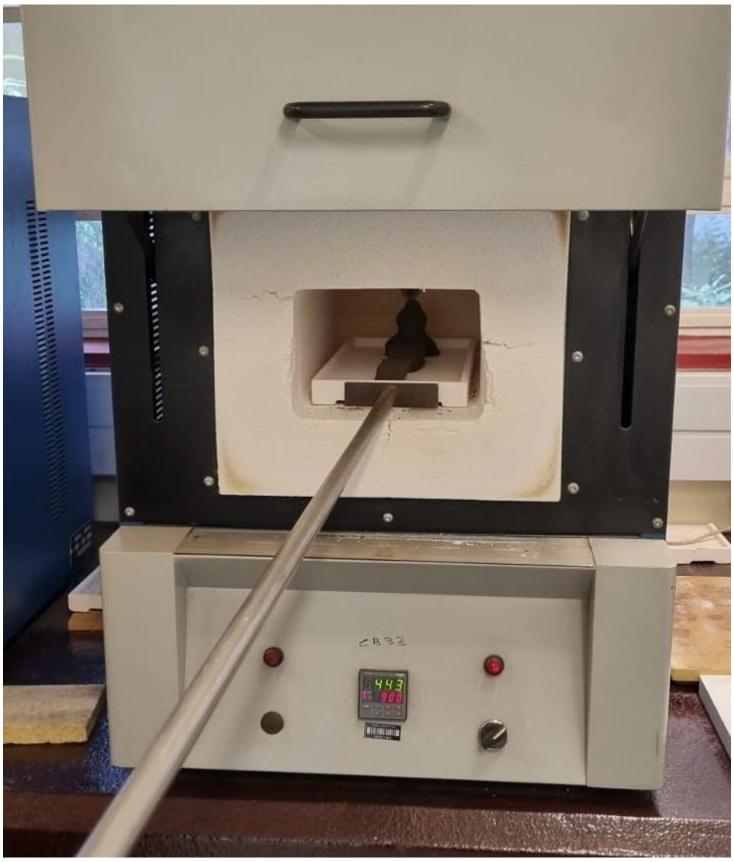

Figure 49: Placing the clay samples in the muffle furnace for firing (photo credit: Chelsea Roberts, 2023)

Ceramic making has a long tradition in South Africa and has been well-documented for different cultural groups and individual artists (Lawson, 1967: 456; Rankin. 1990; Hoeane, 2020:10; Mulaba-Bafubiandi 2015). The firing technique and materials involved vary from region to region, for example the Basotho-Batswana fire their vessels in an open pit with a stone shelter using dried cow dung as fuel (Hoeane, 2020:10), while Zulu potters fire their pots in a designated firing area, often near an embankment, or in a shallow pit (Perrill, 2012: 40) and using a variety of grasses, wood, dung, dry aloe or euphorbia plants (or combination thereof) as fuel (Perrill, 2012: 39-40). The firing takes one to ten hours depending on the size of the pots and during the firing process, the pots turn an ochre red with black spots (Hoeane, 2020:10).

During a trip down to the Eshowe district I was lucky enough to be given a demonstration by two local potters Brian and Ma (mother) Lngubane on how they make (Figure 50) and fire their pots (Figure 51).

Figure 50: (left) the potters roll the clay into long thin rolls which they then use to coiled onto a flat base to create the pots; (right) once shaped and dried, the irregularities between the rolls are shaved and the pots burnished with a burnishing stone (photo credits: Chelsea Roberts, 1 June 2023).

Figure 51: The bonfire for firing is constructed in layers firstly with large logs onto which metal sheets are placed. Small sticks are then placed over the metal sheets and the pot position. More sticks are added and the pot is covered in hay (photo credit: Chelsea Roberts, 1 June 2023).

There had been rain in the area during the week so when they fired their pots they made use of a flat large piece of metal which according to Perrill assists in preventing dampness and moisture from the earth, or exploding stones, from ruining the firing process (Perrill, 2012: 40). They then placed larger logs on before placing smaller sticks and twigs to support the pots. They then covered the whole area with hay and set it on fire they fired the pot in the hay until it reached a deep red colour before taking the pot out and covering it with dried leaves which created a dark black pot. This whole process took maybe 30 minutes for a small pot and could take a few hours for the larger works. I believe the temperature in these traditional firing techniques would reach about 400˚C to 600˚C. It is my belief that if Ntuli did fire his work, this would be the technique that he would use. Indeed, his son Paddy has taken to firing his works as was observed (Figure 52) during the site visit to Eshowe and his meeting. Figure 52 shows a row of yellow ochre-coloured busts in the back row, with a row of darker busts in the front, also fired which resemble the final colour and fire clouds of pit-fired pots.

Figure 52: Paddy Ntuli sculptures after firing in an open-pit (front row) with noticeable fire clouds, and back row with a more typical ochre colour as achieved in an electric kiln (photo credits: Chelsea Roberts, 29 May 2023).

While knowing this though, I decided to fire the work until 900˚C because I believed that this would really test the limits of the clay. I wanted to see that if I pushed the clay and put it under unneeded stress would it crack during firing or in worse case explode. The pieces went in a dark brown colour, and they have exited the kiln as a bright terracotta colour.

Figure 53: (left) the log-shaped form prior to firing; and (right) post-firing (photo credit: Chelsea Roberts, 2023).

Figure 54: Underside of form 2 post-firing showing the bright orange terracotta colour and a mauve coloured core (photo credit: Chelsea Roberts, 2023).

The clay has all the characteristics of a fired clay, the colour has changed from a dominant black to a dominant red colour characteristic of the oxidation of the iron in the clay. In addition, there was also a noticeable change in the weight of the bust went from 131g to 114g, and the log went from 119g to 105g. Overall, the clay handled the firing process very well, the clay remained stable, there are no large visible cracks or loss of material a result consistent with that described by Thicket when re-firing attic vases damaged in a fire. As mentioned in Chapter 2, there are some ethical considerations when re-firing clay artworks and artefacts, however this is mostly related to the research data potential of archaeological ceramics as this treatment would affect the possibility of residue analysis and dating of the clay. Although neither of those are necessarily applicable in the case of the Hezekiel Ntuli artworks, re-firing of the sculptures would still present a visual and aesthetic challenge if the clay changes colour. If there was a way to ensure that the colour of the clay did not change this drastically, I would definitely consider the use of firing of the sculptures as an alternative treatment to the application of consolidants whose use seems to be limited, and in addition may pose further complications for future retreatment. Re-firing could not be applied as a blanket solution for these artworks, obviously the painted works would be an exception since the paint would disintegrate during the firing process.

4.4. Conclusion

Overall, I feel as though I have learned a lot during this experimentation. It is my belief that while the Raviflex in Xylene worked wonders with capillary action I am not sure if capillary action is the best treatment option with the larger objects, as well as the painted objects. Paintbrush application of the consolidant especially if it is to be applied around paint allows more targeted application and control of both application and possible negative effects. Since we do not know what paint Ntuli used[31], it would be preferrable to minimise prolonged contact with a solvent and therefore brush application will be best. In addition, with the larger sculptures large volumes of solvent would be required necessitating a fume hood and large vapour chamber, and the artwork would be sitting in the solution for a very long time. I also believe that each of the consolidants I used has its own uses whether that be as a consolidant or as a surface sealant, the use of these consolidants is all dependent on the clay and the artwork in my opinion. In my case what I found was that for my clay samples, the Raviflex first of all

[31] Testing of various solvents could be attempted in an effort to identify the paint used, however this could be potentially destructive and as the self-sampling fragment were too small for this experimentation, it was decided that insufficient paint media could be sacrificed in an unobtrusive spot for the experimentation to be carried out successfully.

had the best visual properties as it did not really discolour the clay and did not have much of a shine. When testing the four consolidants under the UV Microscope the Raviflex was the one that was absorbed into the clay the most. The only test that the Raviflex failed was the capillary test, where it caused the sample to crumble and disintegrate, but this problem was easily rectified by replacing the Ethanol with Xylene. But this is just a personal opinion and I believe that the consolidant used is dependent on your conditions. If these artworks were found in a dryer and cooler environment, I would have made use of a cellulose based consolidant because in my opinion these worked very well, but because of the climate of where many of these artworks reside, this would promote the growth of mould. If my object had a shiny surface, I would be more likely to use the Butvar or the Paraloid B-72. These treatments are all purely based on my personal decisions and this specific case study.

As mentioned above during this experimentational process I had the chance to fire some clay samples and while the whole process worked incredibly well it did drastically change the colour of the clay. The clay went from a dark warm brown to a bright terracotta colour. This colour change is why ethically I do not think that firing these artworks is the way to go. When this clay is fired the aesthetic value of the object has changed completely. From what I have seen there are no other artworks done by Hezekiel Ntuli that have been fired, so these sculptures would be permanently changed, meaning that their value is permanently changed. I cannot in good conscious make the decision o fire these objects, as first and foremost I do not know if this colour change would have been accepted by the artist. While it is stated that he had originally wanted to fire his work, I doubt it would have turned out how the samples turned out. The reason I am saying this is because if my assumption is correct, I believe Ntuli would have made use of a traditional firing process making use of organic matter. This would have meant that the colour of his finished products would have been darker and variegated between black, brown and terracotta. They would not have been a singular colour such as the bright terracotta of the samples. So, while I do believe that in some cases firing is necessary, such as with cuneiform tablets, I do not believe that one should fire Ntuli’s work. Instead, I suggest trying one of the mentioned methods for applying consolidant before firing is considered.

I definitely think in future I would make use of a lower flame temperature and would like to test out a more traditional firing process on a sample but due to time constraints this is not possible. I would have also liked to fully test out the affect these different consolidant had on painted samples, so that I would get a fuller picture on how to properly conserve these objects.

Chapter 5

Mischief Managed (Conclusion)

5.1 Summary of Chapters

The research presented aimed to gain a better understanding of who Hezekiel Ntuli was, completing the as yet undocumented and newly acquired artworks in the UP Museum collection, and investigating the possibility of preserving and conserving these unfired clay artworks.

Chapter one outlines the aims, methodology and importance of the research.

The literature review presented in Chapter 2 regroups the scant literature available about the artists. I only found about four sources which were supplemented by a fortuitous and impromptu conversation with Hezekiel Ntuli's son, Paddy Ntuli. Paddy Ntuli shed invaluable light onto the life and art of his father. In the second part of Chapter 2, I engaged with Juliette Leeb du Toit to understand her background and motivation for collecting these art works which she then donated to the University of Pretoria. After covering the artist and the collector, I turned my attention to understanding what is conservation and what it entails with regards to ceramics, both fired and unfired.

Chapter 3 consists of the Hezekiel Ntuli artworks' condition reports and documentation to supplement the museum records. With this documentation and condition reporting I was able to identify the specific problems that each artwork was facing. XRF analysis helped me to identify that the objects are all made of clay that originated from the same geographic location. This data also indicated to me which artworks were made with a slip, and that the painted sculptures were made using Titanium white paint. Between talking to Paddy Ntuli and analysing Hezekiel Ntuli's work, it became apparent to me that he made his work of a solid block of clay and carved the faces and shapes he desired out of it. It also became apparent that he made use of a pinching method, where he pinched off pieces of clay from another source and attached it to the sculpture he was working on, in order to add features or decorative elements.

Chapter 4 was completely experimental and included testing of various consolidants, through brush application and capillary consolidation. I started with fourteen solutions and applied them on clay disks to visually judge how they changed the appearance of the clay. Of the fourteen, six solutions which were visually the least intrusive were selected for additional testing using capillary consolidation on new clay samples placed in the selected consolidant, which allowed me to see if the consolidant would flow into the sample ad how far it would be absorbed via capillary action. These included a 7% Paraloid B72, 7% Butvar B98, 7% Aquazol® 500, 7% Aquazol® 200, 7% Raviflex BL 5S all of these were in solution with Ethanol, the sixth solution was a 7% Paraloid B48N in solution with Xylene.

After this I chose the four consolidant solutions that appeared to perform the best namely, Raviflex BL 5S in Ethanol, Paraloid B48N in Xylene, Aquazol® 500 in Ethanol and Aquazol® 200 in Ethanol.

These were applied to four new clay samples using a paint brush and UV ink in order to view the penetration capabilities of the four consolidants. Examining the samples under the UV microscope, the consolidant that penetrated the best was the Raviflex BL 5 S in Ethanol, but for capillary action this caused the sample to crumble. The test was repeated with a new clay cube replacing the ethanol with Xylene, which yielded a better result.

The chapter also included analysis of the clay through XRD prior to consolidation, as well as afterwards to see if there is a change in the clays structure with the addition of the resins. The XRD results showed that there was no phase change occurring with the addition of the resins, the resin did not react with the clay it just covered the surface.

As the laboratories where the microscopy and XRD analyses were carried out had a muffler furnace, I was also able to fire two samples of clay. The sample went into the furnace at a very high temperature and far longer than what would be realistic for an artisanal ceramicist such as Hezekiel Ntuli, however the ceramic fabric of the sample was not damaged at all, and the samples are in a stable ceramic form which would allow for conservation through more conventional means if they were to ever be damaged. While the fired samples are now stable, they are bright orange and would likely clash with Hezekiel Ntuli's aesthetic and what is expected of Hezekiel Ntuli sculptures, as such I believe that in its current form this firing experiment was not successful, however perhaps experimentation with different firing temperatures and duration would yield a more acceptable result for his unpainted artworks. I was able to also preform XRD on this sample and there was a definite change in the clay structure, one can see the Kaolinite is gone and most of the chemically bound water has been driven off.

5.2 Contribution of Study

Firstly, this dissertation has actively contributed to both the UP Museums and Zululand Museum's records as both collections were either undocumented in the case of the former being a new acquisition, and only partially documented in the case of the latter. Additionally, this dissertation contributed to a better understanding of Hezekiel Ntuli's art and the elements that threaten it. This paper also allowed for a more detailed and condensed understanding of Hezekiel Ntuli's life. The experimentation and research done in this paper will also contribute to the understanding and treatment of unfired clay objects in general. I say this because there is so little research done on the conservation of these objects that any new information contributes to the greater understanding of the practice. This paper will hopefully aid others who are faced with similar problems and will help with any conservation they see as needed whether this conservation is preventative or remedial conservation. I hope by writing this paper I can draw more attention to the amazing artist that is Hezekiel Ntuli and I Hope that I can help others in their efforts to not only conserve his works but also any other unfired clay work that we are in danger of losing.

5.3 Limitations of Study

The limitations of my study had purely to do with access, including access to literature, access to a variety of conservation grade materials, and access to analytical equipment.

Firstly, did not have access to all the conservation materials I would have liked to try because on one had some of these materials were not available in South Africa and on the other hand the cost to import some of the materials to South Africa was unfeasible, it was for this reason that some of the consolidants I made use of were consolidants that could already be found in the conservation studio at the University of Pretoria.

So while I did analyse many of Ntuli's art works, I feel that if I had access to more of his works and managed to study more, I would have been able to have a greater understanding of Mr Ntuli's art and his method. Ideally, I would have also like to look at his other animal sculptures such as the ones of Hippo's I would have also like to look at some of his group sculptures, because I believe that would have been a whole different kind of sculpting unlike with his busts.

Lastly, time limitations always hamper research and given additional time, I would have liked to fire a few more samples at different temperatures and duration to see how this affected changes and results. There are multiple different experiments that I would still like to preform and ideally, I would have liked to test more consolidants because I still do not feel like I have found the most appropriate fit for Ntuli's art works that is visually minimally intrusive, penetrates well and provides strength, whilst being sufficiently reversible that safe retreatment of unfired clay will be possible.

5.4 Suggestions for Further Study

Suggestions for further research follow on from the limitations described above including testing of additional conservation materials, and analytical techniques. I would for example have liked to take the samples to the Scanning Electron Microscope (SEM) to look at the possibility of really seeing the absorption of consolidants into the clay. Although using the UV ink was helpful in the absence of SEM analysis, by making use of the SEM I would likely be able to see for sure if the consolidant is penetrating the clay. At the moment one has no way of knowing because unless the consolidant discolours the clay one is unable to see the penetration with the naked eye. I believe the SEM will allow for improved decision-making on what will work best for consolidation of an object.

Secondly, identifying the paint that Ntuli used on his leopards and other painted works. As there is no certainty on what paint Ntuli used, it was deemed too risky to simple test solvents for consolidation directly on the paint as there were no areas large enough to be tested without potential mishaps affecting the visual aspects of the leopard ashtrays, as the wrong solvent could easily damage or remove the paint.

Lastly, I would like further testing to be done on firing of the clay samples as I believe that this may be a more permanent way in which to stabilise the artworks, which if damaged can then be conserved through more conventional means. My motivation is two-fold, firstly museums in South Africa do not always have the resources to ensure optimal storage conditions for their collections in terms of humidity and temperature control, and although the use of appropriate preventive conservation measures can go a long way to preserving these fragile items, this is not always possible as there are few conservators employed in South African Museums who would be able to look after these objects appropriately. Firing the sculptures would make for a more stable and durable material which would be able to handle less than ideal storage conditions a little bit better. Secondly, successful low firing of the sculptures would allow for conventional conservation treatments on a more stable material, treatments which could be far more 'reversible' than what consolidation of unfired clay would be as there is a strong likelihood of damage to the clay fabric when trying to draw out previously applied consolidants or reverse prior repairs. In terms of conservation ethics with regards to firing these artworks, there are no residues or dating concerns that would be erased by firing and so the argument used for not firing archaeological ceramics to preserve evidence is moot in this case. Furthermore, it is documented that Hezekiel Ntuli had always planned to fire his works, but never had the time to do so, as they were purchased as soon as they were made and shown. The artist's intent was thus to ensure a certain strength and permanence through firing which would likely have been done in the same manner as most artisanal potters in South Africa, namely in an open pit or steel drum to which combustible material is added to low fire the sculptures. There is a chance that with different firing temperatures and techniques used by local potters that a less drastic colour changes than that obtained during the experimentation could be achieved, and this warrants further research.

5.5 Conservation of the Artworks

As things currently stand now, I believe that preventative conservation is the way to go with many of Ntuli's artworks. At the moment most of his artworks currently in the possession of the University of Pretoria are in a fairly good and somewhat stable condition considering the material. I believe that it would be best to leave them in a cool and dry area where the humidity is controlled. This will hopefully mean that the artworks will remain in a good and stable condition for years to come. This may be more difficult for the Vukani Museum to achieve as they are naturally in a hotter and more humid region of South Africa.

With this in mind, I have concerns for the large *Bushman bust* and the two *Leopard Ashtrays*, which are in desperate need of a stabilisation treatment. During the nine months of research, they have been placed in a closed steel cabinet out of the dust and somewhat more stable in terms of temperature and humidity and still they have continued to deteriorate, powder and crumble. I believe that if not treated they will continue to degrade and in the case of the *Leopard Ashtray's* it is possible that they will be lost within the next five years. At the moment it appears that the consolidant that works the best was the Raviflex BL 5 S in Xylene first applying the solvent, then moving to a low concentration consolidant like a 2% before finally moving onto a stronger consolidant such as the 7%. I do not currently know how the paint will react and if this consolidant will work on the painted surface, but perhaps focussing on the very crumbly base as a first step might be a good starting point.

Over the past year I have had the honour and the pleasure of studying Hezekiel Ntuli's art, I have grown fond of the manner in which he shows facial expressions and in the life that he brought to his sculptures. While his sculptures could be classified as simple, they have a level of complexity to them that draws people in. His sculptures draw you in with their kind eyes and emotive faces, in my mind Hezekiel Ntuli's style of art is unique and beautiful. It would be a loss to society if these artworks were to be lost so it is my hope that these artworks may be stabilised so they may be displayed and enjoyed by future generations to come.

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Appendices:

Appendix A Letter of Introduction:

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

School of the Arts
Tangible Heritage Conservation

24 February 2023

Letter requesting research access and permission to research the Leeb du Toit Collection from the University of Pretoria Museums

Dear Sir/Madam

My name is Chelsea Roberts and I am currently carrying out research for the requirements of the M(Soc)Sci Tangible Heritage Conservation at the University of Pretoria. The study is provisionally titled *Ubumba Olungashi: A Case Study of Unfired Ceramics by South African Artist Hezekiel Ntuli.*

The research aims to determine an appropriate course of action to stabilise the Hezekiel Ntuli unfired sculptures at the UP Museums. To fulfil this aim I will look at three different clay objects from the Leeb du Toit collection owned by the University of Pretoria. These three objects are made of unfired clay, one of which is also painted. I am hoping that by looking at three different case study objects I will be able to add to the knowledge that other conservators have on how to conserve unfired clay artworks more generally.

Permission is requested for access to the Leeb du Toit Collection (currently un-accessioned), to document in text and photo-documentation the objects, carry out condition assessments and develop conservation treatments to clean, stabilise and conserve the individual objects.

Any questions you may have about this study can be directed to Chelsea Roberts at 0738911198 or u18137785@tuks.co.za, or the dissertation supervisor Isabelle McGinn at 0839530587 or Isabelle.mcginn@up.ac.za

Regards

Chelsea Roberts

Isabelle McGinn

SCHOOL OF THE ARTS
UNIVERSITY OF PRETORIA
FACULTY OF HUMANITIES

Appendix B Museum Access

B1 University of Pretoria Museum Access Form for Leeb du Toit Collection

University of Pretoria of Pretoria Museums
Old Arts Building, Lynnwood Rd • Hillcrest • Pretoria • 0002 • Gauteng
Email: museums@up.ac.za
By appointment only and access to campus via a one time pin

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

UNIVERSITY OF PRETORIA MUSEUMS COLLECTIONS AND ARCHIVES RESEARCH ACCESS FORM

***BONE FIDE* RESEARCHER/STUDENT DETAILS**
Name:........Chelsea Jane Roberts..........
Personnel / external researcher/ student number:......u18137785..........
Affiliation/Institution:......University of Pretoria – Tangible Heritage Conservation..........
Identity Number:.........9905120069084 ....
Physical Address:......1237 Rist Avenue, Queenswood, Pretoria
E-Mail:........u18137785@tuks.co.za..........
Contact number:.............0738911198..........

RESEARCH RECORD FOR MUSEUM USE
Brief description of proposed research topic/title (Attach motivation/ research proposal):
Research on the conservation and care of unfired clay sculptures from the Leeb du Toit Collection, UP Museum..........
Request for access to and permission for:
□ Archives X Physical Collection □ Images □ Research material □ Other

Purpose:
□ Accredited article Thesis X Research project □ Assignment □ Internship □ Other

Details of Collection:
Contents required from specific collection/archive, attach more information:
..Objects from the Leeb du Toit Collection for documentation and provenance research...

Proposed dates for access: from......February 2023..........to......December 2023......
Analysis? Yes/No

GENERAL TERMS AND CONDITIONS

1. Copyright resides in all collections, archives, information, printed or otherwise, including all photographic material to the University of Pretoria. No images, photographs, information, research data or filming may be reproduced in any form or by any means, without the express written permission of the "University of Pretoria Museums".
2. Official notification is expected in writing and should include the date, the expected times and duration research and access. The Museum reserves the right of appropriate access to all Collections and may at any time place certain restrictions on copyright, fragile objects or sensitive Collections.
3. Please note, it is not general practice to remove any collections to other labs or off campus for long durations. All such requests must be motivated in full and made in writing for collections control, asset, inventory checks and insurance purposes.
4. Any SAHRA permitting requirements must be discussed between the Museum manager as Curator and the Supervisor before access to the UP Museum Collections is granted.
5. I hereby undertake to give written recognition to the "University of Pretoria Museums" for any material used and access to the Collections and to provide the University of Pretoria Museum with a copy of any publication (article, electronic theses, book, chapter), which should result from the research undertaken in any of the Collections, Archives or Museums.

.... [signature] Signature of Head of UP Museums — 24/02/2023 Date

.... [signature] .... Signature Research Applicant — ...22 February 2023.......... Date

B2. Fort Nonquai Museum letter of permission granting access to the Hezekiel Ntuli Collection

FORT NONGQAYI
MUSEUM VILLAGE
EZOKUGCINA
AMAGUGU OMLANDO
AKWAZULU

PO Box 37, Eshowe, 3815,
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25 May 2023

TO: Ms Maggi Loubser

Permission to do Research

The Fort Nongqayi Museum hereby gives you permission to do research on our site during the course of the week, 29 May 2023—02 June 2023.

It will be excepted that the Fort Nongqayi Museum, the Vukani Collection and the Zululand Historical Collection will be referenced as a source in all published work.

We are looking forward to hosting you during this period.

Regards

Johannes Diemont
Curator
Fort Nongqayi Museum Village

Appendix C. Email exchange with Juliette Leeb du Toit (25 June 2023)

Questions asked by Chelsea Roberts (UP student)

[**Dear Chelsea**
I have added a preamble as this reflects a significant part of the auto-ethnographic dimensions of my collections. It is a bit long-winded but is quite important]

Preamble

My collecting of South African art, material culture and ceramics throughout my life (from about age 8) must be seen against the matrix of several confluent factors. In a sense, therefore, my interest in local creativity emerged as a result of circumstance, exposure and ideological shifts.

a) Like may white South Africans raised in post WW2 Pretoria, I was raised by three African women: Mina (probably a Tswana) who came to look after me as a six month old infant. She had just lost her newborn son, so I was dearly loved by her as a sort of replacement infant. A few years later there was the feisty city born South Sotho Louisa, who came with us on our Cape or Natal holidays; and finally there was Evelyn Masote, a beautiful Sotho speaker who became a close confidante and carer of me and my two older siblings until I left to go to University and she went back to the Nursing Council in Pretoria. By the age of 8 I became fascinated by what Ms Masote made – embroidered pillowcases for her room; the fact that she insisted on sleeping on a bed raised on two bricks onto which a paint time was placed for each leg of the iron bed (to keep away the tokoloshe, she said); and from an early age I preferred the food that my carers made (mostly vegtables), - mfino (morogo), pap, mahewu etc. Both she and my mother told me about the amalaita's who passed by our home on Saturday or Sunday mornings or afternoons. Often bloodied after stick fighting and I was fascinated by these superb warriors who ran all the way from Mamelodi or even further afield to a central site in Pretoria west. They chanted in low hum…and were given clear passage to run all the way on the side of the road. I also became fascinated by black physiognomies – the sloe eyed beauty of our gardener Simon…who looked like an Egyptian or oriental prince (he was in fact from Venda) or the dignified bearded William who worked for my great aunt…(her husband had been secretary for the interior) and William ran the home with superb precision and care. Every year he went home for two months or longer to 'plow'…I was also acutely aware of differences in dress…a few local Ndebele women worked nearby in Arcadia, coming to work in full married regalia ..including heavy beaded anklets and also neck pieces that resulted in their elongated necks. I asked to look more closely at these as well.

b) Besides my personal encounters, which were rich and endearing, the *main interest was also initiated in the new curriculum at School* (Arcadia primary), a subject called Social Studies. This surprisingly (nogal!) at the height of Apartheid where ethnographic studies and anthropology as mooted by i.a. NJ van Warmelo, were said to reinforce said policy of segregation, but in fact it had the opposite effect for students like me. We were taught about the various groups in SA, their location and practice…alongside select studies of European peoples. But every 6 months (or annually?) we had to realise an independent project on a local African group. I still have three of the books/albums I did when about 10 or 11 years old .One was on the Venda, Ndebele, and southern Sotho; another was on the Bushmen (Khoi- San) and their art and poetry and still another was on South African art. I sourced images in the publication *Panorama* and *Bantu* (my sister later worked for the Department of Information). I also acquired postcards from the art supplier Schweikerdt and made many copies of images found in the local press and on tourist postcard . The course at school, *Social Studies* also resulted in annual trips to local 'ethnic settlements and areas': to the Ndebele village near Pretoria, to the Voortrekker museum and Mounument; to Paul Kruger's home; and to Klapperkop Fort and all the National museums in Pretoria. Once at varsity (TUKS) we also went on digs to Mapungubwe and elsewhere with Prof Eloff. I did not study the subject but begged to be allowed to tag along.

c) The notion of collecting and valuing art/objects also began in two main contexts: my grandfather was Justice Quartus de Wet, and his superb home contained a huge array or oriental carpets, Dutch and mostly Chinese VOC blue and white ceramics and most importantly a real cabinet de curiostés in which were contained jewels, ivory sculptures, exotic pipes and other miniature ceramics. I was only once allowed to touch a small silver box – but this collection never ceased to intrigue me. This entire collection and furniture is in the Koopmans de Wet museum in Cape Town. A second aspect was that I too began to collect what can be called curios: a beautiful beaded horn, and another smaller one and a beaded doll from the Ndebele village. Whenever we went on outings I would add to this growing collection, the pieces hung onto a small woven grass mat on my bedroom wall.

When did you start your collection?

So in effect my collecting started in c1957. On trips to the former Transkei I bought a navy melton doek, a smoking pipe and some beads, and when in Natal I bought bead and cloth at the Umgababa tourist outlet on the Natal south coast. However it was only when I came to Natal in c 1975 that my increasing interest in ceramics and local Zulu material culture occurred: vessels were bought from Umgababa, from local potters and mostly in the 1990s from the Magwaza family near Nkandla and also from Eshowe area. Colleagues Ian Calder and Juliet Armstrong held many pottery exhibitions of rural ware from the late 1980s in the CVA where I worked.

When did you stop collecting?

I continue to collect…!

Where were the objects kept while they were in your possession?

I always kept the objects I purchased either in my bedroom, but from the 1970s these were increasingly on display in my home: in the sitting room, on shelves in my study and my varsity office.

Do you remember where and when you acquired the works by Hezekiel Ntuli and Samuale Mokoyane?

The Ntuli work was at times acquired on field trips that allowed us to visit the Eshowe area. However my colleague Ian Calder (who taught ceramics) located a vast collection of Ntuli works at the Natal Museum. He did a paper on this and we all began scouring the second hand outlets, local sales and auctions to locate more of his work. It was at a PMB Hospice shop that I found the large bushman head together with three cattle sculptures (the latter were donated to the Tatham Art Gallery in Pietermartizburg_ and in effect were initially part of my collection). While previously I was aware of Ntuli pieces for sale at places like the tourist outlet Ivy's, I did not quite like the representational quality of the work at first.
The Mokonyane works were a chance find at the Kloof SPCA charity outlet, c 2018.

Did you acquire these works through a third party or from the artists/artists family?

All the works you mentioned came from secondary outlets, auctions etc. The Magwaza work was bought at their home near Nkandla

What drew you to the works in the collection?

I became increasingly fascinated by the nature of the making of said works. I did a two year course at the CVA on ceramics. All works were acquired as I immediately recognised their origin and cultural value. So technically I was drawn to the fact that the works were made by artists I could identify and I wanted to amass as many as possible in order to trace the variety and proficiency in the works.

Do you perhaps have any Documentation for the collection such as receipts or shipping papers?

No, but I can recall some of the prices paid.

What made you interested in Ntuli? Did you hear of him via word of mouth or did you go to an exhibit that featured him?

As mentioned earlier, I was well aware of his work since the late 1960s…even as far afield as in Pretoria, where his work was held by tourist outlets. Also he appeared in several articles in Bantu and even in Panorama. I had also seen his work on display at the Royal Agricultural Show in Pietermaritzburg since the mid 1970s where he exhibited regularly, and was a renowned prize winner. Ian Calder's excellent paper on his works for the Natal Museum alerted all of us in the CVA as to the relevance of Ntuli and his family as pioneer artists.

I have since ascertained that he knew the artist Gerard Bhengu (whose work I have done several publications on). Both were drawn to ethnic studies because of the widespread popularity of this idiom among white buyers/collectors and later also predominantly black supporters (if not buyers per se).

Appendix D Condition Reports for the Fort Nonquai Museum Eshowe:

This appendix contains condition reports of Hezekiel Ntuli artworks in the Fort Nonquai Museum. The research sample includes all 10 sculptures attributed by the museum to Hezekiel Ntuli. Research was carried out on-site from 29-30 May 2023. The artworks were examined, described, measured and their condition assessed. As no condition reports were available, the following documents will provide valuable information to supplement the museum's existing records. XRF analysis was carried out an all 10 sculptures, and a detached unpainted fragment from the seated leopard was retained for later XRD analysis at the University of Pretoria to compare with the UP clay samples and the provenanced sample of raw clay obtained from Hezekiel Ntuli's son (see figure 53).

Figure 55: Summary table of Hezekiel Ntuli sculptures in the Fort Nonquai Museum

Artwork in the FN Coll.	**Accession number**	**Condition report**	**XRF analysis**	**XRD analysis**
Seated leopard	01/266	D1	Appendix E	Appendix F
Leopard in a tree		D2	Appendix E	n/a
Leopard hunting		D3	Appendix E	n/a
Walking leopard	01/269	D4	Appendix E	n/a
Old Zulu Woman		D5	Appendix E	n/a
Young Zulu Woman		D6	Appendix E	n/a
Old Zulu Man		D7	Appendix E	n/a
Induna	01/271	D8	Appendix E	n/a
uShaka	01/272	D9	Appendix E	n/a
Bushman	01/270	D10	Appendix E	n/a

D.1. Seated Leopard

Figure 1: The front of the leopard statue with its tailpieces

Permanent Location: Fort Nonquai, Kwa-Zulu Natal

Accession Number: 01/266

Place of Production: Eshowe District, KwaZulu-Natal.

Inscriptions: ‘Hezekiel Ntuli’, ‘Eshowe’

Measurements:

Height: 290mm

Length: 400mm

Width: 105mm

Figure 2: The side of the leopard statue, this image also shows crumbling of the tail.

Figure 3: The back of the leopard statue, showing the accession number and signature.

This is a large leopard statue by the South African artist Hezekiel Ntuli. The leopard is in a seated position and appears to be surrounded by rocky terrain. The sculpture is made of two main decorative approaches, the first is unpainted unfired clay and the second is painted unfired clay. The sculpture has been signed at the back and reads Hezekiel Ntuli, Eshowe. The leopard itself is the painted element in the sculpture, the leopard is painted with a titanium white undercoat (as can be seen in the XRF Analysis in Appendix E), with black spots scattered across the sculpture. There is also a peach hue, that has an almost smudged pattern across the sides and back of the leopard.

The sculpture is currently in a state of deterioration. I estimate more change will occur in the sculpture within the space of a year either from dissociation or from active crumbling in the sculpture this crumbling can be seen in the bottom right corner of Figure 2, where the sections of the broken tail sit. At first glance, the main damage that becomes visible is that the end of the statue which makes up the leopard's tail, is in 7 separate pieces (Figure 4), when one tried to reassemble this area, it became very clear that multiple pieces of the tail are missing, and their location is unknown. Upon closer inspection, it became clear the broken tail was not all the damage that was present on the leopard. There are multiple areas where the paint has chipped off of the body of the leopard and there are other missing parts such as a broken ear that's location is unknown, and the other ear is chipped. (Figures 5, 6, 7)

Figure 4: This shows the 7 pieces of the broken leopard's tail.

Figure 5: While showing the missing and chipped ear, also shows the chipping in the paint.

Figure 6: This shows that the left ear of the sculpture has detached.

Figure 7: This image shows that the right ear of the leopard is chipped.

D.2. Leopard in a Tree

Figure 8: A forward-facing image of the leopard in a tree.

Figure 9: This is an image of the back of the sculpture, showing the signature.

Figure 10: Image of a side view of the sculpture.

Figure 11: Left side image of the leopard in a tree sculpture.

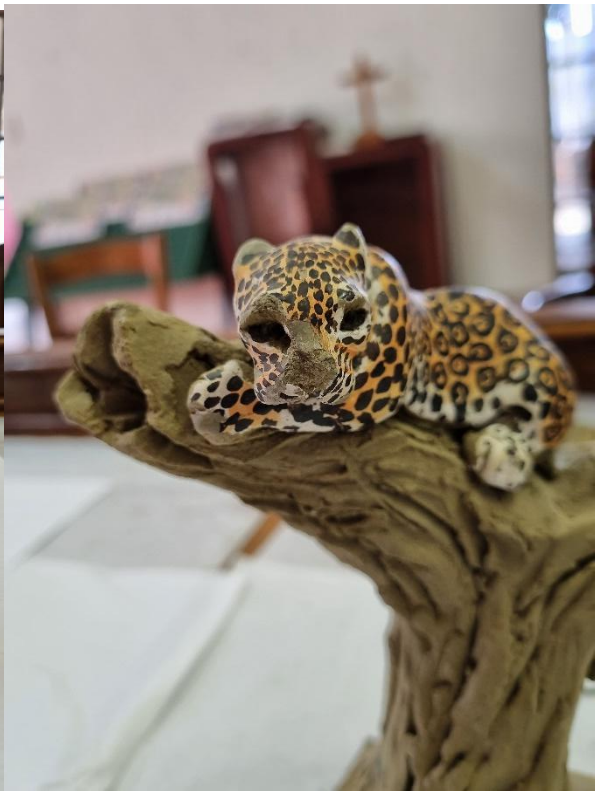


Figure 12: Close up image of the damage to the leopard's face.

Permanent Location: Fort Nonquai, Kwa-Zulu Natal

Accession Number: None Visible

Place of Production: presumed Eshowe District, KwaZulu-Natal. (Unconfirmed)

Inscriptions: None Visible

Measurements:

Height: 199mm

Length: 142mm

Width: 88mm

This is a small sculpture that illustrates a leopard resting in a tree (Figure 8). The tree has no branches and foliage and is just the trunk and the beginning bases of the branches. The sculpture is made of two main decorative elements, is the tree which is textured and made of unfired and unpainted clay. The second part is the leopard, which is resting in the tree, this leopard has been made of unfired clay and is painted. It is unclear to me if this sculpture was made out of a singular lump of clay or if the leopard and the tree were made separately and joined. The leopard has been painted with a white undercoat, on top of this there are black dots. There is also a very distinct orange/ peach colouration to sections of the sculpture. This is a bit unlike other sculptures depicting leopards by Hezekiel Ntuli that I have seen; the orange peach colour is more noticeable and distinct. The sculpture has been signed at the back of the tree trunk, the signature reads, Hezekiel Ntuli, Eshowe. (Figure 9)

Figure 13: This is a flash image of the sculpture; I believe the flash allowed for a clearer image of the damage that is currently present on the sculpture.

This sculpture while perhaps not in a stable condition, is still in an acceptable condition. The unfired base of the sculpture is experiencing active deterioration. The base and edges of the tree trunk are currently crumbling (Figure 13). The painted area of the sculpture is also experiencing deterioration. The leopard has chipping along the face and there is paint that has been chipping off of the sculpture. the leopard is deteriorating at a slower rate than the tree trunk. (Figure 12)

D.3. Leopard Hunting an Impala

Figure 14: the image of the Leopard hunting an impala.

Permanent Location: Fort Nonquai, Kwa-Zulu Natal
Accession Number: None visible

Place of Production: Eshowe District, KwaZulu-Natal.

Inscriptions: 'Hezekiel Ntuli', 'Eshowe'

Measurements:

Height: 125mm

Length: 265mm

Width: 105mm

This is a medium-sized animal sculpture by Hezekiel Ntuli. There are three main focal points to this sculpture, the main focal point and the subject of this sculpture is the leopard, then ones focus shifts to the buck the leopard is standing on before seeing the log the leopard is standing on. The backdrop of this sculpture appears to be a rocky outcrop of the side of a mountain (Figure 14). The majority of this sculpture is made of unpainted and unfired clay. The leopard and the buck, which are the two main focal points of this work are painted unfired clay. The buck has been painted with two main colours, the body is a sandy grey colour, while its ears and underbelly have been painted white. The leopard has four main colours. The first layer is a white undercoat followed by a light yellow on the head and hind quarters as well as hints of peach brushed across the leopard's body. This is then followed by the black markings all across the leopard's body. The back of the sculpture is signed and reads Hezekiel Ntuli, Eshowe (Figure 15).

Figure 15: This is an image of the back of the sculpture with Ntuli's signature visible.

This sculpture is in a dangerous situation currently. Within a space of a year, the sculpture will have pieces broken off and more sections cracking. There are large cracks on the back of the sculpture which is putting the sculpture in immediate danger (Figure 16). As soon as anyone tries to move the sculpture the cracks start to pull away from each other solely separating the base of the sculpture from the top. The sculpture is also actively crumbling, this shows that even without the cracking the clay is currently in a brittle state, and susceptible to change and loss. There is also paint that is chipping off of the sculpture in areas such as the bottom of the jaw. It is my opinion that without proper storage and handling practices, this sculpture's base will break off and crumble within the space of a year. I suggest that any handling of the sculpture should be limited and the sculpture should be placed in a tray to limit any direct handling from occurring.

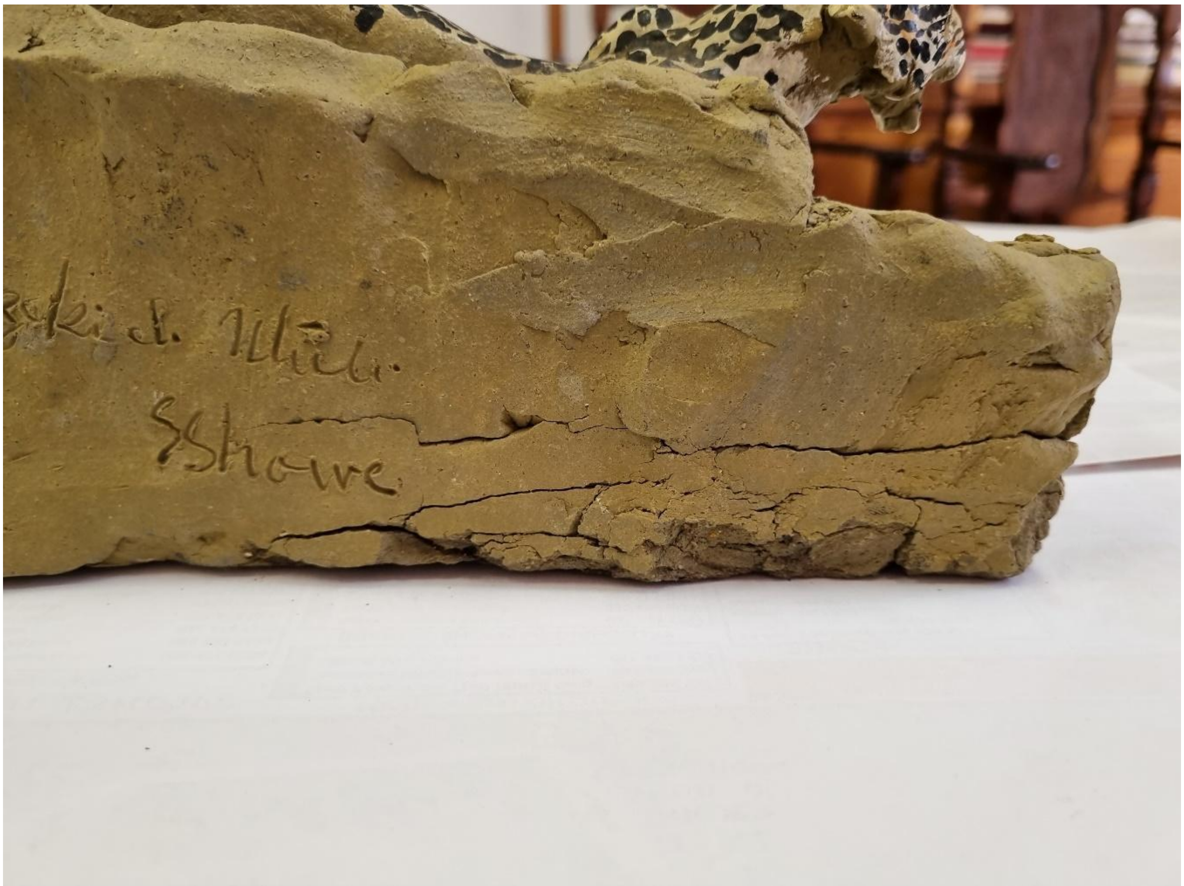


Figure 16: A zoomed-in image of the cracks in the base of the sculpture. This is a large area of worry.

D.4. Walking Leopard

Figure 17: An image of a sculpture made by Elphus assumed to be Hezekiel Ntuli.

Permanent Location: Fort Nonquai, Kwa-Zulu Natal

Accession Number: 01/269

Place of Production: Eshowe District, KwaZulu-Natal.

Inscriptions: 'Elphus', 'Xulu', 'St Thomas Sch', 'Eshowe'

Measurements:

Height: 290mm

Length: 400mm

Width: 105mm

This is a sculpture of a leopard that appears to be walking near a mountainous area (Figure 17). One thing that should be identified is that I do not think that this is a sculpture by Hezekiel Ntuli. There is a signature at the back of the sculpture that reads Elphus. Xulu St Thomas. Sch Eshowe (Figure 18). The leopard sculpture itself is also a red flag that indicates that this sculpture may not be a Hezekiel Ntuli. In this sculpture, the entirety of the leopard is painted as well as the background of the sculpture. the eyes of the sculpture do not have the same shape and dimension that I have come to know in Ntuli’s work. The leopard has been painted with a lead white base (which can be found in the XRF Appendix E), that has an almost peach hue to it in some areas followed by the black spots. The background of the sculpture has been painted with an orange-red undercoat followed by a black overlay (Figure 19). The alternative signature, the painting of the background, and the changes in the way the sculpture was sculpted lead me to believe that this is not a work by Hezekiel Ntuli.

Figure 18: The back of the leopard sculpture with a signature reading Elphus. Xulu St Thomas. Sch Eshowe.

Overall, the condition of this sculpture is good. There are a few pieces of paint that have chipped off as seen in Figure 19 and there are also some chips present in the base of the sculpture as well as the face of the leopard. But I do not expect a change in this object in the next 5 years.

Figure 19: Sowing the chipping in the paint as well as the orange undertone of the black base coat.

D.5. Old Zulu Woman, small

Figure 20: Small Bust of an Old Zulu Woman by Hezekiel Ntuli.

Permanent Location: Fort Nonquai, Kwa-Zulu Natal
Accession Number: None Visible

Place of Production: Eshowe District, KwaZulu-Natal.

Inscriptions: ‘Hezekiel Ntuli’, ‘Eshowe’

Measurements:

Height: 170mm

Width: 138mm

This is a small bust of an old Zulu woman made by Hezekiel Ntuli (Figure 20). The bust measures 170 mm high and with a shoulder width of 138 mm. The bust is a yellowish ochre colour with the underside of the bust being a darker grey colour the bust is made of unfired clay. This colour discrepancy means that Ntuli may have made use of a slip when producing the bust. The back of the bust is signed and reads Hezekiel Ntuli Eshowe as seen in Figure 21; the front right shoulder of the bust has the word Zulu engraved into the clay. The sculpture is wearing a necklace with an imprint of what could have been a stone at one point, while there is a definite imprint visible there is no clear indication of how the stone was attached (Figure 22). The woman is also wearing a headdress. There are pronounced frown lines and smile lines, along with a more drawn-in appearance caused by more concave cheeks and more pronounced cheekbones.

Figure 21: This image shows the back of the bust and Ntuli’s signature.

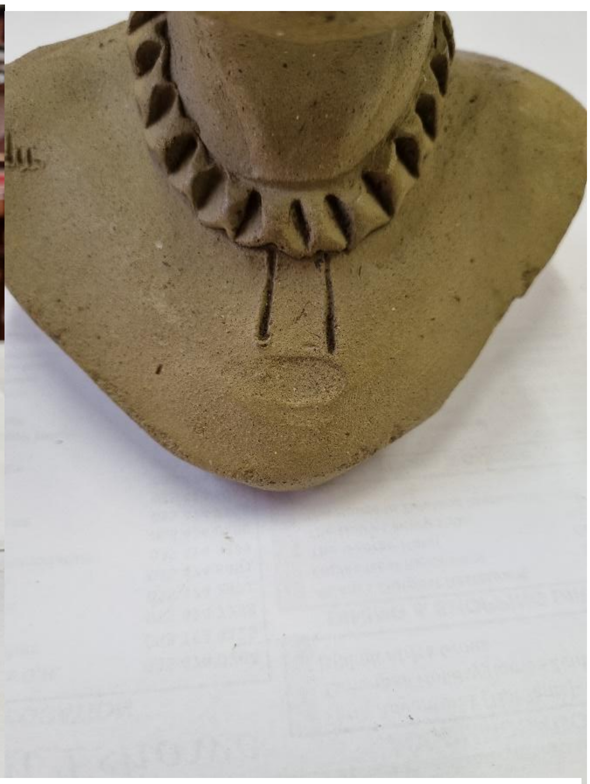


Figure 22: This image shows the indent from the missing stone on the necklace.

The headdress is currently damaged and is deteriorating. There are sections of the headdress that have been lost to dissociation and crumbling (Figure 23). There is slight crumbling around the base of the sculpture but overall, the sculpture is in a good stable condition.

Figure 23: This image shows the deterioration of the headdress of the bust.

D.6. Young Zulu Woman, small

Figure 24: The Bust of a Young Zulu Woman by Hezekiel Ntuli.

Permanent Location: Fort Nonquai, Kwa-Zulu Natal

Accession Number: 01/274

Place of Production: Eshowe District, KwaZulu-Natal.

Inscriptions: ‘Hezekiel Ntuli’, ‘Eshowe’

Measurements:

Height: 181mm

Width: 128mm

This is a small sculpture of a young Zulu woman made by Hezekiel Ntuli (Figure 24). The sculpture is predominantly a yellow-ochre colour and is made of unfired clay. The base of the bust is a darker grey colour. This suggests that the artist made use of a slip to cover the bust. The back of the bust is signed and reads Hezekiel Ntuli, Eshowe (Figure 25). The word Zulu is also engraved into the right front shoulder of the sculpture (Figure 26). The sculpture is wearing a necklace with a stone (made from clay) that rests on the sternum of the sculpture, the bust is also wearing a headdress (Figure 27). As can be seen in the Old Zulu Woman Bust, this stone would have probably been attached later. The woman that this bust is sculpted after, has soft features. There are little to no wrinkles present o the sculpture and the cheeks are full, this gives the sculpture a very youthful appearance.

Figure 25: This Image is the Back of the Bust and clearly shows Hezekiel Ntuli's signature.

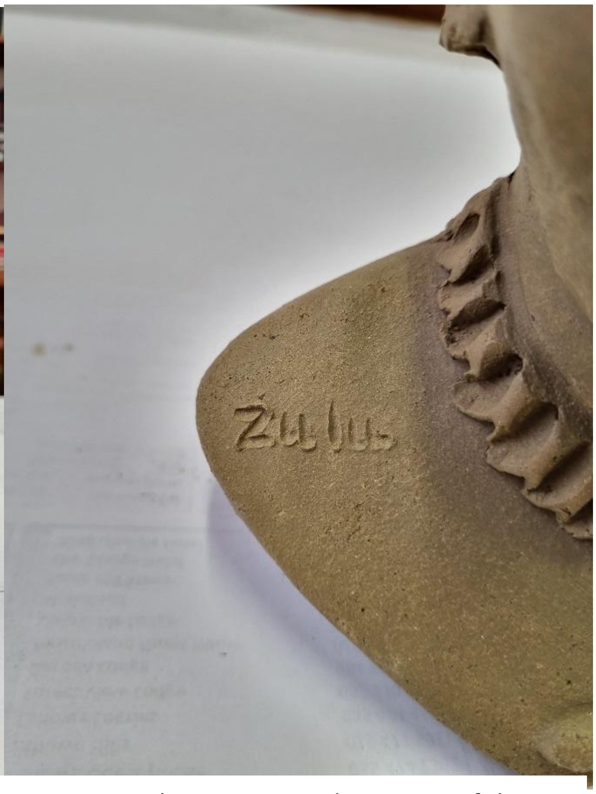


Figure 26: This is a zoomed in image of the word Zulu engraved into the front right hand shoulder.

Figure 27: This is side portrait of the bust which shows the busts headdress and necklace.

Overall, the sculpture is in good condition. While there does not appear to be very much crumbling along the base there is discernible material loss. Multiple drying cracks are present on the interior of the base. These areas are an area of worry because they are areas of weakness in the bust. So while these area do not currently present a problem to the longevity of this art work, if not looked after properly they will be areas where further damage will occur in the future.

D.7. Old Zulu Man, small

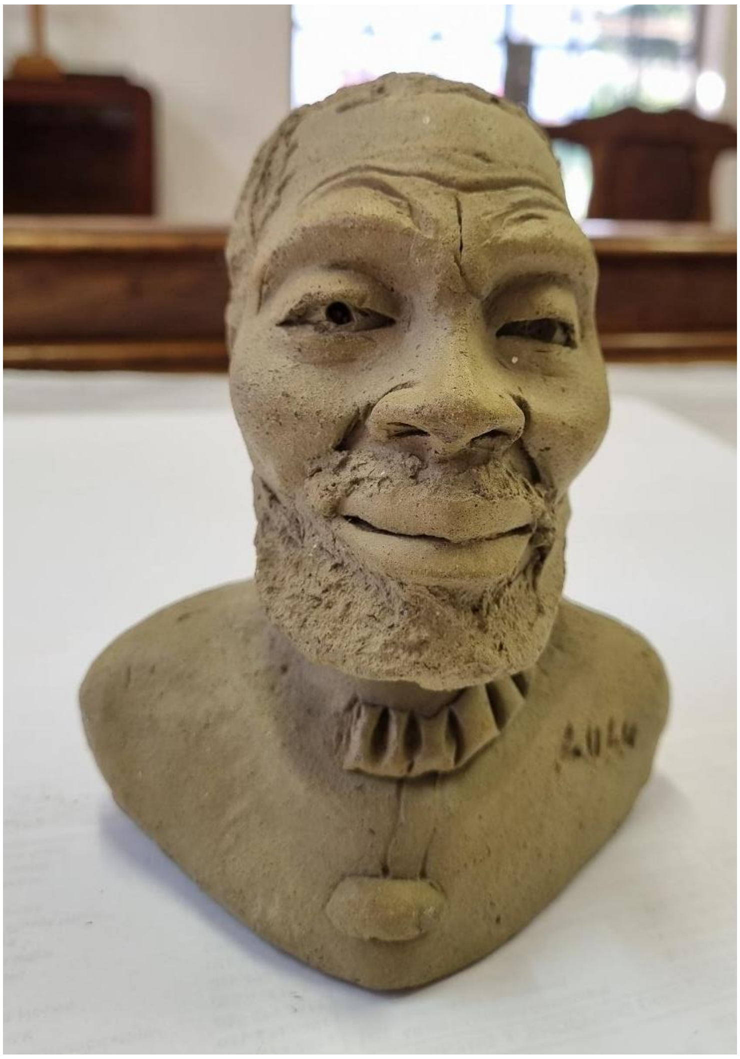


Figure 28: The small bust of a Zulu man by Hezekiel Ntuli

Permanent Location: Fort Nonquai, Kwa-Zulu Natal
Accession Number: None Visible.

Place of Production: Eshowe District, KwaZulu-Natal.

Inscriptions: 'Hezekiel Ntuli', 'Eshowe'

Measurements:
Height: 158mm
Width: 122mm

This is a small bust of a Zulu man made by the artist Hezekiel Ntuli (Figure 28). This bust unlike many others of Ntuli's busts does not have a concave dimple shape in the base of the sculpture. The sculpture is the colour of yellow ochre in areas of damage it becomes obvious that the under colour of the sculpture is a darker grey colour. This colour shift indicated the presence of a slip. The back of the sculpture is signed and read Hezekiel Ntuli, Eshowe. The bust is wearing a necklace, with a stone (Clay) centrepiece resting on the sculpture’s sternum, very similar to the Young Zulu Woman (D.6.), but there is no presence headdress.

For the most part, the sculpture is in good condition, but there are areas of damage present on the sculpture. There are missing areas of slip on the left scapula (Figure 29). This area of the sculpture is currently crumbling. The lobe of the left ear of the sculpture is currently chipped (Figure 30). The necklace the sculpture is wearing is also broken and the missing pieces are missing. The section on the right side of the sculpture's neck has broken off (Figure 31). Even though there are these areas of damage the object for the most part is in a good and stable condition, these areas while they may be worrisome in the future are not having a very large effect on the life of the object currently.

Figure 29: Image showing the damage to the slip.

Figure 30: Image showing the chip to the left ear.

Figure 31: A side portrait showing the missing necklace.

D.8. Induna

Figure 32: An image of the bust named Induna by artist Hezekiel Ntuli.

Permanent Location: Fort Nonquai, Kwa-Zulu Natal

Accession Number: 01/271

Place of Production: Eshowe District, KwaZulu-Natal.

Inscriptions: ‘Hezekiel Ntuli’, ‘Induna’ ,‘Eshowe’

Measurements:

Height: 325mm

Width: 260mm

This is a large bust made by the artist Hezekiel Ntuli. This sculpture has been named Induna which in Zulu means Chief (Figure 32). The words Zulu and Induna have been carved into the front right shoulder of the bust (Figure 33). The bust is also signed mid back and reads Hezekiel Ntuli, Eshowe (Figure 34). The sculpture is wearing a headdress worn by married men called an isicoco and a necklace that goes around the neck and has a separate part that appears to be a stone (clay) and rests on the sculpture's sternum. In the sculpture uShaka (D9) this same stone is missing, in its place there are score marks making me think the stone was attached after the bust was made. The bust is a yellow ochre colour with the forehead of the bust being a reddish ochre colour (Figure 35). The interior of the base of the sculpture is a darker grey colour which hints at the presence of a slip.

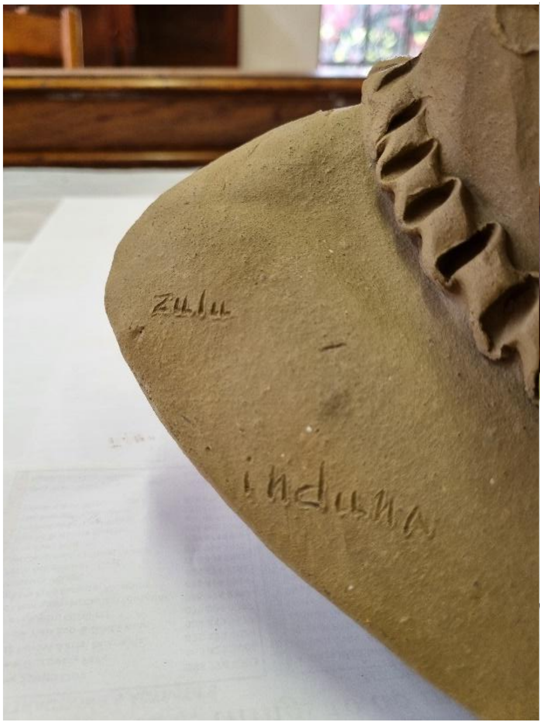


Figure 33: Zoomed in image showing the engraving of Zulu and Induna.

Figure 34: Image showing the back of the Induna sculpture.

Figure 35: A zoomed image showing the red undertone to the clay slip.

This bust is in very good condition. There is no crumbling visible on the bust, neither is there any chipping, cracking, or loss of material. The surface of the bust does not have a clammy surface like the busts in Pretoria. For the most part, this sculpture seems to be stable, and I do not expect any change to occur in the next 5 years.

D.9. uShaka

Figure 36: This is a large bust named uShaka by Hezekiel Ntuli.

Permanent Location: Fort Nonquai, Kwa-Zulu Natal

Accession Number: 01/272

Place of Production: Eshowe District, KwaZulu-Natal.

Inscriptions: ‘Hezekiel Ntuli’, ‘Eshowe’, ‘Zulu’, ‘uShaka’

Measurements:

Height: 361mm

Width: 275mm

This is a large bust made by the South African artist Hezekiel Ntuli. This sculpture has been named uShaka. This suggests that this sculpture was modeled after the great Zulu King Shaka (Figure 36). This sculpture is an ochre colour while the hair of the sculpture is a lighter yellow ochre colour. This may suggest that the hair was added with a more diluted version of the clay, almost like a slip. The bust has two words engraved into the front right shoulder of the sculpture. these engravings read uShaka and Zulu (Figure 38). The sculpture has also been signed in the middle of the busts back, this signature reads Hezekiel Ntuli, Eshowe (Figure 37). There is no headdress present on the sculpture but there is a beaded necklace present that at one point had a stone attached to the sternum (Figure 39). Unfortunately, there is no way of telling if this stone has fallen off or if it was intentionally left off by Ntuli. There is evidence of scoring on the area where the bead would have lay (Figure 39), this may suggest he used this method to attach the stone when the sculpture was mostly dried.

Figure 37: An image of the back of uShaka with Ntuli's signature.

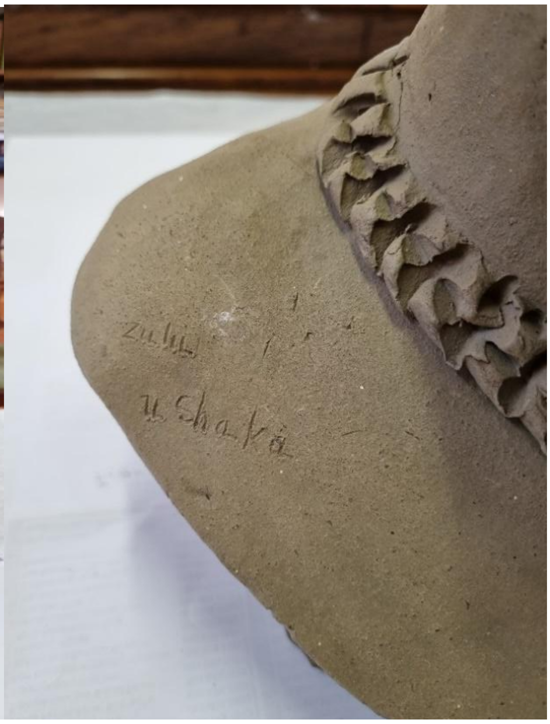


Figure 38: A zoomed image showing the engraved words Zulu and uShaka.

Figure 39: An image of where the stone once rested on the sternum.

Overall, this sculpture is in a very good condition. There is a bit of crumbling on the base of the sculpture but for the most part, there is not any cracking, chipping, or excessive crumbling. The surface of the bust feels stable and has no obvious damage. The base does have a few drying cracks, which in the future could be areas of weakness.

D.10. Bushman

Figure 40: An image of a Bushman bust by Hezekiel Ntuli.

Permanent Location: Fort Nonquai, Kwa-Zulu Natal

Accession Number: 01/270

Place of Production: Eshowe District, KwaZulu-Natal.

Inscriptions: ‘Hezekiel Ntuli’, ‘Eshowe’, ‘Bushman’

Measurements:

Height: 295mm

Width: 255mm

The name of the sculpture is Bushman, and this has been engraved into the front right shoulder of the bust. the name Hezekiel Ntuli, Eshowe is engraved into the top of the busts bald head (Figure 41 and Figure 42). Overall, the bust has many similarities to the bust at up with the exception being that it is in better condition, and the base of the sculpture is shorter than the one at UP. The colour of this work is a darker grey, yellow ochre colour with the hair being slightly lighter in colour and appearing to have been applied with a pinching method.

Figure 41: Zoomed in image of the name of the sculpture Bushman engraved into the front right shoulder.

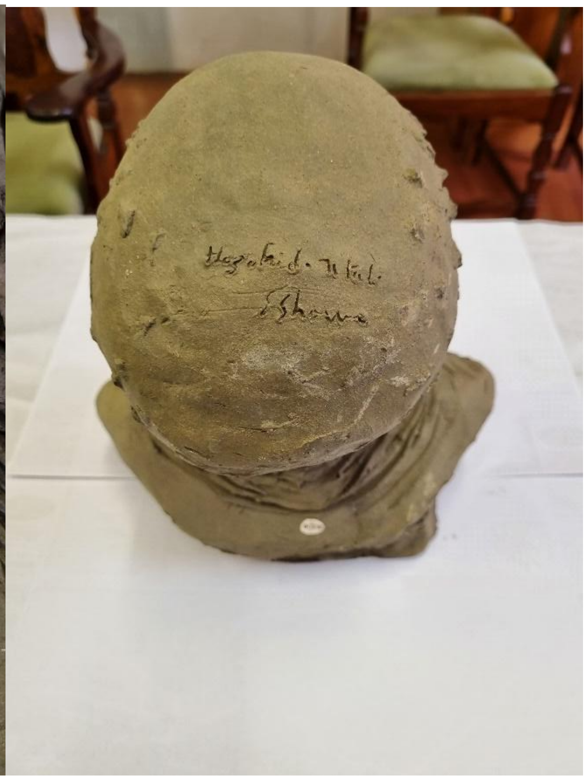


Figure 42: An image showing the top of the sculptures head where the artist signed his work.

Overall, the bust present in Eshowe is in a better condition than the bust present at UP. The base of the bust has some crumbling but nothing major enough to expect change within the next 5 years, the tissue paper did stick to the bottom of the bust. this suggests that the bust is clammy, which can cause further deterioration.

Appendix E XRF data

E1. Instrument Repeatability

With the tripod, the spectrometer was carefully set up to repeatedly analyse one spot on *Zulu Man, large* form LDT Coll., University of Pretoria. This same spot was analysed 11 times to evaluate the spectrometer repeatability (each spot is annotated in the table as Zulu man 1, 2, 3 and so forth). The standard deviation is the average deviation from the average value of the ten measurements.

Standard deviation on one spot, namely Zulu Man, Large LTD Coll. Univ. of Pretoria																											
			Magnesiu	**Aluminiur**	**Silicon dic**	**Phosphor**	**Sulphur**	**Potassium**	**Calcium**	**Titanium**	**Chromium**	**Manganes**	**Iron**	**Cobalt**	**Nickel**	**Copper**	**Zinc**	**Gallium**	**Arsenic**	**Selenium**	**Rubidium**	**Strintium**	**Yttrium**	**Zirconium**	**Barium**	**Tantalum**	**Lead**
File #	**Name**	**ID**	**MgO**	**Al2O3**	**SiO2**	**P**	**S**	**K2O**	**Ca**	**Ti**	**Cr**	**Mn**	**Fe**	**Co**	**Ni**	**Cu**	**Zn**	**Ga**	**As**	**Se**	**Rb**	**Sr**	**Y**	**Zr**	**Ba**	**Ta**	**Pb**
749	Zulu Man, large 1	repeatability ons spot	1,79	18,22	45,84	0,06	0,70	1,23	1,77	0,48	0,0072	0,01	2,67	0,0069	0,0014	0,0034	0,0032	0,0016	0,0005	0,0002	0,0130	0,0072	0,0029	0,0175	0,0247	0,0020	0,0028
750	Zulu Man, large 2		1,65	18,39	45,75	0,06	0,71	1,25	1,77	0,48	0,0084	0,01	2,67	< LOD	0,0021	0,0031	0,0037	0,0019	< LOD	< LOD	0,0130	0,0073	0,0032	0,0183	0,0211	0,0021	0,0033
751	Zulu Man, large 3		1,54	18,17	45,90	0,07	0,70	1,24	1,78	0,48	0,0079	0,01	2,70	< LOD	0,0027	0,0033	0,0031	0,0017	< LOD	0,0002	0,0131	0,0073	0,0029	0,0178	0,0142	0,0027	0,0031
752	Zulu Man, large 4		1,50	18,39	46,30	0,07	0,72	1,24	1,78	0,47	0,0069	0,01	2,69	< LOD	0,0013	0,0030	0,0036	0,0013	< LOD	< LOD	0,0130	0,0074	0,0032	0,0185	0,0239	0,0022	0,0029
753	Zulu Man, large 5		2,53	18,57	46,13	0,07	0,71	1,24	1,77	0,48	0,0083	0,01	2,69	< LOD	0,0033	0,0041	0,0031	0,0015	0,0005	0,0002	0,0130	0,0069	0,0029	0,0174	0,0208	0,0016	0,0026
754	Zulu Man, large 6		1,93	18,06	46,04	0,06	0,69	1,25	1,77	0,48	0,0077	0,01	2,70	< LOD	0,0023	0,0033	0,0039	0,0016	< LOD	< LOD	0,0126	0,0070	0,0033	0,0182	0,0169	0,0026	0,0034
755	Zulu Man, large 7		1,73	18,48	46,28	0,06	0,70	1,25	1,79	0,48	0,0120	0,01	2,68	< LOD	0,0024	0,0032	0,0031	0,0017	0,0007	< LOD	0,0130	0,0070	0,0030	0,0179	0,0217	0,0023	0,0027
756	Zulu Man, large 8		1,30	18,56	46,56	0,07	0,72	1,26	1,78	0,47	0,0088	0,01	2,68	< LOD	0,0023	0,0032	0,0031	0,0015	< LOD	< LOD	0,0133	0,0072	0,0032	0,0178	0,0282	0,0024	0,0032
757	Zulu Man, large 9		1,42	18,41	46,38	0,07	0,70	1,25	1,80	0,47	0,0074	0,01	2,69	0,0044	0,0024	0,0029	0,0035	0,0016	< LOD	< LOD	0,0125	0,0072	0,0031	0,0176	0,0207	0,0023	0,0032
758	Zulu Man, large 10		2,02	18,51	46,57	0,07	0,69	1,25	1,79	0,48	0,0099	0,01	2,68	< LOD	0,0026	0,0034	0,0035	0,0017	0,0008	< LOD	0,0131	0,0074	0,0030	0,0174	0,0157	0,0022	0,0032
759	Zulu Man, large 11		1,60	18,33	46,44	0,06	0,73	1,26	1,79	0,48	0,0074	0,01	2,71	< LOD	0,0022	0,0035	0,0035	0,0019	0,0009	0,0002	0,0127	0,0075	0,0030	0,0178	0,0190	< LOD	0,0029
		Average	**1,73**	**18,37**	**46,20**	**0,07**	**0,71**	**1,25**	**1,78**	**0,48**	**0,01**	**0,01**	**2,69**	**0,006**	**0,002**	**0,0033**	**0,0034**	**0,0016**	**0,0007**	**0,0002**	**0,0129**	**0,0072**	**0,0031**	**0,0178**	**0,0206**	**0,0022**	**0,0030**
		Standard deviation	**0,34**	**0,16**	**0,29**	**0,00**	**0,01**	**0,01**	**0,01**	**0,00**	**0,00**	**0,00**	**0,01**	**0,002**	**0,001**	**0,0003**	**0,0003**	**0,0002**	**0,0002**	**0,0000**	**0,0002**	**0,0002**	**0,0001**	**0,0004**	**0,0041**	**0,0003**	**0,0003**

E2. Standard deviation across sculpture:

To evaluate the homogeneity across a sculpture, 10 readings were obtained from different spots on *Zulu Man* (large), LDT Collection, University of Pretoria. The standard deviation is the average deviation from the average value across the ten spots. Reading #762 is not in the table as we had an error message and in order to not confuse the readings it was omitted.

Surface homogeneity on *Zulu Man (large), DT Coll. Univ. of Pretoria*																											
			Magnesiu	**Aluminiur**	**Silicon dic**	**Phosphor**	**Sulphur**	**Potassium**	**Calcium**	**Titanium**	**Chromium**	**Manganes**	**Iron**	**Cobalt**	**Nickel**	**Copper**	**Zinc**	**Gallium**	**Arsenic**	**Selenium**	**Rubidium**	**Strintium**	**Yttrium**	**Zirconium**	**Barium**	**Tantalum**	**Lead**
File #	Name	ID	MgO	Al2O3	SiO2	P	S	K2O	Ca	Ti	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	As	Se	Rb	Sr	Y	Zr	Ba	Ta	Pb
749	Zulu Man, large 1	Central bust	1,79	18,22	45,84	0,06	0,70	1,23	1,77	0,48	0,0072	0,01	2,67	0,0069	0,0014	0,0034	0,0032	0,0016	0,0005	0,0002	0,0130	0,0072	0,0029	0,0175	0,0247	0,0020	0,0028
760	Zulu Man, large 12	Right shoulder under signature	1,22	11,39	32,95	0,03	1,37	0,86	2,13	0,37	0,0058	0,01	2,15	< LOD	0,0028	0,0029	0,0030	0,0008	< LOD	< LOD	0,0126	0,0069	0,0027	0,0162	0,0227	0,0031	0,0034
761	Zulu Man, large 13	Back of neck	1,90	18,87	46,09	0,04	1,09	1,25	2,45	0,46	0,0079	0,01	2,73	< LOD	0,0017	0,0039	0,0031	0,0015	0,0006	0,0002	0,0119	0,0068	0,0030	0,0164	0,0203	0,0024	0,0030
763	Zulu Man, large 14	middle of back	2,15	15,79	39,28	0,75	0,71	1,25	1,37	0,49	0,0072	0,01	2,99	< LOD	0,0023	0,0032	0,0031	0,0017	0,0008	< LOD	0,0128	0,0074	0,0036	0,0236	0,0185	0,0021	0,0027
764	Zulu Man, large 15	back of hair	1,82	18,15	43,20	0,03	0,75	1,25	2,18	0,46	0,0087	0,01	3,00	< LOD	0,0028	0,0033	0,0032	0,0015	0,0006	< LOD	0,0136	0,0071	0,0032	0,0196	0,0213	0,0028	0,0043
765	Zulu Man, large 16	left shoulder back	1,48	22,77	53,27	0,04	1,24	1,55	2,38	0,53	0,0109	0,01	3,27	0,0055	0,0021	0,0033	0,0031	0,0014	0,0005	< LOD	0,0129	0,0071	0,0034	0,0206	0,0235	0,0023	0,0031
766	Zulu Man, large 17	left clavicula	1,75	19,46	48,35	0,07	0,57	1,28	1,60	0,46	0,0090	0,01	2,57	< LOD	0,0025	0,0042	0,0032	0,0019	0,0007	< LOD	0,0121	0,0067	0,0030	0,0193	0,0202	0,0022	0,0029
767	Zulu Man, large 18	right clavicula	< LOD	19,76	48,28	0,09	0,70	1,29	1,96	0,48	0,0080	0,01	2,72	< LOD	0,0026	0,0036	0,0031	0,0023	0,0008	0,0003	0,0130	0,0073	0,0030	0,0177	0,0214	0,0019	0,0026
768	Zulu Man, large 19	right eyebank	< LOD	23,97	62,45	0,06	1,18	1,62	3,20	0,53	0,0088	0,01	3,23	< LOD	0,0016	0,0034	0,0034	0,0017	< LOD	0,0002	0,0119	0,0069	0,0028	0,0176	0,0205	0,0023	0,0034
769	Zulu Man, large 20	left forehead	1,59	25,80	56,30	0,04	1,20	1,68	2,71	0,58	0,0095	0,01	3,07	< LOD	0,0023	0,0040	0,0029	0,0017	0,0007	0,0002	0,0130	0,0076	0,0033	0,0207	0,0258	0,0018	0,0032
		Average	**1,71**	**19,42**	**47,60**	**0,12**	**0,95**	**1,33**	**2,18**	**0,48**	**0,008**	**0,012**	**2,84**	**0,0062**	**0,0022**	**0,0035**	**0,0031**	**0,0016**	**0,0007**	**0,0002**	**0,0127**	**0,0071**	**0,0031**	**0,0189**	**0,0219**	**0,0023**	**0,0031**
		Standard deviation	**0,28**	**4,13**	**8,42**	**0,22**	**0,29**	**0,24**	**0,54**	**0,06**	**0,001**	**0,002**	**0,34**	**0,0010**	**0,0005**	**0,0004**	**0,0001**	**0,0004**	**0,0001**	**0,0000**	**0,0006**	**0,0003**	**0,0003**	**0,0023**	**0,0023**	**0,0004**	**0,0005**

E3. Selected XRF data

The XRF data presented here is a selection of the raw data for ease of reference as numerous columns yielded little to no information.

1. The application and method and measurement time: GeoExploration, Oxide3phase , 90 seconds columns were deleted as they are identical. Where analytical time is not 90 seconds, a phase may be absent or a blank shot and those measurements were deleted.

2. All the statistical error columns, or the 2 sigma value within which each measurement is expected to be due to counting statistical error on the detector only, was deleted as it says nothing about the actual accuracy or precision of the analyses.

3. All elements under the detection limits that are not expected in the sculpture or paint were deleted, including:

- Cl (Chlorine) was deleted as is likely salt/sweat from fingers
- V (Vanadium) deleted, most under detection limit except where high Ti (Titanium) present (paint) and Ti overlaps on Vanadium
- Co (Cobalt), Ni (Nickel), Cu (Copper) deleted as all low ppm Zn (Zinc) kept File 877 as may be paint
- Ga (Gallium), As (Arsenic), Se (Selenium), Rb (Rubidium), Sr (strontium), Y (Yttrium), Zr (Zirconium), Mo (Molybdenium), Nb (Neobium), Rh (Rhodium), Pd (Palladium), Ag (Silver), Cd (Cadmium), Sn (Tin), Sb (Antimony), Te (Tellerium) deleted
- Kept Ba (Barium), high in #894
- La (Lanthium), Ce (Cerium), Hf (Haffnium), Ta (Tantalum), W (Tungsten), Pt (Platinum), Au (Gold), Hg (Mercury), Tl (Thalium) were all deleted as they were under LOD (Limits of Detection)
- Three high Pb (Lead) ;#873, #877 and #894 maybe lead white pigment?
- Bi (Bismuth), U (Uranium), Th (Thorium) deleted

Hezekiel Ntuli				ElapsedTime																																				
GeoExploration				90 seconds																																				
Oxide3phase																																								
					Magnesiu	Aluminiur	Silicon dic	Phosphor	Suphur	Chlorine	Potassium	Calcium	Titanium	Vanadium	Chromium	Manganes	Iron	Cobalt	Nickel	Copper	Zinc	Gallium	Arsenic	Selenium	Rubidium	Strontium	Yttrium	Zirconium	Niobium	Molybden	Rhodium	Palladium	Silver	Cadmium	Tin	Antimony	Tellurium	Barium	Lanthanur	C
		File #	DateTime	Name	**MgO**	**Al2O3**	**SiO2**	**P**	**S**	**Cl**	**K2O**	**Ca**	**Ti**	**V**	**Cr**	**Mn**	**Fe**	**Co**	**Ni**	**Cu**	**Zn**	**Ga**	**As**	**Se**	**Rb**	**Sr**	**Y**	**Zr**	**Nb**	**Mo**	**Rh**	**Pd**	**Ag**	**Cd**	**Sn**	**Sb**	**Te**	**Ba**	**La**	**Ce**
LDT coll. University of Pretoria Museums				**LDT coll. University of Pretoria Museums**																																				
Zulu Man, large	966524																																							
		749	01-15-2006 15:34	Zulu Man 1	1,7896	18,2247	45,8352	0,061	0,6978	< LOD	1,2312	1,7691	0,4776	< LOD	0,0072	0,0114	2,6709	0,0069	0,0014	0,0034	0,0032	0,0016	0,0005	0,0002	0,013	0,0072	0,0029	0,0175	< LOD	< LOD	< LOD	0,0019	< LOD	< LOD	< LOD	< LOD	< LOD	0,0247	< LOD	<
		750	01-15-2006 15:36	Zulu Man 2	1,647	18,3862	45,7501	0,063	0,7146	< LOD	1,2497	1,7673	0,4793	< LOD	0,0084	0,0108	2,6674	< LOD	0,0021	0,0031	0,0037	0,0019	< LOD	< LOD	0,013	0,0073	0,0032	0,0183	< LOD	< LOD	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	0,0211	< LOD	<
		751	01-15-2006 15:38	Zulu Man 3	1,5355	18,1661	45,9017	0,0689	0,6961	< LOD	1,241	1,7784	0,4778	< LOD	0,0079	0,0115	2,6991	< LOD	0,0027	0,0033	0,0031	0,0017	< LOD	0,0002	0,0131	0,0073	0,0029	0,0178	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0142	< LOD	<
		752	01-15-2006 15:40	Zulu Man 4	1,503	18,3883	46,2987	0,0714	0,7163	< LOD	1,2446	1,784	0,4747	< LOD	0,0069	0,0123	2,6878	< LOD	0,0013	0,003	0,0036	0,0013	< LOD	< LOD	0,013	0,0074	0,0032	0,0185	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0239	< LOD	<
		753	01-15-2006 15:42	Zulu Man 5	2,5289	18,5658	46,1275	0,0677	0,7066	< LOD	1,2429	1,7716	0,4759	< LOD	0,0083	0,0116	2,6929	< LOD	0,0033	0,0041	0,0031	0,0015	0,0005	0,0002	0,013	0,0069	0,0029	0,0174	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0,0208	< LOD	<
		754	01-15-2006 15:44	Zulu Man 6	1,9279	18,0595	46,0357	0,0604	0,6947	< LOD	1,2467	1,772	0,4811	< LOD	0,0077	0,0115	2,697	< LOD	0,0023	0,0033	0,0039	0,0016	< LOD	< LOD	0,0126	0,007	0,0033	0,0182	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0169	< LOD	<
		755	01-15-2006 15:46	Zulu Man 7	1,7321	18,4765	46,2811	0,0585	0,7021	< LOD	1,2478	1,7876	0,4814	< LOD	0,012	0,0112	2,6771	< LOD	0,0024	0,0032	0,0031	0,0017	0,0007	< LOD	0,013	0,007	0,003	0,0179	< LOD	< LOD	< LOD	0,0014	< LOD	< LOD	< LOD	< LOD	< LOD	0,0217	< LOD	<
		756	01-15-2006 15:47	Zulu Man 8	1,3047	18,5578	46,5558	0,067	0,7151	< LOD	1,2569	1,7791	0,4731	< LOD	0,0088	0,0121	2,6817	< LOD	0,0023	0,0032	0,0031	0,0015	< LOD	< LOD	0,0133	0,0072	0,0032	0,0178	< LOD	< LOD	< LOD	0,0017	< LOD	< LOD	< LOD	< LOD	< LOD	0,0282	< LOD	<
		757	01-15-2006 15:49	Zulu Man 9	1,4195	18,4125	46,3764	0,0654	0,6991	< LOD	1,2473	1,7964	0,4748	< LOD	0,0074	0,0103	2,6891	0,0044	0,0024	0,0029	0,0035	0,0016	< LOD	< LOD	0,0125	0,0072	0,0031	0,0176	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0207	< LOD	<
		758	01-15-2006 15:51	Zulu Man 10	2,0245	18,514	46,5698	0,0731	0,6853	< LOD	1,2473	1,7874	0,4752	< LOD	0,0099	0,0116	2,6802	< LOD	0,0026	0,0034	0,0035	0,0017	0,0008	< LOD	0,0131	0,0074	0,003	0,0174	< LOD	< LOD	< LOD	0,0015	< LOD	< LOD	< LOD	< LOD	< LOD	0,0157	< LOD	<
		759	01-15-2006 15:53	Zulu Man 11	1,6034	18,3286	46,4444	0,061	0,728	< LOD	1,2612	1,793	0,4776	< LOD	0,0074	0,0116	2,7088	< LOD	0,0022	0,0035	0,0035	0,0019	0,0009	0,0002	0,0127	0,0075	0,003	0,0178	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,019	< LOD	<
		760	01-15-2006 15:58	Zulu Man 12	1,2228	11,3902	32,9473	0,0321	1,3728	< LOD	0,8575	2,1314	0,367	< LOD	0,0058	0,0095	2,1462	< LOD	0,0028	0,0029	0,003	0,0008	< LOD	< LOD	0,0126	0,0069	0,0027	0,0162	< LOD	< LOD	< LOD	0,0015	< LOD	< LOD	< LOD	< LOD	< LOD	0,0227	< LOD	<
		761	01-15-2006 16:02	Zulu Man 13	1,8953	18,8665	46,0889	0,039	1,0908	< LOD	1,2545	2,4506	0,4646	< LOD	0,0079	0,0105	2,7281	< LOD	0,0017	0,0039	0,0031	0,0015	0,0006	0,0002	0,0119	0,0068	0,003	0,0164	< LOD	< LOD	< LOD	0,0014	< LOD	< LOD	< LOD	< LOD	< LOD	0,0203	< LOD	<
		763	01-15-2006 16:06	Zulu Man 14	2,1497	15,7877	39,2826	0,7546	0,713	< LOD	1,2489	1,3667	0,4892	< LOD	0,0072	0,0126	2,985	< LOD	0,0023	0,0032	0,0031	0,0017	0,0008	< LOD	0,0128	0,0074	0,0036	0,0236	< LOD	< LOD	< LOD	0,0016	< LOD	< LOD	< LOD	< LOD	< LOD	0,0185	< LOD	<
		764	01-15-2006 16:10	Zulu Man 15	1,8154	18,1474	43,2022	0,0329	0,747	< LOD	1,247	2,1809	0,4649	< LOD	0,0087	0,0127	3,0023	< LOD	0,0028	0,0033	0,0032	0,0015	0,0006	< LOD	0,0136	0,0071	0,0032	0,0196	< LOD	< LOD	< LOD	0,002	< LOD	< LOD	< LOD	< LOD	< LOD	0,0213	< LOD	<
		765	01-15-2006 16:13	Zulu Man 16	1,4787	22,774	53,2745	0,0376	1,2387	< LOD	1,5525	2,3827	0,5297	< LOD	0,0109	0,0149	3,2726	0,0055	0,0021	0,0033	0,0031	0,0014	0,0005	< LOD	0,0129	0,0071	0,0034	0,0206	< LOD	< LOD	< LOD	0,0017		< LOD	< LOD	< LOD	< LOD	0,0235	< LOD	<
		766	01-15-2006 16:16	Zulu Man 17	1,7486	19,456	48,3527	0,0695	0,572	< LOD	1,2791	1,6036	0,4577	< LOD	0,009	0,0099	2,5696	< LOD	0,0025	0,0042	0,0032	0,0019	0,0007	< LOD	0,0121	0,0067	0,003	0,0193	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0202	< LOD	<
		767	01-15-2006 16:19	Zulu Man 18	< LOD	19,7587	48,2811	0,0923	0,6981	< LOD	1,2873	1,955	0,4768	< LOD	0,008	0,012	2,7152	< LOD	0,0026	0,0036	0,0031	0,0023	0,0008	0,0003	0,013	0,0073	0,003	0,0177	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0214	< LOD	<
		768	01-15-2006 16:22	Zulu Man 19	< LOD	23,9721	62,4484	0,0638	1,1815	< LOD	1,6173	3,1952	0,5321	0,015	0,0088	0,0131	3,2251	< LOD	0,0016	0,0034	0,0034	0,0017	< LOD	0,0002	0,0119	0,0069	0,0028	0,0176	< LOD	< LOD			< LOD	< LOD	< LOD	< LOD	< LOD	0,0205	< LOD	<
		769	01-15-2006 16:26	Zulu Man 20	1,5914	25,7983	56,295	0,0437	1,1976	< LOD	1,6775	2,7148	0,5807	< LOD	0,0095	0,0126	3,0704	< LOD	0,0023	0,004	0,0029	0,0017	0,0007	0,0002	0,013	0,0076	0,0033	0,0207	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0258	< LOD	<
Bushman	34955575																																							
		770	01-15-2006 16:30	Bushman 1	1,6181	26,1346	64,1286	0,0206	0,4289	< LOD	1,6468	0,2001	0,5815	< LOD	0,0102	0,0137	2,8632	< LOD	0,0018	0,0033	0,0032	0,0013	< LOD	< LOD	0,0106	0,005	0,0027	0,0224	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0,0215	< LOD	<
		771	01-15-2006 16:34	Bushman 2	1,7545	24,36	65,6566	0,0338	0,657	< LOD	1,579	0,2015	0,6111	< LOD	0,0079	0,0145	2,9476	< LOD	0,0021	0,003	0,0031	0,0013	0,0005	< LOD	0,0105	0,0055	0,003	0,0203	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0,027	< LOD	<
		772	01-15-2006 16:38	Bushman 3	2,2389	22,5198	61,2158	0,0386	0,5928	< LOD	1,511	0,1822	0,58	< LOD	0,0087	0,0139	2,856	< LOD	0,0017	0,0033	0,0029	0,0009	0,0005	< LOD	0,0106	0,0054	0,0031	0,0237	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0281	< LOD	<
		773	01-15-2006 16:41	Bushman 4	1,4068	21,8928	61,4876	< LOD	0,6504	< LOD	1,4954	0,1636	0,6198	< LOD	0,0073	0,0165	2,8679	< LOD	0,0027	0,0034	0,0031	0,0013	0,0009	< LOD	0,0107	0,0051	0,0025	0,0208	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0,0297	< LOD	<
		774	01-15-2006 16:47	Bushman 5	1,3666	18,7587	50,0327	< LOD	0,1211	< LOD	1,333	0,1397	0,488	< LOD	0,0071	0,0111	3,0086	< LOD	0,0028	0,0044	0,0029	0,0013	0,0006	< LOD	0,0117	0,0028	0,0027	0,0244	< LOD	< LOD	< LOD	0,0026	< LOD	< LOD	< LOD	< LOD	< LOD	0,0169	< LOD	<
Zulu Man, small	1955573																																							
		775	01-15-2006 16:57	Zulu man, small 1	1,3964	27,6441	67,541	< LOD	0,878	< LOD	2,231	0,2187	0,7203	< LOD	0,0098	0,0176	2,6842	< LOD	0,0019	0,0035	0,0031	0,0013	< LOD	< LOD	0,0131	0,0047	0,0026	0,0202	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0264	< LOD	<
		776	01-15-2006 17:00	Zulu man, small 2	1,6235	24,5921	56,71	< LOD	0,4776	< LOD	1,9335	0,1603	0,5855	< LOD	0,0098	0,0126	2,6795	< LOD	0,0025	0,0036	0,0027	0,0021	< LOD	< LOD	0,0134	0,0034	0,0028	0,0177	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0,0214	< LOD	<
		777	01-15-2006 17:05	Zulu man, small 3	< LOD	32,2869	75,201	< LOD	0,6736	< LOD	2,5093	0,247	0,6925	0,0273	0,0087	0,017	2,8356	0,0054	0,0015	0,0036	0,0029	0,0014	< LOD	< LOD	0,0126	0,0042	0,0024	0,0159	< LOD	< LOD		< LOD		< LOD	< LOD	< LOD	< LOD	0,028	< LOD	<
Zulu Woman, sm	29955572																																							
		778	01-15-2006 17:08	Zulu woman, small 1	1,8286	24,8811	68,8381	< LOD	0,1777	< LOD	1,7472	0,1775	0,5427	0,0142	0,008	0,0125	1,896	< LOD	0,0024	0,0032	0,0023	0,0013	0,0005	< LOD	0,0105	0,0028	0,0026	0,0264	< LOD	< LOD			< LOD	< LOD	< LOD	< LOD	< LOD	0,0184	< LOD	<
		779	01-15-2006 17:11	Zulu woman, small 2	2,0492	18,1402	54,1206	0,0259	0,2829	< LOD	1,361	2,6458	0,4529	< LOD	0,0085	0,009	1,7056	< LOD	0,0018	0,0033	0,0025	0,0012	< LOD	0,0003	0,01	0,0037	0,0025	0,02	< LOD	< LOD	< LOD	0,0016	< LOD	< LOD	< LOD	< LOD	< LOD	0,0138	< LOD	<
		780	01-15-2006 17:14	Zulu woman, small 3	1,4409	19,755	65,1902	0,0313	0,3119	< LOD	1,4833	2,6477	0,4604	< LOD	0,0066	0,009	1,8008	< LOD	0,002	0,0034	0,0023	0,0012	< LOD	< LOD	0,0098	0,0029	0,0023	0,0213	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0137	< LOD	<
Leopard ashtray	955570																																							
		781	01-15-2006 17:17	leopard RF closed mouth 1	1,6638	25,5417	54,8559	< LOD	0,0995	< LOD	1,507	0,1192	0,396	< LOD	0,0062	0,0096	2,1852	< LOD	0,0023	0,0027	0,0027	0,0016	< LOD	< LOD	0,013	0,0023	0,0026	0,0146	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0,0173	< LOD	<
		782	01-15-2006 17:20	leopard RF closed mouth 2	1,6048	26,5216	57,0778	< LOD	1,8248	< LOD	1,7016	0,146	0,7347	< LOD	0,0137	0,0201	2,8037	< LOD	0,0022	0,0035	0,0025	0,0016	< LOD	< LOD	0,0113	0,0045	0,0023	0,0196	< LOD	< LOD				< LOD	< LOD	< LOD	< LOD	0,0319	< LOD	<
		783	01-15-2006 17:23	leopard RF closed mouth 3	2,231	10,9601	19,1457	0,1354	1,5312	0,389	0,7814	3,253	2,5275	< LOD	0,016	0,0781	3,6303	0,1162	< LOD	0,0029	0,0049	0,0015	0,007	0,0004	0,014	0,0065	0,0056	0,0409	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0,0223	< LOD	<
Leopard ashtray B (left facing, open mouth)																																								
		784	01-15-2006 17:27	leopard LF open mouth 1	1,6165	27,2231	54,065	< LOD	0,0838	< LOD	1,5849	0,126	0,3894	< LOD	0,009	0,0096	2,9911	< LOD	0,0033	0,004	0,0026	0,0018	< LOD	< LOD	0,0135	0,0022	0,0028	0,0211	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0159	< LOD	<
		785	01-15-2006 17:31	leopard LF open mouth 2	< LOD	31,2703	62,1939	0,0192	1,7801	< LOD	1,9807	0,1638	0,7619	< LOD	0,0103	0,0197	3,2577	< LOD	0,002	0,0035	0,0025	0,0018	0,0006	0,0003	0,0135	0,0054	0,0026	0,0181	< LOD	< LOD			< LOD	< LOD	< LOD	< LOD	< LOD	0,0342	< LOD	<
		786	01-15-2006 17:34	leopard LF open mouth 3	2,231	12,394	21,3849	0,1497	1,3785	0,3044	0,4168	9,0083	6,5391	< LOD	0,0409	0,1091	2,0001	0,0786	< LOD	0,0034	0,0093	0,0014	0,0052	< LOD	0,0108	0,0064	0,0047	0,0342	< LOD	< LOD		< LOD		< LOD	< LOD	< LOD	< LOD	0,0285	< LOD	<

Fort Nonquai Coll.																																								
		File #	DateTime	Name	MgO	Al2O3	SiO2	P	S	Cl	K2O	Ca	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Rh		Ag	Cd	Sn	Sb	Te	Ba	La	Ce
Seated leopard	01/266																																							
		864	05-29-2023 14:24	Seated Leopard 1	< LOD	24,8939	53,6291	< LOD	0,1858	< LOD	2,0561	0,1625	0,593	< LOD	0,0119	0,0123	2,9065	< LOD	0,0027	0,0033	0,0034	0,0019	0,0006	0,0003	0,0149	0,0036	0,0033	0,0208	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0216	< LOD	< L
		865	05-29-2023 14:28	Seated Leopard 2	1,7533	22,0491	48,7017	< LOD	0,0647	< LOD	1,7466	0,1541	0,5158	< LOD	0,0101	0,009	2,6895	< LOD	0,0022	0,0033	0,0028	0,0014	< LOD	< LOD	0,0133	0,003	0,0029	0,0207	< LOD	< LOD	< LOD	0,0016		< LOD	< LOD	< LOD	< LOD	0,0262	< LOD	< L
		866	05-29-2023 14:31	Seated Leopard 3	1,6653	9,5836	19,3875	0,1246	3,9336	0,92	0,3673	2,5065	16,5613	0,1571	0,1472	0,4583	0,4867	0,0455	< LOD	< LOD	0,0741	< LOD	0,0221	< LOD	0,0096	0,0317	0,0029	0,0305	< LOD	< LOD		0,0015		< LOD	< LOD	< LOD	< LOD	0,2903	< LOD	< L
		867	05-29-2023 14:34	Seated Leopard 4	1,8759	23,6226	52,2829	0,0156	0,0988	< LOD	1,8593	0,1461	0,55	< LOD	0,008	0,0126	3,0181	< LOD	0,0024	0,0034	0,0026	0,0019	< LOD	< LOD	0,0145	0,003	0,0031	0,0209	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0214	< LOD	< L
Walking leopard	01/269																																							
		868	05-29-2023 14:40	Walking Leopard 1	1,8756	12,3934	41,3174	< LOD	0,0691	< LOD	1,3102	0,1056	0,4317	< LOD	0,0058	0,0085	2,8139	0,0068	0,002	0,0032	0,0031	0,001	< LOD	< LOD	0,0139	0,0023	0,0022	0,0154	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0,0235	< LOD	< L
		869	05-29-2023 14:42	Walking Leopard 2	1,6018	17,0001	36,1808	< LOD	0,5622	< LOD	1,2677	0,1079	0,5536	< LOD	0,006	0,0121	3,2257	< LOD	0,0018	0,0041	0,0025	0,0015	0,0007	< LOD	0,0136	0,0037	0,0023	0,0143	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0306	< LOD	< L
		870	05-29-2023 14:49	Walking Leopard 3	< LOD	3,4609	8,3216	0,0268	2,8003	0,3647	0,4282	0,2723	17,3383	< LOD	0,2433	0,224	2,2058	0,0306	< LOD	< LOD	0,0562	< LOD	0,0857	0,0005	0,013	0,0076	< LOD	0,0286	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0555	< LOD	< L
Leopard killing an impala																																								
		872	05-30-2023 10:19	Leopard & impala 1	1,4412	17,2387	41,8536	0,0181	1,2183	< LOD	1,564	0,1579	0,8126	< LOD	0,0115	0,0223	2,6924	< LOD	0,0022	0,0027	0,0029	0,0015	< LOD	< LOD	0,0134	0,0045	0,0035	0,0206	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0337	< LOD	< L
		873	05-30-2023 10:22	Leopard & impala 2	2,2679	4,8928	7,7204	< LOD	2,4928	0,4255	0,2025	0,3606	22,4566	< LOD	0,3757	0,3039	0,8107	0,0334	< LOD	< LOD	0,0687	< LOD	0,1268	0,0007	0,011	0,0035	< LOD	0,0381	< LOD	< LOD				< LOD	< LOD	< LOD	< LOD	0,0203	< LOD	< L
		874	05-30-2023 10:25	Leopard & impala 3	1,8239	18,4333	47,8784	< LOD	0,5914	< LOD	1,6803	0,133	0,6308	< LOD	0,0098	0,0139	2,8498	< LOD	0,0021	0,0029	0,0027	0,0018	0,0007	0,0003	0,0137	0,0035	0,0031	0,0231	< LOD	< LOD	< LOD	0,0016	< LOD	< LOD	< LOD	< LOD	< LOD	0,0253	< LOD	< L
Leopard in a Tree																																								
		875	05-30-2023 10:30	Leopard in tree 1	1,8082	8,6098	24,5277	< LOD	0,2108	< LOD	0,7816	0,0801	0,3447	< LOD	0,0063	0,0122	1,729	< LOD	0,0012	0,003	0,003	< LOD	< LOD	< LOD	0,0119	0,0034	0,0024	0,0224	< LOD	< LOD	< LOD	0,0015	< LOD	< LOD	< LOD	< LOD	< LOD	0,022	< LOD	< L
		876	05-30-2023 10:33	Leopard in tree 2	1,5212	16,6004	44,8654	< LOD	0,1217	< LOD	1,464	0,1365	0,5021	< LOD	0,0093	0,0095	2,2609	< LOD	0,0027	0,0029	0,0032	0,0015	0,0005	< LOD	0,0135	0,0033	0,0033	0,0234	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0151	< LOD	< L
		877	05-30-2023 10:36	Leopard in tree 3	2,2069	0,4177	3,2066	< LOD	2,0407	0,2104	0,0516	0,1515	1,9069	< LOD	0,086	0,1045	0,0888	0,0159	< LOD	< LOD	3,9682	< LOD	0,2696	< LOD	0,0051	0,1802	< LOD	0,0368	< LOD	0,1225	0,0828	0,0157	< LOD	0,0011	< LOD	< LOD	< LOD	0,0971	< LOD	< L
Older Zulu Woman																																								
		878	05-30-2023 10:45	Old Zulu woman 1	1,4271	10,4444	33,2856	< LOD	0,5955	< LOD	1,0234	0,0819	0,4901	< LOD	0,0047	0,0096	1,768	< LOD	0,0018	0,0038	0,0021	0,001	< LOD	0,0002	0,0103	0,0027	0,0026	0,0199	< LOD	< LOD	< LOD	0,0015	< LOD	< LOD	< LOD	< LOD	< LOD	0,0243	< LOD	< L
		879	05-30-2023 10:47	Old Zulu woman 2	1,4638	15,4398	47,6974	< LOD	0,7852	< LOD	1,6936	0,1492	0,6482	< LOD	0,0109	0,0153	2,7055	< LOD	0,0025	0,0028	0,0025	0,0012	< LOD	< LOD	0,0118	0,0041	0,0033	0,0257	< LOD	< LOD	< LOD	0,0013		< LOD	< LOD	< LOD	< LOD	0,0299	< LOD	< L
		880	05-30-2023 10:52	Old Zulu woman 3	1,7176	16,918	59,1919	0,032	0,6773	< LOD	1,8709	2,2447	0,6443	< LOD	0,0108	0,0174	3,3925	< LOD	0,0021	0,0031	0,0032	0,0015	0,0005	< LOD	0,0126	0,0048	0,0036	0,0247	< LOD	< LOD		< LOD		< LOD	< LOD	< LOD	< LOD	0,0268	< LOD	< L
Young Zulu Wor	01/274																																							
		881	05-30-2023 11:06	Young Zulu woman 1	1,7533	12,2202	33,8846	< LOD	0,1315	< LOD	0,8838	0,1047	0,339	< LOD	0,0048	0,0058	1,7696	< LOD	0,0017	0,0038	0,0024	0,0008	0,0005	< LOD	0,0102	0,0023	0,0024	0,0203	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0,0177	< LOD	< L
		882	05-30-2023 11:31	Young Zulu woman 2	1,3784	16,9558	44,6658	< LOD	1,2985	< LOD	1,3534	0,1488	0,7816	< LOD	0,0089	0,0196	2,5699	< LOD	0,0018	0,0032	0,0023	0,0011	< LOD	< LOD	0,0118	0,0041	0,0025	0,0212	< LOD	< LOD	< LOD	0,0015	< LOD	< LOD	< LOD	< LOD	< LOD	0,0338	< LOD	< L
		883	05-30-2023 11:34	Young Zulu woman 3	< LOD	18,4251	46,3273	< LOD	0,936	< LOD	1,3719	0,1482	0,6539	< LOD	0,0085	0,0162	2,8099	< LOD	0,0018	0,0024	0,0022	0,0012	< LOD	0,0003	0,0112	0,0047	0,0027	0,0277	< LOD	< LOD	< LOD	0,0018	< LOD		< LOD	< LOD	< LOD	0,0397	< LOD	< L
		884	05-30-2023 11:40	Young Zulu woman 4	1,9861	19,664	49,3957	< LOD	1,7082	< LOD	1,5369	0,1786	0,8721	< LOD	0,0133	0,023	2,6001	< LOD	0,0023	0,0031	0,0021	0,0016	< LOD	< LOD	0,0123	0,0046	0,0029	0,0279	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0,0333	< LOD	< L
Zulu Man, small	n/a																																							
		885	05-30-2023 11:46	Zulu Man, small 1	1,8506	15,4095	46,8356	< LOD	0,6285	< LOD	1,5259	0,1174	0,6125	< LOD	0,0078	0,0132	1,9865	< LOD	0,002	0,0028	0,0026	0,0011	0,0004	0,0002	0,011	0,0031	0,0035	0,0214	< LOD	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	0,0145	< LOD	
		886	05-30-2023 11:52	Zulu Man, small 2	1,6987	8,8301	30,5472	< LOD	0,438	< LOD	0,9222	0,0849	0,4165	< LOD	0,0052	0,0097	1,4866	< LOD	0,002	0,0038	0,0026	< LOD	< LOD	< LOD	0,0105	0,0028	0,0028	0,0197	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0258	< LOD	< L
		887	05-30-2023 11:56	Zulu Man, small 3	1,3628	20,9094	60,5759	< LOD	0,7935	< LOD	1,9323	0,1617	0,673	< LOD	0,0092	0,0154	2,3609	< LOD	0,0016	0,0033	0,0027	0,0015	0,0005	< LOD	0,0119	0,0037	0,0038	0,0251	< LOD	< LOD			< LOD	< LOD	< LOD	< LOD	< LOD	0,0248	< LOD	< L
		888	05-30-2023 12:03	Zulu Man, small 4	1,6302	12,393	39,5629	< LOD	0,3737	< LOD	1,2816	0,2966	0,5003	< LOD	0,0078	0,0115	1,9452	< LOD	0,0022	0,0035	0,0031	0,0011	0,0007	< LOD	0,0111	0,0034	0,0034	0,0253	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0,0223	< LOD	< L
Married Man	01/275																																							
		889	05-30-2023 12:10	Married man painted headband and bearc	1,3545	13,5463	45,4562	< LOD	0,183	< LOD	1,1734	0,1498	0,4696	< LOD	0,0065	0,0085	1,5005	< LOD	0,0017	0,0027	0,0024	< LOD	< LOD	< LOD	0,0085	0,0026	0,0024	0,0277	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0138	< LOD	< L
		890	05-30-2023 12:14	Married man painted headband and bearc	1,8555	7,3564	31,2131	0,0183	0,4553	< LOD	0,7391	0,5268	0,3377	< LOD	0,0051	0,0087	1,1065	< LOD	0,0019	0,0038	0,005	< LOD	0,0005	0,0002	0,0086	0,0032	0,0019	0,0198	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0139	< LOD	< L
		891	05-30-2023 12:20	Married man painted headband and bearc	2,1653	3,5027	11,247	0,0611	1,5095	0,1375	0,4024	1,4309	0,2164	< LOD	0,0042	0,0261	0,9262	0,0109	0,0014	< LOD	0,0686	< LOD	0,0046	< LOD	0,0083	0,0038	0,0017	0,0203	< LOD	< LOD	< LOD	0,0018		< LOD	< LOD	< LOD	< LOD	0,0706	< LOD	< L
		892	05-30-2023 12:26	Married man painted headband and bearc	1,6549	16,1293	47,6092	0,0231	0,724	< LOD	1,3752	2,4151	0,838	< LOD	0,0108	0,0222	1,9876	< LOD	0,0013	0,0019	0,0466	0,0012	0,0008	< LOD	0,0095	0,0124	0,003	0,0262	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0,0911	< LOD	< L
Married Woman	01/276																																							
		894	05-30-2023 12:36	Married Woman with red hair 1	1,6495	4,5444	16,9537	0,0519	4,115	0,3142	0,2613	3,2025	0,9957	0,1259	< LOD	0,2074	0,4697	< LOD	0,0023	< LOD	0,0404	< LOD	0,0684	0,0008	0,0064	0,127	< LOD	0,0045	< LOD	< LOD	< LOD		< LOD	< LOD	0,0101	< LOD	0,0014	3,2068	< LOD	
		895	05-30-2023 12:42	Married Woman with red hair 2	1,2269	13,7432	54,2309	0,0427	0,6416	< LOD	1,1415	3,2924	0,7459	0,0386	< LOD	0,0372	1,5064	< LOD	< LOD	< LOD	0,1242	0,0012	< LOD	< LOD	0,0085	0,0194	0,0024	0,0269	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0,2293	< LOD	< L
		896	05-30-2023 12:45	Married Woman with red hair 3	1,5665	17,2306	57,4367	< LOD	0,1658	< LOD	1,3714	1,4059	0,5512	< LOD	0,0061	0,0106	1,6319	< LOD	0,0019	0,0031	0,0026	0,001	< LOD	< LOD	0,0086	0,004	0,0023	0,0291	< LOD	< LOD			< LOD	< LOD	< LOD	< LOD	< LOD	0,0158	< LOD	< L
		897	05-30-2023 12:50	Married Woman with red hair 4	1,3031	14,0644	49,9431	0,0203	0,2496	< LOD	1,2605	3,7186	0,5183	< LOD	0,0054	0,0094	1,6359	< LOD	0,0013	0,0033	0,0025	0,0011	0,0005	< LOD	0,0082	0,0041	0,0028	0,0312	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0,0163	< LOD	< L
Induna	01/271																																							
		898	05-30-2023 13:21	Induna 1	1,8291	13,3691	38,0223	< LOD	0,7775	< LOD	1,3449	0,1114	0,6435	< LOD	0,0074	0,0273	2,5129	< LOD	0,0014	0,0021	0,0029	0,0018	0,0008	< LOD	0,0134	0,0038	0,0032	0,0189	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0282	< LOD	< L
		899	05-30-2023 13:25	Induna 2	< LOD	16,8818	43,665	< LOD	0,8113	< LOD	1,5877	0,1204	0,6853	< LOD	0,0102	0,0232	2,632	< LOD	0,0021	0,003	0,0027	0,0015	0,0006	< LOD	0,0132	0,0039	0,0034	0,0202	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0,0209	< LOD	< L
		901	05-30-2023 13:32	Induna 3	1,8781	13,8641	39,49	< LOD	0,7303	< LOD	1,2613	0,1123	0,6179	< LOD	0,0073	0,0145	2,443	< LOD	0,0025	0,0032	0,0031	0,0012	< LOD	< LOD	0,0118	0,0032	0,0035	0,0161	< LOD	< LOD	< LOD	0,0018		< LOD	< LOD	< LOD	< LOD	0,0313	< LOD	< L
		902	05-30-2023 13:35	Induna 4	1,6662	12,1623	32,0924	< LOD	0,0388	< LOD	1,1332	0,0766	0,3948	< LOD	0,0043	0,0077	2,1413	< LOD	0,0021	0,0037	0,0025	0,0012	0,0007	< LOD	0,0118	0,0025	0,003	0,0185	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< L
Ushaka	01/272																																							
		903	05-30-2023 13:40	ushaka 1	2,1317	19,9963	56,2567	0,0438	0,1446	< LOD	1,7945	0,1915	0,5192	< LOD	0,0083	0,0097	2,4132	0,0043	0,0018	0,0039	0,0036	0,0014	0,0007	< LOD	0,0121	0,0034	0,0036	0,0235	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,021	< LOD	< L
		904	05-30-2023 13:43	ushaka 2	1,4123	10,4957	37,8376	< LOD	1,1392	< LOD	1,1109	0,1322	0,6957	< LOD	0,0073	0,0225	1,7836	< LOD	0,0022	0,0036	0,0027	0,001	< LOD	< LOD	0,0112	0,0047	0,0034	0,023	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0285	< LOD	< L
		905	05-30-2023 13:47	ushaka 3	1,6172	15,7448	44,4033	< LOD	0,6484	< LOD	1,5517	0,1388	0,6338	< LOD	0,0089	0,0196	2,2227	< LOD	0,0017	0,0026	0,0028	0,0013	< LOD	< LOD	0,0123	0,0039	0,003	0,0244	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0,0239	< LOD	< L
		907	05-30-2023 14:12	ushaka 4	< LOD	23,1435	62,4617	< LOD	0,4422	< LOD	1,9805	0,1868	0,623	< LOD	0,0076	0,016	2,3926	< LOD	0,0022	0,0029	0,0026	0,0013	0,0004	< LOD	0,012	0,0038	0,003	0,0221	< LOD	< LOD			< LOD	< LOD	< LOD	< LOD	< LOD	0,0238	< LOD	< L
Bushman	01/270																																							
		909	05-30-2023 14:24	bushman 1	1,6961	11,6281	33,0483	< LOD	0,2649	< LOD	0,8943	0,1409	0,4035	< LOD	0,006	0,0093	1,6735	< LOD	0,0021	0,0033	0,0025	< LOD	< LOD	< LOD	0,0111	0,004	0,0032	0,0221	< LOD	< LOD	< LOD	0,0014	< LOD	< LOD	< LOD	< LOD	< LOD	0,0149	< LOD	< L
		910	05-30-2023 14:26	bushman 2	2,4176	15,7429	42,0113	< LOD	0,2626	< LOD	1,3081	0,1679	0,5055	< LOD	0,008	0,012	2,2694	< LOD	0,003	0,0035	0,0035	0,0012	0,0007	0,0003	0,0119	0,0042	0,0031	0,0244	< LOD	< LOD	< LOD	0,0012	< LOD	< LOD	< LOD	< LOD	< LOD	0,0241	< LOD	< L
		911	05-30-2023 14:30	bushman 3	1,2944	20,3508	51,5982	< LOD	0,1955	< LOD	1,5797	0,1667	0,5553	< LOD	0,0091	0,0125	2,7707	< LOD	0,002	0,0031	0,0032	0,0018	< LOD	0,0002	0,0125	0,0049	0,0033	0,0195	< LOD	< LOD	< LOD		< LOD	< LOD	< LOD	< LOD	< LOD	0,0239	< LOD	< L

E4. XRF Average for each sculpture

Hezekiel Ntuli		**ElapsedTime**																							
GeoExploration		**90 seconds**																							
Oxide3phase																									
LDT Coll. University of Pretoria																									
			Magnesiu	**Aluminiur**	**Silicon dic**	**Phosphor**	**Sulphur**	**Potassium**	**Calcium**	**Titanium**	**Chromium**	**Manganes**	**Iron**	**Cobalt**	**Nickel**	**Copper**	**Zinc**	**Gallium**	**Arsenic**	**Selenium**	**Rubidium**	**Strintium**	**Yttrium**	**Zirconium**	**Barium**
File #	**Name**	**ID**	**MgO**	**Al2O3**	**SiO2**	**P**	**S**	**K2O**	**Ca**	**Ti**	**Cr**	**Mn**	**Fe**	**Co**	**Ni**	**Cu**	**Zn**	**Ga**	**As**	**Se**	**Rb**	**Sr**	**Y**	**Zr**	**Ba**
749	Zulu Man, large 1	Central bust	1,79	18,22	45,84	0,06	0,70	1,23	1,77	0,48	0,0072	0,01	2,67	0,0069	0,0014	0,0034	0,0032	0,0016	0,0005	0,0002	0,0130	0,0072	0,0029	0,0175	0,0247
760	Zulu Man, large 11	Right shoulder under signature	1,22	11,39	32,95	0,03	1,37	0,86	2,13	0,37	0,0058	0,01	2,15	< LOD	0,0028	0,0029	0,0030	0,0008	< LOD	< LOD	0,0126	0,0069	0,0027	0,0162	0,0227
761	Zulu Man, large 12	Back of neck	1,90	18,87	46,09	0,04	1,09	1,25	2,45	0,46	0,0079	0,01	2,73	< LOD	0,0017	0,0039	0,0031	0,0015	0,0006	0,0002	0,0119	0,0068	0,0030	0,0164	0,0203
763	Zulu Man, large 14	middle of back	2,15	15,79	39,28	0,75	0,71	1,25	1,37	0,49	0,0072	0,01	2,99	< LOD	0,0023	0,0032	0,0031	0,0017	0,0008	< LOD	0,0128	0,0074	0,0036	0,0236	0,0185
764	Zulu Man, large 15	back of hair	1,82	18,15	43,20	0,03	0,75	1,25	2,18	0,46	0,0087	0,01	3,00	< LOD	0,0028	0,0033	0,0032	0,0015	0,0006	< LOD	0,0136	0,0071	0,0032	0,0196	0,0213
765	Zulu Man, large 16	left shoulder back	1,48	22,77	53,27	0,04	1,24	1,55	2,38	0,53	0,0109	0,01	3,27	0,0055	0,0021	0,0033	0,0031	0,0014	0,0005	< LOD	0,0129	0,0071	0,0034	0,0206	0,0235
766	Zulu Man, large 17	left clavicula	1,75	19,46	48,35	0,07	0,57	1,28	1,60	0,46	0,0090	0,01	2,57	< LOD	0,0025	0,0042	0,0032	0,0019	0,0007	< LOD	0,0121	0,0067	0,0030	0,0193	0,0202
767	Zulu Man, large 18	right clavicula	< LOD	19,76	48,28	0,09	0,70	1,29	1,96	0,48	0,0080	0,01	2,72	< LOD	0,0026	0,0036	0,0031	0,0023	0,0008	0,0003	0,0130	0,0073	0,0030	0,0177	0,0214
768	Zulu Man, large 19	right eyebank	< LOD	23,97	62,45	0,06	1,18	1,62	3,20	0,53	0,0088	0,01	3,23	< LOD	0,0016	0,0034	0,0034	0,0017	< LOD	0,0002	0,0119	0,0069	0,0028	0,0176	0,0205
769	Zulu Man, large 20	left forehead	1,59	25,80	56,30	0,04	1,20	1,68	2,71	0,58	0,0095	0,01	3,07	< LOD	0,0023	0,0040	0,0029	0,0017	0,0007	0,0002	0,0130	0,0076	0,0033	0,0207	0,0258
		Average	**1,71**	**19,42**	**47,60**	**0,12**	**0,95**	**1,33**	**2,18**	**0,48**	**0,008**	**0,01**	**2,84**	**0,0062**	**0,0022**	**0,0035**	**0,0031**	**0,0016**	**0,0007**	**0,0002**	**0,0127**	**0,0071**	**0,0031**	**0,0189**	**0,0219**
		Standard deviation	**0,28**	**4,13**	**8,42**	**0,22**	**0,29**	**0,24**	**0,54**	**0,06**	**0,001**	**0,002**	**0,34**	**0,0010**	**0,0005**	**0,0004**	**0,0001**	**0,0004**	**0,0001**	**0,0000**	**0,0006**	**0,0003**	**0,0003**	**0,0023**	**0,0023**
770	Bushman 1	Mid chest	1,62	26,13	64,13	0,02	0,43	1,65	0,20	0,58	0,0102	0,01	2,86	< LOD	0,0018	0,0033	0,0032	0,0013	< LOD	< LOD	0,0106	0,0050	0,0027	0,0224	0,0215
771	Bushman 2	Right Shoulder	1,75	24,36	65,66	0,03	0,66	1,58	0,20	0,61	0,0079	0,01	2,95	< LOD	0,0021	0,0030	0,0031	0,0013	0,0005	< LOD	0,0105	0,0055	0,0030	0,0203	0,0270
772	Bushman 3	Left scapula	2,24	22,52	61,22	0,04	0,59	1,51	0,18	0,58	0,0087	0,01	2,86	< LOD	0,0017	0,0033	0,0029	0,0009	0,0005	< LOD	0,0106	0,0054	0,0031	0,0237	0,0281
773	Bushman 4	Back of head	1,41	21,89	61,49	< LOD	0,65	1,50	0,16	0,62	0,0073	0,02	2,87	< LOD	0,0027	0,0034	0,0031	0,0013	0,0009	< LOD	0,0107	0,0051	0,0025	0,0208	0,0297
		Average	**1,75**	**23,73**	**63,12**	**0,03**	**0,58**	**1,56**	**0,19**	**0,60**	**0,01**	**0,01**	**2,88**		**0,0021**	**0,0033**	**0,0031**	**0,0012**	**0,0006**		**0,0106**	**0,0053**	**0,0028**	**0,0218**	**0,0266**
		Standard deviation	**0,35**	**1,92**	**2,14**	**0,01**	**0,11**	**0,07**	**0,02**	**0,02**	**0,001**	**0,001**	**0,04**		**0,0005**	**0,0002**	**0,0001**	**0,0002**	**0,0002**		**0,0001**	**0,0002**	**0,0003**	**0,0016**	**0,0036**
774	Bushman 5	underside no slip	1,37	18,76	50,03	< LOD	0,12	1,33	0,14	0,49	0,0071	0,01	3,01	< LOD	0,0028	0,0044	0,0029	0,0013	0,0006	< LOD	0,0117	0,0028	0,0027	0,0244	0,0169
				Extremely homogenous composition that differs from underside - indicative of application of a slip.																					
775	Zulu man, small 1	left scapula	1,40	27,64	67,54	< LOD	0,88	2,23	0,22	0,72	0,0098	0,02	2,68	< LOD	0,0019	0,0035	0,0031	0,0013	< LOD	< LOD	0,0131	0,0047	0,0026	0,0202	0,0264
776	Zulu man, small 2	bottom under breast	1,62	24,59	56,71	< LOD	0,48	1,93	0,16	0,59	0,0098	0,01	2,68	< LOD	0,0025	0,0036	0,0027	0,0021	< LOD	< LOD	0,0134	0,0034	0,0028	0,0177	0,0214
777	Zulu man, small 3	right scapula	< LOD	32,29	75,20	< LOD	0,67	2,51	0,25	0,69	0,0087	0,02	2,84	0,0054	0,0015	0,0036	0,0029	0,0014	< LOD	< LOD	0,0126	0,0042	0,0024	0,0159	0,0280
		Average	**1,51**	**28,17**	**66,48**		**0,68**	**2,22**	**0,21**	**0,67**	**0,01**	**0,02**	**2,73**	**0,0054**	**0,0020**	**0,0036**	**0,0029**	**0,0016**			**0,0130**	**0,0041**	**0,0026**	**0,0179**	**0,0253**
		Standard deviation	**0,16**	**3,87**	**9,29**		**0,20**	**0,29**	**0,04**	**0,07**	**0,00**	**0,00**	**0,09**		**0,0005**	**0,0001**	**0,0002**	**0,0004**			**0,0004**	**0,0007**	**0,0002**	**0,0022**	**0,0034**
778	Zulu woman, small 1	underside left	1,83	24,88	68,84	< LOD	0,18	1,75	0,18	0,54	0,0080	0,01	1,90	< LOD	0,0024	0,0032	0,0023	0,0013	0,0005	< LOD	0,0105	0,0028	0,0026	0,0264	0,0184
779	Zulu woman, small 2	right temple	2,05	18,14	54,12	0,03	0,28	1,36	2,65	0,45	0,0085	0,01	1,71	< LOD	0,0018	0,0033	0,0025	0,0012	< LOD	0,0003	0,0100	0,0037	0,0025	0,0200	0,0138
780	Zulu woman, small 3	left temple	1,44	19,76	65,19	0,03	0,31	1,48	2,65	0,46	0,0066	0,01	1,80	< LOD	0,0020	0,0034	0,0023	0,0012	< LOD	< LOD	0,0098	0,0029	0,0023	0,0213	0,0137
		Average	**1,77**	**20,93**	**62,72**	**0,03**	**0,26**	**1,53**	**1,82**	**0,49**	**0,01**	**0,01**	**1,80**		**0,0021**	**0,0033**	**0,0024**	**0,0012**	**0,00**	**0,00**	**0,0101**	**0,0031**	**0,0025**	**0,0226**	**0,0153**
		Standard deviation	**0,31**	**3,52**	**7,66**	**0,00**	**0,07**	**0,20**	**1,43**	**0,05**	**0,00**	**0,00**	**0,10**		**0,0003**	**0,0001**	**0,0001**	**0,0001**			**0,0004**	**0,0005**	**0,0002**	**0,0034**	**0,0027**
781	leopard A (Closed Mouth)	underside	1,66	25,54	54,86	< LOD	0,10	1,51	0,12	0,40	0,0062	0,01	2,19	< LOD	0,0023	0,0027	0,0027	0,0016	< LOD	< LOD	0,0130	0,0023	0,0026	0,0146	0,0173
782	leopard A (Closed Mouth)	clay back no spots	1,60	26,52	57,08	< LOD	1,82	1,70	0,15	0,73	0,0137	0,02	2,80	< LOD	0,0022	0,0035	0,0025	0,0016	< LOD	< LOD	0,0113	0,0045	0,0023	0,0196	0,0319
		Average	**1,63**	**26,03**	**55,97**		**0,96**	**1,60**	**0,13**	**0,57**	**0,01**	**0,01**	**2,49**		**0,0023**	**0,0031**	**0,0026**	**0,0016**			**0,0122**	**0,0034**	**0,0025**	**0,0171**	**0,0246**
		Standard deviation	**0,04**	**0,69**	**1,57**		**1,22**	**0,14**	**0,02**	**0,24**	**0,01**	**0,01**	**0,44**		**0,0001**	**0,0006**	**0,0001**	**0,0000**			**0,0012**	**0,0016**	**0,0002**	**0,0035**	**0,0103**
783	leopard A (Closed Mouth)	bum spots (painted surface)	2,23	10,96	19,15	0,14	1,53	0,78	3,25	**2,53**	0,0160	0,08	3,63	0,1162	< LOD	0,0029	0,0049	0,0015	0,0070	0,0004	0,0140	0,0065	0,0056	0,0409	0,0223
784	leopard B (Open Mouth)1	underside	1,62	27,22	54,07	< LOD	0,08	1,58	0,13	0,39	0,0090	0,01	2,99	< LOD	0,0033	0,0040	0,0026	0,0018	< LOD	< LOD	0,0135	0,0022	0,0028	0,0211	0,0159
785	leopard B (Open Mouth)2	back no spots	< LOD	31,27	62,19	0,02	1,78	1,98	0,16	0,76	0,0103	0,02	3,26	< LOD	0,0020	0,0035	0,0025	0,0018	0,0006	0,0003	0,0135	0,0054	0,0026	0,0181	0,0342
		Average	**1,62**	**29,25**	**58,13**	**0,02**	**0,93**	**1,78**	**0,14**	**0,58**	**0,01**	**0,01**	**3,12**		**0,0027**	**0,0038**	**0,0026**	**0,0018**	**0,00**	**0,00**	**0,0135**	**0,0038**	**0,0027**	**0,0196**	**0,0251**
		Standard deviation		**2,86**	**5,75**		**1,20**	**0,28**	**0,03**	**0,26**	**0,00**	**0,01**	**0,19**		**0,0009**	**0,0004**	**0,0001**	**0,0000**			**0,0000**	**0,0023**	**0,0001**	**0,0021**	**0,0129**
786	leopard B (Open Mouth)3	bum spots (painted surface)	2,23	12,39	21,38	0,15	1,38	0,42	9,01	**6,54**	0,0409	0,11	2,00	0,0786	< LOD	0,0034	0,0093	0,0014	0,0052	< LOD	0,0108	0,0064	0,0047	0,0342	0,0285
										Ti white paint?															

		Fort Nongquai collection	Magnesiu	Aluminiur	Silicon dio	Phosphor	Sulphur	Potassium	Calcium	Titanium	Chromium	Manganes	Iron	Zinc	Barium	Lead
File #	DateTime	Name	MgO	Al2O3	SiO2	P	S	K2O	Ca	Ti	Cr	Mn	Fe	Zn	Ba	Pb
864	05-29-2023 14:24	Seated Leopard 1	< LOD	24,89	53,63	< LOD	0,19	2,06	0,16	0,59	0,0119	0,01	2,91	0,0034	0,0216	0,0022
865	05-29-2023 14:28	Seated Leopard 2	1,75	22,05	48,70	< LOD	0,06	1,75	0,15	0,52	0,0101	0,01	2,69	0,0028	0,0262	0,0026
866	05-29-2023 14:31	Seated Leopard 3	1,67	9,58	19,39	0,12	3,93	0,37	2,51	16,56	0,1472	0,46	0,49	0,0741	0,2903	0,1372
867	05-29-2023 14:34	Seated Leopard 4	1,88	23,62	52,28	0,02	0,10	1,86	0,15	0,55	0,0080	0,01	3,02	0,0026	0,0214	0,0027
		Average	**1,76**	**18,42**	**40,12**	**0,07**	**1,37**	**1,32**	**0,94**	**5,88**	**0,06**	**0,16**	**2,06**	**0,03**	**0,11**	**0,05**
		Standard deviation	**0,11**	**7,07**	**16,21**	**0,08**	**1,91**	**0,77**	**1,18**	**8,00**	**0,07**	**0,22**	**1,20**	**0,04**	**0,13**	**0,07**
868	05-29-2023 14:40	Walking Leopard 1	1,88	12,39	41,32	< LOD	0,07	1,31	0,11	0,43	0,0058	0,01	2,81	0,0031	0,0235	0,0027
869	05-29-2023 14:42	Walking Leopard 2	1,60	17,00	36,18	< LOD	0,56	1,27	0,11	0,55	0,0060	0,01	3,23	0,0025	0,0306	0,0023
870	05-29-2023 14:49	Walking Leopard 3	< LOD	3,46	8,32	0,03	2,80	0,43	0,27	17,34	0,2433	0,22	2,21	0,0562	0,0555	0,3558
		Average	**1,74**	**10,95**	**28,61**	**0,03**	**1,14**	**1,00**	**0,16**	**6,11**	**0,09**	**0,08**	**2,75**	**0,02**	**0,04**	**0,12**
		Standard deviation	**0,19**	**6,88**	**17,75**		**1,46**	**0,50**	**0,10**	**9,73**	**0,14**	**0,12**	**0,51**	**0,03**	**0,02**	**0,20**
872	05-30-2023 10:19	Leopard hunting 1	1,44	17,24	41,85	0,02	1,22	1,56	0,16	0,81	0,0115	0,02	2,69	0,0029	0,0337	0,0024
873	05-30-2023 10:22	Leopard hunting 2	2,27	4,89	7,72	< LOD	2,49	0,20	0,36	22,46	0,3757	0,30	0,81	0,0687	0,0203	0,6156
874	05-30-2023 10:25	Leopard hunting 3	1,82	18,43	47,88	< LOD	0,59	1,68	0,13	0,63	0,0098	0,01	2,85	0,0027	0,0253	0,0022
		Average	**1,84**	**13,52**	**32,48**	**0,02**	**1,43**	**1,15**	**0,22**	**7,97**	**0,13**	**0,11**	**2,12**	**0,02**	**0,03**	**0,21**
		Standard deviation	**0,41**	**7,50**	**21,66**		**0,97**	**0,82**	**0,12**	**12,55**	**0,21**	**0,17**	**1,13**	**0,04**	**0,01**	**0,35**
875	05-30-2023 10:30	Leopard in tree 1	1,81	8,61	24,53	< LOD	0,21	0,78	0,08	0,34	0,0063	0,01	1,73	0,0030	0,0220	0,0024
876	05-30-2023 10:33	Leopard in tree 2	1,52	16,60	44,87	< LOD	0,12	1,46	0,14	0,50	0,0093	0,01	2,26	0,0032	0,0151	0,0025
877	05-30-2023 10:36	Leopard in tree 3	2,21	0,42	3,21	< LOD	2,04	0,05	0,15	1,91	0,0860	0,10	0,09	3,9682	0,0971	0,7073
		Average	**1,85**	**8,54**	**24,20**		**0,79**	**0,77**	**0,12**	**0,92**	**0,03**	**0,04**	**1,36**	**1,32**	**0,04**	**0,24**
		Standard deviation	**0,34**	**8,09**	**20,83**		**1,08**	**0,71**	**0,04**	**0,86**	**0,05**	**0,05**	**1,13**	**2,29**	**0,05**	**0,41**
878	05-30-2023 10:45	Old Zulu woman 1	1,43	10,44	33,29	< LOD	0,60	1,02	0,08	0,49	0,0047	0,01	1,77	0,0021	0,0243	0,0017
879	05-30-2023 10:47	Old Zulu woman 2	1,46	15,44	47,70	< LOD	0,79	1,69	0,15	0,65	0,0109	0,02	2,71	0,0025	0,0299	0,0025
880	05-30-2023 10:52	Old Zulu woman 3	1,72	16,92	59,19	0,03	0,68	1,87	2,24	0,64	0,0108	0,02	3,39	0,0032	0,0268	0,0027
		Average	**1,54**	**14,27**	**46,72**	**0,03**	**0,69**	**1,53**	**0,83**	**0,59**	**0,01**	**0,01**	**2,62**	**0,003**	**0,03**	**0,002**
		Standard deviation	**0,16**	**3,39**	**12,98**		**0,10**	**0,45**	**1,23**	**0,09**	**0,00**	**0,00**	**0,82**	**0,001**	**0,003**	**0,001**
881	05-30-2023 11:06	Young Zulu woman 1	1,75	12,22	33,88	< LOD	0,13	0,88	0,10	0,34	0,0048	0,01	1,77	0,0024	0,0177	0,0021
882	05-30-2023 11:31	Young Zulu woman 2	1,38	16,96	44,67	< LOD	1,30	1,35	0,15	0,78	0,0089	0,02	2,57	0,0023	0,0338	0,0025
883	05-30-2023 11:34	Young Zulu woman 3	< LOD	18,43	46,33	< LOD	0,94	1,37	0,15	0,65	0,0085	0,02	2,81	0,0022	0,0397	0,0022
884	05-30-2023 11:40	Young Zulu woman 4	1,99	19,66	49,40	< LOD	1,71	1,54	0,18	0,87	0,0133	0,02	2,60	0,0021	0,0333	0,0028
		Average	**1,71**	**16,82**	**43,57**		**1,02**	**1,29**	**0,15**	**0,66**	**0,01**	**0,02**	**2,44**	**0,002**	**0,03**	**0,002**
		Standard deviation	**0,31**	**3,26**	**6,75**		**0,67**	**0,28**	**0,03**	**0,23**	**0,00**	**0,01**	**0,46**	**0,000**	**0,01**	**0,000**
885	05-30-2023 11:46	Zulu Man, small 1	1,85	15,41	46,84	< LOD	0,63	1,53	0,12	0,61	0,0078	0,01	1,99	0,0026	0,0145	0,0025
886	05-30-2023 11:52	Zulu Man, small 2	1,70	8,83	30,55	< LOD	0,44	0,92	0,08	0,42	0,0052	0,01	1,49	0,0026	0,0258	0,0018
887	05-30-2023 11:56	Zulu Man, small 3	1,36	20,91	60,58	< LOD	0,79	1,93	0,16	0,67	0,0092	0,02	2,36	0,0027	0,0248	0,0021
888	05-30-2023 12:03	Zulu Man, small 4	1,63	12,39	39,56	< LOD	0,37	1,28	0,30	0,50	0,0078	0,01	1,95	0,0031	0,0223	0,0031
		Average	**1,64**	**14,39**	**44,38**		**0,56**	**1,42**	**0,17**	**0,55**	**0,01**	**0,01**	**1,94**	**0,003**	**0,02**	**0,002**
		Standard deviation	**0,20**	**5,11**	**12,69**		**0,19**	**0,42**	**0,09**	**0,11**	**0,002**	**0,002**	**0,36**	**0,0002**	**0,01**	**0,001**
898	05-30-2023 13:21	Induna 1	1,83	13,37	38,02	< LOD	0,78	1,34	0,11	0,64	0,0074	0,03	2,51	0,0029	0,0282	0,0020
899	05-30-2023 13:25	Induna 2	< LOD	16,88	43,67	< LOD	0,81	1,59	0,12	0,69	0,0102	0,02	2,63	0,0027	0,0209	0,0020
901	05-30-2023 13:32	Induna 3	1,88	13,86	39,49	< LOD	0,73	1,26	0,11	0,62	0,0073	0,01	2,44	0,0031	0,0313	0,0021
902	05-30-2023 13:35	Induna 4	1,67	12,16	32,09	< LOD	0,04	1,13	0,08	0,39	0,0043	0,01	2,14	0,0025	< LOD	0,0018
		Average	**1,79**	**14,07**	**38,32**		**0,59**	**1,33**	**0,11**	**0,59**	**0,01**	**0,02**	**2,43**	**0,003**	**0,03**	**0,002**
		Standard deviation	**0,11**	**2,01**	**4,79**		**0,37**	**0,19**	**0,02**	**0,13**	**0,00**	**0,01**	**0,21**	**0,0003**	**0,01**	**0,0001**
903	05-30-2023 13:40	ushaka 1	2,13	20,00	56,26	0,04	0,14	1,79	0,19	0,52	0,0083	0,01	2,41	0,0036	0,0210	0,0024
904	05-30-2023 13:43	ushaka 2	1,41	10,50	37,84	< LOD	1,14	1,11	0,13	0,70	0,0073	0,02	1,78	0,0027	0,0285	0,0025
905	05-30-2023 13:47	ushaka 3	1,62	15,74	44,40	< LOD	0,65	1,55	0,14	0,63	0,0089	0,02	2,22	0,0028	0,0239	0,0022
907	05-30-2023 14:12	ushaka 4	< LOD	23,14	62,46	< LOD	0,44	1,98	0,19	0,62	0,0076	0,02	2,39	0,0026	0,0238	0,0022
		Average	**1,72**	**17,35**	**50,24**	**0,04**	**0,59**	**1,61**	**0,16**	**0,62**	**0,01**	**0,02**	**2,20**	**0,003**	**0,02**	**0,002**
		Standard deviation	**0,37**	**5,48**	**11,16**		**0,42**	**0,38**	**0,03**	**0,07**	**0,001**	**0,01**	**0,29**	**0,0005**	**0,003**	**0,0002**
909	05-30-2023 14:24	bushman 1	1,70	11,63	33,05	< LOD	0,26	0,89	0,14	0,40	0,0060	0,01	1,67	0,0025	0,0149	0,0025
910	05-30-2023 14:26	bushman 2	2,42	15,74	42,01	< LOD	0,26	1,31	0,17	0,51	0,0080	0,01	2,27	0,0035	0,0241	0,0024
911	05-30-2023 14:30	bushman 3	1,29	20,35	51,60	< LOD	0,20	1,58	0,17	0,56	0,0091	0,01	2,77	0,0032	0,0239	0,0030
912	05-30-2023 14:34	bushman 4	1,77	9,11	27,06	0,01	0,07	0,82	0,10	0,31	0,0066	0,01	1,58	0,0028	0,0219	0,0022
		Average	**1,80**	**14,21**	**38,43**	**0,01**	**0,20**	**1,15**	**0,14**	**0,44**	**0,01**	**0,01**	**2,07**	**0,00**	**0,02**	**0,00**
		Standard deviation	**0,46**	**4,92**	**10,72**		**0,09**	**0,36**	**0,03**	**0,11**	**0,0014**	**0,0032**	**0,55**	**0,0004**	**0,0043**	**0,0003**

			Magnesiu	Aluminiur	Silicon dic	Phosphor	Sulphur	Potassium	Calcium	Titanium	Chromium
	DateTime	Name	MgO	Al2O3	SiO2	P	S	K2O	Ca	Ti	Cr
49	06-13-2023 10:31	Hezekiels Clay	1,6759	15,396	39,0189	< LOD	0,0684	1,1254	0,1155	0,5351	0,0079

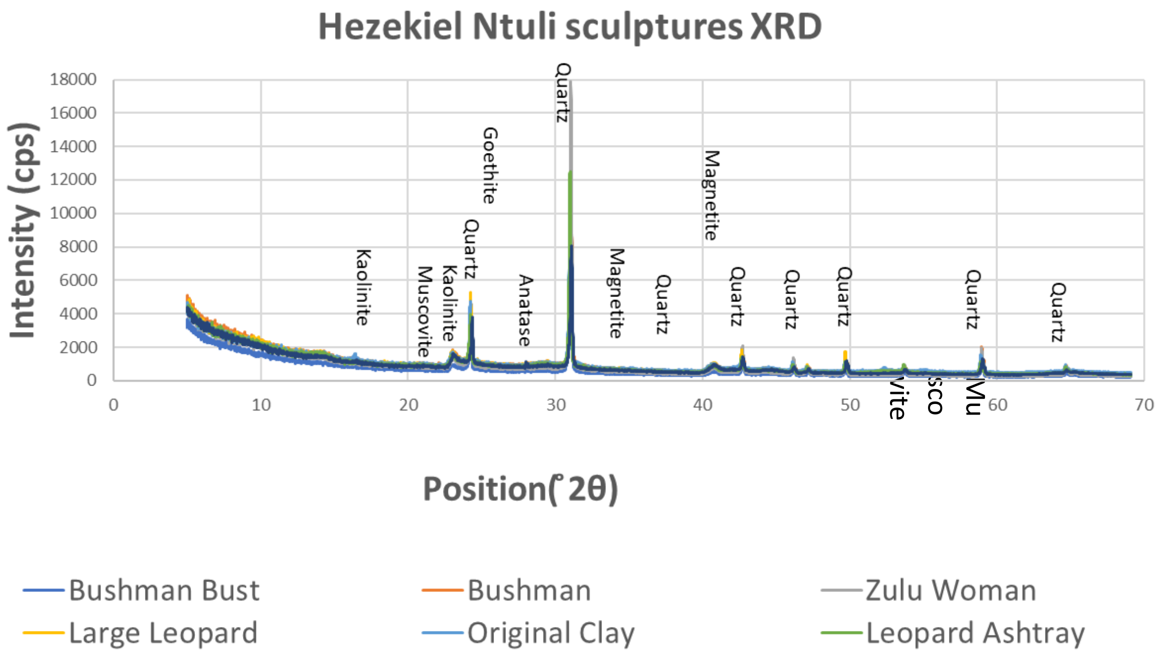
	Manganes	Iron	Cobalt	Nickel	Copper	Zinc	Gallium	Arsenic	Selenium	Rubidium	Strintium	Yttrium	Zirconium	Barium	Tantalum	Lead
	Mn	Fe	Co	Ni	Cu	Zn	Ga	As	Se	Rb	Sr	Y	Zr	Ba	Ta	Pb
49	0,0138	3,9387	0,0056	0,0023	0,0026	0,0025	0,0017	0,0005	0,0002	0,0111	0,0031	0,0029	0,0194	0,0125	0,0021	0,0019
						0										

Appendix F XRD data

F1. XRD data artwork clay samples prior to consolidation treatments - Rietveld refinement Phase quantification analyses

%	Collection	Accession number	Quartz	Kaolinite	Magnetite	Lepidocrocite	Goethite	Anatase	Muscovite
Bushman	LDT	34955575	73.1	25.7	0	0	0	1.3	0
Zulu man, small	LDT	1955573	55.7	39.0	0	0.7	0	0.8	3.8
Zulu Woman, small	LDT	29955572	73.3	24.4	1.8	0	0	0.5	0
Leopard Ashtray A	LDT	955570	66.6	31.3	1.6	0	0	0.5	0
Zulu man, large	LDT	966524	56.4	38.5	3.3	0.9	0	0.9	0
Seated Leopard	FN	01/266	55.0	38.3	3.5	1.0	1.7	0.6	0
Original Clay	n/a	n/a	61.8	33.7	1.3	2.1	0.6	0.5	0

F2. XRD Spectra of Sculptures



F3. XRD spectra from clay samples after consolidation, Rietveld refinement Phase quantification analyses

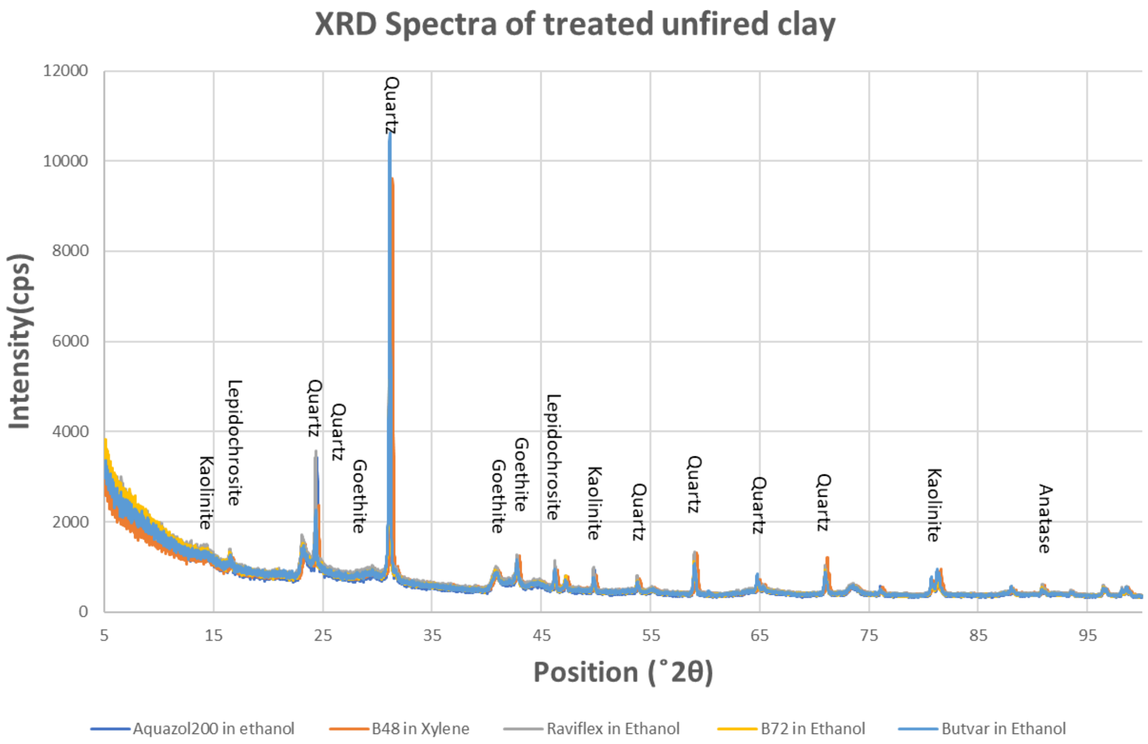
%	Quartz	Kaolinite	Magnetite	Lepidocrocite	Goethite	Anatase	Muscovite
Aquazol200 in ethanol	54.5	40.2		2.3	1.9	1.1	
B48 in Xylene	59.9	35.7		1.9	1.5	1.0	
Raviflex in Ethanol	61.2	35.1		2.3	0.9	0.5	
B72 in Ethanol 2	55.7	39.8		2.3	1.3	1.0	
Butvar in Ethanol	59.9	36.1		1.8	1.5	0.8	
Original Clay	61.8	33.7	1.3	2.1	0.6	0.5	0

The magnetite and muscovite had no readable data as the sample was diluted by the organic consolidant

XRD data of fired clay, Rietveld refinement Phase quantification analyses

	Quartz	Hematite	Magnetite
Fired Clay	91.1	8.9	
Unfired Clay	61.8		1.3

XRD Spectra of treated unfired clay.



XRD Spectra of unfired and fired clay.